Social Network and Inequality in Career Outcomes:

Evidence from Prosecutors in Korea

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September 17, 2018

Abstract

This paper examines the effect of connections with successful senior prosecutors on the probability of promotion for junior prosecutors in South Korea. Successful seniors are defined using the highest rank each senior achieved. To identify a causal network effect, I exploit exogenous variation in networks arising from personnel transfer assignments. Using a dataset on the population of prosecutors, I find a positive network effect: a one standard deviation increase in the number of connections with successful seniors increases the probability of being promoted for a junior by 10.1 percentage points. I evaluate the importance of three potential mechanisms: (1) skill spillovers from a senior to a junior, (2) transmission of information on a junior's characteristics, and (3) nepotism which may be strengthened based on alma mater connections. Empirical evidence from this study consistently indicates information transmission as potential mechanisms facilitating network effect. Skill spillovers and nepotism also have a role in determining a junior prosecutor's promotion.

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1 Introduction

It is well known that social networks play a crucial role in labor market outcomes. A number of previous studies have provided theoretical and empirical evidence of the impact of social networks on finding jobs, focusing on the role of networks as channels for information transmission. However, little attention has been paid to the impact of social networks on career outcomes after a worker finds a job. Also, while economists have long sought to identify the mechanisms behind how social networks function, there is little relevant empirical evidence, especially as related to on career outcomes.

This paper presents new evidence on the role of social networks formed early in a professional's career with reference to his or her probability of promotion. Prosecutors in South Korea serve as the subject, providing a target well suited for identifying the importance of coworker connections. Korean prosecutors belong to a centralized organization with a pyramid structure characterized by rank. Senior prosecutors train juniors, supervise their tasks, appraise their performance, and can recommend some promising juniors for promotion. In this setting, juniors who have more connections to successful seniors[1] will have more opportunities for promotion.

To estimate the effect of connections between a junior and a successful senior on the junior's career outcomes, I use web-based individual level bios for all prosecutors in Korea. Theses bios include each prosecutor's name, age, gender, college and high school, branches where he or she has practiced, and the year of each change in the branch. Branch and timing information for personnel transfers allows career outcomes and co-worker connections to be identified.

The main challenge in identifying a causal effect of social networks is accounting for unobserved individual heterogeneity. To estimate the impact of a prosecutor's social network on career outcomes, I exploit exogenous variation in networks due to periodic personnel transfers. Prosecutor personnel transfers follow a centralized process: the personnel transfer committee, which consists of high-ranking executives, reassigns all prosecutors to new branches periodically. Juniors are transferred to a different branch every two years while seniors are transferred every year, respectively. The specific rules for personnel assignment are not open to the public or prosecutors so that prosecutors cannot self-select their next

[1] I define a successful senior using the highest rank of positions which a senior prosecutor achieves over his or her career. It is defined more precisely in section 2 below.

branch.

Even if the subsequent branch is unpredictable and juniors and seniors rotate across branches, the personnel assignment process may not be random. A potential risk is systematic selection bias: more capable junior prosecutors are more likely to work with able seniors if they tend to be assigned to branches where more successful seniors are located. To the extent that personnel assignment is selective, estimations of network effect are biased. Hence, the first step in my analysis is to empirically document the extent of selection focusing on co-location with a successful senior. The data reveals significant selection on juniors' characteristics across branches, which implies variation in network quality across branches (between-branch variation) is invalid for identifying network effects. Therefore, controlling for between-branch variation using branch fixed effects, I exploit variation in the network within a branch over time (within-branch variation) to identify causal network effects. Empirical evidence supports the assumption that network quality and individual characteristics are independent conditional on branch fixed effects.

The second step in my analysis is to study how successful seniors who worked with a junior prosecutor affect the junior's promotion in the future. I define a successful senior using the rank of the final position achieved over his or her career, and I measure a junior prosecutor's network quality based on the number and share of successful seniors the junior prosecutor worked with during his career as a junior. To account for potential selection on unobserved heterogeneity across branches, I exploit within-branch variation in network quality, controlling for between-branch variation using branch fixed effects.

In the final part of my analysis, I explore potential explanations for underlying mechanisms behind network effects on career outcomes. Three possible explanations are proposed: i) skill spillovers, ii) information transmission, and iii) nepotism based on same-university-alumni connections.[2] A key question of interest is whether and to what extent each potential mechanism can explain a network effect on a junior's probability of promotion. To answer this question, I examine the importance of same-university-alumni connections for promotion as a channel for nepotism. In addition, I develop a falsification test for the potential mechanisms, based on the idea that seniors who already resigned or retired can no longer influence juniors' promotion serving as employee referrals. To the extent that information transmission is important relative to skill spillovers, connections with incumbent

[2]The type of nepotism considered in this paper is an increased promotion opportunity due to alma mater ties rather than productivity. See Section 3 for detailed discussion.

senior prosecutors are more important than with resigned or retired for promotion.

The empirical results show that connections with successful seniors play an important role in career outcomes. A one standard deviation increase in connections with successful seniors raises a junior prosecutor's probability of being promoted by 10.1 percentage points. Similarly, a 10 percentage points increase in the share of successful seniors associated with a given junior increases promotion probability by 2.7 percentage points. These effects are robust against the adjustment of control variables, alternative measures of network quality, and various robustness checks. I find evidence that supports both skill spillovers and information transmission explanations. Nepotism based on alma mater ties also exists among the alumni of the universities with relatively smaller networks.

This analysis contributes to the existing body of knowledge on the effect of social networks on labor market outcomes. Most previous studies have documented the importance of social networks for finding jobs (e.g., Beaman 2012, Glitz 2017, and Nadler 2017), but little attention has been paid to career outcomes after a worker finds a job, due to the limited scope of data available. This article goes beyond existing literature by documenting the role of social networks on a professional's career outcomes. To the best of my knowledge, this is the first paper to document promotion as a career outcome.

In the sense that I document the effect of initial connections with supervisors formed early in a worker's career, my analysis shares some commonalities with Nadler's (2017), who used panel data on freelance workers in Hollywood to measure the magnitude of network effects on the probability of employment for a movie. The social networks examined in his analysis are freelancers' connections to key supervisors who decide which workers are hired.[3] In the context of a freelancer market, Nadler's (2017) outcome of interest is to find a subsequent job, while mine is promotion. Also, I employ a different identification strategy. While Nadler (2017) exclusively relies on dynamic panel data models to deal with unobserved heterogeneity, my analysis exploits variations in networks resulting from exogenous personnel transfers.

This analysis fills a gap in the existing literature by documenting the importance of each potential mechanism by which social networks influence career outcomes. Based on existing research on network effects, I suggest several different explanations for mecha-

[3]Nadler's (2017) main finding is that a freelancer's connection to key supervisors formed in his early career raises the probability of employment by 2 percentage points and that the magnitude of the effect increases to 40 percentage points as a freelancer works with the supervisor more and more times (stronger connections).

nisms by which social networks affect promotion. Social networks serve as a channel for skill spillovers (e.g., Azoulay, Zivin, and Wang 2010), job information transmission (e.g., Beaman 2012, Glitz 2017), and nepotism (Wang 2013). Among these explanations, nepotism has not been documented well. To my knowledge, the only paper focuses on nepotism is Wang's (2013), which considered the effect of marriage networks (father-in-law) on labor market outcomes in China. My analysis contributes to the field by providing evidence on the importance of nepotism and information transmission as mechanisms of social network influences.

2 Data and Institutional Environment

2.1 Data Source and Sample Selection

Data Source

The dataset used in this paper comes from the web page "Law and Business (LAWnB)" which provides a legal information portal service in South Korea. The LAWnB website provides each legal professional's (prosecutors, lawyers, and judges) bio, which includes his or her age, gender, which high school and college the prosecutor graduated from, branch and district offices where he or she has practiced, and year of each change in office or occupation. All my analysis involves individual level bio data on prosecutors. All prosecutor bio data was collected in 2017. A strength of this dataset is that it provides information on each branch and district office where a prosecutor has worked and the year of each personnel transfer. Exploiting such information, I can measure networks which occur from co-location of the same branch.

Sample Selection

In the dataset, the number of observations who have ever worked as a prosecutor is 3,911. The main sample selection criteria are about outcome and network quality variables. The outcome variable of interest is whether a junior prosecutor achieves a position of Deputy

District Attorney (DDA).[4] It usually takes 18-19 years for a prosecutor to be promoted to a DDA, and because the data is collected in 2017, I exclude the 2,334 prosecutors who passed the bar exam after 1994 to avoid any censoring issue. As I will discuss below, this paper studies the initial networks formed in the first three branches of a junior prosecutor, I only consider the prosecutors who have worked at least in three branches.[5] After excluding the observations with any missing value, and following other sample selection criteria, the number of final observations is 1,146. Table A1 describes detailed criteria and the number of observations lost as a result of each selection criterion.

2.2 Institutional Environment and Descriptive Statistics

The Organization of Prosecution Service

All candidates to become legal professionals (prosecutors, judges, and lawyers) in South Korea must pass the a standardized annual bar exam to become certificated. Since 1971, candidates who have passed the bar exam were educated at the Judicial Research and Training Institute (JRTI) for two years. At the end of the training program, candidates can apply for a judge or prosecutor position, and their admission is determined based on their grades at the JRTI. I define a cohort to be the prosecutors who entered the JRTI in the same year.

Once a candidate to become a prosecutor gains admission, he or she is assigned to a branch as a junior prosecutor. I call the first branch to which a junior prosecutor was assigned the *initial branch*. It is known that initial branch assignment does not follow a random process but is based on grades from the bar exam and the JRTI. That is, high-performing juniors are assigned to a branch in the capital, while lower-performing juniors are assigned to more remote branches. Therefore, I assume a junior prosecutor's initial branch can be used as a proxy for pre-career (cognitive or legal) skills.[6]

The organization of prosecution service has a pyramidal structure characterized by a

[4]The outcome variable and institutional environment are introduced below.

[5]Usually, a junior prosecutor is reassigned to new branch every 2 years. Therefore, working in the first three branches is equivalent to 6 years of tenure as a prosecutor. This sample selection criterion may exclude junior prosecutors who are not motivated to be successful as a prosecutor from the sample.

[6]However, initial branch assignment may not be so selective as to be critical to future promotion. When I regress the probability of being promoted to a Deputy District Attorney on initial branch fixed effects, R^2 equals 0.046. The measure of outcome is discussed in detail below.

bureaucratic hierarchy. Seniors with higher rank supervise junior prosecutors with lower ranks in the same office. Figure 1 illustrates theses hierarchical levels. Under the Attorney General (who is at the peak of the pyramid), there are four different ranks: junior prosecutors, Head of Department (HD), Deputy District Attorney (DDA), and District Attorney (DA) in ascending order. The networks of interest in this paper are connections between junior prosecutors and HDs, so I call a HD a *senior prosecutor*. Also, I define a *successful senior* as a HD who achieved a position of DA at some point in his career.

Korea's prosecution offices are organized at the state and regional level and they belong to the executive branch of the government. There is 1 supreme prosecutor's Office, 5 high prosecutors' offices, 18 district prosecutors' offices and 39 branch prosecutors' offices. Junior prosecutors work in district or branch prosecutors' offices. There are several departments in each branch, and a department consists of one HD and several junior prosecutors. Hereafter, for simplicity, both district and branch prosecutors' offices are referred to as *branches*. While the types of tasks junior prosecutors perform do not change by branch, the number of prosecutors varies greatly across branches. Table A2 describes the distribution of branch size during the time period of analysis. Given the large variation in the number of successful seniors across branches, personnel transfers result in the inequality in network quality discussed below.

Outcomes and Descriptive Statistics

In this paper, I analyze promotion as a career outcome for prosecutors. The wage of a prosecutor in Korea is set by a deterministic function based on the prosecutor's tenure, so it provides no useful information. Also, because the organization of prosecution service follows an up-or-out promotion system, prosecutors of the same cohort are promoted to the next rank simultaneously and resign if they fail to get a promotion before the next cohort rises.[7] Therefore, successfully reaching a high rank is a meaningful measure of a prosecutor's economic outcome.

The primary outcome variable is a binary variable that indicates whether a junior prosecutor achieved a position of DDA during his or her career. As Table 1 shows, 35%

[7]When a prosecutor fails to be promoted to a higher rank before the next cohort rises, leaving the organization is not a *de jure* requirement, but a *de facto* requirement. The de jure requirement is due to the organization culture which puts emphasis on hierarchy of cohorts. Although a prosecutor who failed to be promoted decided not to resign, which is a very rare case during the period of the analysis, there is no promotion opportunity anymore.

of the prosecutors in the final sample were promoted to DDA. Success in being promoted to DDA is more meaningful than promotion to other positions for studying the effect of social networks on promotion. The majority of junior prosecutors (78%) in the data were promoted to HD. In case of DA, it is believed that external factors such as connections with political party are important for becoming a DA.[8] Therefore, I focus on promotion to DDA as a career outcome.

Table 1 also presents descriptive statistics for the final sample. Most prosecutors in the sample are male (99%), and the average age for passing the bar exam is around 25. The bottom panel of Table 1 provides summary statistics of the major universities prosecutors graduated from. The top 5 major universities represent 80%.

Personnel Transfer Process and Branch Offices

In this study, the main identification strategy is to use the periodic personnel transfer process for Korean prosecutors as a quasi-experiment. A junior prosecutor is re-assigned to a new branch every 2 years. Also, most prosecutors with seniority (HD, DDA, and DA) are reassigned every year, and they build a career by climbing from a small rural branch office to a large branch or district office near the capital city. Therefore, most prosecutors have to rotate through different branches.

Periodic personnel transfer follows a centralized process: the personnel transfer committee consists of several high-ranking executives, who reassign prosecutors based on work performance appraisals. The detailed process for personnel assignment is not open to the public or even to prosecutors, so subsequent branches are unpredictable. That is, it is difficult for prosecutors to self-select their subsequent branches. [9]

Measuring Network Quality

In this analysis, the primary networks of focus are connections between junior and senior prosecutors (HDs), which arise in early in the career of a junior prosecutor. I define a junior prosecutor's social network as the junior's connections with senior prosecutors with

[8] It is believed that promotion to a District Attorney can be affected by political regime. For example, the president can exercise political leverage to the promotion decision so that prosecutors who have a connection with the president (through same region of birth, same school alumni connection, etc.) are promoted to DA.

[9] Although subsequent branch is very unpredictable and most seniors rotate from small branches to larger branches, the personnel assignment process may not be random. Potential threats in identification of network effects will be discussed in Section 4.

whom the junior prosecutor worked at the same branch in the same period. Considering that it usually takes 13-14 years for a junior prosecutor to be promoted to the next rank (HD), endogenous formation of social networks is a concern of using all connections formed during these 13-14 years of tenure: a more capable junior may tend to be assigned to a larger branch where more successful seniors are located. To avoid this potential threat, the network building phase is restricted to the networks which are formed early in a junior prosecutor's career (*initial networks*). This encompasses the connections with seniors which arise from the first 3 branches a junior prosecutor works at.[10]

The main hypothesis of this paper is that a junior prosecutor with a high-quality network is more likely to be promoted to a higher-ranking position. To consider heterogeneous network quality across juniors, I define the quality of a senior prosecutor using the final rank in his or her career. Because prosecution service follows an up-or-out promotion system, the final rank of a prosecutor represents the highest rank achieved over a career. Specifically, a HD whose final position was a DDA is considered as a *successful senior*.

The primary measure of a junior prosecutor's network quality is the *number*(#) of successful seniors with whom the junior worked at the same branch in the same period. Coworkers in the same branch typically know each other, and seniors can observe the juniors at their branch. Therefore, the number of successful seniors who know about a junior's ability is important given that seniors can provide employee referrals. To the extent that the *scale* a network is important, the number of successful seniors is a valid measure of a junior prosecutor's network.

I also use an alternative measure for network quality, *share*(%) of successful seniors, which is calculated as the ratio of the number of successful seniors to the total number of seniors with whom a junior worked at the same branch. A junior prosecutor does not necessarily equally interact with every senior prosecutor at the same branch, especially at large branches where many seniors are located. If the quality or strength of each connection is more important than the scale of his or her network, then the number of successful seniors may not capture network quality well. Given that there is no measure of actual interactions between individuals, I employ the share of successful seniors as a measure of the *average quality* of senior prosecutors in a junior prosecutor's network.

Table 2 provides summary statistics for the measures of initial network quality. During

[10] I implement a robustness check whether estimates of network effect are sensitive to the network formation period below.

his or her tenure at the first three branches, on average, a prosecutor encountered 50 seniors and 19 successful seniors. On average, a junior prosecutor shared branches with 16 seniors who were alumni from his or her university, and 7 seniors who were not only alumni but also successful. The distribution of same-university-alumni connections is right-skewed: the 50th percentile for the number of alumni senior prosecutors is 6, which is less than the mean (16). The standard deviation of each measure of network quality is very large relative to the mean, which implies that connections with seniors are distributed across junior prosecutors in an unequal manner. This inequality in number of successful seniors results from heterogeneous branch size as described in Table A2.

3 Conceptual Framework

In this analysis, I study the impact of connections with successful seniors that arise early in a prosecutor's career.

As standard human capital theory (Mincer 1974) explains, a worker accumulates human capital through on-the-job training and learning by doing. Previous studies on network effects found evidence that social networks can be a channel of skill spillovers. For example, Azoulay, Zivin, and Wang (2010) find evidence that connections to an academic "superstar" have a positive effect on publication rates. The tasks performed by prosecutors are human-capital intensive, and junior prosecutors acquire skills under the supervision of senior prosecutors. Therefore, it is conceivable that a junior who has worked with a successful senior can increase skill level more than others who have no chance to work with a successful senior.

Another potential explanation about network effects on career outcome is information transmission. Previous literature has studied the impact of social networks in an imperfect market where networks play a role as a channel of information transmission. For example, Calvo-Armengol and Jackson (2004) developed a theoretical model where agents randomly receive job offers, and an employed agent passes his job offer to an unemployed member of his network. Montgomery (1991) highlighted the role of network members as employee referrals for firms to screen applications.

Although existing theoretical frameworks do not discuss career outcomes such as promo-

tion, these theoretical frameworks provide implications to interpret the impact of networks on career outcomes. If the personnel committee cannot observe a junior prosecutor's ability well due to imperfect information, the senior prosecutors of the junior will be asked to work as employee referrals when the junior's personnel transfer or promotion is determined.

Favoritism or nepotism also may exist, but it is little known to what extent nepotism is embedded in network effects, and there is no existing research which provides a theoretical framework of nepotism associated with social networks. The only study which interprets network effects as nepotism is a study of Wang (2013), who empirically documented the impact of the death of a father-in-law on a worker's earnings. Unlike Wang (2013), the type of nepotism of interest in this paper is favoritism among coworkers who are collocated in the same branch office, and the favoritism could be strengthened by ties between two workers who graduated from the same university. In the context of the universe of prosecutors in Korea, I define nepotism as an increased promotion opportunity due to alumni connections rather than productivity. If senior prosecutors have a taste or preference against the graduates of other universities in the similar manner with Becker's (1971) taste-based discrimination model, seniors may be willing to recommend a junior with a alumni connection to the personnel committee rather than other juniors regardless of the junior's ability.

Without any direct measure of an individual prosecutor's productivity, it is difficult to distinguish one of the explanations from the others. In this paper, I provide indirect evidence to evaluate the importance of each of the potential mechanisms using a junior's connection with the seniors who resigned (or retired) before the junior's promotion is determined (*resigned seniors*) and the seniors who graduated from the same university as the junior (*same-university alumni*). Because the organization of prosecution follows an up-or-out promotion system, the timing of a junior's promotion is the same for all prosecutors in a cohort. Under the assumption that resigned seniors cannot serve as employee referrals, the information-transmission explanation predicts that resigned seniors do not have a positive effect on their juniors' promotion. On the other hand, skill-spillovers explanation predicts that resigned and non-resigned seniors have a similar impact on their junior's promotion. In case of nepotism, there will be a positive effect of same-university-alumni connections on promotion if nepotism is an important mechanism of social networks.

4 Empirical Strategy

The aim of this paper is to identify the effect of a junior's connections with successful seniors on the junior's probability of promotion. To study a causal network effect, it would be ideal if there are random variation in the networks. However, the personnel assignment process may not be random but a systematic selection on unobserved characteristics of prosecutors across branches may exist. For example, network formation is endogenous if abler junior prosecutors tend to be assigned to large branches where more successful seniors work (selection on ability between branches): the measures of network quality (# and % of successful seniors) are correlated with unobserved characteristics. In this section, I discuss the potential endogeneity problem and suggest an identification strategy.

A simple model to estimate the effect of network quality on promotion is:

$$Promotion_i = NetworkQuality_i\gamma + X_i'\beta_x + Z_i'\beta_z + u_i$$

where $Promotion_i$ is an indicator for whether junior prosecutor i is promoted to a DDA, and $NetworkQuality_i$ is a measure of junior i's network quality. X_i includes observable characteristics, while Z_i represents the characteristics observed by the personnel committee but *unobserved* by researchers: grade in the bar exam and Judicial Research and Training Institute (JRTI), and the junior's performance appraisal, etc.

If there is a systematic correlation between unobserved ability (Z_i) and network quality, the estimator of the network effect γ is biased. For example, it is conceivable that the juniors with high grades in JRTI and excellent performance are likely to be assigned into the large branches with many successful seniors. To check the potential systematic selection, I document the correlation between *observable* measures of a junior prosecutor's ability and network quality: age at passing the bar exam and university selectivity.[11] Figure A1 visualizes the correlation between network quality and the observable measures of ability, which implies the existence of selection on ability across branches.

To deal with the potential selection bias across branches, the identification strategy in this paper aims to exploit *within*-branch variation in network quality over time, using

[11] It is conceivable that abler people are likely to pass the bar exam at younger age, and that prosecutors who graduated from the most prestigious university are likely to be competent.

branch fixed effects to control for *between*-branch variation. If the number of successful seniors in a branch is independent of the unobserved ability of juniors who are assigned to the branch conditional on branch fixed effects, the causal effect of successful seniors is identified.

$$NetworkQuality_{iby} \perp\!\!\!\perp (Z'_{iby}, u_{iby}) \mid Branch_b$$

Subscript i, b, and y respectively indicates individual, branch, and year. Given a certain branch b, if unobserved characteristics are independent of network quality among the junior prosecutors who worked in branch b in different years, I can utilize year-to-year deviation within each branch as a source of exogenous variation in network quality to identify causal network effect.

There is no direct way to test that network quality is independent of an individual's unobserved heterogeneity. However, I can show that network quality is uncorrelated with observed characteristics conditional on branch fixed effects: if network quality is uncorrelated with every observable variable (including observable measures of ability), it will be credible to assume conditional independence between network quality and individual's unobserved ability. To examine the credibility of the conditional independence assumption, I empirically check the correlation between network quality and various observables conditional on branch fixed effects and year fixed effects.[12] That is, using the final sample, I calculate residuals from the regression of each observable variable on branch fixed effects and year fixed effects, and then check whether the residuals are correlated with network quality. Like Figure A1, I construct branch-year cell and calculate the average of the residuals of each observable variable by the branch-year cell.

Figure 2, A2, A3, and A4 provide visual evidence of conditional independence: given branch fixed effects, regardless of whether network quality is measured by the number or share of successful seniors, network quality is uncorrelated with any observed control variable. The number of unsuccessful seniors is also uncorrelated with any observable variable within branches (Figure A5 and A6). These empirical results support the credibility of the conditional independence assumption.

Based on the empirical supports above, to identify the effect of the connections with successful seniors, I estimate the following linear probability model:

[12] Year fixed effects control for common time trend in promotion probability.

$$Promotion_i = NetworkQuality_i\theta + \sum_{b}^{B} Branch_{ib}\psi + X_i'\beta + U_i \quad (1)$$

where $Promotion_i$ is the indicator for whether individual i achieved a DDA; $Branch_{ib}$ is the indicator which equals 1 if branch b is one of the first 3 branches of individual i [13] (b = 1,2,3,..., B, where B=55 [14]); and X_i are individual characteristics which include gender, age at passing the bar exam, 48 high school fixed effects,[15] 43 university fixed effects, 16 region fixed effects, and 23 cohort fixed effects; and U_i equals (Z_i', u_i). The parameter of interest is θ which represents the effect of junior i's network quality on the probability of being promoted.

Note that the measure of junior prosecutor i's network quality is i's stock of the connections with successful seniors. The main measure of a junior prosecutor's network quality is the *number* of the connections with successful seniors which arise from the junior's first 3 branches. Another measure is the *share* of successful seniors.

5 Results

Table 3 shows the estimate of θ from model (1). In panel A of Table 3 network quality is measured as the number of successful seniors. While the number of unsuccessful seniors is not correlated with a junior prosecutor's promotion probability (column 1), 10 additional successful seniors is associated with a 2.6 percentage point increase in the probability of promotion to DDA (column 2). In columns (3)-(6), the connections with 10 additional successful seniors raise the probability of promotion by 5.1-5.8 percentage points, while 10 additional unsuccessful seniors lower the promotion probability by 3.1-4.1 percentage points. In column (6), I estimate model (1) controlling for cohort fixed effects and branch fixed effects under the assumption that network quality is independent of individual's unobserved characteristics conditional on branch and year. Given that the standard deviation

[13] In other words, I control for branch fixed effects using a set of indicator variables for every possible combination of a junior's first 3 branches. This model is restrictive in the sense that each branch fixed effect does not change by the order of branches. More flexible model may allow branch fixed effect to vary by the order of branches, by controlling for every possible permutation of an individual's first 3 branches.

[14] the total number of branches in the sample is 56

[15] Prosecutors in the sample graduated from 239 high schools.

of the number of a junior's connections with successful seniors is 17.7 (Table 2), a one standard deviation increase in connections with successful seniors raises the promotion probability by 10.1 percentage points. Considering only 35 percent of the observations in the sample could be promoted to DDA (Table 1), the networks have a large impact on promotion. The estimates of network effect are statistically significant and they are not sensitive to control variables.

Panel B employs the share of successful seniors as a measure of network quality. When between-branch variation is controlled for by branch fixed effects in column (6), a junior prosecutor is 2.7 percentage points more likely to be promoted to a rank of DDA for each additional 10 percentage points increase in the share of successful seniors.

5.1 Potential Mechanisms

As discussed in Section 3, I test for the potential mechanisms by exploiting resigned seniors and same-university-alumni connections.

Same-University-Alumni Connections

If nepotism among same-university alumni is embedded in the network effect, the seniors who graduated from the same university with a junior have a larger effect than other seniors. To examine the effect of alma mater connections, I re-estimate equation (1) by disaggregating successful (and unsuccessful senior) prosecutors by whether the seniors graduated from the same university as a junior:

i. $UnsuccessDiffuniv_i$: the *unsuccessful* seniors who graduated from *different* universities from the junior i's.

ii. $UnsuccessSameuniv_i$: the *unsuccessful* seniors who have *same*-university-alumni connections with the junior i.

iii. $SuccessDiffuniv_i$: the *successful* seniors who graduated from *different* universities from the junior i's.

iv. $SuccessSameuniv_i$: the *successful* seniors who have *same*-university-alumni connection with the junior i.

Using the four categories above, I estimate model (2) below.

$$\begin{aligned} Promotion_i = \theta_1 UnsuccessDiffUniv_i + \theta_2 UnsuccessSameUniv_i + \\ \theta_3 SuccessDiffUniv_i + \theta_4 SuccessSameUniv_i + \\ \sum_b^B Branch_{ib}\psi + X_i'\beta + U_i \end{aligned} \tag{2}$$

Table 4 reports the results. The number and the share of seniors in each category are employed in Panel A and Panel B, respectively. In column (1)-(5), the estimates show that, regardless of same-university-alumni connections, the connections with successful [unsuccessful] seniors are positively [negatively] associated with promotion probability. In column (6) of Panel A, the estimated network effect is larger for successful & same-university seniors than for different-university seniors, although the different is not statistically significant. For each 10 additional successful & same-university seniors, the probability of promotion increases by 6.2 percentage points. Among unsuccessful seniors, however, alma-mater connections are more negatively associated with promotion probability.

The estimates of network effect using the share measures in Panel B are estimated imprecisely and the coefficients show qualitatively different results from Panel A. In column (6), the estimated coefficient on successful & same-university seniors is smaller than the coefficient on different-university seniors ($0.16<0.21$). Together with the statistical insignificance in the difference between estimates by same-university-alumni connections, these estimates imply that, in general, nepotism based on same-university networks is not critical factor on promotion.

A concern is the possibility that the effect of same-university networks may be masked by the graduates of Seoul National University (SNU) whose university alumni network is very large. The share of graduates of SNU in the prosecution organization is 46 percent (Table 1) so that they meet 20 times more successful alumni seniors on average (Table A3). Previous studies argue that an increase in network size can mitigate the network effect on labor market outcomes because within-network competition is heightened as the number of network members increases (Calvo-Armengol 2004, Beaman 2012). In the context of the universe of prosecutors, the competition between junior prosecutors who graduated

from SNU may mitigate the effect of alma mater ties. Also, the marginal effect of same-university connections could decrease in the number of seniors in the network. To examine this possibility, I re-estimate model (2) with the interaction terms between network-quality measures and an indicator for SNU graduate. Table 5 reports the results with the number measure of network quality (Table A4 shows the result using share measure). The results show that the effect of same-university connection is fairly different between SNU and other universities. In column (5), the positive effect of successful & same-university seniors is much larger for non-SNU graduates than SNU graduates. Interestingly, the negative effect of *unsuccessful* seniors is also larger for non-SNU graduates. In column (6), the positive effect of successful seniors without alma-mater tie exists only for non-SNU graduates. The results with using the share measure of network quality in Table A4 are qualitatively similar. These estimates imply that nepotism based on university network exists mainly among the prosecutors whose alma mater networks are relatively small.

The Connections with Resigned and Non-resigned Seniors

If networks are just a channel of information transmission without any skill spillovers and the seniors who already resigned (or retired) can no longer serve as employee referrals, then only non-resigned (and successful) seniors have a positive effect on the juniors' promotion. To the extent that skill spillovers are embedded in networks, there will be no difference in the effects of resigned and non-resigned seniors. To explore the importance of each potential mechanism, I look for the effect of successful seniors by categorizing them into resigned or non-resigned seniors.[16]

i. $SuccessResigned_i$: the *successful* seniors who *resigned or retired* before the junior i's year of promotion.

ii. $SuccessNonresigned_i$: the *successful* seniors who did *not* resign or retire before the junior i's year of promotion.

Using the measures above, I estimate model (3) below:

[16] I do not separate unsuccessful seniors by resignation due to their extremely low retention rate. In the sample, average number of a junior's connections with unsuccessful & non-resigned senior is 0.43, while it is 29.4 with unsuccessful & resigned seniors. See Table 2 for summary statistics for successful & resigned seniors.

$$Promotion_i = \alpha_1 UnsuccessfulSenior_i + \alpha_2 SuccessResigned_i + \alpha_3 SuccessNonresigned_i + \sum_b^B Branch_{ib}\psi + X_i'\beta + U_i \quad (3)$$

Panel A and B in Table 6 present the results with using the number and share of seniors, respectively. In terms of magnitudes, in column (6) of Panel A, the connections with 10 additional successful & non-resigned seniors are associated with 6.2 percentage points increase in the probability of promotion. This magnitude is larger than the estimated coefficient on successful & resigned seniors, but the difference between them is not statistically significant, which is consistent with skill-spillovers hypothesis. On the other hand, Panel B shows qualitatively different results: an increase of 10 percentage points in the share of successful & non-resigned seniors raises a junior's promotion probability by 5.1 percentage points, which is more than twice as large as the coefficient on successful & resigned seniors. This result supports information-transmission explanation.

The results in Panel A and B are reconcilable in the sense that the estimate of non-resigned seniors are larger than that of resigned seniors in both results, which can be explained by information-transmission hypothesis. However, given the statistically insignificant difference between the effects of resigned and non-resigned seniors in Panel A, skill-spillovers hypothesis is also supported. Further study is needed to assess the relative importance of each potential mechanism to explain the network effect.

5.2 Robustness Checks

The main findings on the effect of successful seniors on promotion are qualitatively similar in various alternative specifications. In this section, I implement some robustness checks to examine whether the findings are robust to i) definition of successful seniors, ii) network formation periods, and iii) subsample by cohorts.

Definition of Successful Seniors

In the main specification, a successful senior is defined as a HD promoted to a District

Attorney (DA) at some point in his career. An alternative and broader definition of a successful senior is a HD promoted to a Deputy District Attorney (DDA), which is a lower rank than a DDA. In Table 7, I repeat the analysis of Table 3 using the alternative definition of a successful senior. In Columns (3)-(6) of Panel A, the estimates are qualitatively similar to the results in Table 3. The effect of the number of successful seniors reported in Panel A is smaller than the corresponding estimates in Table 3. These results make sense because the seniors who are less successful could have a smaller impact on their seniors' career outcomes. In case of share of successful seniors in Panel B, however, the estimates are not quantitatively different from the corresponding estimates in Table 3. The estimate becomes smaller and not precise conditional on cohort and branch fixed effects (column 6).

Network formation periods

In the main specification, I measure initial networks as a stock of connections formed in the first 3 branches of a junior prosecutor, which corresponds to 5-6 years of tenure. A concern to study a casual network effect is potentially endogenous network formation. Previous studies note the possibility that an individual who begins his or her career with a high-quality network is more likely to get an opportunity to make more connections over time (e.g. Granovetter 1974, 1988, and Nadler 2017). In the context of this paper, a promising junior prosecutor who meets relatively many successful seniors at his or her initial branch may tend to be assigned to a subsequent branch where more successful seniors are located. Although my identification strategy deals with this concern by controlling for between-branch variation in network quality using branch fixed effects, I can explore this concern further by examining whether the estimate is sensitive to the network formation period.

In Table 8, I estimate model (1) using different network formation periods. That is, I re-define a junior's network as his or her connections with successful seniors formed in the first t branches, where t = 2, 3, ... , 7. In column 4, 6, 8, 10, and 12, the first t branch fixed effects are constructed in a consistent manner with the main specification. Because the number of branches where a prosecutor worked as a junior varies across individuals, I additionally control for the number of branches worked at as a junior prosecutor.[17] The estimate of network effect in Panel A is decreasing in the length of network formation period, which implies that initial networks are more important than the networks formed

[17]Column (4) of Table 8 corresponds to column (6) of Table 3. The estimates are slightly different because the number of branches worked at is controlled for in Table 8.

in later career. In case of the share of successful seniors in Panel B, the estimates are less precise and not decreasing in the network formation period.[18]

A natural and interesting question is the effect of total networks: the initial networks may capture only a portion of total network effect if what really matters for promotion is the total stock of networks which a junior prosecutor accumulated before his year of promotion. If the identification assumptions of model (1) hold, the estimate in column (12) allows me to assess the full effect of networks. Given that the standard deviation of the total number of connections with successful seniors is 27.5 (mean is 45.0), a one standard deviation increase in the number of successful seniors increases the probability of promotion by 7.1 percentage points: a smaller effect than initial network effect (10.1 percentage points). [19]

Subsamples by Cohorts

The junior prosecutors in my sample passed the bar exam between 1971 and 1993. If there was an unknown systematic change in personnel assignment process or institutional change associated with promotion system, the main identification strategy which exploits the within-branch variation in network quality over time may not be valid. To check whether the main findings on the network effects are robust over time, I split the main sample into the two subsamples: the prosecutors who passed the bar exam between 1971 and 1985 ("early cohorts", 572 observations) and between 1986 and 1993 ("late cohorts", 574 observations).

In Table 9, I estimate model (1) using interaction terms between the network quality measures and an indicator for late cohort. In column (2) and (4), the estimates are quantitatively similar with the results in Table 3, and the network effect is not different between early and late cohorts.

[18] In both panel A and B, the estimates of the network effect are not statistically significant when network formation period is defined as the first 2 branches. This result may be due to insufficient within-branch variation in network quality during the few years of early career, or it could imply that there exists just a selection on unobserved characteristics across different branches without any significant causal network effect. However, given that there is no correlation between observable characteristics (including observable measures of ability) and network quality conditional on branch and cohort fixed effects (Table2, A2-A6), it is difficult to believe that that there exists significant selection on unobserved characteristics.

[19] If there is not significantly endogenous network formation, an interpretation is that initial networks are more important than the networks formed in later career even in the case where networks are not self-reinforcing (Granovetter, 1974, 1988).

6 Conclusion

While existing literature has provided the empirical evidence on the role of social networks in finding a job, there have not been any studies that document the impact of social networks on a worker's career outcomes such as promotion. In this paper, I investigate a universe of professionals where tasks are highly human-capital intensive and promotion is an important economic outcome: South Korea's prosecutor service. Using year-to-year variation in network quality within branches, I find that per one standard deviation increase in the number of connections with successful seniors raises, a junior prosecutor's probability of being promoted increases by 10.1 percentage points.

I explore potential explanations for the underlying mechanism behind the network effect. As a potential channel of nepotism, I examine the role of same-university-alumni connections in getting a promotion. Also, based on the assumption that senior prosecutors cannot influence their juniors' promotion after they resigned or retired, I implement a falsification test to examine the information-transmission hypothesis. I find evidence that supports both skill-spillovers and information-transmission explanations. Nepotism based on the alma-mater ties also exists among the alumni of the universities with relatively smaller networks. However, the extent to which the potential mechanism can explain the network effect on promotion remains unclear. Further research on the mechanisms are possibilities for future studies.

Further research is also needed on other aspects. I measure network quality using the number and share of successful seniors, interpreting the former as scale and the latter as an average quality of networks. But other dimensions of network structure are omitted in this paper. For example, previous studies suggest that network effect varies by the tie strength (e.g. Grenovetter 1973, and Gee, Jones, and Burke 2017). In the context of the prosecutor, the connections can be strengthened by the amount of time shared in the same branch. Also, connections between junior prosecutors could be important to assess the full network effect due to the fact that intra-network competition exists. Beaman (2012) suggests that network effect varies with the tenure composition of social networks because competition between network members with similar tenure results in negative externality. In the context of this paper, more junior prosecutors within a branch can heighten competition and mitigate the effect of successful seniors. Finally, to evaluate the full effect of networks including the connections formed in later career, further studies on institutional

environment and identification strategy are also needed to deal with potentially endogenous network formation.

References

[1] Azoulay, Pierre; Joshua Graff Zivin; and Jialan Wang. 2011. "Superstar Extinction." Quarterly Journal of Economics 125 (2), 549-89.

[2] Becker, Gary S. [1957] 1971. "The Economics of Discrimination." 2nd ed. Chicago: Univ. Chicago Press.

[3] Beaman, Lori. 2012. "Social Networks and the Dynamics of Labour Market Outcomes: Evidence from Refugees Resettled in the U.S." Review of Economic Studies 79, 128-161

[4] Calvo-Armengol, Antoni. 2004. "Job Contact Networks." Journal of Economic Theory 115, 191-206.

[5] Calvo-Armengol, Antoni, and Matthew O. Jackson. 2004. "The Effects of Social Networks on Employment and Inequality." The American Economic Review 94 (3), 426-454.

[6] Glitz, Albrecht. 2017. "Coworker Networks in the Labor Market." Labour Economics 44, 218-230.

[7] Granovetter, Mark S. 1973. "The Strength of Weak Ties." American Journal of Sociology 78 (6), 1360-80.

[8] Granovetter, Mark S. 1974. "Getting a Job: A Study of Contacts and Careers." University of Chicago Press.

[9] Granovetter, Mark S. 1988. "The Sociological and Economic Approaches to Labor Market Analysis: A Social Structural View." in George Farkas and Paula England, eds., Industries, Firms and Jobs, Plenum Press, chapter 9, 187-216.

[10] Gee, Laura K., Jason Jones, and Moira Burke. 2017, "Social Networks and Labor Markets: How Strong Ties Relate to Job Finding on Facebook's Social Network." Journal of Labor Economics 35 (2), 485-518.

[11] Mincer, Jacob. 1974. "Schooling, Experience, and Earnings." New York: Columbia University Press (for National Bureau of Economic Research).

[12] Montgomery, James D. 1991. "Social Networks and Labor-Market Outcomes: Toward an Economic Analysis." The American Economic Review, 81 (5), 1408-1418.

[13] Nadler, Carl. 2017. "The Dynamics of Networked Labor Markets: Evidence from Freelancers." Working Paper.

[14] Wang, Shing-Yi. 2013. "Marriage Networks, Nepotism, and Labor Market Outcomes in China." American Economic Journal: Applied Economics, 5(3): 91-112

A1. Tables and Figures

Figure 1: The Hierarchical Levels in the Prosecution Service

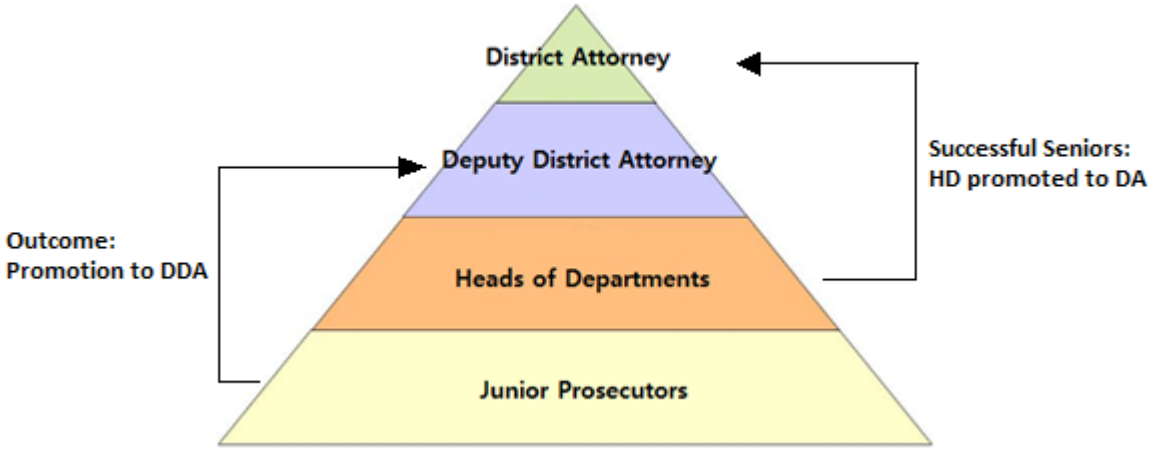
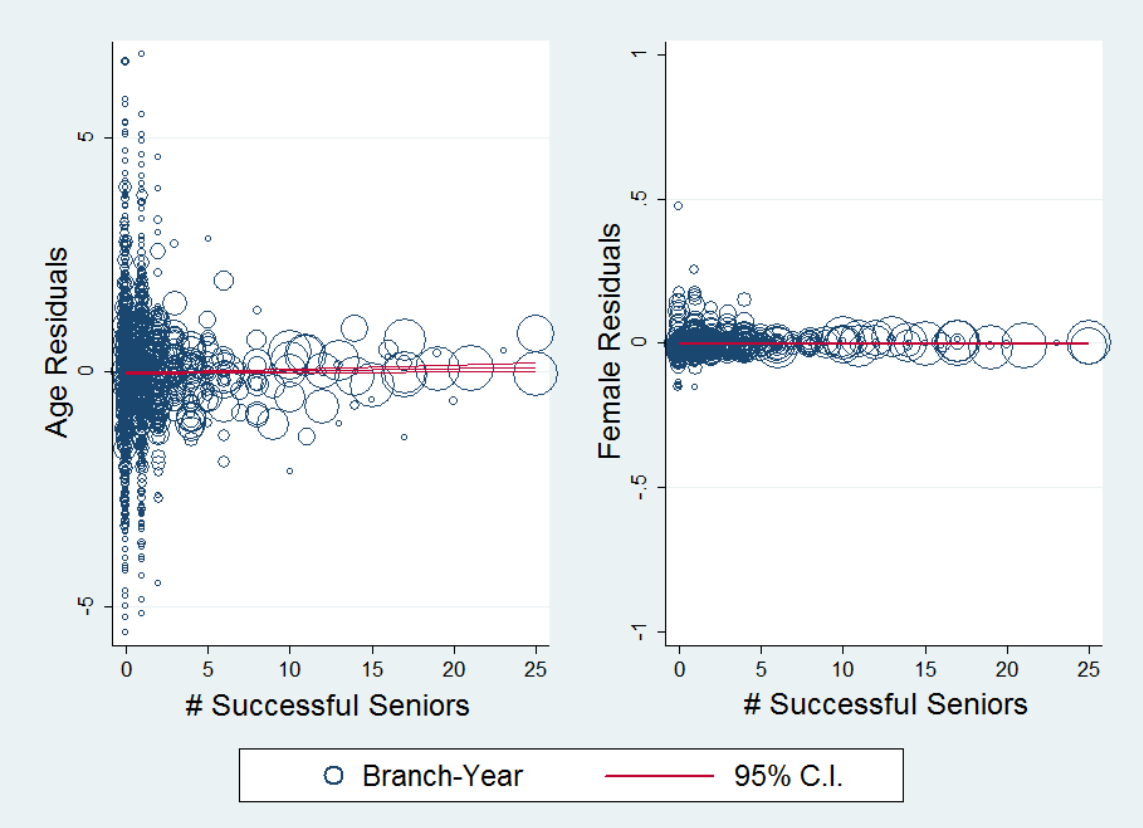


Figure 2: Residuals of Demographics and Network Quality



Note: I construct branch-year cell using the final sample which is selected in Section 2. By branch-year cell, I calculate average age at passing the bar exam and the share of female juniors. Each branch-year cell is weighted by the number of juniors who worked at the branch in that year. Size of circle represents the number of juniors in each cell. See text for details.

Table 1: Summary Statistics

Variable	Mean	SD
Outcomes		
Head of Department (HD)	0.78	0.42
Deputy District Attorney (DDA)	0.35	0.48
District Attorney (DA)	0.15	0.36
Female	0.01	0.1
Age at passing bar exam	25.36	2.65
Share of Universities		
Seoul National University (SNU)	0.46	0.5
Korea University (KU)	0.18	0.38
Yonsei University (YS)	0.06	0.23
Hanyang University (HY)	0.06	0.24
Sungkyunkwan University (SKKU)	0.05	0.22
Others	0.19	0.39

Note: Sample size is 1,146.

Table 2: Summary Statistics for Initial Network Quality

Network Quality	Mean	Std.	10th	50th	90th
# Seniors	49.61	34.93	17	40	98
# Successful Seniors	19.76	17.65	4	12	46
# University Alumni	16.27	21.26	0	6	47
# Successful University Alumni	7.49	11.38	0	2	26
# Successful/Resigned Seniors	14.32	14.56	2	8	37

Note: The sample size is 1,146. Initial networks are defined as the connections with successful seniors formed in the first 3 branches a junior prosecutor worked at. Resigned (or retired) seniors are a junior prosecutor's seniors who left the organization of prosecution 3 years before the timing of the junior's promotion to a DDA.

Table 3: The Effect of Connections with Successful Seniors on Probability of Promotion

	(1)	(2)	(3)	(4)	(5)	(6)
	A. Network Quality Measure: # Successful Seniors					
# Unsuccessful Seniors * 10	-0.005		-0.041***	-0.041***	-0.031***	-0.040***
	[0.007]		[0.010]	[0.010]	[0.010]	[0.015]
# Successful Seniors * 10		0.026***	0.058***	0.054***	0.051***	0.057***
		[0.008]	[0.011]	[0.011]	[0.012]	[0.021]
R-squared	0.001	0.009	0.024	0.054	0.158	0.253
	B. Network Quality Measure: % Successful Seniors					
% Successful Seniors			0.428***	0.388***	0.355***	0.272**
			[0.083]	[0.084]	[0.089]	[0.138]
R-squared			0.023	0.05	0.155	0.249
Demographics				O	O	O
University/High School FE					O	O
Full Branch FE/ Cohort FE						O
Observations	1,146	1,146	1,146	1,146	1,146	1,146

Note: Standard errors in brackets. Dependent variable is the probability of being promoted to a rank of DDA ($Promotion_i$). Demographics include gender, age at passing the bar exam, and region of birth.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 4: The Effect of Successful Seniors by Same-University-Alumni Connection

	(1)	(2)	(3)	(4)	(5)	(6)
	A. Measure of Network Quality: #					
# Unsuccessful & Different	-0.014					-0.034*
university seniors *10	[0.016]					[0.020]
# Unsuccessful & Same		-0.024			-0.050*	-0.051*
university seniors *10		[0.023]			[0.028]	[0.029]
# Successful & Different			0.018			0.054**
university seniors *10			[0.018]			[0.024]
# Successful & Same				0.017	0.043	0.062**
university seniors *10				[0.022]	[0.027]	[0.028]
R-squared	0.246	0.246	0.246	0.246	0.249	0.253
	B. Measure of Network Quality: %					
% Unsuccessful & Different	-0.077					
university seniors *10	[0.145]					
% Unsuccessful & Same		-0.365**			-0.344*	-0.271
university seniors *10		[0.185]			[0.209]	[0.217]
% Successful & Different			0.157			0.206
university seniors *10			[0.146]			[0.165]
% Successful & Same				0.174	0.039	0.155
university seniors *10				[0.159]	[0.179]	[0.202]
R-squared	0.246	0.249	0.247	0.247	0.249	0.250
Observations	1,146	1,146	1,146	1,146	1,146	1,146

Note: Note. Standard errors in brackets. The denominator of every share measure (%) is the number of total seniors (#Successful + #Unsuccessful seniors). Dependent variable is the probability of being promoted to DDA ($Promotion_i$). All control variables, cohort fixed effects, and branch fixed effects are controlled in every specification.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 5: The Effect the Number of Successful Seniors by Alumni Connection and SNU

	(1)	(2)	(3)	(4)	(5)	(6)
# Unsuccessful & Different	-0.010				-0.035*	-0.034
university seniors * 10	[0.016]				[0.021]	[0.023]
# Unsuccessful & Different	-0.022					-0.006
university seniors * 10 * SNU	[0.022]					[0.040]
# Unsuccessful & Same		-0.134			-0.182	-0.19
university seniors * 10		[0.109]			[0.119]	[0.122]
# Unsuccessful & Same		0.109			0.139	0.168
university seniors * 10 * SNU		[0.106]			[0.116]	[0.127]
# Successful & Different			0.018		0.048**	0.052**
university seniors * 10			[0.018]		[0.024]	[0.025]
# Successful & Different			-0.017			-0.053
university seniors * 10 * SNU			[0.037]			[0.071]
# Successful & Same				0.250	0.328*	0.305
university seniors * 10				[0.162]	[0.182]	[0.185]
# Successful & Same				-0.230	-0.272	-0.235
university seniors * 10 * SNU				[0.159]	[0.183]	[0.188]
R-squared	0.247	0.247	0.247	0.248	0.255	0.256
Observations	1,146	1,146	1,146	1,146	1,146	1,146

Note: Standard errors in brackets. Dependent variable is the probability of being promoted to a DDA. All control variables, cohort fixed effects, and branch fixed effects are controlled for in every specification.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 6: The Effect of Successful Seniors by Resignation

	(1)	(2)	(3)	(4)	(5)	(6)
	A. Measure of Network Quality: #					
# Unsuccessful Seniors *10	-0.015			-0.023*	-0.023	-0.041**
	[0.012]			[0.013]	[0.014]	[0.016]
# Successful & Resigned Seniors *10		0.030		0.042**		0.055**
		[0.020]		[0.021]		[0.022]
# Successful & Non-Resigned *10			0.010		0.036	0.062*
			[0.026]		[0.031]	[0.033]
R-squared	0.247	0.247	0.246	0.250	0.248	0.253
	B. Measure of Network Quality: %					
% Successful & Resigned Seniors				0.019		0.191
				[0.130]		[0.145]
% Successful & Non-Resigned					0.397**	0.511***
					[0.174]	[0.194]
R-squared				0.246	0.250	0.251
Observations	1,146	1,146	1,146	1,146	1,146	1,146

Note: Standard errors in brackets. The denominator of every share measure (%) is the number of total seniors (#Successful + #Unsuccessful seniors). Dependent variable is the probability of being promoted to DDA ($Promotion_i$). All control variables, cohort fixed effects, and branch fixed effects are controlled for in every specification.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 7: The Effect of Connections with Successful Seniors using Alternative Definition

	(1)	(2)	(3)	(4)	(5)	(6)
	A. Network Quality Measure: # Successful Seniors					
# Unsuccessful Seniors * 10	-0.025**		-0.069***	-0.068***	-0.054***	-0.067***
	[0.011]		[0.014]	[0.014]	[0.015]	[0.022]
# Successful Seniors * 10		0.015***	0.035***	0.031***	0.032***	0.030**
		[0.005]	[0.007]	[0.007]	[0.007]	[0.012]
R-squared	0.004	0.006	0.027	0.055	0.16	0.254
	B. Network Quality Measure: % Successful Seniors					
% Successful Seniors			0.427***	0.392***	0.345***	0.175
			[0.083]	[0.084]	[0.088]	[0.125]
R-squared			0.022	0.051	0.154	0.247
Demographics				O	O	O
University/High School FE					O	O
Full Branch FE/ Cohort FE						O
Observations	1,146	1,146	1,146	1,146	1,146	1,146

Note: Standard errors in brackets. Successful seniors are defined as the HDs promoted to DDA. Dependent variable is the probability of being promoted to DDA ($Promotion_i$). Demographics include gender, age at passing the bar exam, and region of birth.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 8: The Effect of the Connections with Successful Seniors by Network Formation Period

Network Formation Period	First 2 Branches		First 3 Branches		First 4 Branches		First 5 Branches		First 6 Branches		First 7 Branches	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
A. Network Quality Measure: Number of Successful Seniors (#)												
# Unsuccessful Seniors*10	-0.016	-0.033	-0.023*	-0.029*	-0.002	0.000	0.004	0.008	0.010	0.014*	0.008	0.012
	[0.020]	[0.026]	[0.013]	[0.015]	[0.009]	[0.011]	[0.008]	[0.009]	[0.007]	[0.008]	[0.007]	[0.008]
# Successful Seniors*10	0.054***	0.028	0.054***	0.055***	0.054***	0.047***	0.049***	0.034***	0.046***	0.026**	0.049***	0.026**
	[0.019]	[0.033]	[0.012]	[0.020]	[0.009]	[0.015]	[0.008]	[0.012]	[0.008]	[0.011]	[0.007]	[0.011]
R-squared	0.218	0.271	0.229	0.294	0.258	0.305	0.271	0.329	0.280	0.336	0.280	0.335
B. Network Quality Measure: Share of Successful Seniors (%)												
% Successful Seniors	0.168**	0.024	0.380***	0.213	0.643***	0.247	0.805***	0.362**	0.836***	0.289	0.867***	0.295
	[0.076]	[0.102]	[0.091]	[0.135]	[0.106]	[0.161]	[0.116]	[0.175]	[0.122]	[0.182]	[0.122]	[0.183]
R-squared	0.213	0.269	0.223	0.290	0.238	0.295	0.246	0.320	0.245	0.325	0.248	0.326
Control Variables/ Cohort FE	O	O	O	O	O	O	O	O	O	O	O	O
Full Branch FE		O		O		O		O		O		O
# Branches where junior worked		O		O		O		O		O		O
Observations	1,146											

Note: Standard errors in brackets. Dependent variable is the probability of being promoted to DDA. Control variables include gender, age at passing the bar exam, and fixed effects for high school, university, region, and cohorts. "# Branches where junior worked" is the number of branches where the individual performed as a junior prosecutor. As mentioned in Section 2, all observations in the final sample worked in at least 3 branches. For each specification, branch fixed effects are constructed in a consistent manner with the main specification (model 1).
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 9: The Effect of Successful Seniors on Promotion by Cohorts

	# Successful Seniors		% Successful Seniors	
	(1)	(2)	(3)	(4)
# Unsuccessful Seniors*10	-0.040***	-0.067**		
	[0.015]	[0.030]		
# Successful Seniors*10	0.057***	0.055**		
	[0.021]	[0.026]		
# Unsuccessful Seniors *10 * Late Cohort		0.033		
		[0.033]		
# Successful Seniors *10 * Late Cohort		-0.004		
		[0.026]		
% Successful Seniors			0.272**	0.286*
			[0.138]	[0.154]
% Successful Seniors * Late Cohort				-0.04
				[0.201]
R-squared	0.253	0.254	0.249	0.249
Cohort FE/				
Branch FE	O	O	O	O
Demographics	O	O	O	O
High school FE/				
University FE	O	O	O	O
Observations	1,146	1,146	1,146	1,146

Note: Standard errors in brackets. Dependent variable is the probability of being promoted to a rank of DDA. The prosecutors in the sample passed the bar exam between 1971 and 1993. Late Cohort is defined as the prosecutors who passed the bar exam after 1985.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

A2. Appendix: Tables and Figures

Table A1: Sample Selection Criteria

	N	Sample Restriction
Raw data	3,911	People who ever worked as a prosecutor in data
	3,603	People who passed the bar exam after 1970
	1,269	People who entered JRTI before 1994
	1,188	People who worked in at least three branches
Final sample	1,146	People whose demographics are not missing

Note: From the bio data on prosecutors, I construct an individual level dataset which includes individual career outcomes and network quality variables. In the raw dataset, the number of observations who have ever worked as a prosecutor is 3,911. In 1971, Judicial Research and Training Institute (JRTI) was established and there might be significant institutional change in the admission and promotion process of prosecutors among candidates who passed the bar exam. Also, as mentioned in text, a cohort is defined as the prosecutors who entered the JRTI in the same year. To measure cohort consistently, I exclude 308 observations of prosecutors who passed the bar exam before 1971. See the text for other sample restriction criteria.

Table A2: Distribution of Branch Size, 1974-2002

	Mean	SD	P10	P50	P90
# Senior Prosecutors (HD)	9.29	7.94	1.45	6.45	25.95
# Successful Senior Prosecutors	3.5	4.53	0.26	1.69	13.54
# Junior Prosecutors	31.18	29.26	4.47	21.81	95.17
Number of Branches	64				

Note: The weighted average of each statistics over the time period of analysis (1974-2002) is reported: each branch is weighted by the number of juniors. A successful senior is defined as a HD who achieved a position of DDA at some point in his career.
I calculate the descriptive statistics using the final sample (see Table A1). The number of prosecutors varies a lot across branches, and the distribution of branch size is highly right-skewed. The median of the number of juniors and the number of seniors are lower than the corresponding means. The large variation in the number of successful seniors across branches results in the inequality in network quality: a junior prosecutor assigned to a large branch in the 90th percentile of the number of successful seniors makes eight times more connections than a junior in a branch in the median.

Table A3: Distribution of Initial Network Quality by Alumni Connection and SNU

	Mean	SD	P10	P50	P90	N
	A. Graduates of Seoul National University					
# Same university & Successful seniors	15.46	12.77	3	11	34	525
# Same university & Unsuccessful seniors	17.24	11.3	6	14	33	525
# Different university & Successful seniors	6.46	7.07	0	4	17	525
# Different university & Unsuccessful seniors	13.75	12.2	3	9	31	525
	B. Graduates of Other Universities					
# Same university & Successful seniors	0.75	1.41	0	0	3	621
# Same university & Unsuccessful seniors	1.62	2.35	0	1	5	621
# Different university & Successful seniors	17.18	15.91	4	10	43	621
# Different university & Unsuccessful seniors	27.28	16.91	10	24	49	621

Note: The sample size is 1.146.

Table A4: The Effect the Share of Successful Seniors by Alumni Connection and SNU

	(1)	(2)	(3)	(4)	(5)	(6)
% Unsuccessful & Different	-0.349**					
university Seniors	[0.136]					
% Unsuccessful & Different	0.015					
university Seniors * SNU	[0.213]					
% Unsuccessful & Same		-1.494***			-1.341***	-1.317***
university Seniors		[0.474]			[0.490]	[0.492]
% Unsuccessful & Same		1.097**			1.361**	1.280**
university seniors * SNU		[0.507]			[0.547]	[0.565]
% Successful & Different			0.397***		0.319**	0.345**
university seniors			[0.132]		[0.129]	[0.137]
% Successful & Different			-0.102			-0.231
university seniors * SNU			[0.370]			[0.408]
% Successful & Same				0.838	1.106	1.093
university seniors				[0.885]	[0.883]	[0.884]
% Successful & Same				-0.468	-0.684	-0.686
university seniors * SNU				[0.902]	[0.916]	[0.916]
R-squared	0.196	0.201	0.197	0.196	0.210	0.211
Observations	1,146	1,146	1,146	1,146	1,146	1,146

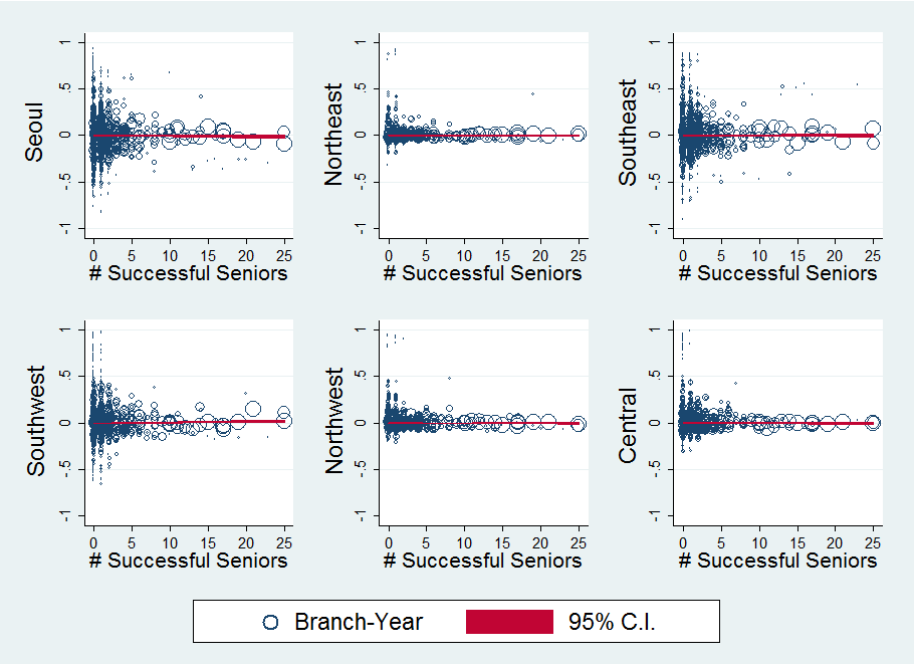
Note: Standard errors in brackets. The denominator of every share measure (%) is the number of total seniors (#Successful + #Unsuccessful seniors). Dependent variable is the probability of being promoted to a rank of DDA. All control variables, cohort fixed effects, and branch fixed effects are controlled for in every specification.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Figure A1: Observable Measures of Ability and Network Quality

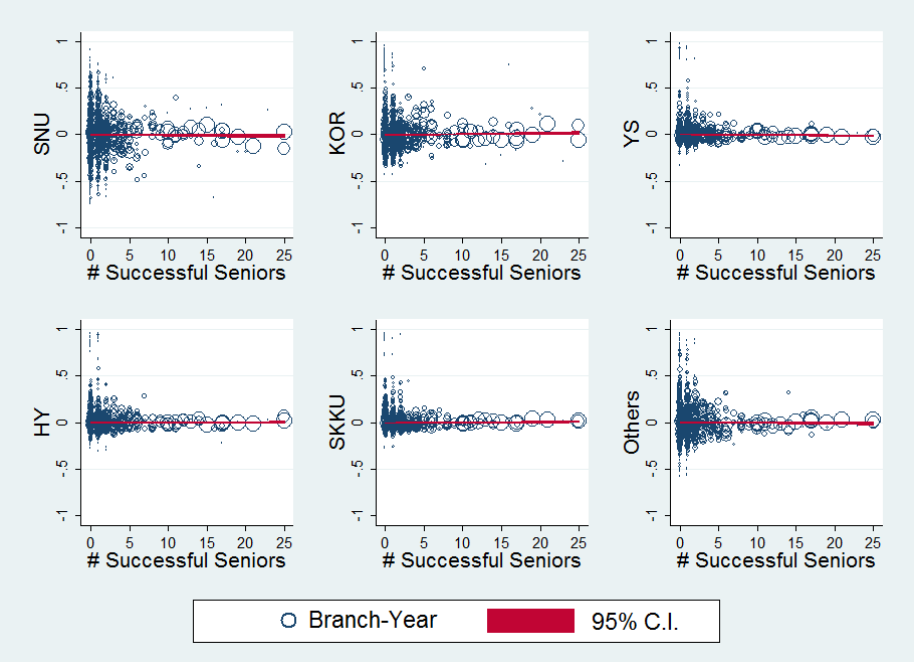
Note: I construct branch-year cell using the final sample which is selected in Section 2. By the branch-year cell, I calculate average age at passing the bar exam and the share of juniors who graduated from Seoul National University (SNU), which is the most prestigious university in South Korea.

Figure A1 illustrates that there is a correlation between the observable measures of ability and the number of successful seniors. Each branch-year cell is weighted by the number of juniors who worked at the branch in the year. The junior prosecutors who passed the bar exam at a young age are more likely to be assigned to branches with many successful seniors. Also, the share of juniors who graduated from SNU is larger for branches with many successful seniors. The existence of selection on observed measures of ability across branches implies that there could also exist selection on unobserved ability.

Figure A2: Residuals of Observable Variables and the Number of Successful Seniors



Residuals of Regions and the Number of Successful Seniors



Residuals of Universities and the Number of Successful Seniors

Figure A3: Residuals of Demographics and the Share of Successful Seniors

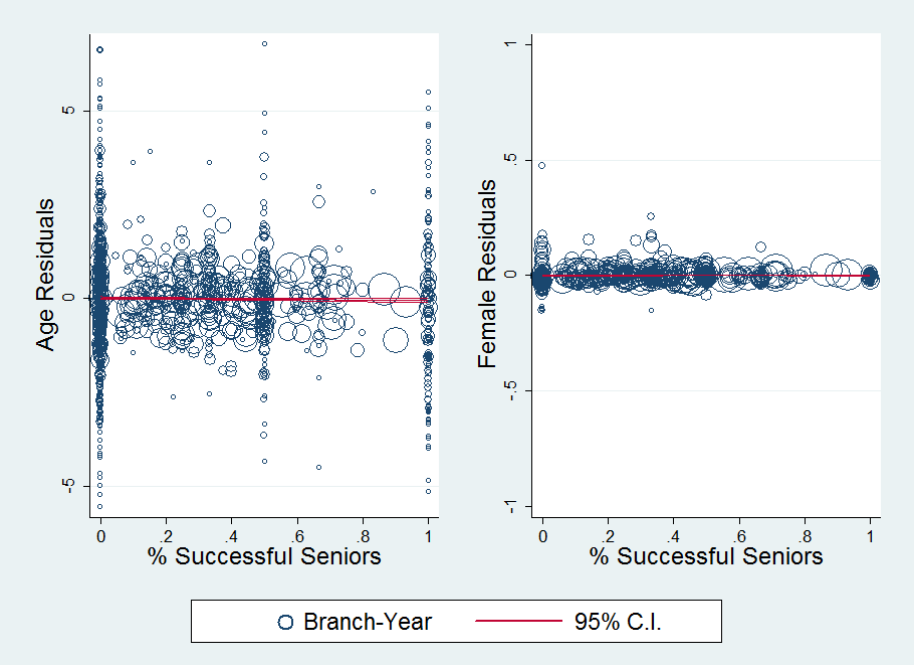
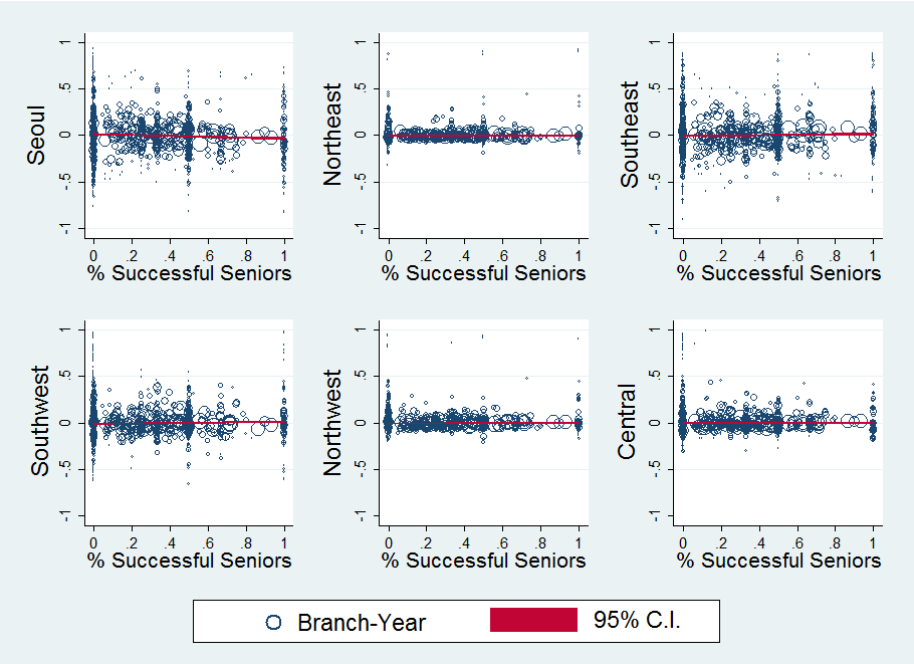
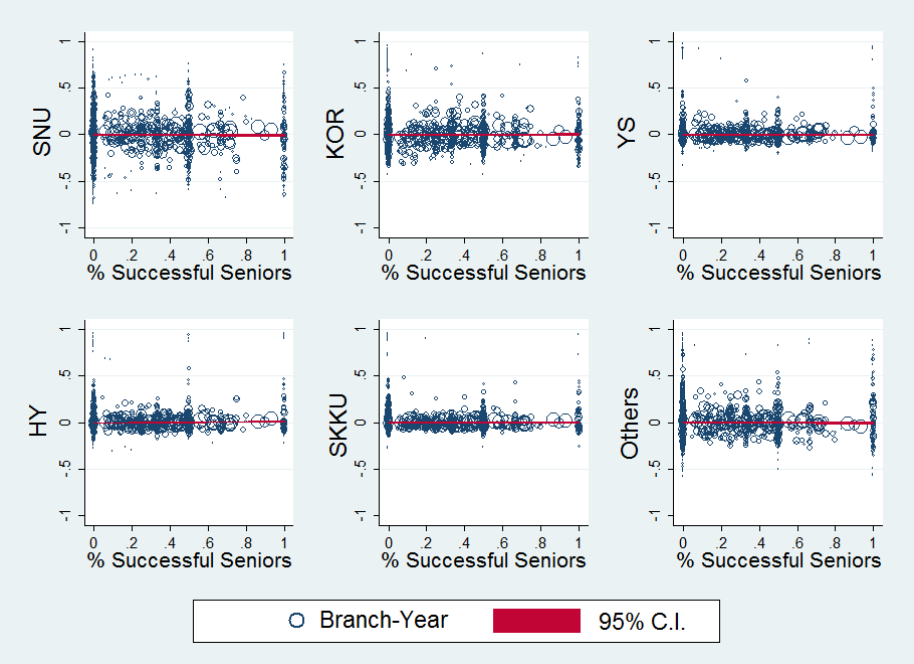


Figure A4: Residuals of Observable Variables and the Share of Successful Seniors



Residuals of Regions and the Share of Successful Seniors



Residuals of Universities and the Share of Successful Seniors

Figure A5: Residuals of Demographics and the Number of Unsuccessful Seniors

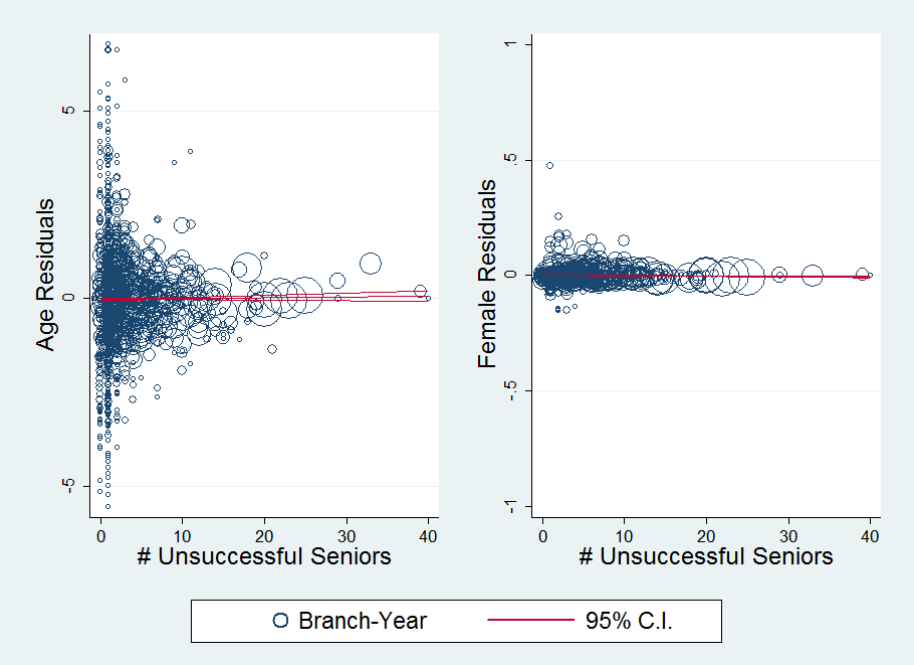
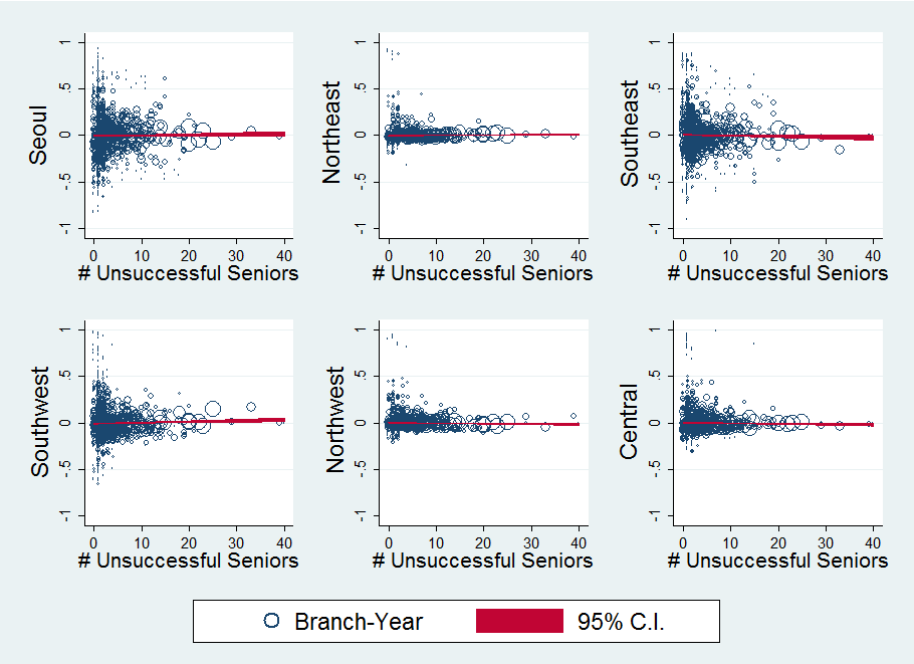
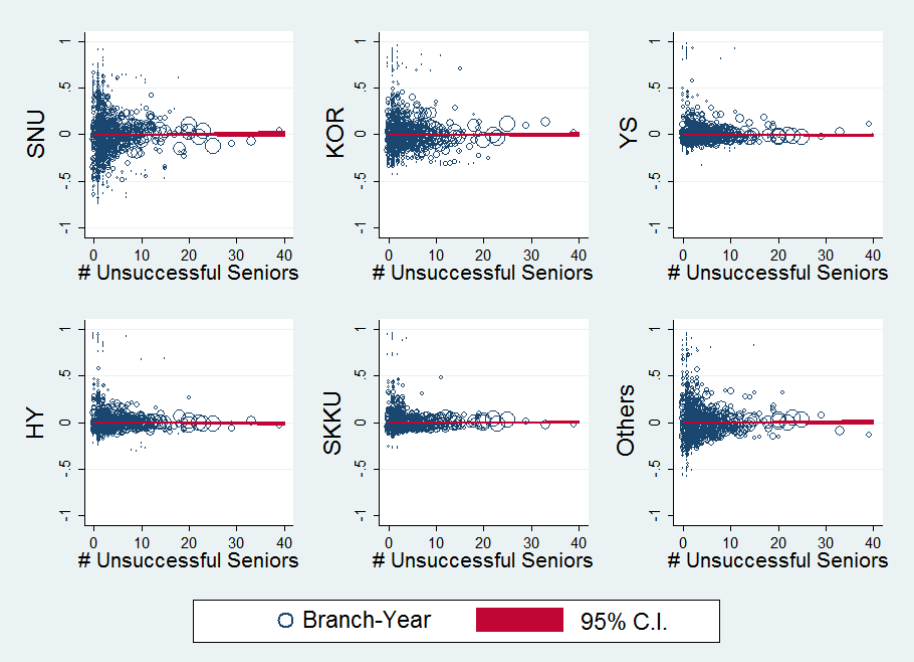


Figure A6: Residuals of Observable Variables and the Number of Unsuccessful Seniors



Residuals of Regions and the Number of Successful Seniors



Residuals of Universities and the Number of Successful Seniors