Financial Services Industry

A Theoretical Approach to Analyst Turnover and Adverse Selection

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This paper suggests a theoretical model to explain the high turnover rate of Korean analysts in terms of adverse selection. This model shows that the overall turnover rate could be higher than expected in a typical adverse selection model where only the *L*-type with low forecasting ability is more likely to move. This occurs when a securities firm makes a high wage offer to recruit *H*-type after observing good past performance, despite the risk that the analyst is, in fact, of *L*-type.

I. Introduction

The number of analysts has significantly increased as the Korean securities market has become more competitive since the mid-2000s.[1] In addition to this quantitative growth, the more remarkable fact is that the turnover rate of analysts has not only steadily increased since 2005, except for 2008, but also has stayed very high. The average annual turnover rate over the recent six years is 11.5%, much higher than 3.8% in the United States, and 2.5% in other domestic industries.[2]

This high turnover rate implies that an adverse selection problem may be observed in the analysts' turnover pattern. In the presence of asymmetric information, adverse selection arises when an informed agent's decision adversely affects uninformed agents. This adverse selection problem has been widely investigated in various markets

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1) The number of registered analysts in 2010 was 1,575, almost double the 800 in 2004. (KOFIA (2011)).

2) KOFIA (2011), and Kim et al. (2010).

such as durable goods, assets, health insurance, labor, and credit markets since Akerlof (1970) and Wilson (1979). Especially, as for the labor market, Greenwald (1986) presents a multi-period game theoretic model where current employers are informed about the abilities of their workers. In this model, employers concentrate their efforts to prevent turnover of their better workers using their private information. This accordingly leads to a typical adverse selection problem where the less competent are more likely to move in the labor market. Considering this result, it can be easily inferred that analysts with low forecasting ability are more likely to move. In this regard, this paper suggests a theoretic model to explain the recent high turnover rate of domestic analysts in terms of adverse selection.

The empirical literature on the analyst turnover presents the following two salient features. First, analysts are more likely to move when the forecasting performance of the previous year was good(Lee (2011)). This implies that securities firms compete with each other to recruit analysts based on the previous performance because it is very hard to tell the ability of analysts specialized in making earnings forecast. Secondly, analysts with high turnover rates tend to have relatively low precision of earnings forecast (Mikhail et al. (1999), Jacob et al. (1999)), or low evaluation scores (KOFIA (2011)). This indicates that a high forecasting performance typically does not persist after the turnover. In addition, analysts who frequently move to other securities firms seem to have low forecasting ability.

This paper provides a game theoretic model where there are two identical securities firms and one analyst in the market. This analyst may have either high (*H*-type) or low forecasting ability (*L*-type) with equal probability. Considering Greenwald (1986) and empirical turnover features in the analyst market, it is assumed that the securities firm currently hiring the analyst is aware of his forecasting ability while the other competing securities firm are not. In this model, the competing uninformed securities firm makes a wage offer after making inference on the type of the analyst based on the forecasting performance.

In this model, there are two turnover patterns depending on the performance and analyst type. The first is the typical turnover pattern as in Greenwald (1986) that *L*-type

with low forecasting ability is more likely to move irrespective of past performance. The second is that *H*-type with high forecasting ability is also more likely to move if the past forecasting performance is good and competing securities firm offers a higher wage, which is different from Greenwald (1986). That is, the turnover rate could be higher than expected in the typical adverse selection model whenever the past performance turns out to be good. In this case, the competing securities firm offering a high wage in order to recruit *H*-type might suffer from profit losses as the hired analyst could actually be of *L*-type.

In addition to the recent quantitative growth of domestic analysts, the remarkable fact is that their turnover rate has not only steadily increased but also its level is very high. This paper suggests a theoretical model to explain this high turnover rate in terms of adverse selection.

This paper is organized as follows. Section II describes the model setup. Section III presents the recruiting competition equilibrium between securities firms, and section IV analyzes the turnover decision and its adverse selection feature.

II. Model Setup

Suppose a market where there are two identical securities firms *A*, *B* and one analyst. There is no contingent contract other than wage between the analyst and any securities firm. Assume that securities firms and the analyst are risk-neutral and the reservation wage of the analyst is zero.

Recruiting competition between securities firms and turnover decision of the analyst proceed over two periods as follows. In period 1, the analyst who is aware of his forecasting ability works for securities firm *A* and makes earnings forecast for companies that he covers. At the end of period 1, his forecasting performance is publicly announced. At the beginning of period 2, two securities firms make their respective wage offer to the analyst. After comparing the two wage offers, the analyst decides on whether to remain at firm *A* or move to firm *B*. Finally, the analyst works for

the securities firm he has chosen in period 2 and retires at the end of period 2.

It is commonly known that an analyst has either high or low forecasting ability with equal probability, i.e., $\phi=1/2$. Let $p_H \equiv p \in (1/2, 1)$ and $p_L \equiv 1-p \in (0, 1/2)$ denote the forecasting precision of the analyst with high and low forecasting ability, respectively. Then, the analyst is of *H*-type if his forecasting ability is high, and of *L*-type otherwise. So, the ex-ante probability that the analyst is of θ-type is 1/2, and the forecasting precision of θ-type is p_θ, $\theta \in \{H, L\}$.

Assume that securities firm *A* hiring the analyst in period 1 observes the type but the competing securities firm *B* does not. In other words, the type is private information that only the analyst and firm *A* know. This means that securities firm *A* has come to learn the type by directly observing the working process and communicating with the analyst in period 1.

The revenue of the securities firm hiring the analyst is v_H if the earnings forecasting turns out to be correct and $v_L (v_H > v_L > 0)$ otherwise. Let $\pi(H)$ and $\pi(L)$, respectively, denote the expected revenue that the securities firm earns by hiring *H*-type and *L*-type, which is shown in (II-1). Hence, the wage offer strategy that securities firm *A* makes to the θ-type in period 2 is $w_A(\theta) \in [0, \pi(\theta)]$, $\theta \in \{H, L\}$.

$$\pi(H) \equiv pv_H + (1-p)v_L,\ \pi(L) \equiv (1-p)v_H + pv_L \qquad \text{(II-1)}$$

On the other hand, uninformed securities firm *B* should make inference on the type based on the publicly announced performance v_θ, $\theta \in \{H, L\}$ at the end of period 1. Let $\phi_{\theta'}(v_\theta)$, θ, $\theta' \in \{H, L\}$ denote the posterior belief that securities firm *B* makes with Bayes' rule on the type $\theta \in \{H, L\}$, which is given in (II-2).[3] This $\phi_{\theta'}(v_\theta)$, θ, $\theta' \in \{H, L\}$ is the probability that securities firm *B* believes the analyst to be type θ' after observing performance v_θ, $\theta \in \{H, L\}$. Let $\pi_\phi(v_\theta)$ denote the expected revenue based on the posterior belief. Then, the wage offer strategy that firm *B* makes to the analyst in period 2 is $w_B \in [0, \pi_\phi(v_\theta)]$.

3) This can be easily obtained with two conditions $\phi=1/2$, and $p_H = p = 1-p_L > 1/2$.

$$\phi_H(v_H)=\phi_L(v_L)=p,\ \phi_H(v_L)=\phi_L(v_H)=1-p \quad \text{(II-2)}$$

$$\pi_\phi(v_\theta)\equiv\phi_H(v_\theta)\pi(H)+(1-\phi_H(v_\theta))\pi(L) \quad \text{(II-3)}$$

In period 2, the analyst chooses to stay if the wage offer of securities firm *A* $w_A(\theta)$ is higher than that of securities firm *B* w_B, and moves otherwise. If two wage offers are same, then the analyst chooses to stay or move with equal probability 1/2. Since the reservation wage is zero, the wage of the analyst in period 2 is $w=max\{w_A(\theta), w_B\}\geq 0$.[4)]

The most interesting feature in this model is that two identical securities firms with different information on the type compete to hire the analyst. The turnover pattern in this asymmetric information could be different from the typical adverse selection if a mixed strategy equilibrium existed.

The most interesting feature in this model is that two identical securities firms with different information on the type compete to hire the analyst. Because of this feature, securities firm *A* can try to prevent *H*-type from leaving by using its informational advantage, which will accordingly lead to the adverse selection problem that only the *L*-type moves to securities firm *B* as in Greenwald (1986). However, it is also possible that *H*-type as well as *L*-type also move if two securities firms have no choice but to use mixed wage offer strategies. Sections III and IV investigate this possibility in more detail.

III. Equilibrium Analysis

1. Benchmark - symmetric information case

To begin with, suppose that securities firm *B* also knows the type of the analyst in period 2. In this case of full information, two securities firms make their wage offer

4) The equilibrium concept of recruiting competition between two securities firms and turnover decision is a Bayesian Nash Equilibrium (BNE).

depending on the expected revenue $\pi(\theta)$, $\theta \in \{H, L\}$ determined by the type.[5)]

In this case, wage offers rise up to $\pi(\theta)$ at which the expected payoff is zero because two identical securities firms compete with each other to hire the analyst of type θ. As a result, it can be easily seen that two securities firms offer $\pi(\theta)$ as the equilibrium wage to the θ-type in period 2, and the analyst chooses to move with probability 1/2.

Suppose that securities firm *A* does not know the type in period 2. In this case, securities firm *A* should also form a posterior belief based on the announced performance of period 1. Hence, competing wage offers are determined by the expected revenue $\pi_{\phi}(v_{\theta})$, $\theta \in \{H, L\}$ associated with the posterior belief.[6)]

As in the full information case, wage offers increase up to the level at which the expected payoff is zero. So, in equilibrium, two securities firms offer $\pi_{\phi}(v_{\theta})$, and the analyst chooses to move with probability 1/2.

This shows that the turnover rate does not change even if the equilibrium wage does under symmetric information on the analyst type between securities firms. To put it differently, recruiting competition between securities firms does not increase the turnover rate in the presence of symmetric information.

2. Recruiting competition under asymmetric information

A. Non-existence of pure strategy equilibrium

Informed securities firm *A* determines the wage level for extension of the analyst's contract based on the expected revenue $\pi(\theta)$, $\theta \in \{H, L\}$. On the other hand, uninformed securities firm *B* chooses the wage level for a new recruit using the expected revenue $\pi_{\phi}(v_{\theta})$, $\theta \in \{H, L\}$ derived from publicly available performance. The analyst stays at securities firm *A* if it offers a higher wage or moves to securities firm *B* otherwise.

Due to asymmetric information on the analyst type between securities firms, not

5) The equilibrium concept is a Sub-game Perfect Nash Equilibrium (SPNE).

6) The equilibrium concept of the recruiting competition in period 2 is a Bayesian Nash Equilibrium (BNE).

only does the feasible set of wage strategies change but also informed securities firm *A* takes the lead in recruiting competition. This should especially be the case if the analyst is of *H*-type. For example, securities firm *B* cannot make a wage offer higher than $\pi_{ø}(v_{\theta})$, $\theta \in \{H, L\}$, but securities firm *A* can prevent turnover with a wage offer slightly higher than this level.

Ironically, however, two securities firms compete with each other to hire the analyst of *H*-type using mixed strategies instead of pure strategies because of this informational asymmetry. That is, any securities firm cannot certainly hire *H*-type by sticking to pure strategies. The following shows the non-existence of pure strategy equilibrium in which both securities firms offer a certain level of wage with probability one.

Consider any wage level $w_B \in [0, \pi_{ø}(v_{\theta})]$ of securities firm *B*. If it intends to hire *L*-type, it will suggest a wage less than or equal to $\pi(L)$. If securities firm *B* offers a wage strictly less than $\pi(L)$, then securities firm *A* can secure the analyst by offering a wage slightly higher than that of securities firm *B* and less than $\pi(L)$. Hence, the only way that securities firm *B* hires *L*-type is to offer $\pi(L)$ to the analyst. In this case, the expected payoff of securities firm *B* is zero.

If securities firm *B* is satisfied with hiring *L*-type, securities firm *A* makes *H*-type analyst stay at the wage offer slightly higher than $\pi(L)$. This in turn implies that securities firm *B* can recruit *H*-type if it raises the wage higher than $\pi(L)$. So, securities firm *B* increases its wage offer higher than this level in order to employ *H*-type.

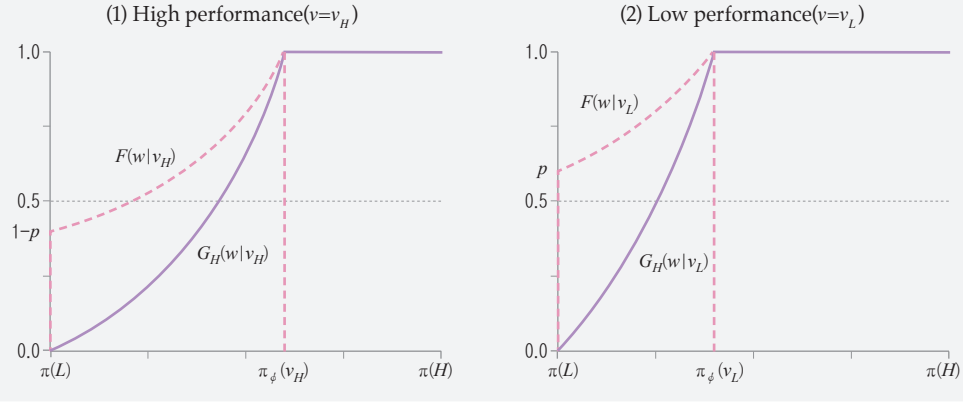
If securities firm *B* tries to hire *H*-type, then competing wage offers go up to $\pi_{ø}(v_{\theta})$, $\theta \in \{H, L\}$, which is the maximum level that securities firm *B* can suggest. However, it is impossible for securities firm *B* to recruit *H*-type at this wage level because securities firm *A* can afford to offer more than $\pi_{ø}(v_{\theta})$. This clearly implies that securities firm *B* cannot hire *H*-type with pure strategies. In the worst case, it is possible for securities firm *B* to hire *L*-type at its highest wage offer $\pi_{ø}(v_{\theta})$. So, securities firm *B* has to try to recruit *L*-type at a wage offer less than or equal to $\pi(L)$. As a result, there is no equilibrium where both firms play pure strategies.

B. Mixed strategy equilibrium

Let $F(w|v_\theta)=Pr(w \geq w_B)$ denote the equilibrium wage offer distribution of securities firm *B*. Let $G_H(w|v_\theta)=Pr(w \geq w_A(H))$ denote the equilibrium wage offer distribution with which securities firm *A* makes an offer to the $\bar{H}$-type. Then, Figure 1 displays the equilibrium wage offer distribution of each securities firm in period 2.[7)]

According to Figure 1, securities firm *B* suggests $\pi(L)$ with the posterior probability that the analyst is of *L*-type and a higher wage than $\pi(L)$ with the posterior probability that the analyst is of *H*-type after observing his performance v_θ, $\theta \in \{H, L\}$ of period 1. The expected payoff of securities firm *B* is zero. On the other hand, securities firm *A* suggests $\pi(L)$ to the *L*-type with probability one while it offers a mixed strategy equilibrium wage G_H to the *H*-type in response to the mixed strategy equilibrium wage offer of securities firm *B*. In this case, securities firm *A* expects zero payoff from the *L*-type and some positive payoff $\pi(H)$-$\pi_\phi(v_\theta)$ from the *H*-type.

Figure 1. Mixed Strategy Equilibrium Wage Offer Distribution



This implies that the only way for securities firm *B* to recruit *H*-type is to vary the wage offer, which intends to distract securities firm *A*. In other words, securities firm *A*

7) Securities firm *B* makes a wage offer $F(w|v_\theta)=\frac{\pi(H)-\pi_\phi(v_\theta)}{\pi(H)-w}$, $\forall w \in (\pi(L), \pi_\phi(v_\theta)]$, $Pr(w_B^* = \pi(L))= 1-\phi_H(v_\theta)$ $=\phi_L(v_\theta)$ to the analyst. Securities firm *A* makes a wage offer $G_H(w|v_\theta)=\frac{\phi_L(v_\theta)(w-\pi(L))}{\phi_H(v_\theta)(\pi(H)-w)}$, $\forall w \in [\pi(L), \pi_\phi(v_\theta)]$ to *H*-type, and $w_A^*(L)=\pi(L)$ to *L*-type.

is no longer guaranteed to prevent the turnover of *H*-type analyst whenever securities firm *B* offers either wage $\pi(L)$ or wage $w_B \in [\pi(L), \pi_{\phi}(v_{\theta})]$ following its equilibrium distribution. In this way, uninformed securities firm *B* can raise the possibility of hiring *H*-type. In addition, it could minimize the expected payoff of securities firm *A* at the minimum level $\pi(H)-\pi_{\phi}(v_{\theta})$ by using mixed strategies.

Securities firm *A* correspondingly plays mixed strategies to make the expected payoff of securities firm *B* zero with its informational advantage. Furthermore, equilibrium wage offer distribution G_H first-order stochastically dominates the equilibrium wage offer distribution *F* as shown in Figure 1. So, the average wage level that securities firm *A* offers to the *H*-type is higher than that of securities firm *B*, given the performance of period 1. Therefore, securities firm *A* can also raise the possibility that *H*-type chooses to remain rather than move by playing mixed strategies.

Uninformed securities firm *B* tries to hire *H*-type by varying its wage offers, which intends to distract securities firm *A*. In response, informed securities firm *A* not only varies its wage offers but also makes a higher wage offer on average, which intends to prevent the turnover of the *H*-type as much as possible.

Note that the average level of wage offers associated with good past performance is higher than that associated with bad one according to the mixed strategy equilibrium wage offers. This is because the observed high performance makes securities firm *B*'s posterior belief $\phi_H(v_H)$, that the analyst is of *H*-type, larger than the ex-ante probability $\phi=1/2$, which in turn raises the wage offer.

IV. Turnover Decision and Adverse Selection

1. Turnover decision

As for the turnover of the *L*-type, equilibrium condition shows that securities firm *A* always offers $\pi(L)$ to the *L*-type. So, the analyst of *L*-type chooses to move if securities

firm *B* offers a wage higher than $\pi(L)$ with probability $\varnothing_H(v_\theta)$. If it suggests $\pi(L)$ with probability $\varnothing_L(v_\theta)$, then the *L*-type moves with probability 1/2. Hence, the probability of *L*-type's turnover, denoted by $P_L(v_\theta)$ is as follows:

$$P_L = \phi_H(v_\theta) + \frac{\phi_L(v_\theta)}{2} = \frac{1}{2} + \frac{\phi_H(v_\theta)}{2} \quad \text{(IV-1)}$$

The analyst of *H*-type receives a wage offer $w_A(H)$ from securities firm *A* and w_B from securities firm *B*. Since the probability that securities firm *B* offers $\pi(L)$ is $1-\varnothing_H(v_\theta) = \varnothing_L(v_\theta)$, *H*-type stays at securities firm *A* with this probability $1-\varnothing_H(v_\theta)=\varnothing_L(v_\theta)$. This means that *H*-type chooses to move if securities firm *B* offers a wage higher than $\pi(L)$ and securities firm *A* offers a wage less than the wage offer of securities firm *B*. Hence, the probability that *H*-type moves, denoted by $P_H(w_B|w_\theta)$, is as follows:

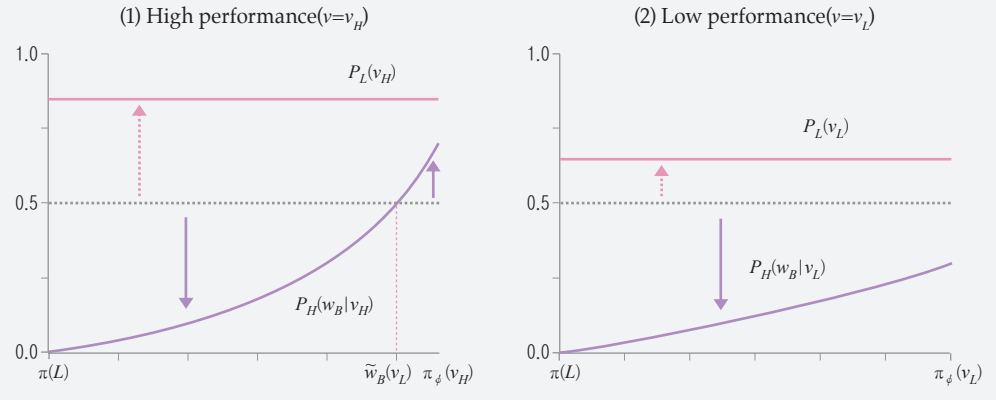
$$P_H(w_B|v_\theta) = \varnothing_H(v_\theta)G_H(w_B) \leq \varnothing_H(v_\theta) \quad \text{(IV-2)}$$

2. Adverse selection

Figure 2 displays the turnover probability of each type and demonstrates how the adverse selection problem arises depending on the type and performance.

Basically, as in Greenwald (1986), a typical adverse selection problem emerges in a way that only the turnover of *L*-type prevails irrespective of past performance. Furthermore, it is easily seen that *H*-type as well as *L*-type are also more likely to move if securities firm *B* offers a sufficiently high wage to recruit *H*-type after observing high past performance.

Figure 2 Turnover probability under asymmetric information



The intuition is that the bargaining power of informed securities firm *A* diminishes as securities firm *B* can afford to offer a higher wage in response to the high past performance. As described in the previous section, in equilibrium, securities firm *B* tries to distract securities firm *A* in order to hire *H*-type by changing its wage offer while securities firm *A* tries to prevent the turnover of *H*-type. This effort of securities firm *A* becomes more effective when the analyst's performance is low so that it can limit the maximum turnover probability at 1-*p*, lower than the benchmark level. However, if the announced performance is high, the maximum turnover probability inevitably reaches to *p*, higher than the benchmark level. This equivalently increases the turnover probability up to the level higher than the benchmark. In other words, the effort of securities firm A to retain *H*-type could end in vain despite the informational advantage.

_L_-type is more likely to move irrespective of the uninformed securities firm _B_'s wage offer level and his performance. _H_-type is much less likely to move if his performance is low. However, _H_-type becomes more likely to move depending on the wage offer level of securities firm _B_ if his performance is high.

One thing to note here is the possibility that the analyst is of *L*-type even if securities firm *B* has successfully hired him at a high wage level with the belief that he should be of *H*-type. Hence, securities firm *B* should take the risk that it might suffer from ex-

post negative payoff after hiring the analyst.

In sum, there exists an adverse selection problem that *L*-type is more likely to move irrespective of the performance. In addition to this typical adverse selection problem, *H*-type with high forecasting ability is also more likely to move in some cases. This phenomenon arises when securities firm *B* observing high performance tries to recruit *H*-type at the risk of hiring *L*-type. As a result, the overall turnover rate in the analyst market could be higher than expected in a typical adverse selection problem.

V. Conclusion

This paper suggests a theoretical model to explain the high turnover rate of domestic analysts market in terms of adverse selection. The key results show that turnover probability remains at a constant level while equilibrium wage varies if the two securities firms have the same information on the analyst type. On the other hand, the analyst who tends to move is typically of *L*-type in the presence of asymmetric information between securities firms. However, *H*-type also becomes more likely to move as long as the outside wage offer is sufficiently high and his previous performance is good, which leads to the increase in the overall turnover rate in the market.

These results bear some policy implications. First, it is necessary to improve transparency in analysts' research in terms of public access to their reports or informational disclosure, which helps to reduce the overall asymmetric information. It also requires that both analysts and securities firms make more innovative efforts to improve the efficiency or productivity of their research. This will help to not only stabilize the turnover rate but also improve overall market efficiency and human resources allocation. In this regard, this model could be extended to a model considering research incentives for career concerns. In addition, more in-depth empirical research needs to be done on the adverse selection in the analyst market.

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