Who Get Displaced and
How Much Do They Lose After the Displacement?

Kang, Changhui

(Department of Labor Economics, Cornell University)

The study aims at investigating the following two things.

First, it tries to show what kinds of employees were displaced from the firms that cut their workforce in the process of economic crisis that hit Korean economy in late November 1997. Those who were young or old relative to about 38 years of age, were not head of households and were employed on the part-time basis, in small-sized, construction industries were significantly more likely to be displaced from their employers. When the samples are restricted to Seoul-KyongKi business region, those born in KyongSang province were significantly more likely to be displaced from the firms than those born in JonRa province were.

Second, the study also intends to measure the magnitude of earnings losses experienced by those who have been displaced in post-crisis period. Every worker (whether displaced or not) lose about 4.2% in post-crisis period relative to pre-crisis monthly earning level. Those who have experienced prior displacement will lose about 6.5 9.9% points more in post-crisis period than those who have retained their employment during the economic crisis.

. Introduction

The study aims at investigating the following two things.

First, it tries to show what kinds of employees were displaced from the firms that cut their workforce in the process of economic crisis that hit Korean economy in late November 1997. Second, the study also intends to measure the magnitude of earnings losses experienced by those who have been displaced. Since we are using data collected during the period between June and October of 1998, the analyses are mainly focused on the time period between December of 1997 and October of 1998.

Given the data, the first objective would be accomplished through comparing characteristics of those displaced from the firms after November 1997 with those of employees that have remained employed in the firms during the period between December 1997 and the survey date of 1998. This analysis highlights the main components of either personal or firm

characteristics, that affect the decision made by firms trying to cut off part of their employees. In addition to the general analysis, a variable of birth place will be included in the analysis as a part of explanatory variables as well as the ones used previously. The reason is that it is one of the particular concerns of Korean labor economists to see if there is any discriminating effect of the birth place of employees on the probability of being displaced from the employment restructuring firms.

In the second place, to measure the magnitude of earnings losses experienced by those who have been displaced, we restrict our sample to (1) those who have never displaced between December 1997 and the survey date of 1998, and (2) those who have been displaced from old employer (after November 1997) to get re-employed by a new employer (by the survey date of 1998). The amount of earnings losses arising from the displacement will be the difference in the current earnings (as of the survey date) between those displaced and not.

In measuring the earnings losses caused by the displacement, however, there are some econometric issues needed to be discussed, in advance. Since the economic depression imposes the earnings losses to those displaced as well as to those not, a real effect of the displacement on the post-crisis earning level has to be sorted out of time effect that affects the post-crisis earning level of those displaced and not, in common. In addition, it is suspected that a variable indicating the displacement status may be endogenous in a simple OLS regression applied to the cross-section data in the sense that it may be correlated with an error term in the regression. We are proposing a fixed effect method among others to separate the time effect from the real effect of the displacement and overcome the problem of endogeneity of the displacement status in OLS of the cross-section data.

The paper is organized as follows. The data used for the analysis and the descriptive statistics are briefly discussed in Section   . A probit analysis will be applied, in Section   .1, on the probability that one gets displaced from his employer, and the same analysis will be employed in Section   .2 for the sample restricted to those whose employers at the risk of displacement are (or were) doing business in Seoul-KyongKi region. It is to investigate the discriminating effect of the birth place of employees on the displacement likelihood. Section is solely devoted to measuring the earnings losses of those displaced. In Section   .1, a simple OLS analysis will be used that includes a variable representing whether one have experienced the displacement (during the period between December 1997 and the survey date) before getting employed. In Section   .2, the limitations and drawbacks of the simple OLS analysis are discussed, and analytical methods that are able to overcome those problems are suggested and applied to measure the effect and magnitude of the prior displacement on the post-crisis earning.

. Data

Korea Labor Institute conducted a survey of 5,000 households and 13,783 household members over 15 years of age from June to October of 1998 to construct a dataset titled "Korean Labor Panel" of 1998[1]. From the survey for individuals, the information is available on observable individual characteristics such as sex, age, years of schooling, birth place, etc., worker's occupation, form of employment (part-time or full-time) and firm characteristics of both most recent and current employer that consist of industry and total size of employees of the firm. The calendar date in which an individual left his most recent employer is able to be identified, which enables us to construct the sample of individuals that left their most recent employers during the period between December 1997 and the survey date of 1998.

By identifying the reason that those individuals left their employers, a sample of those who left the most recent employer for involuntary reasons[2] such as separation by being fired or by employer bankruptcy[3] will be constructed. Those individuals will be defined as "separators", those who were displaced from employers in the process of the restructuring forced by the economic crisis. In contrast, those who continue to remain employed between December 1997 and the survey date of 1998 will be defined as "stayers". To construct the sample of stayers, it is supposed that every firm that employs them has experienced downsizing of its employment during the period after the economic crisis. Consequently, "stayers" are viewed as survivors of employment downsizing during the period of interest.

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1) It will be created to be panel data for years to come.
2) In the survey, a question is asked as to why one left his most recent employer. The reason for leaving the most recent employer is classified as involuntary if a respondent answered "it was either because of employer bankruptcy, because of being fired, or because of no jobs assigned to me". The separation is supposed to be due to being fired if a respondent answered it was because of being fired or because of no jobs assigned. It is supposed to be due to employer bankruptcy if he answered it was because of employer bankruptcy. The reason is classified as voluntary if he answered in other ways than listed as involuntary.
3) Information given by the survey make it impossible to distinguish between a shut-down of an entire firm and that of one of its establishments with the entire firm alive. The employer bankruptcy may imply a shut-down of one of establishments of an entire firm that has more than one establishments. As a result, those displaced by the employer bankruptcy may include those displaced by mother firm's decision to shut down one of its establishments and cut entire workforce in it. This point turns out to matter in interpreting the estimation result given in (.2).

T able 1 reports means and proportions of the variables stratified by whether one has been displaced and how he has been displaced. It also displays the results of the T-test for age[4], years of schooling, monthly earning level and years of tenure, and the Chi-Square test for other variables measured at the risk of displacement[5].

Age, years of schooling and monthly earning level are significantly different across separators and stayers, while years of tenure is not. Proportion of male, household head, full-time, blue collar and professional workers is also significantly different. Firm characteristics such as firm size and industry[6] have distinct effects on the displacement likelihood, as well. The similar tendencies reappear when those who have displaced are subdivided into those displaced by employer bankruptcy and those displaced by being fired in reference to their reasons of the displacement.

. Who Get Displaced?

1. Model on Displacement Likelihood

Since the tests applied in Section   control for just one of the variables of worker's characteristics unconditionally, controlling for other variables is required in order to estimate the marginal effect of one of the characteristics on the displacement likelihood. It can be accomplished by regressing the displacement status against characteristics of a worker and the

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4) Age ranges from 15 to 60 since those over 60 years of age were excluded from the analyses.
5) The variables are measured as of the calendar date of displacement for those who has been displaced, while measured as of the survey date for those who have retained their employment until the survey date.
6) All industries are summarized by five representative industries that are put together based on 3-digit industry codes. They are construction industry, light industry, heavy industry, service industry of low wage, and service industry of high wage. Construction industry is the construction industry. Light industry consists of industry of nondurable manufacturing, primary metals, and fabricated metals. Heavy industry is constructed by industry of nonelectrical machinery, electrical machinery, transportation equipment and other durable manufacturing. Service industry of low wage is made up of wholesale and retail trade. Finally, service industry of high wage includes industry of transportation, communication and public utilities, finance, insurance and real estate, and professional, business and entertainment services. Those who were employed in agriculture, mining industry and government sector were excluded from the analysis of Section   and   .

firm employing him, and taking account of the discrete nature of the displacement status in the regression. The situation exactly fit with the analytical method of probit model.

<div align="center">< Table 1 : Composition of Samples Used in Probit Analysis ></div>

	Stayers	Separators		
		Separation in Total	Separation by Bankruptcy	Separation by Being Fired
Means :				
Age	36.01	*37.42	36.03	**38.44
Education(Year)	12.65	**11.17	**11.58	**10.88
Monthly Earning(W1,000)	1243.24	**1124.11	1144.03	*1109.50
Tenure(Year)	4.94	4.81	*3.88	5.49
Proportions(%) :				
Male	64.50	**56.81	58.22	*55.78
Married	70.88	70.72	70.55	70.85
Head	57.81	**46.38	*48.63	**44.72
Full-time	87.25	**77.68	*80.82	**75.38
Occupation :				
Blue Collar	35.56	**46.67	*44.52	**48.24
White Collar	35.63	38.26	41.10	36.18
Professional	28.81	**15.07	**14.38	**15.58
Firm Size :				
1~ 10	23.56	**41.16	**37.67	**43.72
11~ 30	16.94	13.33	17.12	*10.55
31~ 100	16.00	18.26	*23.29	14.57
101~ 300	10.00	10.72	12.33	9.55
301~1000	10.38	**4.93	*4.11	*5.53
1001~	33.50	**16.52	**9.59	**21.61
Industry :				
Construction	6.00	**14.49	**18.49	**11.56
Light	14.81	*19.42	19.18	19.60
Heavy	15.88	13.91	12.33	15.08
Service of Low Wage	18.50	**30.14	**34.25	**27.14
Service of High Wage	44.81	**22.03	**15.75	**26.63
Number of Observations	1600	345	146	199

Note : * and ** indicate significant differences in mean or proportion of the variable across
stayers and separators at 5% and 1% significance level, respectively.

The analysis is able to be modeled as follows ;

Suppose that a separator takes 1 and a stayer takes 0 for a variable D_i that is a dummy variable representing whether one has been displaced from his employer in the period between December 1997 and the survey date of 1998[7]. Then, the probability that one is displaced is

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7) Note, again, that it is supposed that every firm in which our sample workers are employed has restructured its employment during this time period.

$$\Pr(\text{Separator}) = \Pr(D_i = 1) = \Phi(X_i{}'\beta)$$

where X_i is $(K \times 1)$ vector of worker i's characteristics consisting of usual personal characteristics and characteristics associated with his employer at the risk of displacement, β is $(K \times 1)$ vector of parameters associated with them, and $\Phi(\cdot)$ is a cumulative distribution function (i.e. CDF) of the standard normal distribution. And, the probability that one remains employed during the same period is

$$\Pr(\text{Stayer}) = \Pr(D_i = 0) = 1 - \Phi(X_i{}'\beta)$$

Taking a derivative of $\Pr(\text{Separator})$ with respect to X_{ik} $(k = 1, \cdots, K)$ to interpret the estimators given by the analysis, we have

$$\frac{\partial \Pr(Separator)}{\partial X_{ik}} = \frac{\partial \Phi(X_i{}'\beta)}{\partial X_{ik}} = \phi(X_i{}'\beta) \cdot \beta_k$$

where $\phi(\cdot)$ is a probability density function of the standard normal distribution.

Since $\phi(\cdot)$ is always positive over every possible argument in it, a characteristic X_{ik} increases(or decreases) the likelihood of displacement if β_k is positive(or negative, respectively), other things being equal.

Table 2 reports the estimation results of the probit analysis.

Three distinct models are applied depending upon whether the model is estimated in terms of the overall displacement likelihood, the likelihood of being displaced by employer bankruptcy, or the likelihood of being displaced by worker being fired with his employer alive.

Worker characteristics of firms cutting their workforce are shown to have little to do with firm bankruptcy, while a firm with more than 1,000 employees and in the service industry of high wage is significantly less likely to be bankrupt than a firm with less than 10 employees and in light industry, respectively[8].

< Table 2 : Estimates of Probit Analysis on Displacement Likelihood >

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8) Comparing the results with those obtained in Section 2, it turns out that the test results based on unconditional analysis that some of worker characteristics have effects on the firm bankruptcy disappear so that they are due to the effect of sample composition.

Explanatory Variables \ Dependent Variables	Overall Displacement	Displacement by Employer Bankruptcy	Displacement by Being Fired
Intercept	**1.69 (0.57)	0.54 (0.77)	**1.52 (0.66)
Male	0.01 (0.11)	-0.05 (0.14)	0.05 (0.13)
Age	**-0.10 (0.03)	*-0.08 (0.04)	**-0.10 (0.04)
Age Sq.	**0.001 (0.000)	0.001 (0.000)	**0.001 (0.000)
Education	-0.03 (0.02)	-0.01 (0.02)	-0.03 (0.02)
Married	0.16 (0.12)	0.23 (0.17)	0.09 (0.15)
Head	**-0.35 (0.11)	-0.21 (0.14)	**-0.42 (0.13)
Monthly Earning(W1,000)	0.06 (0.13)	0.22 (0.18)	-0.02 (0.15)
Monthly Earning Sq.	0.03 (0.02)	-0.01 (0.03)	0.04 (0.02)
Tenure	-0.01 (0.02)	-0.01 (0.02)	-0.00 (0.02)
Tenure Sq.	0.001 (0.001)	0.000 (0.001)	0.00 (0.00)
Full-time	*-0.21 (0.10)	-0.13 (0.13)	**-0.26 (0.12)
Occupation :			
Professional	-0.19 (0.12)	-0.18 (0.16)	-0.19 (0.14)
White Collar	-0.06 (0.10)	0.01 (0.13)	-0.11 (0.12)
Firm Size :			
11~ 30	**-0.45 (0.11)	-0.22 (0.14)	**-0.59 (0.14)
30~ 100	-0.21 (0.11)	0.03 (0.14)	**-0.39 (0.14)
101~ 300	-0.17 (0.13)	-0.00 (0.17)	-0.24 (0.16)
301~1000	0.01 (0.17)	0.21 (0.25)	-0.06 (0.19)
1000~	**-0.63 (0.12)	**-0.83 (0.19)	**-0.46 (0.14)
Industry :			
Construction	**0.51 (0.14)	**0.56 (0.18)	*0.36 (0.17)
Heavy	-0.06 (0.13)	-0.11 (0.17)	-0.02 (0.15)
Service of Low Wage	0.02 (0.12)	0.12 (0.16)	-0.08 (0.15)
Service of High Wage	**-0.44 (0.11)	**-0.53 (0.16)	**-0.34 (0.13)
Log-Likelihood	-806.465	-440.690	-555.273
Total # of Observations	1945	1746	1799
Total # of Separators	345	146	199

Note : 1) In the parenthesis are standard errors.
2) * and ** indicate the estimate is significant at 5% and 1% level, respectively.
3) Reference group is female, unmarried, non household head, part-time, blue collar
worker employed in a firm with less than 10 employees of light industry.

In contrast, worker characteristics as well as firm characteristics have an effect on the likelihood of the displacement by being fired. Those who are young and old relative to about 38 years of age, are not head of households and are employed on the part-time basis are significantly more likely to get fired by their employers. The effect of firm size on the likelihood of getting fired is more pronounced than shown for the likelihood of being separated for employer bankruptcy in that workers employed in the firms with more than 10 employees are significantly less likely to get fired than those in firms with less than 10 employees. Workers in the construction industry are exposed to significantly high rate of displacement for

both reasons. The overall likelihood of displacement itself generally reiterates the estimation results obtained for the likelihood of being fired with employers remaining alive.

2. Discriminating Effect of Birth Place on the Likelihood of Displacement

In this section, we restrict the sample to those whose employer was doing business in Seoul-KyongKi region at the risk of displacement, and include a variable of worker's birth place as a part of explanatory variables as well as the usual ones. Since Seoul-KyongKi region has wider dispersion of birth places than any other regions in the country, this restriction is going to better pinpoint the analysis that will see if there is any effect of employee's birth place on the likelihood of being displaced from the employment restructuring firms.

The estimation results are reported in Table 3.

Overall, those born in KyongSang province were significantly more likely to get displaced any way from the firms than those who were born in JonRa province were. When the cause of the displacement is subdivided, it is believed that those born in KyongSang province were significantly more likely to get fired from the firms that cut their workforce than those born in JonRa province were. It is a little puzzling, however, that those born in KyongSang and Seoul-KyongKi province were significantly more likely to get displaced from the firms that were bankrupt than those born in JonRa province were.

Here, in order to avoid misleading interpretations about the result given for the likelihood of displacement by employer bankruptcy, a couple of comments should be provided. First, it is necessary to note that a small sample problem may not give a full credit to the results given by the estimation. As reported in <Appendix Table 1>, there are only 8 and 10 workers born in JonRa and KyongSang province, respectively, who get displaced by employer bankruptcy, although there are quite enough observations of stayers within each region of birth place. Second, from information given by the data, we are not able to distinguish between a shut-down of an entire firm and that of one of its establishments with the entire firm alive. That is, it is possible that the employer bankruptcy means a shut-down of one of establishments of an entire firm that has more than one establishments, == footnote 3). In this case, the displacement should be regarded as resulting from an employee being fired rather than from the bankruptcy. As a result, the effect estimated as regards the displacement by bankruptcy may be confounded with the effect associated with the displacement by being fired. For these two reasons, some degree of caution is required to draw a firm conclusion from the analysis applied to the displacement likelihood by employer bankruptcy. The

estimation result suggested in the paper should be viewed as a preliminary attempt to measure the effect of birth place in the sense that it should be supplemented with a large amount of data and similar analyses in the future.

Nonetheless, given the estimation results from the data currently available, it is believed that employee's birth place is one of the factors taken into account when a firm tries to cut its part of workforce[9]. Since there is no reasonable explanation based upon economic (not political) theory currently available, the effect should be called a 'discriminating effect' of employee's birth place on the displacement likelihood.

Ⅳ. How Much Do They Lose After the Displacement?

1. Basic Model

In this section, we try to measure the earnings losses experienced by those who have been displaced during the economic crisis and re-employed until the survey date through comparing them with those retaining their jobs during the corresponding period. It is required in order to accomplish it to restrict the sample only to those who have retained their jobs and those who have been displaced and re-employed in a new job until the survey date[10].

As shown in Fig 1, there are significant reductions in monthly earnings between pre and post-crisis period among separators and stayers, in common[11]. Overall, the separators have lost 24.6% of monthly earning compared to the pre-crisis level, while the stayers have experienced 14.9% reduction. When the separators are subdivided into those displaced by the employer bankruptcy and those displaced by being fired, the former ones have lost 25.3% and the latter ones have lost 23.6% of their monthly earning.

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9) The results don't change when the residence region around 14 years of age of a worker is used on behalf of the birth place.

10) It will give some degree of reduction in the sample of those experiencing the displacement without changing the sample of those retaining jobs at all. As a result, it is necessary to note that our results of the earnings losses are based on a small number of separators relative to that of stayers. However, this limitation is not able to be overcome given the data currently available. The analysis performed in the paper should be augmented using data for years to come.

11) The post-crisis earning is the post-displacement earning for the separators, at the same time.

< Table 3 : Estimates of Probit Analysis on Displacement Likelihood
- Sample Restricted to Seoul-KyongKi Region >

Explanatory Variables \ Dependent Variables	Overall Displacement	Displacement by Bankruptcy	Displacement by Being Fired
Intercept	*2.21 (0.86)	0.89 (1.20)	*2.09 (0.99)
Male	0.11 (0.15)	0.11 (0.20)	0.10 (0.18)
Age	*-0.11 (0.05)	-0.11 (0.06)	-0.10 (0.05)
Age Sq.	*0.001 (0.001)	0.001 (0.001)	*0.001 (0.001)
Education	**-0.08 (0.02)	*-0.07 (0.03)	*-0.07 (0.03)
Married	0.09 (0.17)	0.22 (0.24)	-0.04 (0.20)
Head	*-0.32 (0.15)	-0.20 (0.21)	*-0.37 (0.18)
Monthly Earning(W1,000)	-0.31 (0.22)	-0.02 (0.32)	-0.41 (0.25)
Monthly Earning Sq.	**0.12 (0.04)	0.04 (0.07)	**0.13 (0.05)
Tenure	0.03 (0.03)	0.06 (0.04)	0.02 (0.03)
Tenure Sq.	0.000 (0.001)	-0.003 (0.002)	0.000 (0.001)
Full-time	-0.20 (0.15)	-0.30 (0.20)	-0.16 (0.17)
Firm Size(100)	-0.02 (0.02)	*-0.05 (0.02)	0.01 (0.02)
Firm Size Sq.	0.000 (0.000)	0.000 (0.000)	-0.001 (0.001)
Occupation :			
Professional	-0.07 (0.16)	0.13 (0.23)	-0.17 (0.19)
White Collar	-0.03 (0.15)	0.25 (0.21)	-0.19 (0.17)
Industry :			
Construction	0.35 (0.20)	**0.76 (0.27)	-0.01 (0.25)
Heavy	-0.37 (0.19)	-0.07 (0.27)	*-0.47 (0.22)
Service of Low Wage	0.07 (0.17)	0.35 (0.24)	-0.09 (0.20)
Service of High Wage	**-0.57 (0.16)	*-0.49 (0.24)	**-0.52 (0.18)
Birth Place :			
Seoul-KyongKi	0.27 (0.16)	*0.57 (0.23)	0.07 (0.18)
Kyong Sang	**0.57 (0.19)	*0.67 (0.28)	*0.51 (0.21)
Other Provinces	0.15 (0.17)	0.21 (0.25)	0.10 (0.19)
Log-Likelihood	-384.209	-195.776	-272.932
Total # of Observations	976	875	910
Total # of Separators	167	66	101

Note : 1) In the parenthesis are standard errors.
   2) * and ** indicate the estimate is significant at 5% and 1% level, respectively.
   3) Reference group is female, unmarried, non household head, part-time, blue collar worker
      employed in a firm of light industry and born in JonRa province.

Fig 1. Change in Monthly Earnings Between Pre and Post-Crisis Period
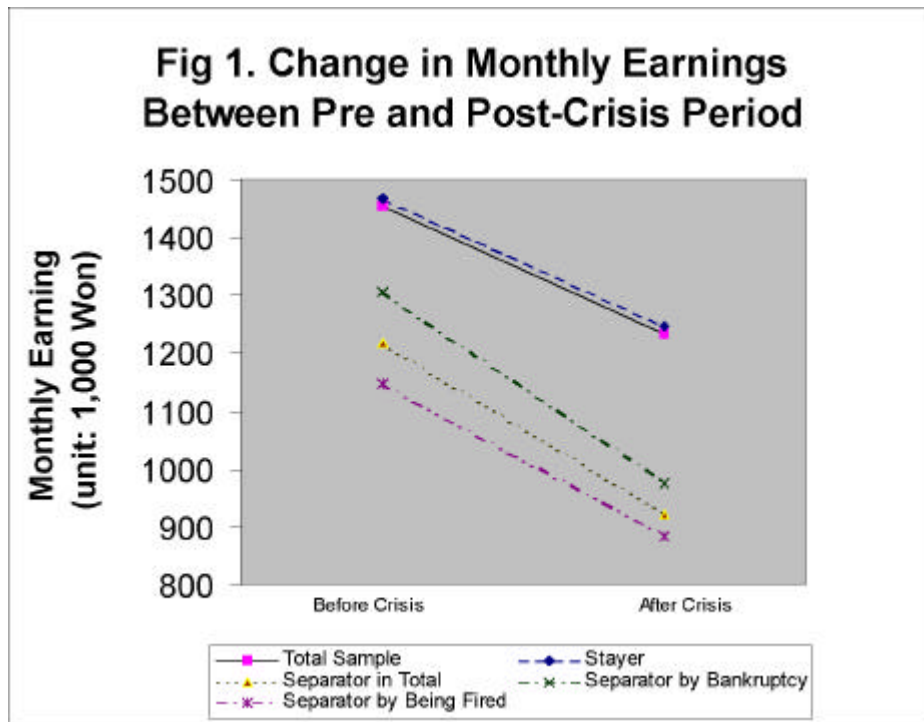
Since those estimates are based on the unconditional analysis of the pre and post-crisis monthly earning levels, it is necessary to control for the individual characteristics and employer characteristics in the analysis that will produce a genuine effect of the displacement on earning reductions. Basic model(Model 0) will be a simple OLS regression of the post-crisis earning level onto the observable characteristics of workers and firms, and the variable representing whether one has been displaced earlier. It can be described as follows ;

$$\ln W_i = X_i{}'\beta + D_i \cdot \gamma_1 + u_i$$

where $\ln W_i$ is log of the post-crisis (monthly) earning level in current firm, X_i is a $(K \times 1)$ vector of observable personal characteristics and characteristics of current employer, D_i is a dummy variable that takes 1 if one has been displaced and 0 otherwise, u_i is an error term that is supposed to be independent of X_i and D_i, and β and γ_1 are parameters associated with X_i and D_i, respectively. The results of Model 0 are reported in <Appendix Table 3>.

2. Two Alternative Models

There is a suspicion, however, that, given the estimation results obtained in probit analyses of Section , the variable D_i of the displacement status may be correlated with u_i in Model 0 even if X_i is supposed to be independent of u_i. That is, it is believed that some characteristics (especially unobserved to data analysts) of an individual may affect not only the post-crisis earning level, also the displacement status. Then, the estimate for γ_1 associated with D_i will be biased (downward or upward depending on the nature of the correlation between D_i and u_i) as long as it is obtained through applying OLS regression to cross-sectional post-crisis earning data.

We are proposing two different approaches of estimation based on the same underlying model in order to avoid the possible biases induced by the correlation especially between D_i and u_i. The underlying model that both Model 1 and 2 will be based upon in the sequel is described as follows ;

$$\ln W_{iT} = X_{iT}{}'\beta + D_{iT} \cdot \gamma_1 + T \cdot \gamma_2 + \alpha_i + e_{iT} \qquad (T = 0, 1) \qquad (1)$$

where T takes 1 for the post-crisis period and 0 for the pre-crisis period, γ_2 is a parameter associated with it, α_i is an unobservable (only to data analysts), time invariant, individual characteristic, e_{iT} is a pure error term of $E(e_{iT}) = 0$, and $\ln W_{iT}$ [12], X_{iT}, D_{iT}, β and γ_1 are corresponding to those defined in Model 0. Note that D_{i0} and D_{i1} take 0 and 1 for those who have been displaced, while they take 0 and 0 for those who have not, respectively [13]. In the Model 1 and Model 2 that follow, u_i of the Model 0 is decomposed into α_i that is permitted to be correlated with D_{iT} and X_{iT} , and e_{iT} that is supposed to be independent of X_{iT}, D_{iT} and α_i..

Given the new specification to deal with the possible correlation between regressors and the

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12) The pre-crisis earning level is constructed based on a question that asks "how much your monthly earning level has changed after November 1997 in comparison to the corresponding earning level before it". It is recalculated using the post-crisis earning level and the percentage by which, a respondent answers, his earning level has been increased, decreased, or kept constant. Consequently, the pre-crisis earning is, at the same time, the pre-displacement earning level for those displaced during the period of economic crisis.

13) As a results, the variable D_{iT} has already been interacted with time.

error term in Model 0, we are proposing two estimation strategies differing in the way that α_i is dealt with.

The first estimation strategy (Model 1) is replacing α_i with the log of pre-crisis earning level to get rid of biases induced by an omitted variable (i.e. α_i) that may be correlated with D_{iT} if Model 0 is applied (Ruhm(1992)).

Then, the estimation model will be described as follows ;

$$\ln W_{i1} = X_{i1}{}'\beta + D_{i1} \cdot \gamma_1 + \delta \cdot \ln W_{i0} + e_{i1}$$

where $\ln W_{i0}$ is log of the pre-crisis earning level and δ is a parameter associated with it. This model does not induce a bias to the estimator for D_{i1} as long as e_{i0} remains uncorrelated with e_{i1}[14]. A variable T is excluded from the equation since only the post-crisis characteristics are used in the regression. OLS is applied to get estimates in the model.

The overall displacement effect on the post-crisis earning is measured with the coefficient of D_{i1} in the regression, while the effects of the displacement by employer bankruptcy and by being fired are able to be estimated when D_{i1} is substituted for by DB_{i1} and DF_{i1}, respectively. Here, DB_{i1} takes 1 if one has been displaced by employer bankruptcy and 0 if one remains employed, while DF_{i1} takes 1 if one has been displaced by being fired and 0 if one remains employed.

The estimation results are shown in Table 4.

The event that one has been displaced before getting a new job significantly reduces the post-crisis earning by approximately 6.5%($= e^{-0.067} - 1$) compared to that of those remaining employed. The experience of being fired significantly reduces the post-crisis earning by 10.1%, whereas the effect of displacement by employer bankruptcy is not quite significant although it displays negative effect on the post-crisis earning level.

Although Model 1 provides unbiased estimate for the effect of the displacement, it may be said to be exposed to some drawbacks when we try to fully evaluate the effect of displacement on the post-crisis earning level.

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14) This assumption turns out to be unnecessary in the second estimation strategy.

<Table 4 : Estimates of OLS for Post-Crisis Earning with a Control of Pre-Crisis Earning >

Explanatory Variables	Dependent Variable = Log of Post-Crisis Monthly Earning(W1,000)		
Intercept	**0.823 (0.116)	**0.786 (0.118)	**0.802 (0.117)
Displaced	*-0.067 (0.028)		
Displaced by Bankruptcy		-0.013 (0.041)	
Displaced by Being Fired			**-0.107 (0.035)
Male	**0.051 (0.017)	**0.053 (0.017)	**0.051 (0.017)
Age	-0.0003 (0.005)	-0.0004 (0.005)	-0.001 (0.005)
Age Sq.	-0.0000 (0.0000)	-0.0000 (0.0000)	-0.0000 (0.0000)
Education	**0.008 (0.002)	**0.008 (0.002)	**0.009 (0.002)
Married	0.008 (0.018)	0.007 (0.018)	0.010 (0.018)
Head	-0.029 (0.016)	-0.032 (0.017)	-0.032 (0.017)
Tenure	**0.008 (0.003)	**0.008 (0.003)	**0.008 (0.003)
Tenure Sq.	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)
Full-time	**0.119 (0.017)	**0.109 (0.018)	**0.113 (0.017)
Union	-0.028 (0.016)	-0.026 (0.016)	-0.028 (0.016)
Occupation :			
Professional	**0.061 (0.018)	**0.063 (0.018)	**0.059 (0.018)
White Collar	**0.057 (0.015)	**0.058 (0.015)	**0.057 (0.016)
Firm Size :			
11~ 30	0.001 (0.017)	0.002 (0.018)	-0.001 (0.018)
30~ 100	0.007 (0.018)	0.004 (0.018)	-0.002 (0.019)
101~ 300	-0.011 (0.022)	-0.014 (0.022)	-0.012 (0.022)
301~1000	0.019 (0.023)	0.017 (0.023)	0.015 (0.023)
1000~	*0.046 (0.019)	*0.042 (0.019)	*0.040 (0.019)
Industry :			
Construction	0.035 (0.026)	0.022 (0.027)	0.031 (0.027)
Heavy	0.014 (0.020)	0.015 (0.020)	0.016 (0.020)
Service of Low Wage	0.014 (0.020)	0.011 (0.020)	0.017 (0.020)
Service of High Wage	0.023 (0.017)	0.019 (0.017)	0.022 (0.017)
Pre-Crisis Earning(W1,000)	**0.821 (0.013)	**0.828 (0.013)	**0.825 (0.013)
Adj R-Square	0.824	0.827	0.826
Total # of Observations	1837	1789	1804
Total # of Separators	81	33	48

Note : 1) In the parenthesis are standard errors.
2) * and ** indicate the estimate is significant at 5% and 1% level, respectively.
3) Reference group is non-displaced, female, unmarried, non household head, part-time, blue collar worker employed in a firm with less than 10 employees of light industry.

First, there will be at least two different effects involved in the reduction of post-crisis earning level. One of them will a "time effect" that results from macroeconomic depression and shrinkage of labor demands during the economic crisis and that affects both separators and stayers in the post-crisis period, at the same time. The other will a pure "displacement effect" abstracted from the time effect, which only affects the post-crisis earning of

separators. Model 1 is not able to provide the amount of time effect on the post-crisis earning although it supplies an unbiased estimate for the displacement effect.

Second, as pointed out in the specification of Model 1, it supposes that an error term e_{iT} is uncorrelated across time, which may cause a concern from a economic point of view since residual parts left unexplained in the regression may be persistent over time and an estimation model should not be abstracted from it.

Model 2 (D.Card et al.(1994) and L.Jacobson et al.(1993)) that will overcome the limitations indicated about Model 1 will be described as follows, with a slight modification to the specification given in (1) ;

$$\ln W_{iT} = X_{iT}{}'\beta_1 + Z_i{}'\beta_2 + D_{iT} \cdot \gamma_1 + T \cdot \gamma_2 + \alpha_i + e_{iT} \quad (T = 0, 1) \quad (2)$$

where X_{iT} is a $(K_1 \times 1)$ vector of time varying explanatory variables such as age, tenure at the job and employer characteristics, Z_i is a $(K_2 \times 1)$ vector of observable time invariant characteristics of an individual such as sex, years of schooling, marital status, and household head status[15], e_{iT}'s may be correlated with each other over time, and other variables as well as parameters follow the definitions given in Model 1. This specification not only produces an estimate for the time effect, also allows for an arbitrary correlation among e_{iT}'s over time. Another merit of this specification is that the Hausman test (Hausman(1978), Hausman and Taylor(1981)) is able to be performed to test a hypothesis that there exists such an α_i that may be correlated with observable individual and employer characteristics (D_{iT}, in particular). The test will be applied later in this section.

The estimation is accomplished by the method of mean differencing that is usually applied to so-called fixed effect model of panel data.

Let $\overline{\ln W_{i\cdot}}$, $\overline{X_{i\cdot}}$, $\overline{T}$ and $\overline{e_{i\cdot}}$ be means of $\ln W_{iT}$, X_{iT}, T and e_{iT} over T, respectively. Then, mean differencing gives a formula that follows ;

$$\ln W_{iT} - \overline{\ln W_{i\cdot}}$$
$$= (X_{iT} - \overline{X_{i\cdot}})'\beta_1 + (D_{iT} - \overline{D_{i\cdot}}) \cdot \gamma_1 + (T - \overline{T}) \cdot \gamma_2 + (e_{iT} - \overline{e_{i\cdot}})$$

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15) A single year of data on individual characteristics force us to maintain the assumption that years of schooling(of those not completing their education), marital status, and household head status are kept constant over the periods of interest, even if they may actually not be.

Note that the time invariant components(Z_i and α_i) of the specification go away by the mean differencing so that the possible correlation among α_i and D_{iT} (or X_{iT}) turns out to be assumed away. As a result, there will no biases involved in applying OLS to the above model as long as X_{iT}, D_{iT} and T are not correlated with e_{iT}, which is the case of our model setting.

To interpret the estimation results, let us go back to equation (2).

For one who has never been displaced during the post-crisis period, the expected log earnings in the pre and post-crisis period are

$$E(\ln W_{i0}|D_{i0}=0)=X_{i0}{}'\beta_1+Z_i{}'\beta_2+\alpha_i \ ,$$
$$E(\ln W_{i1}|D_{i1}=0)=X_{i1}{}'\beta_1+Z_i{}'\beta_2+\gamma_2+\alpha_i$$

Then, difference between them will be

$$E(\ln W_{i1}|D_{i1}=0)-E(\ln W_{i0}|D_{i0}=0)=(X_{i1}-X_{i0}){}'\beta_1+\gamma_2$$

Likewise, for one who has been displaced during the post-crisis period, the expected log earnings in the pre and post-crisis period are

$$E(\ln W_{i0}|D_{i0}=0)=X_{i0}{}'\beta_1+Z_i{}'\beta_2+\alpha_i \ ,$$
$$E(\ln W_{i1}|D_{i1}=1)=X_{i1}{}'\beta_1+Z_i{}'\beta_2+\gamma_1+\gamma_2+\alpha_i$$

Then, difference between them will be

$$E(\ln W_{i1}|D_{i1}=1)-E(\ln W_{i0}|D_{i0}=0)=(X_{i1}-X_{i0}){}'\beta_1+\gamma_1+\gamma_2$$

As indicated above, the time effect(γ_2) is shared both by separators and stayers. If we want to get an estimate for the genuine effect(γ_1) of the displacement on the post-crisis earning level of a separator, we need another difference in difference in expected log earning between a stayer and a separator.

Genuine Effect of Displacement $= \gamma_1$

$= \{ E (\ln W_{i1} | D_{i1} = 1) - E (\ln W_{i0} | D_{i0} = 0) \}$

$\quad - \{ E (\ln W_{i1} | D_{i1} = 0) - E (\ln W_{i0} | D_{i0} = 0) \}$

That is why this estimate is called 'difference in difference' estimate.

Table 5 reports the estimation results and test statistic of the Hausman test.

Overall, the displacement decreases the post-crisis earning level of separators by approximately 9.9%, compared to that of stayers. And, the post-crisis earning levels of both stayers and separators have been reduced by about 4.2% in comparison to the pre-crisis level[16]. In sum, separators will lose about 14.1% of pre-crisis monthly earning after the crisis, while stayers will lose about 4.2%. The results are generally similar when the separators are subdivided into those displaced by employer bankruptcy and by being fired. Moreover, estimation results given above generally reiterate when hourly wage rates are used, except that the time effect becomes about 3% points higher in absolute value than that obtained using monthly earnings[17].

< Table 5 : Fixed Effect Model on Monthly Earnings and Hausman Specification Test >

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16) Since the time effect is mixed up with the effect of age that increases by one as time goes from 0 to 1, and the age effect is believed to be positive for monthly earning level, the estimated time effect will be larger (in absolute value) than that estimated in the Table 5.

17) When the hourly wage rates are used, the time effect decreases the post-crisis earning level by 7.5%, 6.4% and 7.7%, depending on the displacement dummies used for Table 5, respectively.

Explanatory Variables	Dependent Variable = Log of Monthly Earnings(W1,000)		
Time	*-0.043 (0.023)	-0.039 (0.024)	**-0.050 (0.024)
Displaced	***-0.104 (0.038)		
Displaced by Bankruptcy		-0.088 (0.055)	
Displaced by Being Fired			**-0.113 (0.047)
Tenure	-0.001 (0.008)	-0.006 (0.011)	0.002 (0.010)
Tenure Sq.	-0.0000 (0.0002)	-0.0001 (0.0003)	-0.0000 (0.0003)
Age Sq.	***-0.002 (0.000)	***-0.002 (0.000)	***-0.002 (0.000)
Hausman Test Statistic	Chi-sq(5)=63.43***	Chi-sq(5)=55.54***	Chi-sq(5)=48.85***
Adj R-Square	0.336	0.331	0.338
Total # of Observations	5386	5140	5188
Total # of Separations	152	63	89

Note : 1) In the parenthesis are standard errors.

2) *, ** and *** indicate the estimate is significant at 10%, 5% and 1% level, respectively.

Here, we need to figure out where those decreases in monthly earnings for separators are coming from. The total effect of the displacement consists of at least two effects that follow.

The first one will result from the loss of (firm-specific) human capitals when a worker changes his employers. A tenure that may be one of indicators of the human capitals decreases after the movement since the tenure clock will reset as soon as one is hired in the new firm. If tenure has a significant effect on the earning level, it will reduce the post-crisis earning level of separators by some degree[18]. The same thing can happen if one moves either between occupations or between firms of industries that require quite distinct contents of skills.

The second effect is arising from change in form of employment and employer characteristics such as firm size. For example, one will lose his earning a lot either if he gets hired on the part-time basis with the new employer after leaving the full-time job with the old employer, or if he moves from large-sized firm to small-sized firm that usually pays less to the employees. There is an evidence (<Appendix Table 2>) from our data that those displaced tend to move from full-time job to part-time job in comparison to those who voluntarily quit their previous jobs during the period after the economic crisis. Total effects induced by change in form of employment, occupation, industry and firm size of employers are analytically embodied in the estimate for γ_1[19].

In bottom of Table 5, the Hausman test statistics are reported. They show a clear evidence that there exists an (unobserved and time invariant) individual specific component in the earnings equation that is correlated with (time varying) individual characteristics and the displacement status. This confirms the validity of specification given by Model 1 and Model 2.

. Concluding Remarks

So far we have investigated the two issues raised earlier in the introduction.

Probit analyses on the likelihood of displacement show that worker characteristics as well as firm characteristics have significant effect on the overall likelihood of displacement. When

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18) The estimate for tenure effect is proven to be not significant in the estimation of fixed effect model as opposed to the effect estimated in the cross section context. This possibility is analytically dealt with and justified in term of theory of job matching in J.G. Altonji et al.(1987) and K. Abraham et al.(1987) using the American data.

19) In order to separately measure the effect of changing firm size, industry, and form of employment, the variables representing those changes will be required. Our data do not support those detail procedures. As a result, the overall effect is only allowed for.

the displacement is divided by two distinct causes, worker characteristics of firms cutting their workforce are shown to have little to do with firm bankruptcy, while a firm with more than 1,000 employees and in the service industry of high wage is significantly less likely to be bankrupt relative to a firm with less than 10 employees and in light industry, respectively. In contrast, worker characteristics as well as firm characteristics have an effect on the likelihood of the displacement by being fired. Moreover, the effect of worker's birth place on the displacement likelihood is proven to be significant. Those born in KyongSang province were significantly more likely to get displaced any way from the firms than those who were born in JonRa province were.

Two estimation models are suggested and analyzed that measure an unbiased effect of displacement on the post-crisis earning. Overall, the displacement decreases the post-crisis earning level of separators by approximately 6.5 9.9%, compared to that of stayers. And, the post-crisis earning levels of both stayers and separators have been reduced by about 4.2% in comparison to the pre-crisis level. Consequently, separators will lose about 10.7 14.1% of pre-crisis monthly earning after the crisis, while stayers will lose about 4.2%. The estimated earnings losses are, however, said to be short-term effect since the post-crisis earning levels are measured less than one year away from the beginning of the economic crisis. There should be more to be done with data to come in order to fully evaluate the long-term effect of worker's displacement on earning level and its growth after it.

< References >

Abraham, K.G. & H.S. Farber (1987), "Job Duration, Seniority, and Earnings", *American Economic Review*, Vol.77, No.3, pp.278-97

Altonji, J.G. & R.A. Shakotko (1987), "Do Wages Rise with Job Seniority?", *Review of Economic Studies*, Vol.54, No.3, pp.437-59

Card, David & Alan B. Krueger (1994), "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania", *American Economic Review*, Vol.84, No., pp.772-93

Hausman, J.A. (1978), "Specification Tests in Econometrics", *Econometrica*, Vol.46, No.6, pp.1251-71

_____ & W.E. Taylor (1981), "Panel Data and Unobservable Individual Effects", *Econometrica*, Vol.49, No.6, pp.1377-98

Jacobson, L.S., R.J. LaLonde, & D.G. Sullivan (1993), "Earnings Losses of Displaced Workers", *American Economic Review*, Vol.83, No.4, pp.685-709

Ruhm, C.J. (1991), "Are Workers Permanently Scarred by Job Displacements?", *American Economic*

< Appendix Table 1 : Number of Observations of Stayers and Separators
in the Restricted Sample of Seoul-KyongKi Business Region >

Birth Place	Stayers	Separators		
		Separation in Total	Separation by Bankruptcy	Separation by Being Fired
Seoul-KyongKi	354	71	35	36
JonRa	156	26	8	18
Kyong Sang	115	31	10	21
Other Provinces	184	39	13	26
Total	809	167	66	101

< Appendix Table 2 : Proportions of Those Who Changed Their Industry, Occupation,
or Form of Employment (Unit : %) >

Change in :	Separators		Quitters	
	Proportions	Total Number	Proportions	Total Number
Industry	42.9	133	39.2	153
Occupation	24.8	121	27.8	133
Form of Employment :		137		139
Part-time Part-time	19.7	27	15.1	21
Part-time Full-time	4.4	6	6.5	9
Full-time Part-time	24.8	34	14.4	20
Full-time Full-time	51.1	70	64.3	89

< Appendix Table 3 : Estimates of OLS for Post-Crisis Earning >

Explanatory Variables	Dependent Variable = Log of Post-Crisis Monthly Earning(W1,000)		
Intercept	**5.123 (0.166)	**5.170 (0.170)	**5.109 (0.167)
Displaced	0.008 (0.050)		
Displaced by Bankruptcy		-0.004 (0.074)	
Displaced by Being Fired			0.016 (0.063)
Male	**0.275 (0.029)	**0.273 (0.029)	**0.277 (0.029)
Age	**0.032 (0.009)	**0.030 (0.009)	**0.032 (0.009)
Age Sq.	**-0.0004 (0.0001)	**-0.0004 (0.0001)	**-0.0004 (0.0001)
Education	**0.041 (0.004)	**0.041 (0.004)	**0.041 (0.004)
Married	*0.067 (0.032)	*0.066 (0.032)	*0.071 (0.032)
Head	*0.071 (0.029)	*0.072 (0.030)	*0.067 (0.029)
Tenure	**0.028 (0.005)	**0.028 (0.005)	**0.027 (0.005)
Tenure Sq.	-0.0004 (0.0002)	-0.0004 (0.0002)	-0.0004 (0.0002)
Full-time	**0.259 (0.030)	**0.249 (0.031)	**0.260 (0.031)
Union	-0.040 (0.028)	-0.044 (0.029)	-0.045 (0.029)
Occupation :			
Professional	**0.173 (0.031)	**0.171 (0.032)	**0.168 (0.032)
White Collar	*0.063 (0.027)	*0.055 (0.028)	*0.063 (0.028)
Firm Size :			
11~ 30	0.056 (0.031)	0.058 (0.031)	0.055 (0.031)
30~ 100	0.058 (0.032)	0.061 (0.033)	0.058 (0.033)
101~ 300	**0.102 (0.038)	**0.106 (0.039)	**0.105 (0.039)
301~1000	**0.126 (0.040)	**0.133 (0.040)	**0.126 (0.040)
1000~	**0.169 (0.033)	**0.176 (0.034)	**0.169 (0.033)
Industry :			
Construction	**0.163 (0.047)	**0.156 (0.048)	**0.157 (0.048)
Heavy	0.060 (0.035)	0.058 (0.036)	0.063 (0.035)
Service of Low Wage	0.053 (0.035)	0.049 (0.036)	0.050 (0.036)
Service of High Wage	0.037 (0.030)	0.035 (0.031)	0.039 (0.030)
Adj R-Square	0.449	0.443	0.451
Total # of Observations	1837	1789	1804
Total # of Separators	81	33	48

Note : 1) In the parenthesis are standard errors.
2) * and ** indicate the estimate is significant at 5% and 1% level, respectively.
3) Reference group is non-displaced, female, unmarried, non household head, part-time,
blue collar worker employed in a firm with less than 10 employees of light industry.