Trade liberalization and Heterogeneous Effects on Wages *

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Abstract

Using Korean survey data from years of 2000 to 2015, this paper investigates heterogeneous income distribution effects of trade liberalization. The Hecksher-Ohlin-Samuelson (HOS) theory provides predictions on wage differences between different groups of workers. Accordingly, most of previous research to study the effects of trade liberalization on wage differences focus on workers' characteristics (e.g. skilled or non-skilled, etc) while heterogeneity within the same worker group has not been yet much investigated. To fill this gap, this paper provides empirical evidence of wage inequality across firms within the same group of workers caused by trade liberalization, potentially implied by the new-new trade model with firm heterogeneity (i.e. Melitz (2003)). Our empirical model follows the difference-in-difference (DID) specification, supposing that trade liberalization influences tradable sectors while non-tradable sectors are not affected or relatively less. Our results are twofold. First, wages of non-skilled workers in tradable sectors in Korea have increased since its FTAs with with more advanced countries, the US and the EU while the effects on skilled workers are not significant. This finding is in line with the HOS theorem. Second, we find that the Korea's FTAs with the US and the EU increases wages of workers in the medium-large size firms most in tradable sectors, indicating the heterogeneous income distribution effects across the same group of workers as suggested in the literature such as Bustos (2011). The unskilled in small and medium firms are also positively affected by FTAs but the effects are less significant, whereas those in large firms do not seem to gain from trade liberalization.

Keywords: Income inequality, wages, firm heterogeneity, trade liberalization

JEL Classification Numbers: F13, F14, F16

*All errors are ours.

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1 Introduction

Most prevailing argument on the income distribution effects of trade liberalization in the international trade literature is the Hecksher-Ohlin-Samuelson (HOS) theorem. It predicts trade liberalization increases non-skilled workers' wages if a country is relatively skilled worker-scarce compared to the partner country. Accordingly, an extensive studies have empirically analyze changes in wage inequality followed by trade liberalization. (e.g Goldberg and Pavcnik (2003);Zhu and Trefler (2005); Han et al. (2012)).

However, this theorem is silent on wage differences within the same group of workers and so do empirical studies. The HOS theorem implies that if a country is relatively unskilled-worker-abundant, all unskilled workers are expected to be better off through trade liberalization so that one cannot derive further implication for heterogeneous income distribution among gainers (non-skilled workers) and losers (skilled workers).

The new-new trade model which introduces heterogeneity in firm productivity provide some prediction to this question but direct studies on this question are still lacking. One of few exceptions are Helpman et al. (2010) and Helpman et al. (2017) which incorporate search and matching frictions into a Melitz (2003) model show that trade participation contributes to wage inequality between firms due to the greater market access and returns of exporting firms, and more productivity firms pay higher wages within the sector.

Some other studies with firm heterogeneity also provide relevant implications pointing out that high productivity firms have incentives to upgrade product quality or technologies and increase productivity with trade liberalization to pursue higher profits in the integrated market (e.g. Aw et al. (2011); Bustos (2011); Verhoogen (2008)). Especially, following the Melitz (2003) model, Bustos (2011) shows that medium-large-sized firms (the third quantile firms) have the highest incentive to upgrade technology after trade liberalization as they expect the largest returns in the integrated market through trade liberalization and such argument is supported by empirical evidence. Verhoogen (2008) also proposes that trade induces quality upgrading but heterogeneously across plants and it results in wage inequality within the same industry. He finds that using Mexican manufacturing data more productive exporting plants provide higher-quality goods, upgrade quality, and raise wage gaps within the same industry. These theoretical and empirical findings imply that wages in more productive firms with greater expected returns after trade liberalization are likely to increase the most.

In this paper, we directly investigate heterogeneous income distribution effects of trade liberalization potentially implied by the new-new trade model with firm heterogeneity as argued in Helpman et al. (2010) and Helpman et al. (2017). This paper provides empirical evidence of

wage inequality between firms within the same group caused by trade liberalization which has been missed in the classical trade theories but implied in the model with firm heterogeneity.

Our empirical model follows the difference-in-difference (DID) specification. Using the survey data of the Korean Labor & Income Panel Study (KLIPS), we suppose trade liberalization influences tradable sectors while non-tradable sectors are not or relatively less affected. This specification is different from most studies in the literature in which data are usually restricted to the tradable manufacturing firm-level so that the effects of trade liberalization cannot be compared to the relatively less affected non-tradable firms which are candidates of a control group.

In this study, trade liberalization in Korea is represented by the two free trade agreements (FTAs) of Korea with trading partners, the European Unions (EU) and the United States (US). Korea implemented these two major FTAs within a year, one with EU in July 2011 and one with US in March 2012. It is indisputable that the potential impact of these two FTAs on Korea's welfare must be most substantial as the economic size of them are largest, except one with Korea's largest trading partner, China, which was formed in December 2015.

Our results are twofold. First, wages of non-skilled workers in tradable sectors in Korea have more increased compared to those in non-tradable sectors since FTAs with the US and the EU while skilled workers' gains in tradable sectors are not statistically different from those from non-tradable sectors. This finding is in line with the HOS theorem as Korea can be supposed to be relatively skilled-worker-scarce in comparison to the US and the EU. Second, we find that trade liberalization increases wages of non-skilled workers in the medium-large size firms in tradable sectors compared to non-tradable sectors. The unskilled in small and medium firms are also positively affected by trade liberalization but the effects are less significant, whereas those in large firms do not seem to gain from trade liberalization. Our finding supports arguments of Bustos (2011) and Helpman et al. (2017) which provide the theoretical and empirical analysis showing that medium-sized firms (the third quantile firms) and greater market access due to trade liberalization have the highest incentives to upgrade the technology so that their profits increase.

The rest of the paper is organized as follows. The next section explains the empirical model. Section 3 describes the data. Section 4 presents and discusses the estimation results and robustness tests. The last section concludes.

2 Empirical Model

To examine whether trade liberalization affects workers' wages, we use the difference-in-difference (DID) specification following a conventional wage equation. We suppose trade liberalization influences tradable sectors while non-tradable sectors are not affected or relatively much less affected due to trade liberalization. Someone, however, may argue that non-tradable sectors are also significantly affected by trade liberalization, in particular when goods from tradable sectors are main inputs of production. To address this issue, we construct the control group of non-tradable sectors where the ratio of valued added to total output of the industries each sector falls into[1] is greater than 0.5 so that the impacts from trade liberalization are relatively small on those sectors.The next section provides the explanation on how to construct the control group using an input-output data.

Trade liberalization in this paper is measured using an indicator variable of FTA, which refers to the formation of the free trade agreements (FTAs) between Korea and the US and one between Korea and the EU.

The DID specification we use is following:

$$\begin{aligned} lnWage_{it} = \alpha + \mathbf{X}_{it}\beta_1 + +\beta_2 FirmSize_{it} + \beta_3 hour_{it} + \beta_4 Bigcity_{it} + \beta_5 Regular_{it} \\ + \gamma_1 tradable_{i(s)} + \gamma_2 FTA_t + \gamma_3 (tradable_{i(s)} \times FTA_t) + u_{it} \end{aligned} \tag{1}$$

where $Wage_{it}$ is monthly wage of individual i at time t; $\mathbf{X}_{it}$ is a vector of to individual characteristic variables including gender, education, martial status, experience, experience squared; $FirmSize_{it}$ is the number of workers of the firm that individual i works for at time t; $hour_{it}$ is working hours per week for individual i at time t; $Bigcity_{it}$ is an indicator variable taking a value of one if individual i lives in a big city at time t and zero otherwise; $Regular_{it}$ takes a value of one if individual i is a regular worker at time t and zero otherwise; $tradable_{i(s)}$ takes a value of one if the industry (s) that individual i works for is a tradable sector and zero otherwise; FTA_t equals one for years after the FTA between Korea and the US or the EU came force into, which is year 2011 and zero otherwise and the error term is given by:

$$u_{it} = \tau_t + \omega_s + \eta_k + \mu_i + \epsilon_{jt} \tag{2}$$

where τ_t, ω_s, η_k and μ_i are year, industry, occupation (k), and individual fixed effect,

[1] Industries are classified into 33 categories in the OECD input-output tables and sectors into 227 at KSIC 3-digit level.

respectively and ϵ_{it} is an idiosyncratic error term. Since these fixed effects absorb not only observed variables which included in Eq. (1) but also unobserved variables such as time shocks or individual's ability, including each of fixed effects could be important to avoid potential endogenous bias.

Using the same specification in Eq. (1) but dividing the samples into multiple groups, we further empirically examine income distribution effects explained from the classical HOS theory and those explained from the new-new trade theory with firm heterogeneity. To investigate whether there exists income distribution effects sourced from the HOS theory, we divide the samples into two sub-groups; skilled and unskilled workers. Next, instead of different level of workers' skill, we divide the samples into four groups where they are different in terms of firm size the workers work for; small, medium, medium-large and large. Lastly, we further divide each of groups by firm size into two groups; skill and unskilled so that we can analyze if there exists different trade liberalization effects on wages due to firm heterogeneity even across the similar skill-level workers.

3 Data

Our data comes from the Korean Labor & Income Panel Study (KLIPS) published by the Korean Labor Research Institute. This survey was first launched in 1998 and now has more than 18 waves, being carried out once a year. It covers 5,000 households and their members (11,855 individuals in all) who currently live in Korea. For this paper, we restrict the sample to 4,509 individuals who are currently wage earners at private sectors only from the year of 2000 to 2015, which leave us 12,967 observations in total.

KLIPS contains various questions related to individual characteristics in terms of labor activities. For our study, we use variables such as gender, age, education, working hours per week, firm size, contract type (regular/irregular), region of residence as well as the occupation and the industry at each year. Table 1 shows descriptive statistics.

We use household survey data, not firm level data. The DID method we use for the empirical analysis requires a control group which is not (relatively less) affected by the FTA. Firm (or plant) level data available are mostly containing manufacturing (or tradable) sector data only. As a few exceptions, Pavcnik (2002) separates non-traded sectors from traded sectors using the Chilean firm (or plant) level data. In her study, she defines non-traded sectors as industries where plants that belong to exports less than 15% of its total output and those that belong to imports to total domestic output falls less than15%. That is, traded sectors in her study is

Table 1: Descriptive Statistics

	Mean	S.D.	Min	Max
Age (years)	38.27	10.38	18	65
Female	0.42	0.49	0	1
Married (=1)	0.65	0.48	0	1
Monthly Income (10,000KRW)	5.02	0.52	2	9
Years of Schooling	12.93	2.69	6	22
Years of Experience	18.34	11.74	0	52
Firm Size (number of employees)	406.42	3196.73	1	100000
Regular Worker (=1)	0.83	0.38	0	1
Manager	0.30	0.46	0	1
Average Weekly Working Hour	51.08	12.10	3	168
Big City	0.80	0.40	0	1
Observations	12967			

the sectors which are less likely to be traded, but not sectors which are less affected by trade liberalization. Also, traded sectors based on this criteria may vary significanlty depending on data points or countries covered in a study.

When we use survey data which include service sectors (or non-tradable sectors), however, it is much clearer to divide sectors which are relatively more and less affected from trade liberalization so that it is easier to construct a control group for the DID analysis.

To define whether a sector falls into an industry affected by two major FTAs, we match 3-digit Korean Standard Industrial Classification (KSIC) and 2-digit Harmonized System(HS).[2] One may say that if none of HS codes falls into any KSIC code, we may use those industries to construct a control group. However, all of non-traded sectors may not be good candidates of the control group in our study. It is because non-traded sectors could be also significantly affected by trade liberalization, in particular when goods from traded sectors are main inputs of production. To address this issue, we sort out non-traded sectors that are *relatively* weakly affected by trade liberalization. To do this, we use value added and output ratio from the OECD input-output data. Table A1 presents value added and output ratio of 33 industries in 2011 based on the OECD input-output industry categories, year before the FTAs between Korea and the EU, and the US entered into force. We construct the control group of "non (or less)-affected" sectors of which the ratio is greater than 0.5, implying that the dependence on its own industry is larger than the likely tradable intermediate goods to generate total values. It includes 12 out of 33 industries. The largest difference of the ratio between "Other community,

[2] Multiple HS 2-digit codes may fall into one KSIC 3-digit.

social and personal services" industry and "Post and telecommunications" industry, where one falls into the control group, the other does not, also supports our choice of 0.5 as a criterion to divide sectors as (more) affected and non(or less)-affected. As Input-output data are also less disaggregated compared to the KSIC 3-digit, we convert the input-output data to KSIC 3-digit. This process drops out about half of sectors (52 sectors out of 105 non-tradable sectors) at KSIC 3-digit level. To check the sensitivity of our criterion, we reestimate our specifications setting all 105 "non-tradable" sectors as a control group and present the results in Appendix. We find qualitative results remain the same while quantitative results turn out to be more significant with the control group we newly construct.

Of course non(or less)-affected sectors included in our control group may vary depending on data points and country-coverage as in Pavcnik (2002). However, as shown in Table A1, 12 industries, Education, Real estate activities, Public administration and defense, R&D and other business activities, Mining and quarrying, Financial intermediation, Renting of machinery and equipment, Agriculture, hunting, forestry and fishing, Health and social work, Wholesale and retail trade, Computer and related activities and Other community, social and personal services, used as our control group, seem to be relatively less likely to be affected by tariff reduction on goods which is the main objective of the FTAs unless other types of liberalization (e.g. investment policies) is accompanied with FTAs, regardless time or country coverage in a dataset.

4 Estimation Results

4.1 Main Results

Table 2 presents the overall effect of the FTAs on workers' wage. Applying DID technique on Mincer type wage equation (Mincer (1974)), we attempt to measure the impact of the FTAs by looking at the coefficient of the interaction term between FTA treatment variable and the tradable variable. This precisely looks at the wage variation of wage earners in the tradable sector since Korea's FTAs with the US and the EU, which might differ from wage earners who are not affected by the FTAs. We run three specifications; (1) Column 1 shows baseline results from pooled OLS with only time fixed effects, (2) Column 2 additionally includes occupation fixed effects and industry fixed effects on the pooled sample, and (3) Column 3 treats dataset as panel, whereby we consider also individual fixed effects as well. Consistently we find a positive impact of trade liberalization on the log wage, although only individual fixed

effects model assures a statistical significance at 10% level. Since the FTAs, wage earners in tradable sectors report about 1.6%-2.8% higher income than those in non (or less)-affected sectors. Other variables show quite typical results of Mincer equation (Mincer (1974)). Female workers earn about 40% less than male workers. There seem marriage premium and big city premium, but these vanish when we control for individual fixed effects. However, still there are positive returns to schooling (6.3%) and experiences (6%). Also, being a regular worker is largely correlated to the wage, even though its magnitude becomes smaller when we control for individual effects, meaning that workers with higher ability tend to become regular at work, and therefore, earn higher wages. These baseline results show the possible positive effect of the FTAs on wages and also credibility of our dataset which work in line with literature.[3] In other words, we might interpret these results such that trade liberalization (FTAs in our study) generally increase the wage of workers in private sectors in Korea. We, then, would investigate where this positive effect comes from precisely by looking at the heterogeneity of workers' and firms' characteristics.

Table 3 breaks down our sample into skilled workers and non skilled workers. Skilled workers are conventionally defined as workers who has special skill, training, knowledge, and (usually acquired) ability in their work. Also, as we use occupations to define 'skilled' workers, skilled workers are mainly those who are in managerial positions. Using KLIPS, skilled workers are whose value of occupation code is either 0 (legislators, senior officials, managers), 1 (professionals), or 2 (skilled technicians, associate professionals).[4]

According to the HOS theory, if a country is relatively skilled-worker-scarce, non skilled workers would gain under trade liberalization, while skilled workers would get hurt. Our results suggest the positive effect on wages due to trade liberalization from Table 2 mainly comes from the wage increase of non-skilled workers. This result can be intuitive in a way that Korean workers can be regarded as less skilled compared to the workers in the US and the EU, which can be consistent with the theory. Wages of non-skilled workers in tradable sectors have increased by about 5% more compared to those in non (or less)-affected sectors, statistically significant at 1% level. This means that the FTAs boost up the wage increase faster for non skilled workers in tradable sectors than those in non (or less)-affected sectors. However, there is no significant difference between skilled workers, although the coefficient of the DID variable is negative as the HOS theory predicts, which is shown in column(6), Table 3.

[3] From following tables, we will not report coefficients of other variables for brevity.

[4] Other occupations considered to be non skilled in our study have the following codes:3 (clerks), 4 (service workers), 5 (sales workers), 6 (agricultural, forestry, and fishery workers), 7 (craft and related traded workers), 8 (plant, machine operators and assemblers), 9 (elementary occupations).

Table 2: Overall Effect on Log Income

	(1)	(2)	(3)
FTA × Tradable	0.0158	0.0231	0.0282*
	(0.0195)	(0.0184)	(0.0165)
Tradable (=1)	0.0149	-0.0727**	-0.0608
	(0.0130)	(0.0362)	(0.0551)
Female (=1)	-0.391***	-0.403***	
	(0.0128)	(0.0130)	
Married (=1)	0.111***	0.0879***	0.0240
	(0.0136)	(0.0128)	(0.0171)
Big City (=1)	0.0592***	0.0416***	-0.00548
	(0.0140)	(0.0131)	(0.0252)
Firm Size (number of employees)	0.0000209***	0.0000179***	0.00000258
	(0.00000244)	(0.00000219)	(0.00000161)
Average Weekly Working Hour	-0.000366	0.00145***	0.00151***
	(0.000424)	(0.000379)	(0.000280)
Years of Schooling	0.0574***	0.0391***	0.0632***
	(0.00334)	(0.00317)	(0.0150)
Years of Experience	0.0229***	0.0214***	0.0599***
	(0.00176)	(0.00168)	(0.0113)
Years of Experience^2	-0.0447***	-0.0375***	-0.0597***
	(0.00376)	(0.00361)	(0.00582)
Regular Worker (=1)	0.201***	0.142***	0.0806***
	(0.0137)	(0.0125)	(0.0117)
Year FE	Yes	Yes	Yes
Occupation FE	No	Yes	Yes
Industry FE	No	Yes	Yes
Individual FE	No	No	Yes
Observations	12967	12967	12967
Adjusted R^2	0.507	0.569	0.496

Standard errors in parentheses are clustered at individual level.

Significant level: * 0.10 ** 0.05 *** 0.01

Table 3: Heterogeneous Effect on Log Income by Skilled vs. Non Skilled

	Non Skilled			Skilled		
	(1)	(2)	(3)	(4)	(5)	(6)
FTA × Tradable	0.00229	0.0122	0.0510***	0.0315	0.0474	-0.0233
	(0.0229)	(0.0216)	(0.0181)	(0.0424)	(0.0417)	(0.0402)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Occupation FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	Yes	Yes	No	Yes	Yes
Individual FE	No	No	Yes	No	No	Yes
Observations	9128	9128	9128	3839	3839	3839
Adjusted R^2	0.508	0.565	0.484	0.514	0.562	0.526

Standard errors in parentheses are clustered at individual level.

Significant level: * 0.10 ** 0.05 *** 0.01

Table 4: Heterogeneous Effect on Log Income by Firm Size

	(1) Small	(2) Medium	(3) Medium-Large	(4) Large
FTA × Tradable	0.0291	0.0287	0.117**	-0.0778
	(0.0245)	(0.0261)	(0.0569)	(0.0740)
Year FE	Yes	Yes	Yes	Yes
Occupation FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes
Observations	6296	3939	1649	1083
Adjusted R^2	0.465	0.516	0.561	0.682

Standard errors in parentheses are clustered at individual level.

Significant level: * 0.10 ** 0.05 *** 0.01

Most of previous research to study the effects of trade liberalization on wage differences focus on workers' characteristics (e.g. skilled or non-skilled, etc) since the development of HOS theory, while heterogeneity within the same worker group has not been yet much investigated. To fill this gap, we further break down the sample of non-skilled and skilled workers across firm sizes. Firms are categorized into four different groups by its size. We define small firms (the number of employees < 10), medium firms ($10 \leq$ the number of employees < 50), medium-large firms ($50 \leq$ the number of employees < 250), and large firms (the number of employees ≥ 250). Table 4 presents the overall heterogeneous FTA effects by firm sizes without the skill differentiation. While workers in other firms are not affected, wages of workers in medium-large-sized firms increase by 11.7% more in tradable sectors.

Results discussing the heterogeneous effect by firm sizes and skills are reported in Table 5. For non-skilled workers, the FTAs increase wages of workers for all size firms except large firms, while the effect is the largest for the medium-large-sized firms, from which we can infer that there might be large heterogeneous effects. Korea's FTAs with the US and the EU have increased wages of non-skilled workers in the medium-large-sized firms by 17.5% more in tradable sectors. Non-skilled workers in small and medium firms are also positively affected by the FTAs, earning 6.6% and 6% more. Yet, workers in large firms do not seem to gain from trade liberalization. For skilled workers, magnitudes of coefficient estimates are all smaller than corresponding estimates from non-skilled workers, and none of them are statistically significant, indicating that there is no FTA effect on wages regardless firm sizes. These findings imply that positive effects of the FTAs on medium-large-sized firms found in Table 4 only apply to non-skilled workers, and they are the gainers from trade liberalization on average as shown in Table 3.

Table 5: Heterogeneous Effect on Log Income by Firm Size and Skills

	Non Skilled				Skilled			
	(1) Small	(2) Medium	(3) Medium-Large	(4) Large	(5) Small	(6) Medium	(7) Medium-Large	(8) Large
FTA × Tradable	0.0659**	0.0598*	0.175**	-0.0806	-0.0480	-0.0288	-0.00504	0.0633
	(0.0254)	(0.0277)	(0.0575)	(0.0816)	(0.0675)	(0.0502)	(0.0658)	(0.110)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4324	2879	1168	757	1972	1060	481	326
Adjusted R^2	0.466	0.500	0.571	0.678	0.496	0.678	0.561	0.753

Standard errors in parentheses are clustered at individual level.

Significant level: * 0.10 ** 0.05 *** 0.01

As mentioned in Section 2, we further test the sensitivity of the control group we propose in this study. We repeat estimations for all specifications using a different control group which includes all non-tradable sectors adding the other half sectors dropped out from our original control group. Tables A3, A4, A5 and A6 show the results. Qualitative results remain the same with the biggest wage increases for the non-skilled in medium-large firms as shown in Table A6. Moreover, the larger coefficient estimate with the control group we propose in this study may reinforce our findings.

According the new-new trade theory (i.e. Melitz (2003), small firms are not productive enough to export either before and after trade liberalization while large firms' profits increase. Bustos (2011) provides the theoretical and empirical analysis arguing that medium-large-sized firms (the third quantile firms) have the highest incentives to upgrade the technology because their profits increase most after trade liberalization among four groups. Our results in line with her findings. While her findings imply firms' profits changes across firms size due to trade liberalization, our findings show that the gains for workers follow the same pattern. This argument is supported by the theory from Helpman et al. (2010), which shows that more productive firms pays higher wages. Arai (2003) also show that wages are positively correlated with firms' profits.

4.2 Robustness Tests

The key identification assumption of the DID method is that wage trends of both the treatment and control groups would be the same before trade liberalization so that wage differences between two groups is induced from trade liberalization. To test the parallel trends assumption, we only use data of years prior to Korea's FTAs with the US and the EU, following Muralidharan and Prakash (2017). Thus, the DID specification for parallel trend tests is the same as Eq.(1) while replacing the variable, FTA_t with the year indicator for each year, using the data of the period 2000-2011. We follow all specifications in the previous section to see any differences wage trends between treatment and control groups for heterogenous skill-level and firm size.

In Table 6, column (1) shows the results from all sample and columns (2) and (3) provide results from the non-skilled and skilled samples, respectively. For all specifications, we do not reject the null hypothesis of parallel trends and the magnitude of estimated coefficients are relatively much smaller than those from Tables 2 and 3. Table 7 shows the results from the sample of non-skilled and skilled workers across firm size. Again, we do not reject the null hypothesis of parallel results for every group except for the non-skilled workers in small-sized firms and the magnitude of estimated coefficients are small. The negative coefficient estimate

for the non-skilled workers in small-sized firms might reinforce our finding from Table 6.

Next, we further estimate Eq.(1) for each year from 2005 to 2012 and see if there exists any wage difference across different groups before the Korea's FTAs with the US and the EU came into force. Two things are worth mentioning. First, we omit years of 2007 and 2008 when the global financial crisis influenced international trade substantially. Second, we find the implications of our results by separating the sample period before and after Korea-US FTA and Korea-EU FTA are *signed on* given that firms might get ready for economic shocks (here, Korea's FTAs with the US and the EU) once they are announced. Negotiations of Korea-US FTA have officially begun in 2006 and concluded in 2007 while they came into force several years later. Similarly, the first negotiation of Korea-EU FTA was held in year 2007 and concluded in 2009.[5] Thus, we set years of 2005 and 2006 are pre-negotiation period and years afterwards are post-negotiation period till year 2012, excluding the global financial crisis period.

The results from the sample of non-skilled and skilled workers across firm size are presented in Table 8. The upper panel shows the estimates from the pre-negotiation period while the lower panel shows them from the post-negotiation period. On the one hand, for the pre-negotiation period all coefficient estimates are statistically insignificant with one exception in 2005 and their magnitude is relatively small. On the other hand, for the post-negotiation period coefficient estimates for non-skilled workers in medium-large size firms are statistically significant at 1% or 5% level in every year while the magnitude is the largest in 2012 when the FTAs came into force. For skilled workers in all-sized firms we find they are statistically insignificant for both pre and post-negotiation periods with one exception of the negative estimate in 2009 for medium-large firms. These results support our findings in Section 4.1.

[5] Source: http://www.fta.go.kr/main/situation/kfta/ov/

Table 6: Pre-trend Test: Overall Effect and Skills, Before 2012

	(1) Full Sample	(2) Non Skilled	(3) Skilled
Year×Tradable	0.00227	0.000973	0.0102
	(0.00213)	(0.00358)	(0.00700)
Occupation FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes
Observations	9916	7072	2844
Adjusted R^2	0.105	0.441	0.486

Standard errors in parentheses are clustered at individual level.
Significant level: * 0.10 ** 0.05 *** 0.01

Table 7: Pre-trend Test: Overall Effect on Log Income, Before 2012

	Non Skilled				Skilled			
	(1) Small	(2) Medium	(3) Medium-Large	(4) Large	(5) Small	(6) Medium	(7) Medium-Large	(8) Large
Year×Tradable	-0.0117*	-0.00174	0.0222	-0.000314	-0.00745	0.00304	-0.0130	0.0172
	(0.00545)	(0.00733)	(0.0128)	(0.0151)	(0.0119)	(0.00828)	(0.0151)	(0.0154)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3124	2289	980	679	1376	810	386	272
Adjusted R^2	0.430	0.456	0.487	0.633	0.469	0.666	0.546	0.693

Standard errors in parentheses are clustered at individual level.

Significant level: * 0.10 ** 0.05 *** 0.01

Table 8: Pre-FTA Test: Firm-Skill Heterogeneous Effect

	Non Skilled				Skilled			
	(1) Small	(2) Medium	(3) Medium-Large	(4) Large	(5) Small	(6) Medium	(7) Medium-Large	(8) Large
Pre-Negotiation Period								
2005	-0.0221	0.0537*	0.0821	0.0443	0.0105	-0.0277	-0.00961	0.0644
	(0.0281)	(0.0310)	(0.0817)	(0.0618)	(0.0545)	(0.0499)	(0.0758)	(0.0758)
2006	-0.0136	0.0181	0.0949	0.0518	-0.0142	0.0153	-0.0866	0.0437
	(0.0272)	(0.0312)	(0.0673)	(0.0556)	(0.0564)	(0.0390)	(0.0607)	(0.0783)
Post-Negotiation Period								
2009	0.0111	0.0704**	0.134**	-0.215**	-0.0809	0.0756*	-0.141**	0.105
	(0.0279)	(0.0318)	(0.0622)	(0.0971)	(0.0636)	(0.0427)	(0.0716)	(0.0935)
2010	0.0307	0.0808**	0.168***	-0.181	-0.0566	0.0294	-0.100	0.0950
	(0.0280)	(0.0352)	(0.0489)	(0.118)	(0.0595)	(0.0463)	(0.0870)	(0.117)
2011	0.0533**	0.0586*	0.154***	-0.157*	-0.0370	0.0211	0.0271	0.115
	(0.0258)	(0.0319)	(0.0512)	(0.0832)	(0.0600)	(0.0451)	(0.0845)	(0.139)
2012	0.0659***	0.0598**	0.175***	-0.0806	-0.0480	-0.0288	-0.00504	0.0633
	(0.0254)	(0.0277)	(0.0575)	(0.0816)	(0.0675)	(0.0502)	(0.0658)	(0.110)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4324	2879	1168	757	1972	1060	481	326

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

5 Concluding Remarks

The HOS theorem has been a prevailing theory to explain income distribution effects of trade liberalization. However, it fails to suggest implications on wage differences within the same group of factors within a country.

In this study, we provide further empirical evidence of income distribution effects of trade liberalization, finding some implications from the new-new trade model with heterogeneous firm productivity.

Using the survey data, we first show that wages of non-skilled workers in tradable sectors in Korea have increased since the FTAs with the US and the EU. This finding is in line with the HOS model as Korea can be supposed to be relatively skilled-worker-scarce in comparison to the US and the EU. Then, we test the heterogeneous wage effects of trade liberalization by the firm size, following the literature implied by the new-new trade models. The FTAs increase wages of workers in the medium-large size firms in tradable sectors. The unskilled in small and medium firms are also positively affected by FTAs but the effects are relatively small, whereas those in large firms do not seem to gain from trade liberalization. Various robustness tests confirm our findings of heterogenous income different effects among non-skilled workers.

The limitation of our study is that even though we find heterogenous wage effects of trade liberalization, our study does not provide the evidence of through which channels non-skilled workers in medium-large firms are compensated with higher incomes.

Based on the existing studies (e.g. Aw et al. (2011); Bustos (2011); Verhoogen (2008)), we presume that heterogenous income distribution effects among the same group of workers are attributed to exporting firms' higher (expected) profits leading to technology and/or product quality upgrade with trade liberalization. To check this presumption, Korean firm level data with technology or research-related variables must be available. To our knowledge, such panel dataset which covers both pre and post FTAs period are not publicly accessible. It could be a future study when they are available, reconfirming the existing literature which provide empirical evidence from other countries.

Table A1: Value Added and Output Ratio, 2011 in Korea

Industry	**V.A.& Output Ratio**
Education	0.757
Real estate activities	0.724
Public administration and defense; compulsory social security	0.678
R&D and other business activities	0.626
Mining and quarrying	0.583
Financial intermediation	0.560
Renting of machinery and equipment	0.555
Agriculture, hunting, forestry and fishing	0.555
Health and social work	0.552
Wholesale and retail trade; repairs	0.540
Computer and related activities	0.519
Other community, social and personal services	0.503
Post and telecommunications	0.391
Construction	0.354
Transport and storage	0.335
Hotels and restaurants	0.332
Pulp, paper, paper products, printing and publishing	0.294
Other non-metallic mineral products	0.289
Fabricated metal products	0.282
Other transport equipment	0.281
Textiles, textile products, leather and footwear	0.265
Electricity, gas and water supply	0.261
Electrical machinery and apparatus, nec	0.259
Rubber and plastics products	0.250
Manufacturing nec; recycling	0.250
Machinery and equipment, nec	0.243
Wood and products of wood and cork	0.233
Computer, Electronic and optical equipment	0.224
Motor vehicles, trailers and semi-trailers	0.201
Chemicals and chemical products	0.166
Basic metals	0.156
Food products, beverages and tobacco	0.155
Coke, refined petroleum products and nuclear fuel	0.055

Source: OECD

Table A2: Descriptive Statistics

	Mean	S.D.	Min	Max
Age (years)	38.99	10.49	18	65
Female	0.40	0.49	0	1
Married (=1)	0.65	0.48	0	1
Monthly Income (10,000KRW)	5.02	0.52	2	9
Years of Schooling	12.75	2.79	6	22
Years of Experience	19.24	11.98	0	52
Firm Size (number of employees)	352.29	2947.91	1	100000
Regular Worker (=1)	0.80	0.40	0	1
Manager	0.26	0.44	0	1
Average Weekly Working Hour	52.04	12.77	3	168
Big City	0.79	0.41	0	1
Observations	18032			

Table A3: Overall Effect on Log Income

	(1)	(2)	(3)
FTA × Tradable	0.00448	0.00451	0.0131
	(0.0171)	(0.0161)	(0.0139)
Tradable (=1)	-0.00510	-0.0163	-0.0146
	(0.0105)	(0.0179)	(0.0262)
Female (=1)	-0.383***	-0.390***	
	(0.0104)	(0.0111)	
Married (=1)	0.104***	0.0838***	0.0250*
	(0.0113)	(0.0104)	(0.0136)
Big City (=1)	0.0549***	0.0397***	-0.00668
	(0.0124)	(0.0113)	(0.0214)
Firm Size (number of employees)	0.0000206***	0.0000178***	0.00000358**
	(0.00000209)	(0.00000189)	(0.00000161)
Average Weekly Working Hour	0.000711**	0.00239***	0.00233***
	(0.000352)	(0.000323)	(0.000261)
Years of Schooling	0.0541***	0.0364***	0.0534***
	(0.00288)	(0.00271)	(0.0150)
Years of Experience	0.0237***	0.0228***	0.0586***
	(0.00150)	(0.00141)	(0.00929)
Years of Experience^2	-0.0447***	-0.0403***	-0.0653***
	(0.00322)	(0.00298)	(0.00481)
Regular Worker (=1)	0.184***	0.138***	0.0783***
	(0.0109)	(0.0101)	(0.00960)
Year FE	Yes	Yes	Yes
Occupation FE	No	Yes	Yes
Industry FE	No	Yes	Yes
Individual FE	No	No	Yes
Observations	18032	18031	18031
Adjusted R^2	0.500	0.563	0.478

Standard errors in parentheses are clustered at individual level.

Significant level: * 0.10 ** 0.05 *** 0.01

Table A4: Heterogeneous Effect on Log Income by Skilled vs. Non Skilled

	Non Skilled			Skilled		
	(1)	(2)	(3)	(4)	(5)	(6)
FTA × Tradable	-0.00845	-0.00338	0.0292*	0.0441	0.0299	-0.0311
	(0.0190)	(0.0181)	(0.0152)	(0.0344)	(0.0331)	(0.0307)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Occupation FE	No	Yes	Yes	No	Yes	Yes
Industry FE	No	Yes	Yes	No	Yes	Yes
Individual FE	No	No	Yes	No	No	Yes
Observations	13375	13374	13374	4657	4657	4657
Adjusted R^2	0.495	0.554	0.454	0.508	0.555	0.526

Standard errors in parentheses are clustered at individual level.

Significant level: * 0.10 ** 0.05 *** 0.01

Table A5: Heterogeneous Effect on Log Income by Firm Size

	(1) Small	(2) Medium	(3) Medium-Large	(4) Large
FTA × Tradable	0.0128	0.0233	0.0487	-0.0644
	(0.0206)	(0.0225)	(0.0444)	(0.0662)
Year FE	Yes	Yes	Yes	Yes
Occupation FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes
Observations	9091	5261	2273	1406
Adjusted R^2	0.441	0.521	0.530	0.667

Standard errors in parentheses are clustered at individual level.

Significant level: * 0.10 ** 0.05 *** 0.01

Table A6: Heterogeneous Effect on Log Income by Firm Size and Skill

	Non Skilled				Skilled			
	(1) Small	(2) Medium	(3) Medium-Large	(4) Large	(5) Small	(6) Medium	(7) Medium-Large	(8) Large
FTA × Tradable	0.0419*	0.0276	0.105**	-0.115*	-0.0195	-0.00488	-0.122	0.0509
	(0.0220)	(0.0246)	(0.0457)	(0.0646)	(0.0493)	(0.0467)	(0.0750)	(0.103)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6867	3878	1661	968	2224	1383	612	438
Adjusted R^2	0.421	0.499	0.519	0.651	0.482	0.641	0.571	0.716

Standard errors in parentheses are clustered at individual level.

Significant level: * 0.10 ** 0.05 *** 0.01

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