ABSTRACT

KIM, SONGNYEON. Three Essays on Policy Impacts on Labor Markets: Global Recession, Trade Liberalization, and Maternity Protection. (Under the direction of Ivan Kandilov and John Beghin.)

This thesis studied on how labor market performances are impacted by trade and socioeconomic environments. The second and third chapters explore trade impacts on skill-wage premium. While starting from the traditional Heckscher-Ohlin theory of trade, I test the theory in Korean and Mexican event study.

The second chapter investigates how regional exporting characteristics affect the skill-wage premium surrounding the Global Recession event in 2008. Recent trade theories predict that exporters would use more high-skilled labor. Thus, if we observe an increase in exports in a given region, then we would expect to see an increase in the demand for skilled workers. However, the opposite may also happen if the trade primarily involves intermediates — a decline in exports may lead to an increase in the skill premium. This paper studies how exports affect regional labor markets in South Korea, a country that experienced a sharp decline in exports following the Great Recession of 2007-2008. A panel dataset is employed to test this by using regional differences in the exporting activity, which is constructed for 15 Korean regions from 2001 to 2014 using individual data from the Korean Labor and Income Panel Study and the U.N. Commodity Trade Statistics data. To avoid potential endogeneity of exports, this paper leverages the impact of the Global Recession, which brought about a decrease in regional exports, with regions that had more active exporters initially experiencing a more substantial decline in exports. The analysis also utilizes the regional exposure to fluctuations in the exchange rate constructed based on the region's industrial composition, to use in place of exports. The panel analysis confirms that declining exports bring about higher skilled wages, i.e., regions with more substantial initial exports experience more significant declines in exports and an increase in the skill premium after the Great Recession.

The third chapter first tries to replicate implications from Amiti & Cameron (2012) because evidence of decreasing skill-wage premium in developing countries is not a prevalent phenomenon.

By doing this, I expect to find support for the existence of different channel of trade measures that affect skill-wage premium. Amiti & Cameron (2012) have shown that Indonesia, a low-skill abundant country, experienced a reduction in the skilled-wage premium when input tariffs fell. They rationalize it by suggesting that when the input tariff falls, it induces firms to redirect their skill-intensive inputs towards imports, hence the domestic demand for skill declines. This paper investigates whether this pattern holds for Mexico. Mexico is abundant in unskilled labor and its major trading partners are skill abundant countries, such as the United States. I use annual data on 3,200 plants from Mexico's Industrial Survey that encompasses the period of large-scale trade liberalization from 1984 to 1990. When the input tariff declines, the empirical results from panel analysis show that the skill-wage premium falls, as well across all wage equations including wage bill, personnel wage, and hourly wage. Results from the regressions on relative individual wage show that output license coverage played a role in reducing skill-wage premium as a result of competition with skill- intensive imported goods. Furthermore, the effect of quota is differential according to a firm's exporting activity.

In the last chapter, I compare the distinction of Korean maternity leave expansion in 2001 and 2006, which aims to identify the effect of benefit cost transfer from private to public. The Korean government has demonstrated consistent efforts to strengthen maternity protection. Major recent policy changes for firms with fewer than 300 workers were enacted in November 2001 and January 2006. The first changes were to expand paid maternity leave up to 90 days from 60 days and to give subsidies for the last 30 days of leave. The second round of legislation increased the duration of the subsidies for the whole 90 day periods. This research compares the impacts on female labor market outcomes as a result of each policy amendments. The 2001 and 2006 legislation were different in that the former focused more on increasing the duration of maternity leave and the later increased the coverage of monetary compensation. While both protection expansions can increase female labor supply, the former change increased the costs of hiring female workers and the later buffered the cost burden for firms hiring women. My analysis utilizes the Korean Labor Income Panel Study(KLIPS) that covers the periods before and after each policy changes. The panel regressions using difference-

in-difference fashion show that labor market outcomes such as wages and employment respond more to the later policy change than they respond to the former only among certain age group, namely female who ages from 26-30.

Three Essays on Policy Impacts on Labor Markets: Global Recession, Trade Liberalization, and Maternity Protection

by
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DEDICATION

This thesis is dedicated to my parents, who supported with unfathomable love and strength,
Somin who endured the journey with me and kept me going with endless love and caring,
my brother who filled in my place while I was away from home country,
and my baby girl, the most lovable in the world.

BIOGRAPHY

Songnyeon Kim was born in Seoul, Republic of Korea. He graduated Chungdam High school in 2000 and entered Hankuk University of Foreign Studies in Seoul. He served as a member of army from 2002 to 2004. After receiving his bachelor's degree in economics at Hankuk University of Foreign Studies in Seoul in 2007, he continued the master's course at the same school, where he received the degree in 2009. The author was employed as a researcher in public research institutions in Korea from 2009 to 2011. In August 2011, he joined the doctoral program of economics at North Carolina State University.

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CHAPTER

1

INTRODUCTION

In this thesis, I studied on how labor market performances were impacted by trade environment and socioeconomic environments. The second and third chapters explore trade impacts on skill-wage premium. While starting from the traditional Heckscher-Ohlin theory of trade, I test the theory in Korean and Mexican event study. The second chapter investigates how regional exporting characteristics affect skill-wage premium surrounding the Global Recession event in 2008. The third chapter first tries to replicate implications from Amiti & Cameron (2012) because evidence of decreasing skill-wage premium in developing countries not a prevalent phenomenon. By doing this, I expect to find support for the existence of different channel of trade measures that affect skill-wage premium. In the last chapter, I compare the distinction of Korean maternity leave expansion in 2001 and 2006, which aims to identify the effect of benefit cost transfer from private to public.

The second chapter investigates the relationship between regional exports and the skilled wage premium in South Korea during the period from 2001 to 2014 surrounding the Global Recession in

2008. The Global Recession brought about a significant decline also in the Korean exports. Shrinking trade could affect the skilled workers' wage premium through various channels. First, traditional Heckscher-Ohlin theory predicts that when the trade between two economies opens, it would increase the skill-wage premium in the relatively skill-abundant economy. It implies that the skill premium in a country can increase(or decrease) depending on how much more(or less) skill abundant it is than the trading partner. If the Korean economy is skill-abundant compared to its major trading partners, and it faces a significant decline in exports, then it would experience decreasing demand for the skilled labor. When we take into account the Korean case in periods surrounding the Global Recession, it is a subject that needs empirical evaluation of evidence. It is because that while the Korean economy is more skill abundant than China, a country that increased in the share of Korean exports, it is less skill-abundant to two major trading partners, Japan and the United States. This paper tests which of the suggested predictions fits better in the Korean case with reduced form analysis of a panel data. Furthermore, I use the impact of the Global Recession to avoid the potential endogeneity that arises from using regional exports. There are two parts to my analysis that include the regional level and the individual level. One of restrictions that the regional analysis has is that the regional average specifications cannot incorporate personal demographic characteristics. It is why I used the individual level panel data, as well.

Results from the regional analysis provide some evidence that the foreign exchange exposure has a positive effect on the skill-wage premium. It implies that the terms of trade improvement induce exports increase that accompanies the growth in skill-wage premium. The impact on relative employment of skilled workers is positive, but statistically insignificant. From the individual level analysis, it is clear that the Global Recession increased the skilled wage premium more in regions where initial exports were higher. The possible explanations for the results are that the traditional Heckscher-Ohlin effect is present because China, a relatively less skill abundant country, has grown in importance for Korean exports. It is also consistent with the context where regions with the higher initial exports are more engaged in the global supply chain so that as exporters produce more of intermediate goods with rented technology, the skill-premium in such a region would increase.

On the other hand, we could not confirm the prediction of Verhoogen (2008). If the prevision of Verhoogen (2008) were to explain the Korean case, the regional skill-wage premium difference should have narrowed after the Global Recession.

Amiti & Cameron (2012) is one of a few researches that associated the trade opening with lower skilled wage premium. The research presented evidences on that input tariff reduction has narrowed the wage gap in Indonesia where unskilled labor are largely abundant. They explained that reducing intermediate input tariff enabled firms to redirect their source of input from domestic or in-house toward imports from higher skilled countries. This mechanism takes place if major trading partners are more skill abundant. To test this implication in Mexican trade liberalization in 1980's, the third chapter analyzed the effects of tariffs and license coverage cuts on the skilled-labor demand by incorporating the channels of input source redirection, import competition, and the quality upgrading due to the export expansion. I will utilize the input tariff as a main source of variation using the plant-level of Mexico Industrial Survey from 1986 until 1990. In addition to the input and output tariffs, we analyze the effect of input license coverage and output license coverage as well.

The other mechanisms that trade opening can affect the demand for the skilled labor are import competition and exports expansion. When trade opens with more skill-abundant countries, the less skill-abundant country would experience decreasing demand for the skilled labor. It is because the trade opening leads for domestic producers to compete with skill abundant foreign exporters. Autor et al. (2013) presented the empirical evidence that the import competition afflicted the U.S. economy in that it induced the unemployment and wage cut as the local exposure to the import competition enhances. On the other hand, quality upgrading mechanisms or exports expansion can explain the increasing demand for skilled workers in a country with trade expansion. For example, Verhoogen (2008) found that as initially more productive plants expand their exports, the skill-wage premium increases because the exporters should meet the demand for higher-quality in the advanced countries via quality upgrading. Khandelwal (2010) showed that the larger the magnitude of quality valuation is between countries, the less impact from the import competition. The research

developed a theoretical model where the quality inference is derived from the discrete choice model, which, in the model, suggests the valuation for the quality decides the length of quality ladder and longer ladder lessens the loss from disadvantages of higher costs of northern producers.

Finally, the fourth chapter studied on the differential effect of Korean maternity benefit expansion both in 2001 and 2006. The government has exerted consistent efforts to expand maternity protection by legislation. Major recent policy changes for firms with less than 300 workers were enacted in November 2001 and January 2006. The first were to include expansion of paid maternity leave up to 90 days from 60 days and subsidization towards new working mothers for the last 30 days of leave. The second legislation increased the duration of subsidies for the whole 90 days. Kim (2011) is the study that is closely related to my research. The author analyzed only 2001 Korean maternity expansion effect using Korean Labor and Income Panel Studies(KLIPS) from 1998 to 2005. The research employed a difference-in-difference-in-differences(DDD) scheme to incorporate age and gender at the same time. Results suggest that the Korean labor reform in 2001 was not effective in terms of labor market outcomes since the author didn't find significant evidence for change of employment and wage after maternity benefit expansion.

In this research, I will incorporate 2006 legislation in Korean labor market as well since it lessens burden for employers to hire young females and is more extensive in terms of protection compared to 2001 revision. In result, we can expect clearer results from the later reform. This chapter compares impacts on female labor market outcomes from each policy reform. The 2001 and 2006 legislation were different in that the former focused more on increasing the duration of maternity leave and the later increased the coverage of leave compensation subsidies. While both of protection expansions are expected to induce more of female labor supply, the former legislation increased costs of hiring female workers and the later buffered cost burden for firms to hire women. The analysis utilizes KLIPS data that can cover the before and after each policy changes. The panel regressions in Difference-in-Difference(DD) fashion show that the labor market outcomes such as wages and employment respond more to later reform than to the former only among certain age group, namely female who ages from 26-30.

CHAPTER

2

THE IMPACT OF EXPORTS ON THE REGIONAL DEMAND FOR SKILL: EVIDENCE FROM SOUTH KOREA

2.1 Introduction

This research investigates the relationship between regional exports and the skilled wage premium in South Korea during the period from 2001 to 2014 surrounding the Global Recession in 2008. The Global Recession brought about a significant decline also in the Korean exports. Shrinking trade could affect the skilled workers' wage premium through various channels. First, traditional Heckscher-Ohlin theory predicts that when the trade between two economies opens, it would

increase the skill-wage premium in the relatively skill-abundant economy. It implies that the skill premium in a country can increase(or decrease) depending on how much more(or less) skill abundant than the trading partner. If the Korean economy is skill-abundant compared to major trading partners and it faces a significant decline in exports, then it would experience decreasing demand for the skilled labor. Waddle (2017) suggests that if an economy mainly produces intermediate goods with rented technology and exports those products, then both the economy that provides advanced technology and the other economy that uses the technology experience an increase in the demand for skilled labor. Also, Verhoogen (2008) studied the skill upgrading behavior induced by increased exports. The research suggests that exporting firms tend to utilize higher skill level than non-exporters do. Thus, when exports increase(or decrease) in one region where there are more active exporters, it is expected that the skilled wage premium will increase(or decrease) more than the other regions where their exports are less active. In this context, as an exporting economy suffers from a decline in the exports, it will experience less demand for skilled workers. Furthermore, the magnitude of the impact will depend on the initial level of exports.

When we take into account the Korean case in the period surrounding the Global Recession, it is a subject that needs empirical evaluation. While the Korean economy is more skill abundant than China, a country that increased in the share of Korean exports[1], it is less skill-abundant than two major trading partners, Japan and the United States.

Thus, if the effect of traditional trade theory predicts is dominant, the skilled wage premium after the Global Recession would have fallen. Otherwise, if the effect that depends on the trade relationship between Korea and China is prevalent, the prediction from Waddle (2017) would be apparent. This paper tests which of suggested predictions fits better in the Korean case with reduced form analysis of a panel dataset. Furthermore, I use the impact of the Global Recession to avoid the potential endogeneity that arises from using regional exports. My analysis consists of two parts - one at the regional level, and one at the individual level. As the regional average specifications cannot incorporate individual demographic characteristics, I used an individual level panel data, as well.

[1] In 2001, Korean exports to China had 12.67% of total Korean exports to the World. It steadily grew up to 28.70% in 2014.

South Korea is an excellent example to study regional exports, skilled labor demand and the skill upgrading channel. It is because it is a country where exports mainly have driven economic growth. Moreover, its regional industrial structure was designed and regionally diversified by national development planning of the government authorities in the 1960s' and the 1970s'. In addition to that, the Korean case allows us to test the predictions in Waddle (2017). The skill composition of the Korean labor forces has changed over time. The share of skilled workers in the Korean labor force increased to a level of that in Japan and the United States. The share of exports to China in the total Korean exports has increased from about 12.7% in 2001 to 28.7% in 2014. Moreover, the share of intermediate products in the exports to China is as high as 70%.

The results of the regional analysis provide some evidence that the foreign exchange exposure has a positive effect on the skill-wage premium. It implies that the terms of trade improvement induces an increase in exports, that accompanies the growth in the skill-wage premium. The impact on the relative employment of skilled workers is positive, but statistically insignificant. From the individual level analysis, it is clear that the Global Recession increased the skilled wage premium more in regions where initial exports were higher.

The possible explanations for the results are that the traditional Heckscher-Ohlin effect is present because China, a relatively less skill abundant country, has grown in importance for Korean exports. It is also consistent with the context where regions with the higher initial exports are more engaged in the global supply chain so that as exporters produce more of intermediate goods with rented technology, the skill-premium in such a region would increase. On the other hand, we could not confirm the prediction of Verhoogen (2008). If the context in Verhoogen (2008) were to explain the Korean case, the regional skill-wage premium difference should have narrowed after the Global Recession.

2.1.1 Literature

Among the literature of the trade impacts (e.g., tariff reductions, off-shoring, and trade openness) on the skill-premium, several facts emerge. First, trade liberalization usually increases the skill-premium

in exporting firms or industries in short-run according to Hoekman et al. (2005) and the sectors that face import competition would shrink[2]. Second, even though skill-biased technology change effects are present, the trade effect (factor price shocks) often appear to dominate effects from skill-biased technology change when it comes to the reallocation of skill-composition, according to Burstein & Vogel (2017). Third, Hahn & Y. Choi (2016) stated that the larger and more R&D intensive firms induce the increase in skill-premium. Hoekman et al. (2005) pointed out that the wage response to a trade opening is usually more significant than that of employment.

The literature on the relationship between the trade pattern change and skilled labor demand is divided in whether the skill-wage premium in the less developed countries would fall as predicted by Heckscher-Ohlin. Michaels (2008) utilized the mid-20th century's highway system expansion in the U.S. as a variation of reduced trading cost. The research showed that, with the trade expansion due to the smaller transportation cost, the skill abundant counties showed the increase in the skill-wage premium and decreased the skill-demand in skill-scarce counties. While this research framework utilizes the regional pattern of trade to explain the difference in the local labor market, both of Kandilov (2009) and Chiquiar (2008) linked the regional trade pattern to the skilled labor demand change. The results from both of papers are consistent with the traditional Heckscher-Ohlin theory's prediction. Kandilov (2009) employed the U.S. county-level data in the 1980s and 1990s and constructed the regional trade exposure using region-industry data and the industrial pattern of trade. The results show that more substantial regional trade exposure to developing countries increases the local skill-wage premium. Chiquiar (2008) operated an empirical study on 1990s' Mexico economy where NAFTA expanded its trade. He compared the closest regions to the North American market and the others. The analysis found that the skill-wage premium in the region that is near to the U.S. experienced a decrease in the skill-wage premium.

The literature that expects to see rises in both of the advanced countries and the developing countries include Zhu & Trefler (2005) and Burstein & Vogel (2017). Zhu & Trefler (2005) modeled a mechanism where 'Southern catchup' is present. The least skill-intensive productions in the

[2]Autor et al. (2013) is the research mainly on the intensified import competition with Chinese products. The subjected sectors suffer from increased unemployment and the associated benefit expenditure.

advanced economies transferred into the most skill-intensive sector of developing economies[3]. Therefore, the skill-demand in developing countries also rises with the trade expansion. Burstein & Vogel (2017) studied skill-premium change induced by a reduction in trade costs for 60 countries. They found that almost all the countries, including advanced and developing economies, experienced an increase in the skill-wage premium. Their results suggest that there is a combined effect of the inter-sector and the intra-sector factor reallocation. In the advanced economy, the skilled labor demand in the skill-intensive sectors increases. In the meanwhile, in all economies, the skilled labor demand increased in the more productive and skill-intensive firms within a sector. Feenstra & Hanson (1995)

Verhoogen (2008) and Waddle (2017) explain explicitly how exporters' behavior can affect the skill premium. Verhoogen (2008) studied the Mexico case surrounding the 1994 peso crisis(and the previous devaluation from 1986-1988) with a plant level panel dataset. He developed a model, in which productivity of a plant is correlated with greater exports, wage of blue and white collars and higher quality. The suggested hypothesis tells us that the most productive plants engage in the exports, and they demand more of the skilled labor, to attract the Northern American consumers with the quality upgrade(skill upgrading) when the relative prices between two countries changes(in this case, it is the devaluation of Mexican Peso). He also performed empirical studies on the relationship between initial productivity and differential changes in key variables such as wages, capital intensity, quality measures, and etc. He found that the initially more productive plants experienced more of the overall wage increase and higher skill-wage premium[4]. It also found that the magnitude of changes is more prominent after the 1994 peso crisis.

Findings from Hahn & Y. Choi (2016) support Verhoogen (2008) in the context of Korean economy. Hahn & Y. Choi (2016) investigated the export impact on the labor skill composition and its difference across firm size. The authors conduct decomposition analysis, and they found that Korean economy in 1990s' experienced massive skill upgrading that is driven by within-sector reallocation. The

[3]This result is also consistent with the outsourcing hypothesis as in Feenstra & Hanson (1995).

[4]The caveat Verhoogen (2008) underscored is that the specific mechanism of quality upgrading behavior in the period of peso crisis focus on the intra-industry wage variances, not the wage inequality in the whole economy level, which include inter-industry shifts as well.

authors also conclude that R&D intensity explains a substantial share of intra-industry skill intensity and premium. Kapri (2014) is the research where the author utilized Chinese tariff reduction (2001 WTO) as a source of variation that affect the skill composition of firms using Workplace Panel Survey (2002-2009). He concluded that changes of Korean firm-level skill intensity were mainly driven by factor reallocations between heterogeneous firms in terms of size and profitability.

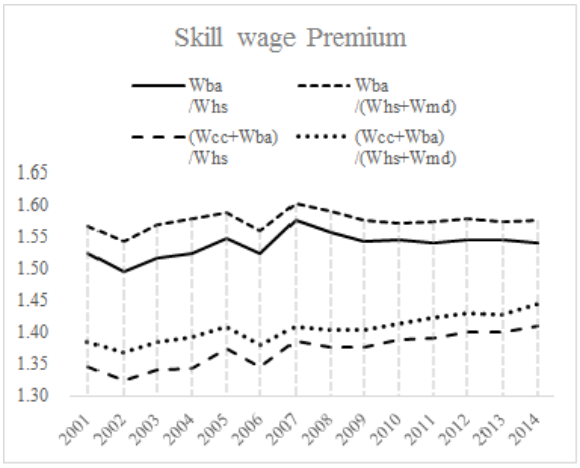
Alongside with Acemoglu (2003) that linked the skill-biased technology change induced by trade opening, Waddle (2017) relates the firms' decision on technology-related trade pattern and the impact on the labor market. The author investigated a mechanism in which both an advanced country and the partner experience increase in the skill-wage premium. It is because plants that produce intermediate goods by adopting rented technology demand higher skills. On the other hand, an advanced country increases its investment in technology due to increased marginal returns to the technology(royalty).

2.1.2 Background

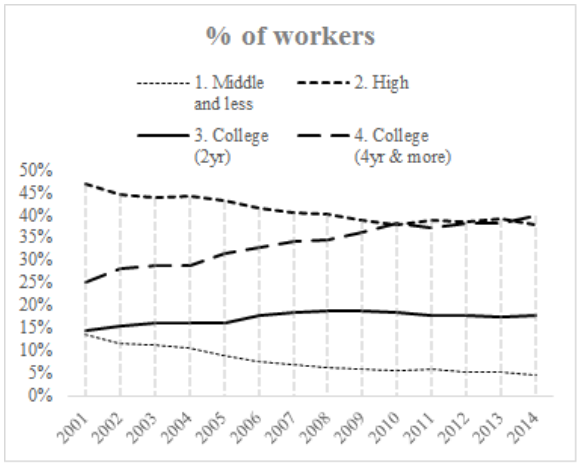
There has been a significant upgrade in the skill composition of the Korean labor force in the 1990s, and it continued in 2000s. Figure (2.1a) shows the wage-skill premium in Korea during 2001 - 2014, until 2007, the skill premium trended upwards. [5] In the period after 2007, the series changes its pattern, in particular, the skill-wage premium of bachelor's degree holders over high school diploma holders(solid line) starts to decrease. Figure (2.1b) suggests that share of workers with more than bachelor's degree in the labor pool has increased over that period. Thus, a straightforward interpretation of this figures implies that there is increasing skilled labor supply.

After the Global Recession(years after 2008), not surprisingly, Korean exports experienced a downturn compared to the steady growth in the period before 2008. Figure (2.2a) shows an immediate downturn following the Global Recession of 2008 and recovering in 2010 and 2011. It is noteworthy that the growth of exports and imports after the Great Recession slowed down signifi-

[5] Possible cause of the trough in 2006 is the changing pattern of minimum wage growth. In years before 2006, the minimum wage growth rate had been over 10%. It continued up to 2007. Minimum wage application rate has increased consistently from 2.1% in 2001 to 12.3%. However, after 2007, minimum wage application rate decreased or did not grow as fast as before.

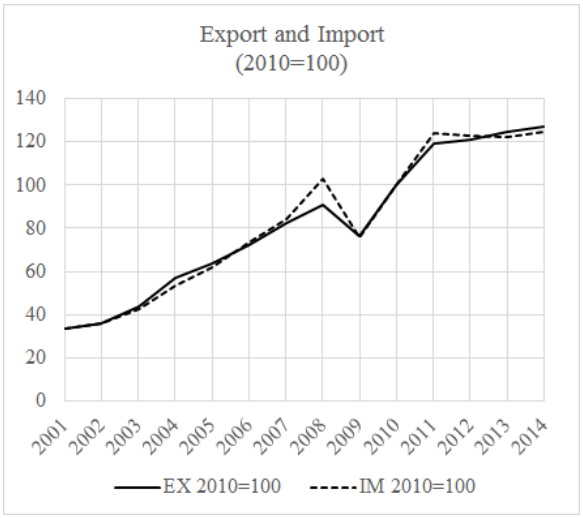


(a) Skilled wage premium.

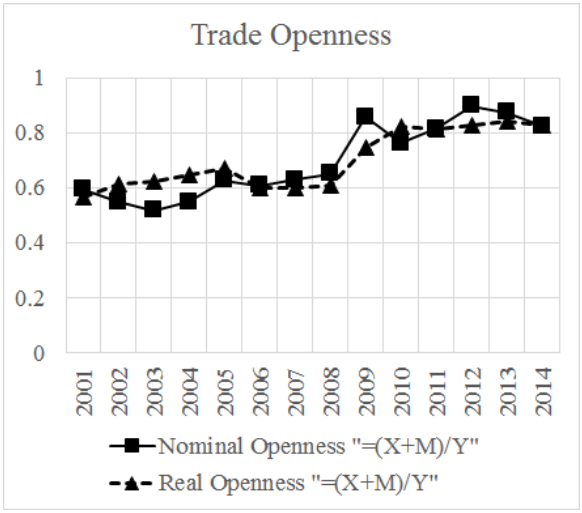


(b) Share of workers in skill level.

Figure 2.1 Labor market performances and level of education. (Source: Survey on Labor Conditions by Employment Type)

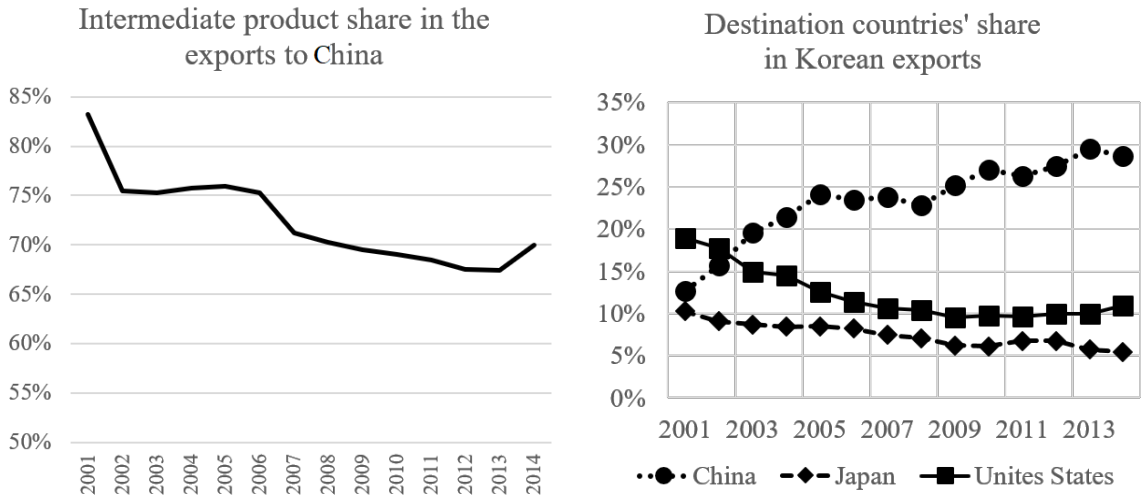


(a) Exports and imports.



(b) Trade openness.

Figure 2.2 Trends of trade in South Korea. (Source: Bank of Korea)



(a) Intermediate production in exports to China.

(b) The shares of exports to major trading partners in total exports of Korea.

Figure 2.3 The composition of Korean exports. (Source: WITS)

cantly. Figure (2.2b) suggests that the trade openness defined as (Exports + Imports)/GDP shows a jump in the years of 2008 - 2009, which indicates the country also experienced a more significant reduction in GDP compared to Exports and Imports.

Combining those two aspects of the labor market and trade patterns, we can hypothesize that the Global Recession's negative impact on exports could induce a decline in the wage-skill premium because exporting firms suffer from the Global Recession and relative demand for high-skilled workers shifts downward. If this hypothesis is correct, it might be useful to investigate regional differences of trade and local labor markets. Different regional exports exposure could induce differential negative impact on the labor market. In areas with high export exposure before the Global Recession, the Recession will bring about a more considerable decline in the skill premium.

However, it is possible that the scenario in Waddle (2017) fits in this case. The share of intermediate goods in exports to China has been around 70% and China's share in the Korean exports as a major destination has ever grown during the period. If Korean economy is producing a large share of intermediate goods with technology that is more skill intensive compared to China, all in all, it is

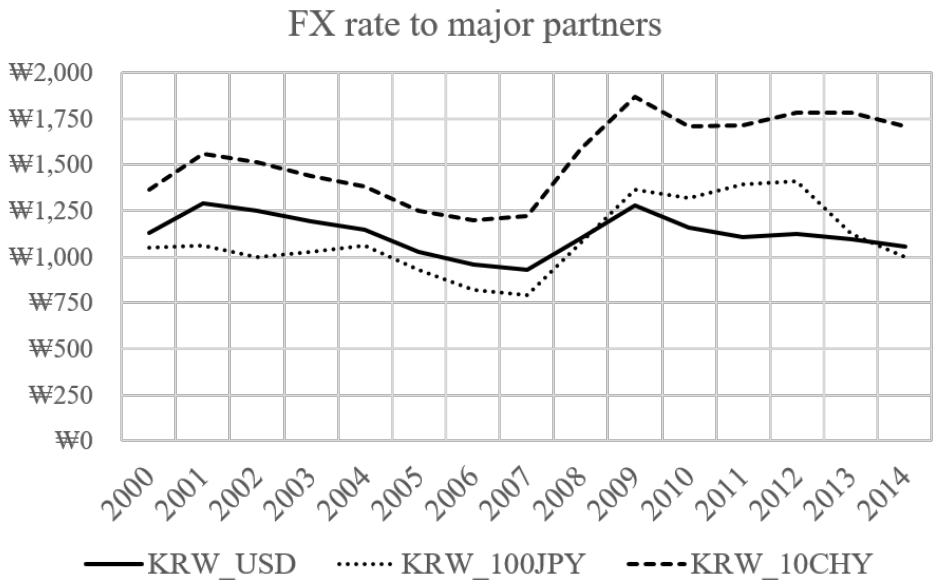


Figure 2.4 Exchange rate of Korean Won to major partners' currency.

possible that the skill-wage premium increases over the sample period. See Figure(2.3a) and (2.3b).

Figure(2.4) presents trends of foreign exchange rates from 2001 to 2014. The specifications in this research elected ratios of Korean Won to U.S. Dollar, Japanese Yen, and Chinese Yuan since they are major trade partners for Korean exporters. In 2001, there were financial risks due to the process of resolving credit bubble, which resulted in defaults of a few credit card companies. After 2001, we observed decreases in all of three foreign exchange series until 2007, which means that Korean won had been appreciated in that period. Then, Korean Won is depreciated rapidly in 2008 and 2009, where the Global Recession took place.

The exchange rate between Korean Won to Chinese Yuan decreased after 2009, but it did not reach the level before 2007. Thus, the terms of trade for Korean firms that export to China improved after the Global Recession. For Korean firms that export to Japan, the terms of trade were better than before the Global Recession until 2012. However, the terms of trade deteriorated after the Japanese monetary expansion in 2012. The general pattern of the ratio of Korean Won to U.S. Dollar resembles others until 2007. The exchange rate of Korean Won to U.S. Dollar did not increase as

much as Korean Won to Chinese Yuan or Korean Won to Japanese Yen in 2008 and 2009. In result, the terms of trade for Korean exporters to the United States kept deteriorating after 2010, and the terms of trade in 2014 are worse than that of 2001.

2.2 Empirical Strategy

There are two parts to our analysis that include the regional level and the individual level. The regional level analysis utilizes regional level data on relative employment directly from Economically Active Population Survey(EAPS). [6] It is convenient to use regional shares of skilled workers EAPS employment data for an employment equation and matching it to the regional average wage-skill premium.

However, it has two restrictions. The first is that regional-average specifications cannot incorporate critical demographic characteristics that help determine wages such as age, gender, marriage, and tenure. Moreover, the second is that technically, we can have a bias since the sample size of each regional group is different. In this research, to overcome those, we also utilize individual information to take account of individual demographic information and weighted regression for the regional-level data.[7]

2.2.1 Analysis with Regional Aggregate Data

We first begin with the most straightforward specification of relative wage and relative labor quantities. Since theory predicts that exports increase demand for skilled labor, if exports grow in one region, then the region's wage-skill premium should increase, as well, all else equal. In equation (2.1) & (2.2), the subscripts s and u respectively represent skilled workers and unskilled workers.

[6] In a case where we calculate average employment according to educational attainment from KLIPS, several rural regions do not have enough sample to calculate credible average employment ratio.

[7] We employed the weight of square-root of group sample size for resolving heterogeneity problem of group average variables according to Solon et al. (2015).

The subscripts r and t imply region and year.

$$log\left(\frac{W^s}{W^u}\right)_{rt} = \alpha_0 + \alpha_1 \text{exports}_{rt} + \text{year}_t + \text{region}_r + \epsilon_{rt} \tag{2.1}$$

$$log\left(\frac{L^s}{L^u}\right)_{rt} = \beta_0 + \beta_1 \text{exports}_{rt} + \text{year}_t + \text{region}_r + \epsilon_{rt} \tag{2.2}$$

However, this simple version has a potential problem of endogeneity in that the skilled-labor wage and the share of skilled workers not only are the result of but also can affect exporting firms' location decision. Thus, to avoid endogeneity, this research utilizes different two instruments in the reduced form style. First, the specifications in the paper include the interaction term of regional exports in 2001 and a Great Recession dummy, which are the years since 2008. The idea behind this is that initially, more export-oriented regions suffered larger declines in exports following the Great Recession. The Great Recession for Korean exporters reduced global demand. Figure (2.2a) indicates that 2009's downturn in exports was sharp. The exports index(based upon the value of 2010) decreases from 2008's roughly 90 to below 80 the following year.

When the Great Recession negatively impacted exports, it reduced them differentially more in regions with higher initial exports in 2001. Based on theory, those regions should suffer a larger decline in the wage-skill premium. γ_1 and δ_1 in the reduced form specifications(equations (2.3) and (2.4)) are interpreted as the net effect of decreased exports following the Great Recession on the relative wage premium and relative employment.

$$log\left(\frac{W^s}{W^u}\right)_{rt} = \gamma_0 + \gamma_1\left(\text{exports}_{r,2001} \cdot D(Year > 2007)_t\right) + \text{year}_t + \text{region}_r + \epsilon_{rt} \tag{2.3}$$

$$log\left(\frac{L^s}{L^u}\right)_{rt} = \delta_0 + \delta_1\left(\text{exports}_{r,2001} \cdot D(Year > 2007)_t\right) + \text{year}_t + \text{region}_r + \epsilon_{rt} \tag{2.4}$$

The second variation in place of regional exports in the equation (2.5) and (2.6) is the regional foreign exchange exposure. That is considered exogenous with respect to firms' export decisions. Here, the term FX exposure$_{rt}$ represents the terms of trade effect since it is constructed as the amount of Korean wons per foreign currency. Hence, when the FX exposure increases, it improves

the terms of trade. The estimators η_1 and δ_1 from equation (2.5) and (2.6) are expected to be positive as exports increase when the terms of trade increase.

$$log\left(\frac{W^s}{W^u}\right)_{rt} = \eta_0 + \eta_1 \text{FX exposure}_{rt} + \text{year}_t + \text{region}_r + \epsilon_{rt} \tag{2.5}$$

$$log\left(\frac{L^s}{L^u}\right)_{rt} = \delta_0 + \delta_1 \text{FX exposure}_{rt} + \text{year}_t + \text{region}_r + \epsilon_{rt} \tag{2.6}$$

2.2.1.1 Construction of Regional Foreign Exchange Exposure

Foreign exchange exposure is constructed in the context of Kandilov (2009) and Bound & Holzer (2000). For Korean exporters, the major trading currencies are the U.S. Dollar, the Japanese Yen, and the Chinese Yuan. First, we aggregate those foreign exchange rates using weights as 2001's exports share of industry i and destination c (U.S., Japan, or China) in total exports[8] of the industry i, as in equation (2.7).

$$\Delta E_{it} = \sum_j d\log\left(\frac{KRW}{Currency_j}\right) \cdot \left(\frac{Exports_{i,j,2001}}{Exports_{i,2001}}\right), \text{ j=(USA, JPN, CHN)} \tag{2.7}$$

Then, this measure is normalized by multiplying it by the industrial share of top three exports destination (U.S., Japan, and China). Furthermore, to convert the industrial foreign exchange exposure into a regional foreign exchange exposure, exports share of each industry in each region is used, so that the completed foreign exchange exposure measure is in the form of a weighted average as it appears in equation (2.8). Thus, the measure in equation (2.8) can be utilized in estimating specifications (2.5) and (2.6).

$$\text{FX exposure}_{rt} = \sum_i \Delta E_{it} \cdot \left(\frac{Exports_{i,r,2001}}{Exports_{r,2001}}\right) \cdot \left(\frac{\Sigma_j Exports_{i,j,2001}}{Exports_{i,2001}}\right) \tag{2.8}$$

[8]We extracted exports by industry from UN Comm. Trade dataset. The number of trade partners associated with Korea during the sample period is 233 and it includes entries such as Other Asia, Antarctica, United States Minor outlying, and Unspecified.

2.2.2 Individual Level Analysis

As we want to incorporate demographic characteristics such as age, tenure, gender, and marriage in our wage analysis, we introduce Mincerian wage specifications in this section. The difference from the regional analysis is that the dependent variable in this section is the log of individual wage or the dummy variable which indicates employment status (1 if employed and 0 otherwise). Since the wage variable and employment dummy themselves do not represent skilled wage premium or relative employment between skill level anymore, the wage equation needs to incorporate the interaction term between the explanatory variables proxying for exports and educational attainment (dummy variable for bachelors' degree).

Specification (2.9) and (2.10) present the simplest version of the Mincerian wage equation and employment status equation. We use exports, $Exports_{rt}$, and a matrix of individual characteristics, X_{irt}, including dummies for educational attainment of workers with less than bachelor's degree, age, squared age and the dummy for marriage as well as tenure for the wage equation only.

$$\begin{aligned} log(wage_{irt}) = {} & \xi_0 + \xi_1 log(Exports_{rt}) + \xi_2 D(Bachelor_{it}) \\ & + \xi_3 D(Bachelor_{it}) log(Exports_{rt}) + X_{irt}\xi_4 \\ & + D(\text{Industry}_{i,t}) + GR_t * D(\text{Industry}_{i,t}) + D(Year_t) + D(Region_r) + \nu_i + \epsilon_{irt}, \\ & \text{where } i \text{ is for individual, } r \text{ is for region and } t \text{ is for year.} \end{aligned} \tag{2.9}$$

$$\begin{aligned} Pr(employed_{irt}) = {} & \theta_0 + \theta_1 log(Exports_{rt}) + \theta_2 D(Bachelor_{it}) \\ & + \theta_3 D(Bachelor_{it}) log(Exports_{rt}) + X_{irt}\theta_4 \\ & + D(Year_t) + D(Region_r) + \nu_i + \epsilon_{irt} \end{aligned} \tag{2.10}$$

We can interpret the estimated parameter, ξ_1 as the marginal impact of regional exports on

individual wage when one does not have bachelor's degree. ξ_2 is the average premium of four-year college; and $\xi_1+\xi_3$ represents the marginal effect of regional exports on college graduates. Therefore, we are mainly interested in ξ_3 because, a positive, significant estimate of ξ_3 implies that the elasticity of individual's wage with respect to regional exports is positive.

As we did in the regional analysis, we can use the same alternative exogenous variables here, the Global Recession dummy and the exchange rates. To do so, we also estimate (2.11) and (2.12)[9] by replacing $Exports_{rt}$ with the interaction term of initial regional exports, $log(Exports_{r,2001})$ and the dummy for the Global Recession, $D(Year > 2007)$. The employment equation is estimated using a panel logit model.

$$\begin{aligned} log(wage_{irt}) = \psi_0 + \psi_1 log(Exports_{r,2001})D(Year > 2007) + \psi_2 D(Bachelor_{it}) \\ + \psi_3 D(Bachelor_{it}) log(Exports_{r,2001})D(Year > 2007) + X_{irt}\psi_4 \\ + D(Year_t) + D(Region_r) + D(\text{Industry}_{i,t}) + GR_t * D(\text{Industry}_{i,t}) + \nu_i + \epsilon_{irt} \end{aligned} \quad (2.11)$$

In specification (2.11), we are particularly interested in ψ_3. We can interpret ψ_3 such that if it is positive (negative), then college graduates wage premium increased (decreased). Since the Great Recession is assumed to bring about a decrease in exports, we expect ψ_3 to be negative if Verhoogen (2008)'s prediction fits in this case. Because it expects to observe active exporters positively respond to the exports trend when they face a sharp exports shocks, the skill premium difference across regions would decline. On the other hand, if ψ_3 appears to be negative, then the skill premium in the regions that exported more initially increased even when the region is more exposed to the Global Recession. As a matter of fact, entities that exports actively are the ones who affected by the Global Recession and, at the same time, more involved in the Global supply chain. If we can find the aforementioned negative ψ_3, it would be the evidence that supports Waddle (2017).

[9] One may think of equation (2.11) and (2.12) as the reduced form specifications instead of Instrumental Variable setup.

$$
\begin{aligned}
Pr(employed_{irt}) = \kappa_0 + \kappa_1 log(Exports_{r,2001}) D(Year > 2007) + \kappa_2 D(Bachelor_{it}) \\
+ \kappa_3 D(Bachelor_{it}) log(Exports_{r,2001}) D(Year > 2007) + X_{irt}\kappa_4 \\
+ D(Year_t) + D(Region_r) + \nu_i + \epsilon_{irt}
\end{aligned}
\tag{2.12}
$$

Finally, we also use local foreign exchange exposure to investigate the impacts of the terms of trade effect on wages and employment. While ι_1 is the regional terms of trade effect on wages of unskilled workers, $\iota_1 + \iota_3$ represents the effect for college graduates. If ι_3 is positive, we can confirm the channel, in which the terms of trade improvement(or worsened) bring about the exports expansion so that the regions that are more exposed to the exporting activity respond by the demand expansion(or contraction) in skilled labor.

$$
\begin{aligned}
log(wage_{irt}) = \iota_0 + \iota_1 \text{FX exposure}_{rt} + \iota_2 D(Bachelor's_{it}) \\
+ \iota_3 D(Bachelor's_{it}) \text{FX exposure}_{rt} + X_{irt}\iota_4 \\
+ D(Year_t) + D(Region_r) + D(\text{Industry}_{i,t}) + GR_t * D(\text{Industry}_{i,t}) + \nu_i + \epsilon_{irt}
\end{aligned}
\tag{2.13}
$$

$$
\begin{aligned}
Pr(employed_{irt}) = \omega_0 + \omega_1 \text{FX exposure}_{rt} + \omega_2 D(Bachelor_{it}) \\
+ \omega_3 D(Bachelor_{it}) \text{FX exposure}_{rt} + X_{irt}\omega_4 \\
+ D(Year_t) + D(Region_r) + \nu_i + \epsilon_{irt}
\end{aligned}
\tag{2.14}
$$

2.3 Data

The data we utilize in the analyses include labor market data from the Korean Labor and Income Panel Study(KLIPS, 2001∼2014) and trade data from UN Comm-trade database for the same period.

Across regional specifications, the wage equations employ as a dependent the relative wage between skilled workers and unskilled workers. For the employment equations in regional analysis, the dependent variable is the ratio of skilled workers to unskilled workers. In the regional level analysis, We calculated the regional average wage from KLIPS, and the relative employment comes from the Economically Active Participation Survey(EAPS). The reason that we use EAPS instead of KLIPS is that the number of employed workers in the sample from KLIPS for some regions is minimal. On the other hand, we use log of individual wage and a dummy that indicates if one is employed in place of the dependent variables.

For the trade variables, we extracted regional exports from Korean Customs Services that is recorded according to the address of producers, and the value of exports to different partners by industrial classification(ISIC rev.3) comes from the U.N. Comm-trade dataset. A set of personal characteristics such as wage, employment status, educational attainment, marriage information, age, gender, union, and tenure are utilized in the individual level analysis.

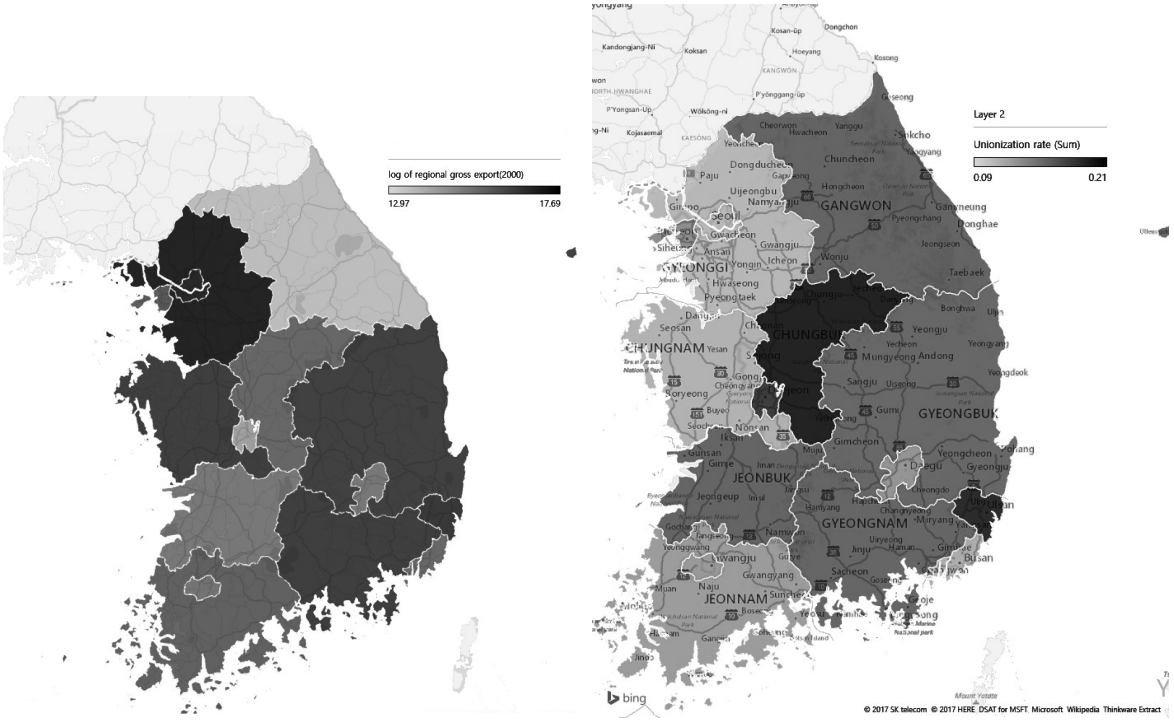
2.3.1 Regional Differences in Exports

Table (2.1) shows the regional pattern of export differences, which is quite consistent over time. Across the period, values of exports are relatively higher in regions of the metropolitan capital area, which includes Seoul, Kyunggi and the South-eastern coastal industrial area encompassing Ulsan, Kyungbook, and Kyungnam. In the meanwhile, exports are lower in the mountainous regions and the South-western areas.

These regional export patterns reflect central development planning of the 1960s' and the 1970s' when it was planned to concentrate heavy industry such as shipbuilding, transportation equipment and chemical industries in the South-eastern coastal areas so that producers can utilize the large port of Busan. In the case of the metropolitan-capital area, as the Korean economy grew, other industries such as electronics and IT products centered in that area, which is abundant in highly skilled workers. In general, the differences in regional exports are reasonably consistent over time. Figure (2.5a) shows the pattern of exports in a graph.

Table 2.1 Regional exports. (Source: Korean Customs Services)

log of regional gross export							
Codes	2000	2006	2007	2008	2009	2010	2014
Busan	15.63	15.98	16.18	16.38	16.08	16.33	16.42
Daegu	15.10	15.16	15.26	15.34	15.19	15.46	15.79
Daejeon	13.87	14.77	14.81	14.92	14.88	15.08	15.29
Gangwon	12.97	13.91	13.98	14.18	13.95	14.23	14.46
Gwangju	15.21	16.11	16.18	16.07	16.02	16.26	16.52
Gyeonggi	17.69	18.04	18.03	18.01	17.89	18.27	18.45
Incheon	16.07	16.66	16.91	16.85	16.56	16.86	17.13
North Chungcheong	15.61	15.98	16.05	16.05	15.92	16.15	16.39
North Gyeongsang	16.80	17.57	17.68	17.69	17.48	17.62	17.67
North Jeolla	15.11	15.59	15.72	15.75	15.63	16.17	15.88
Seoul	17.51	17.10	17.16	17.33	17.33	17.63	17.87
South Chungcheong	16.87	17.55	17.72	17.58	17.50	17.80	17.91
South Gyeongsang	16.86	17.34	17.46	17.87	17.83	17.88	17.67
South Jeolla	15.81	16.84	16.96	17.20	16.98	17.23	17.40
Ulsan	17.05	17.90	18.02	18.20	17.94	18.08	18.26



(a) log of exports in 2000, source: Customs Services Korea. **(b)** Unionization rates in 2001, source: KLIPS.

Figure 2.5 Exports and unionization.

2.3.2 Data Description On Labor

Table 2.2 Descriptive data on labor by region from KLIPS (2001).

region_name	Workers	Workers with BA degree / Other Workers	Wages of BA degree / Other Wages	Unionization rate
Busan	407	0.204	1.528	9.53%
Daegu	212	0.198	1.585	11.54%
Daejeon	139	0.311	1.898	18.79%
Gangwon	69	0.211	1.253	15.58%
Gwangju	115	0.402	1.439	11.12%
Gyeonggi	724	0.259	1.696	8.74%
Incheon	233	0.159	1.352	12.22%
North Chungcheong	81	0.209	1.768	21.06%
North Gyeongsang	150	0.087	1.270	15.33%
North Jeolla	151	0.466	1.492	15.58%
Seoul	989	0.364	1.849	8.68%
South Chungcheong	87	0.088	1.451	9.13%
South Gyeongsang	258	0.178	1.290	15.48%
South Jeolla	92	0.314	1.328	10.96%
Ulsan	123	0.171	1.234	20.33%

Note: Ages of sample are from 25 to 60

Table (2.2) exhibits labor market indicators from 2001 sample of the KLIPS dataset. Note that the sample shows that workers concentrated in the capital-metropolitan area (Seoul, Incheon, and Gyeonggi) and the south-eastern area (Busan, Ulsan and South Gyeongsang). The wage-skill premium is defined as the ratio of the wages of workers with bachelor's degree (4-year college) and the wages of others (less than 4-year college).

In Figure (2.6a), we can see that the South-eastern coastal area has low skill-wage premium even though those areas have a large volume of exports as shown in Figure (2.5a). Perhaps, the high unionization rate is what contributes to higher low-skilled wages. It can be seen in Figure (2.5b) that the South-eastern coastal areas including Ulsan, North, and South Gyeongsang, in which exporting manufacturers are strong, exhibit relatively higher unionization rate. To clarify the regional unionization effect, we calculate unionization rates using the KLIPS dataset and include them in

the regional and individual level analysis.

Table 2.3 Relative ratio of the economic active population and employed workers by region from EAPS (2001).

Region	$\frac{\text{EAP with BA degree}}{\text{Other EAP}}$	$\frac{\text{Workers with BA degree}}{\text{Other Workers}}$
Busan	17.69%	18.01%
Daegu	19.25%	19.55%
Daejeon	29.94%	30.69%
Gangwon	14.53%	14.53%
Gwangju	29.91%	29.95%
Gyeonggi	26.00%	26.36%
Incheon	13.18%	13.45%
North Chungcheong	14.81%	14.78%
North Gyeongsang	10.40%	10.37%
North Jeolla	15.85%	15.33%
Seoul	33.96%	34.64%
South Chungcheong	10.55%	10.63%
South Gyeongsang	15.09%	15.01%
South Jeolla	9.20%	9.15%
Ulsan	15.14%	15.46%

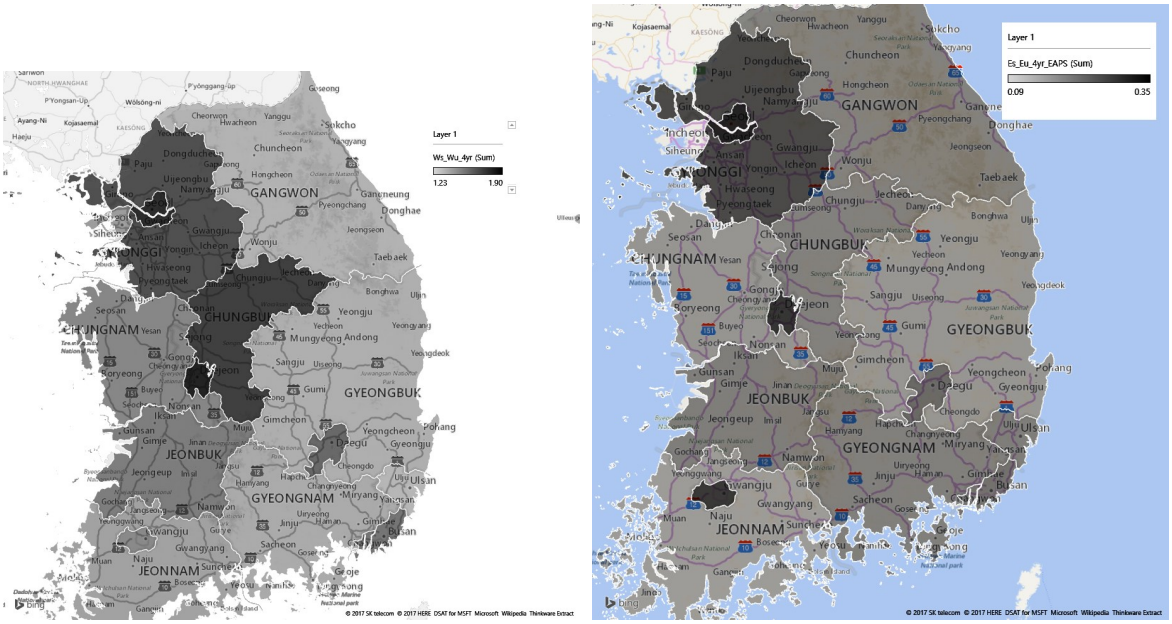
Note: Sample subjects encompass 15 years old and older

Comparing the ratios of skilled workers to unskilled workers in Table 2.2 and Table 2.3 shows evidence that North and South Jeolla, North Chungcheong and Gangwon data from the KLIPS sample likely exaggerates the relative ratio of skilled workers.

2.3.3 Samples

This section provides details on the sample and the purpose of each level of the empirical analysis. First, the sample period is from 2001 to 2014. It is selected because it contains years both before and after 2008's Global financial crisis. We also avoid using the first three waves(1998, 1999, 2000) of KLIPS since the Korean economy suffered from the Asian currency crisis of 1997 and in that following period.

In the regional level analysis, the sample is limited to individuals older than 15 years old. In the



(a) skilled wage premium in 2000, source: KLIPS.

(b) Relative employment of Skilled workers in 2001, source: EAPS.

Figure 2.6 Relative wage and employment.

individual panel analysis, we limit the sample to individuals ages 25 to 60 so that we can extract only the actively searching or employed and limit the age up to where National Pension System kicks in. Also, we limited samples to men only. For the regional analysis, we exclude Jeju island, and Sejong (Special Administrative District).

2.4 Results

2.4.1 Regional Level Analysis

We first estimate the basic specifications using regional foreign exchange exposure and the interaction of Great Recession and the initial regional exports in place of the regional exports. Table (2.4) shows the results. To eliminate the time trend from the wage skill premium, we use the residuals from Eq. (2.15) below as our dependent variable. While most of the coefficients of interest are statistically insignificant, the coefficient of FX exposure in the employment equation is positive

at 0.504, as expected. The signs of the coefficients are somewhat consistent across specifications, which suggests that there is a negative impact of exports on the skilled wage premium and a positive impact on relative employment.

$$log\left(\frac{W^s}{W^u}\right)_{rt} = \sigma_0 + \sigma_1 \text{TimeTrend}_t + \nu_{rt} \tag{2.15}$$

$$log\left(\frac{E^s}{E^u}\right)_{rt} = \rho_0 + \rho_1 \text{TimeTrend}_t + \psi_{rt} \tag{2.16}$$

$$\nu_{rt} = \alpha + \beta_1 \text{exports}_{rt} + \text{year}_t + \text{region}_r + \epsilon_{rt} \tag{2.17}$$

$$\psi_{rt} = \gamma + \delta_1 \text{exports}_{rt} + \text{year}_t + \text{region}_r + \mu_{rt} \tag{2.18}$$

The results of column (1) and (2) in Table 2.4 may suffer from heteroscedasticity since the wage equations use a dependent variable that is from group averages. Solon et al. (2015) introduced a test and solutions for heteroscedasticity problems arising from using group average variables. Following their method, first, we obtain the residuals from a basic model and then we regress the squared residuals on the inverse of group sample size (here, the number of workers in each sample region) as shown in equation (2.19).

$$\epsilon^2_{rt} = \lambda_0 + \lambda_1 (\text{no. of workers})^{-1}_{rt} + residual_{rt} \tag{2.19}$$

The results of testing for heteroscedasticity are presented in Table (2.5), in which, we have substantial evidence of heteroscedasticity for the wage equation. Further, Solon et al. (2015) suggest that weighting by the square root of the group sample size can improve the estimates when the sample size is relatively small for some groups.

Table 2.6 presents results from the weighted regression, where the estimates show a positive coefficient on regional foreign exchange exposure in the skill premium equation with a magnitude of 0.311. Even though the estimated coefficient is not precisely an elasticity of the skill-premium with respect to foreign exchange rate fluctuation, it is very similar to it. In that spirit, when terms of trade

Table 2.4 Basic model.

	(1)	(2)	(3)	(4)
VARIABLES	log Ws/Wu resid.	log Ws/Wu resid.	log Es/Eu resid.	log Es/Eu resid.
FX exposure$_{rt}$	-0.0970		0.504	
	(0.577)		(0.681)	
log(Exports$_{r,2001}$)$\cdot D(Year > 2007)_t$		-0.00860		0.00981
		(0.0240)		(0.00848)
Constant	-0.0306	-0.0368	-0.138**	-0.106***
	(0.0381)	(0.0268)	(0.0482)	(0.0179)
Observations	210	210	210	210
R-squared	0.082	0.085	0.517	0.518
Number of region_code	15	15	15	15
Region FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

Table 2.5 Residual regression on group sample sizes.

	(1)	(2)
	NU_01_Wrt	NU_01_XGR
VARIABLES	resid.	resid.
employed_inv	1.295***	1.221***
	(0.409)	(0.405)
Constant	6.53e-05	0.000494
	(0.00292)	(0.00290)
Observations	210	210
R-squared	0.046	0.042

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

improve by 1%, the estimated effect on wage skill premium is about 0.3%. Results for employment equations are in column (3) and (4) of Table 2.4, even though the evidence is not strong enough, the elasticity is positive, too.

In specifications with the interaction term between initial exports and the Global Recession dummy, both the wage and the employment equations show positive effects, but the statistical significance is not substantial. Overall, the signs of the coefficients are positive, as expected from a demand shock.

Table 2.6 Weighted regression with group sample sizes.

	$log(Ws/Wu)\cdot\sqrt{\text{(no. of workers)}}$ resid.	
VARIABLES	(1)	(2)
FX exposure$_{rt}\cdot$ (no. of workers)$_{rt}^{1/2}$	0.311*	
	(0.174)	
log(Exp$_{r,01}$)$\cdot D(Year>07)\cdot$ (no. of workers)$_{rt}^{1/2}$		0.00290
		(0.00230)
Constant	-0.394	-0.108
	(0.402)	(0.318)
Observations	210	210
R-squared	0.118	0.131
Number of region_code	15	15
Region FE	YES	YES
Year FE	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

2.4.2 Results on The Individual Level Analysis

In this section, we use the individual level panel data from KLIPS. The results from the Mincerian wage estimation are in Table 2.7, 2.8, and 2.9. We present versions of specifications across individual analysis including pooled cross-section, individual fixed effect with or without the balanced panel.

Table 2.7 presents the possibly endogenous regression. Across the specifications in the Table 2.7, we can confirm a positive and significant effect of $log(Exports)$ on skilled workers wages, which implies when a region experiences an increase in exporting activity, the local skill-wage premium also increases.

Table 2.9 shows the regression results that incorporate the interaction between initial regional exports and the Global Recession dummy in place of $log(Exports_{r,t})$. Those specifications indicate that the positive impact of the interaction term is particularly present for skilled workers. In a region that was exporting more in 2001, skilled workers suffered less or widened the skill-wage gap relative to the unskilled workers from the Global Recession when exports declined. In particular, after we consider individual fixed effects in specifications, the signs and the statistical significance for coefficients of $BA*GR*log(Exports_{01})$ are robust across sample composition. On the other hand, the results from the specifications using the regional foreign exchange exposure in Table 2.8 yielded positive but not significant coefficients. Even though the terms of trade effect seem positive and the coefficients' size is relatively larger, the standard errors are too big to reject the hypothesis that it is zero.

Since there could arise the sample selection bias when we limit the samples to the balanced panel, we test the robustness of the specifications with propensity score weighting method[10] The estimations' results with propensity score weighting is reported in Table 2.10. We constructed the propensity scores using the individual information in the initial wave of the panel and compared those between the personals in all waves and not. The propensity score weighted regression results are still consistent with those from the wage specifications except that the estimations with regional exports do not show statistical significance anymore. Other than the variables of interests, we could confirm that the union-ship presence in each of workplace has a significant effect on increasing wages. Moreover, the positive effect of marriage, tenure and the quadratic but almost linear relationship in wage and age.

Estimation results on the employment probability are recorded in Table 2.11[11]. The coefficients

[10]We followed the invert probability method suggested in Guo & Fraser (2014).

[11]When we include individual fixed effect, many observations are taken away due to lack of variation in the period, and

Table 2.7 Estimation on log wage using regional exports.

	log(wage)		
	(1)	(2)	(3)
BA	-0.0415	-0.310**	-0.361
	(0.0726)	(0.139)	(0.228)
log(Exports)	0.0402***	0.0247**	0.00951
	(0.0145)	(0.0115)	(0.0172)
BA*log(Exports)	0.0194***	0.0262***	0.0360***
	(0.00423)	(0.00784)	(0.0139)
Less than High school	-0.258***	-0.0623	-0.0216
	(0.00886)	(0.0589)	(0.0673)
Dropped out or in college	-0.00222	-0.0462	0.0193
	(0.0109)	(0.0298)	(0.0418)
2 yr college	0.104***	0.00653	0.0330
	(0.00586)	(0.0336)	(0.0527)
Age	0.0642***	0.132***	0.124***
	(0.00248)	(0.00334)	(0.00497)
Age^2	-0.000780***	-0.000909***	-0.000813***
	(2.94e-05)	(3.50e-05)	(5.07e-05)
Tenure	0.0224***	0.0119***	0.0129***
	(0.000407)	(0.000811)	(0.00120)
Married	0.207***	0.0643***	0.0836***
	(0.00580)	(0.00833)	(0.0147)
Union	0.141***	0.0237***	0.0230***
	(0.00546)	(0.00555)	(0.00867)
Constant	2.619***	0.928***	0.948***
	(0.255)	(0.199)	(0.303)
Observations	32,952	32,952	11,311
Number of pid	5,473	5,473	1,220
R^2	0.493	0.835	0.836
Year FE	YES	YES	YES
Region FE	YES	YES	YES
Industry FE	YES	YES	YES
Industry*GR	YES	YES	YES
Individual FE		YES	YES
Balanced in Obs			YES

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 2.8 Estimation on log wage using foreign exchange exposure.

	log(wage)		
	(1)	(2)	(3)
BA	0.289***	0.141***	0.240***
	(0.00569)	(0.0349)	(0.0694)
FX_EXPOSURE	0.113	0.0183	0.284
	(0.250)	(0.153)	(0.238)
BA*FX_EXPOSURE	0.0926	0.00503	0.0249
	(0.0765)	(0.0467)	(0.0800)
Less than High school	-0.257***	-0.0614	-0.0194
	(0.00885)	(0.0586)	(0.0672)
Dropped out or in college	-0.00203	-0.0452	0.0174
	(0.0109)	(0.0296)	(0.0418)
2 yr college	0.104***	0.0105	0.0420
	(0.00586)	(0.0334)	(0.0523)
Age	0.0645***	0.135***	0.129***
	(0.00248)	(0.00344)	(0.00516)
Age$\hat{2}$	-0.000783***	-0.000918***	-0.000828***
	(2.94e-05)	(3.49e-05)	(5.08e-05)
Tenure	0.0224***	0.0120***	0.0131***
	(0.000406)	(0.000810)	(0.00120)
Married	0.207***	0.0646***	0.0839***
	(0.00581)	(0.00833)	(0.0148)
Union	0.142***	0.0241***	0.0230***
	(0.00546)	(0.00555)	(0.00868)
Constant	3.282***	1.250***	0.936***
	(0.0695)	(0.115)	(0.194)
Observations	32,952	32,952	11,311
Number of pid	5,473	5,473	1,220
R^2	0.492	0.835	0.835
Year FE	YES	YES	YES
Region FE	YES	YES	YES
Industry FE	YES	YES	YES
Industry*GR	YES	YES	YES
Individual FE		YES	YES
Balanced in Obs			YES

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 2.9 Estimation on log wage using initial regional exports.

	log(wage)		
	(1)	(2)	(3)
BA	0.287***	0.120***	0.227***
	(0.00784)	(0.0353)	(0.0699)
GR*log(Exports01)	-0.0157***	-0.00648*	-0.0123**
	(0.00381)	(0.00339)	(0.00482)
BA*GR*log(Exports01)	0.000236	0.00294***	0.00253***
	(0.000580)	(0.000492)	(0.000725)
Less than High school	-0.257***	-0.0664	-0.0203
	(0.00887)	(0.0585)	(0.0668)
Dropped out or in college	-0.00227	-0.0368	0.0261
	(0.0108)	(0.0297)	(0.0420)
2 yr college	0.104***	0.0172	0.0556
	(0.00587)	(0.0335)	(0.0525)
Age	0.0645***	0.140***	0.139***
	(0.00248)	(0.00532)	(0.00740)
Age$\hat{2}$	-0.000783***	-0.000898***	-0.000804***
	(2.94e-05)	(3.50e-05)	(5.10e-05)
Tenure	0.0224***	0.0119***	0.0130***
	(0.000406)	(0.000809)	(0.00120)
Married	0.207***	0.0633***	0.0830***
	(0.00581)	(0.00833)	(0.0148)
Union	0.141***	0.0245***	0.0237***
	(0.00546)	(0.00554)	(0.00866)
Constant	3.302***	1.052***	0.550**
	(0.0675)	(0.173)	(0.276)
Observations	32,952	32,952	11,311
Number of pid	5,473	5,473	1,220
R^2	0.492	0.835	0.836
Year FE	YES	YES	YES
Region FE	YES	YES	YES
Industry FE	YES	YES	YES
Industry*GR	YES	YES	YES
Individual FE		YES	YES
Balanced in Obs			YES

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 2.10 Estimation on log wage with propensity score weighting.

	log(wage)		
VARIABLES	(1)	(2)	(3)
BA	-0.240	0.212**	0.205**
	(0.405)	(0.101)	(0.0991)
log(Exports)	0.00815		
	(0.0231)		
BA*log(Exports)	0.0270		
	(0.0256)		
FX_EXPOSURE		0.200	
		(0.264)	
BA*FX_EXPOSURE		0.0657	
		(0.0872)	
GR*log(Exports01)			-0.0238**
			(0.00967)
BA*GR*log(Exports01)			0.00234*
			(0.00135)
Observations	11,311	11,311	11,311
Number of pid	1,220	1,220	1,220
Within R^2	0.504	0.504	0.505
Year FE	YES	YES	YES
Region FE	YES	YES	YES
Industry FE	YES	YES	YES
Industry*GR	YES	YES	YES
Individual FE	YES	YES	YES
Balanced in Obs	YES	YES	YES
Propensity Score Weight	Used	Used	Used

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Note: All models include control variables, such as educational dummies, age, age^2, tenure, married, union

Table 2.11 Estimation on employment probability.

	Pr(employed=1)								
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
BA	0.623	0.168***	0.223***	-0.428	0.508***	0.506***	-1.350	0.494**	0.571**
	(0.468)	(0.0371)	(0.0484)	(1.263)	(0.110)	(0.126)	(3.019)	(0.245)	(0.255)
log(Exports)	0.297***			0.227			0.149		
	(0.0837)			(0.158)			(0.296)		
BA*log(Exports)	-0.0269			0.0550			0.110		
	(0.0275)			(0.0745)			(0.181)		
FX_EXPOSURE		-1.081			-2.323			-3.511	
		(1.603)			(2.433)			(4.157)	
BA*FX_EXPOSURE		-0.490			-0.441			-0.321	
		(0.468)			(0.695)			(1.337)	
GR*log(Exports01)			-0.0521**			-0.0394			0.0119
			(0.0231)			(0.0510)			(0.101)
BA*GR*log(Exports01)			-0.00680*			-2.75e-05			-0.0125
			(0.00370)			(0.00799)			(0.0176)
Less than High school	-0.244***	-0.245***	-0.241***	-0.440***	-0.439***	-0.436***	-0.345	-0.344	-0.342
	(0.0441)	(0.0441)	(0.0442)	(0.149)	(0.149)	(0.149)	(0.245)	(0.245)	(0.245)
Dropped out or in college	-0.690***	-0.690***	-0.691***	-1.995***	-1.990***	-1.990***	-0.532	-0.529	-0.525
	(0.0472)	(0.0471)	(0.0472)	(0.151)	(0.150)	(0.150)	(0.341)	(0.338)	(0.338)
2 yr college	0.252***	0.253***	0.251***	0.467***	0.470***	0.471***	0.143	0.146	0.148
	(0.0462)	(0.0462)	(0.0462)	(0.133)	(0.133)	(0.133)	(0.275)	(0.275)	(0.277)
Age	0.389***	0.389***	0.390***	0.642***	0.644***	0.644***	0.634***	0.639***	0.646***
	(0.0124)	(0.0124)	(0.0124)	(0.0349)	(0.0349)	(0.0349)	(0.0719)	(0.0723)	(0.0725)
Age$\hat{2}$	-0.00497***	-0.00497***	-0.00498***	-0.00803***	-0.00805***	-0.00805***	-0.00803***	-0.00808***	-0.00816***
	(0.000146)	(0.000145)	(0.000146)	(0.000412)	(0.000412)	(0.000412)	(0.000809)	(0.000813)	(0.000815)
Married	1.423***	1.421***	1.424***	1.639***	1.641***	1.642***	1.067***	1.071***	1.073***
	(0.0336)	(0.0336)	(0.0337)	(0.104)	(0.104)	(0.104)	(0.214)	(0.214)	(0.213)
Constant	-11.77***	-6.670***	-6.738***	-14.72***	-10.74***	-10.88***	-12.15**	-9.497***	-9.885***
	(1.437)	(0.273)	(0.252)	(2.760)	(0.701)	(0.689)	(5.220)	(1.501)	(1.491)
Observations	43,014	43,014	43,014	43,014	43,014	43,014	14,163	14,163	14,163
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Region FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of pid	6,663	6,663	6,663	6,663	6,663	6,663	1,408	1,408	1,408
Individual RE				YES	YES	YES	YES	YES	YES
Balanced in Obs							YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

of variables used in place of regional exports yielded overall negative signs and no statistical significance. Column (3) in Table 2.11 shows some evidence of the negative effect of initial regional exports on employment for both of skilled and unskilled workers and the difference. If any, yet minimal negative effect is present in this case, we can interpret that as in the case where after the Global Recession, while both of skilled and unskilled labor forces suffered from reduced chance of being employed in more active regions in initial exporting activity, the effect of initial regional exports on skilled workers' probability of employment is more negative than that of unskilled labor. We should also note that the average benefit of bachelor's degree on the employment is positive and significant, generally.

Since the coefficients from logit estimations are not suitable for interpreting the magnificence of effects, I calculated marginal effects for key variables of interests. Table 2.12 and 2.13 presents the average marginal effects of key variables over bachelor's degree across specifications. As shown in Table 2.11, with the introduction of panel estimation, the statistical significance of coefficients of interests faded away that is also present in Table 2.13.

First, Table 2.12 shows that if regional exports that an individual resides in has 1% larger exports than others, regional annual exports gives rises to about 4% and 2.8% increase in employment chance for both unskilled workers and skilled workers. However, as we can confirm in the estimation results in Table2.11, The difference of effects between skill-levels are not evident. The regional foreign exchange exposure has statistically insignificant marginal effects. Finally, the initial regional exporting activity exhibits that for 1% increase of initial exports, there are 0.71% and 0.63% decrease of employment for unskilled and skilled workers. The difference of marginal effects between skill-groups are not confirmed.

2.5 Conclusion

In this paper, I studied several channels through which exports can affect the skill premium and relative employment of skilled workers in Korea between 2001 and 2014. Results from the regional

the optimization process stops because it reaches flat region. Thus, we instead employ the random effect model.

Table 2.12 Average marginal effects from pooled cross-section estimation of employment probability.

	$y = Pr(Employed = 1)$					
	dy/dx	Std. Err.	z	$P > z$	[95% Conf. Interval]	
			$x = log(Exports)$			
BA=0	0.040681	0.01147	3.55	0.000	0.0182	0.0632
BA=1	0.028772	0.00922	3.12	0.002	0.0107	0.0468
			$x = FXExposure$			
BA=0	-0.14837	0.22013	-0.67	0.500	-0.580	0.2831
BA=1	-0.16743	0.17142	-0.98	0.329	-0.503	0.1686
			$x = log(Exports01) * 1(GR = 1)$			
BA=0	-0.00714	0.00317	-2.25	0.024	-0.0134	-0.0009
BA=1	-0.00629	0.00247	-2.55	0.011	-0.0111	-0.0015

analysis provide some evidence that foreign exchange exposure, a proxy for export activity, has a positive effect on the skill premium. Terms of trade improvement induce growth in exports increase that accompanies the growth in the skill premium. The relative employment regression, on the other hand, did not yield any statistically significant results to confirm the positive pattern.

The individual panel analysis presents some evidence that the Global Recession increased the skill premium more in regions where initial exports were higher. Also, the probability of employment declined more for low-skilled workers after the Great Recession in regions that initially had higher exports. However, I could not confirm the evidence for the regional foreign exchange exposure channel once I control for individual characteristics. Based on the results, I could find little support for the prediction in Verhoogen (2008). If the theoretical framework of Verhoogen (2008) were to explain the Korean case, the difference in the regional skill premium should have narrowed(or at least remained unchanged) following the Global Recession and the decline in exports.

All in all, the results suggest that the Global Recession affected the wage inequality, more in regions that had higher initial exports. Considering the literature that deals with the relationship between exports and the skill premium, there are likely several reasons for which the skill premium increased in more actively exporting areas even after the sharp decline in Korean trade following

the Great Recession.

First, according to the traditional Heckscher-Ohlin theory, when trade declines, the skill premium could increase in Korea if the country is less skill abundant compared to its significant trading partners, such as Japan and the United States. Table 2.15, for example, presents evidence which shows that Korean share of the population with post-secondary education is similar to that of the United States and 3.5 percent below that of Japan. However, when we take into account postgraduate education, the U.S. dominates Korea.

Another mechanism that could explain my findings relates to production of intermediate goods using rented technology as proposed by Waddle (2017). If Korean regions with initially higher exports are also more engaged in the global supply chain, i.e. they are more involved in production of the intermediate goods using rented technology, the skill-premium in these regions would increase following a decline in trade. During the period surrounding the Global Recession, Korean exports to China increased compared to exports to other countries and the majority of exported goods were intermediate products such as industrial supplies and capital goods. These include electronic and mechanical parts, machinery, and chemical products.

Finally, I find little impact of exports on the likelihood of employment. This, however, is not surprising, and it is in line with previous work by Hoekman et al. (2005), in which they argue that trade typically affects wages much more than it affects the probability of employment.

2.6 Auxiliary Tables and Figures

Table 2.13 Average marginal effects from random-effect panel logit regression on employment probability.

	$y = Pr(Employed = 1)$					
	dy/dx	Std. Err.	z	$P > z$	[95% Conf. Interval]	
			$x = log(Exports)$			
BA=0	0.01955	0.01364	1.43	0.152	-0.00717	0.04628
BA=1	0.01887	0.01128	1.67	0.094	-0.00323	0.04097
			$x = FXExposure$			
BA=0	-0.19978	0.20930	-0.95	0.340	-0.61000	0.21045
BA=1	-0.18489	0.16524	-1.12	0.263	-0.50875	0.13896
			$x = log(Exports01) * 1(GR = 1)$			
BA=0	-0.00339	0.00439	-0.77	0.441	-0.01199	0.00522
BA=1	-0.00264	0.00342	-0.77	0.440	-0.00934	0.00407

Table 2.14 Variance inflation factor from pooled cross section regression on wage.

Year*Region FE								
Variable	VIF	1/VIF	Variable	VIF	1/VIF	Variable	VIF	1/VIF
BA	261.01	0.004	BA	1.57	0.637	BA	3.09	0.324
log(EXrt)	105.32	0.009	FX exposure rt	204.27	0.005	GR*log(EX01 r)	314.12	0.003
BA*log(EXrt)	261.48	0.004	BA*FX exposure rt	1.56	0.643	BA*GR*log(EX01 r)	3.31	0.302
Year FE, Region FE								
Variable	VIF	1/VIF	Variable	VIF	1/VIF	Variable	VIF	1/VIF
BA	257.5	0.0039	BA	1.56	0.639	BA	3.05	0.328
log(EXrt)	51.69	0.0193	FX exposure rt	51.82	0.019	GR*log(EX01 r)	213.92	0.005
BA*log(EXrt)	258	0.0039	BA*FX exposure rt	1.51	0.663	BA*GR*log(EX01 r)	3.25	0.308

Table 2.15 Share of population by educational attainment.

	Japan	Korea	USA	China
Post-secondary non-tertiary	50.5	46.9	45.7	9.7
Short-cycle tertiary	21.1	13.2	10.7	5.8
Bachelor	29.4	33.7	22.2	3.5
Master	..	..	11.0	0.4
Doctoral	..	..	1.8	..

source: stat OECD

CHAPTER

3

THE IMPACT OF TARIFFS ON THE SKILLED-WAGE PREMIUM: EVIDENCE FROM MEXICAN PLANT-LEVEL INDUSTRIAL SURVEY

3.1 Introduction

Large part of the traditional trade literature supported the idea that trade liberalization is responsible for widening the wage gap between skilled and unskilled workers. The literature on the increasing skill-wage premium in advanced economies includes Michaels (2008), Leichenko & Silva (2004),

and Kandilov (2009). They each utilized different sources of variation such as regional highway installment, urban and rural differences, and the exposure to the trade with developing countries. All of them found that the skilled wage premium is increasing in regions with higher skill endowment and decreasing in the regions with less skill and rural areas when trade grows.

The Stolper-Samuelson theorem implies that skill abundant(or unskilled labor abundant) countries will experience increasing(or decreasing) skill-wage premium when they open trade with less(or more) skill-abundant economies. However, In contrast to what Stolper-Samuelson would suggest, increasing skill-wage premium in developed countries is commonly observed while decreasing skilled wage premium in developing countries is not. Not many researchers could find evidence on that a trade opening in a developing country leads to reduced wage inequality. This is called Stolper-Samuelson missing link or skill-wage premium puzzle.

According to Acemoglu (2003) and Autor (2014), skilled wage premium in the United States has rapidly grown since 1979, notwithstanding the concurrent increase of college graduates supply. For example, the wage gap between male high school graduates and college graduates were $17,411 in 1979 and $34,969 in 2012[1]. On the other hand, while surveying the literature on the relationship between trade opening and inequality, Goldberg & Pavcnik (2007) found that little support for the Stolper-Samuelson style prediction for developing countries, which suggests globalization would decrease income inequality[2]. Mexico, the country of subject for this research showed increasing wage premium of white collar workers as shown in Figure 3.6a. In the meanwhile, Amiti & Cameron (2012) showed that Indonesian skill-wage premium has decreased from 1991 to 2000 in various definitions. The relative wage between non-production workers and production workers fell from 2.52 in 1991 to 2.20 in 2000. The relative wage between workers with less than primary education and upper secondary education had also decreased from 2.22 to 2.05 during the same period[3].

[1] based on 2012 U.S. dollar

[2] OECD (2018) states that income inequality has risen among OECD countries through several decades

[3] A recent study on Latin American countries (De la Torre et al., 2013) showed that there were decreasing trends of wage premium of additional education in 2000's. They tested three hypotheses and found little evidence for industrial shifts towards less skill intensive sectors. They suspected that the more inclusive higher education system offer the broader window of opportunity for students from lower socioeconomic class, which results in decreasing average premium for additional education. They rather suspected there would be a quality problem in education system

Many researchers tried to explain why they observe skill-wage premium increase in less developed countries. The literature includes endogenous skill-biased technology change such as Acemoglu (2003) and quality upgrading or factor reallocation in Verhoogen (2008), Burstein & Vogel (2017), and Bernard & Jensen (1997). Zhu & Trefler (2005) proposed a Southern catch-up channel where developing countries expand the skill intensive sectors, and the demand for skill grew in the similar context of outsourcing hypothesis as in Feenstra & Hanson (1995). Verhoogen (2008), Burstein & Vogel (2017), and Bernard & Jensen (1997) emphasize the importance of export expansion among heterogeneous firms. Verhoogen (2008) showed that initially more productive plants are inclined to produce higher quality products to attract consumers in high-income trading partners, so they pay higher wages and higher premium for skilled workers. Burstein & Vogel (2017) found that the fall in trading cost induces more productive firms or sectors to attract more skilled workers with higher wage. Bernard & Jensen (1997) stated that the demand increase for non-production workers in U.S. in 1980s' was mainly driven by exporters. One recent theoretical piece of research is Blanchard & Willmann (2016), in which they connect the endogenous human capital decision and trade liberalization. They assert that if the cost of climbing the educational ladder is lower for the home country, then the home country will experience the middle class crowded out with trade opening. In the meanwhile, the less developed trading partner will face the opposite.

Among literature that tried to find evidence on traditional Stolper-Samuelson effect in developing economies, Amiti & Cameron (2012) is one of a few studies that associated trade opening with lower skilled wage premium. The research present evidence that input tariff reduction has narrowed the wage gap in Indonesia where unskilled labor is abundant. Furthermore, the output tariff has no significant effect on the wage skill premium once the authors control for the input tariff. They claim that reducing the intermediate input tariff enables firms to redirect their source of input from domestic or in-house toward imports from higher skilled countries. This mechanism takes place if the country's major trading partners are more skill abundant.

I analyze the effects of tariffs and license coverage cuts on the skilled-labor demand by incorporating the channels of input source redirection, import competition, and quality upgrading for

exports in the empirical analysis. I will utilize changes in input tariffs as the main source of variation using plant-level data from the Mexico Industrial Survey from 1986 until 1990. In addition to the input and output tariffs, I analyze the effect of input license coverage and output license coverage, as well. This survey defined license coverage as the average share of commodity categories under import licensing or reference prices, as a percentage of the value of the category's production. Equation (3.1) represents the construction of the license coverage. V_c implies the production value of the commodity sector c and VLC_c represents the value of categories under the license or reference pricing. We can interpret the effect of input and output license coverage in similar fashion to that of tariffs[4].

$$\text{license coverage}_c = \frac{1}{N}\sum_{c=1}^{N}\frac{VLC_c}{V_c} \tag{3.1}$$

Atkin (2016) studied the case of Mexico from 1986 through 2000 and he found that the increasing exports discouraged young students from acquiring education because the costs of having more education outweighed their increased potential labor income in the exporting sector that expanded because of trade liberalization. This could be one of reasons that skilled labor supply was restricted after the trade liberalization. Combining the possibility of declining skilled labor demand due to trade with advanced (skill abundant) economies, the post-liberalization equilibrium value of the skill share$\left(\text{skill share} = \frac{\text{the number of white collar workers}}{\text{the number of blue collar workers}}\right)$ would decrease if there is no other effect.

The other mechanisms through which trade liberalization can affect the demand for skilled labor are import competition and export expansion. When trade with more skill-abundant countries grows, the less skill-abundant country would experience decreasing demand for the skilled labor. It is because the trade opening leads to higher competition for domestic producers with skill abundant foreign exporters. Autor et al. (2013) present the empirical evidence that import competition affects

[4] The literature on trade barriers and political economics agrees on that the tariff and quota are not equivalent as the traditional theory of trade proposes because of monopolistic market structure(Bhagwati, 1965) or politicians' incentive structure (J. P. Choi, 1996; Magee, 1988). In the meanwhile, quota is often considered more distortionary than tariff because license coverages are distributed by authoritarian discretion. Khandelwal et al. (2013) looked into the case of exports quota reduction in the clothing and textile industry in China. The results are in contrast to the efficient outcome from the conceptual model where the quota is alloted according to firms' productivity.

the U.S. economy in that it induced higher unemployment and wage cuts as the local exposure to the import competition grows. On the other hand, quality upgrading mechanisms or export expansion can explain the increasing demand for skilled workers in a country with trade expansion. For example, Verhoogen (2008) found that as initially more productive plants expand their exports, the skill premium increases because the exporters would meet the demand for higher-quality goods in high-income trading partners via quality upgrading. Khandelwal (2010) shows that the larger the difference in quality valuation between countries, the less impact from the import competition. The research developed theoretical model where the quality inference is derived from the discrete choice model, which, in the model, suggests the valuation for the quality determines the length of the quality ladder and longer ladder benefits northern(developed country) producers.

Amiti & Cameron (2012) included output tariffs and their interactions with export shares in their analysis. We can interpret the output tariff effect as a channel of import competition and the interaction term as the representation of the export expansion effect. It means that a heavier exporter is a more productive firm and they would need higher skilled workers to keep up quality.

Mexico is a less skill-abundant country compared to its major trading partners after the trade liberalization in 1986. Figure 3.1 shows that the gross enrollment ratio(GER) in the 1980's in tertiary education. GER is defined as the percentage of students enrolled in tertiary education given the school-age population corresponding to the educational level. Mexico's GER of around 15% is much higher than that of Indonesia and little higher than Colombia but still significantly smaller than the average GER of developed countries(easily above 35% and rising up to 45% in 1991)[5].

Mexico became a member of the General Agreement on Tariffs and Trade(GATT) on August 24, 1986, and experienced a trade liberalization, which led to reduced tariffs and import quotas. One of the country's major trading partners is the Unites States, which is more skill abundant countries. Figure 3.2 presents the average trade share of imports and exports from Mexico Industrial Survey from 1986 to 1990. Panel 3.2a shows that the import share from the U.S. is little above 28%, and

[5]If the level of educational attainment among white and blue collar workers heightened overall, using the dependent variable of relative wages would compromise models' unbiasedness cased by the wage trends induced by changes of educational composition in work forces. Inclusion of industrial specific trends of relative wage could mitigate this problem.

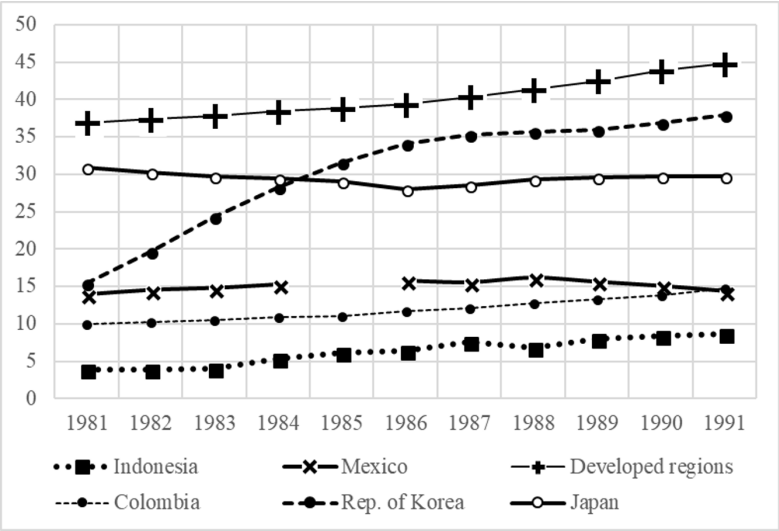


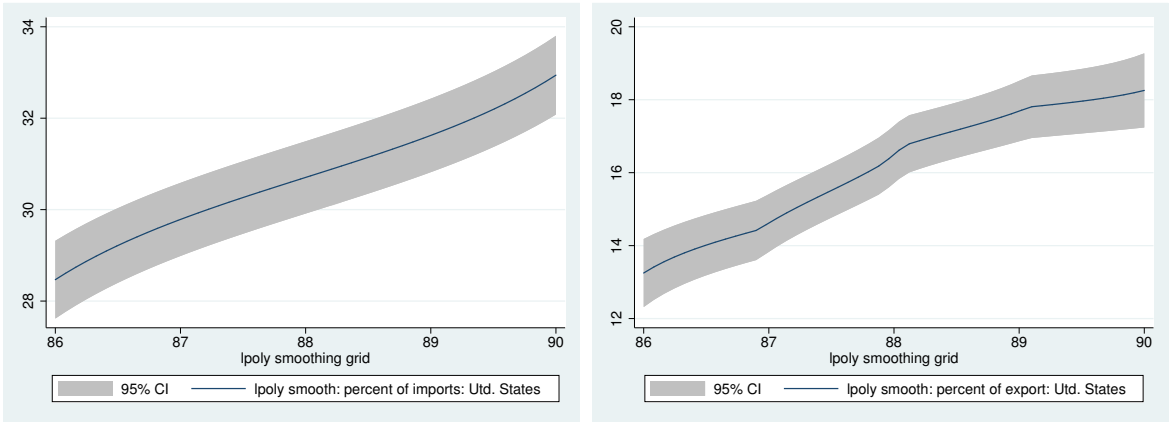
Figure 3.1 Gross Enrollment Ratio of tertiary education. (source: UNESCO Institute for Statistics)

it slightly increased over the sample period up to around 33%. In panel 3.2b, the upward trend of exports to the U.S. is steadily rising from 13% in 1986 to 18% in 1990.

Mexico had a large part of its trade share with higher skilled countries. Thus, it has the potential to exhibit a decrease in skilled labor demand because of the channel where the home economy replace domestically or in-house sourced intermediate inputs with intermediate goods imported from more skill abundant trading partners.

3.2 Estimation Strategy

We estimate the impact of the Mexican trade liberalization on the wage premium and the demand for skilled labor in a manner similar to Amiti & Cameron (2012). The estimation includes input and output tariffs and the interaction terms between the tariffs and the firm's import and export shares. In particular, the coefficient on the interaction term between the average input tariff and the import share is the one in which we are interested because it represents the semi-elasticity of the skilled wage premium to the input tariff that differentiates according to the magnitude of imports in a firm's cost structure. If Mexico is similar to Indonesia, the coefficient would be to be positive since



(a) Share of imports from U.S.

(b) Share of exports to U.S.

Figure 3.2 Trade share with United States.

importing firms would enjoy lower input tariff and substitute their domestic input with foreign intermediate goods that require higher skills and it results in reduction in the demand for skilled labor in the domestic economy.

A distinguishing aspect of this specification is that we can control for quotas, or industry license coverage. Following removal of quotas after the trade liberalization, firms could import inputs or outputs more easily so that it also has the same effect as reducing the tariffs. Our specifications(the full version) include all of trade policy instruments, see equation (3.2). In order to control for the size effect of plants, the 'number of workers' is included. We also use state-year fixed effect to control year-region specific effects. To control for all time-invariant firm characteristics, we include firm fixed effects. Goldberg & Pavcnik (2005) investigated the effect of industrial affiliation on the wage premium. They focused on the mechanism where heterogeneous political influence of each industry differently affects trade protection policy so that the trade openness in each industry becomes endogenous. Thus, we include the industrial time trend, $I(industry)_{jt} * \tau_t$[6], to incorporate industry

[6] τ_t is 1, 2, ...if the year is 1986, 1987, ...

specific effects.

$$
\begin{aligned}
\ln\left(\frac{\mu^w}{\mu^b}\right)_{it} =& \beta_0 + \beta_1 * \text{input tariff}_{jt} + \beta_2 * \text{input tariff}_{jt} * \text{import share}_{it} \\
&+ \beta_3 * \text{output tariff}_{jt} + \beta_4 * \text{output tariff}_{jt} * \text{export share}_{it} \\
&+ \beta_5 * \text{input license}_{jt} + \beta_6 * \text{input license}_{jt} * \text{import share}_{it} \\
&+ \beta_7 * \text{output license}_{jt} + \beta_8 * \text{output license}_{jt} * \text{export share}_{it} \\
&+ Z_{it} * \gamma + I(state)_{it} * I(Year)_t + I(industry)_{jt} * \tau_t + \text{firm FE}_i + \epsilon_{it} \\
&\text{, where subscript } i \text{ indicates firms, } j \text{ is for industries, and } t \text{ is for years}
\end{aligned}
\tag{3.2}
$$

In equation (3.2), μ^w_{it} and μ^b_{it} represent the dependent variables of interest including wage, hourly wage, the wage bill, and the number of workers, respectively. The superscript w means white collar or non-production workers, and the superscript b means blue collar workers. In order to control for the firm size, we employ log of the number of employee. Z_{it} is a vector of firm characteristics such as firm sizes measured by $\log(labor)_{it}$ and skill composition, $\frac{L^w}{L^b}_{it}$.

We expect that when tariffs and license coverage declines, firms will substitute skill intensive domestic inputs with imported inputs so domestic demand for skill will shrink. Hence, β_1, the coefficient on the input tariff, should be positive and the effect increases as a firm imports more, which means that β_2 also should be larger than zero. Thus, coefficients on the input trade variables, β_1, β_2, β_5, and β_6 are expected to be positive. Amiti & Cameron (2012) interpreted the coefficient of input tariff and import share as an effect of already importing firm's substitution from in-house sourced inputs for imported inputs. Since producers are giving up the more skill-intensive intermediate production, their demand for the skilled workers would decrease. Also, importers could have redirected their intermediates supply from domestic production towards imported inputs. In this case, domestic input producers face lower demand for them so that the skill demand for them decreases as well.

When the output tariff falls, it leads to an increase in import competition with skill abundant foreign exporters and to a decrease in the demand for skilled labor. Thus, we expect the signs of

β_3 and β_7 to be positive. On the other hand, the prediction going in the opposite direction can be explained by skill upgrading. Verhoogen (2008) found that the large devaluation of the peso in 1994, led to exports expansion in initially more productive plants and the skill-wage premium also increased. If we assume that exporters are generally more productive firms than non-exporters, and falling output tariffs indirectly reflect the trading partners' openness, we can expect that as the decline in output tariffs, more productive firms (exporters) will demand more skilled workers. Hence, β_4 (or β_8) would be negative if exports induce an increase in the demand for skill.

We expect that the firm size will have negative effect on relative wages($\gamma_1 < 0$). In Brown & Medoff (1989) studied mechanisms and reasons why bigger firms pay higher wage. Among the stylized facts they found, is that the wage-size effect is little in the subgroup of higher skilled workers such as technical, professional, and non-production workers. If this holds true also for Mexican firms, then the wage-size effect is larger among blue-collar workers and smaller for white collars so that the skilled-wage premium reduces as a firm's size grows. Skill shares are included in the estimations of personal wage and hourly wage. Since firms with higher skill shares are considered skill-intensive, they would pay more to attract skilled workers.

3.3 Data

3.3.1 Industrial Composition

This research takes advantage of the plant-level panel dataset from Mexico's Annual Industrial Survey by the "Secretary of Commerce and Industrial Development" (SECOFI) in the period from 1986 to 1990[7]. In each year, 3,218 plants are in the panel. There are 129 4—digit level industries[8]. For the upper level, 2—digit industrial classification is provided with 47 categories. Table 3.1 presents top 10 ranked industries in terms of the number of plants involved in each of 2-digit level industrial classification. The ranking presents that it includes textile, clothing, machinery and equipment, and

[7]The dataset starts from 1984 but there are no information on exports and imports in 1984 and 1985 dataset, so we only utilize data from 1986

[8]Corresponding ISIC codes are available in the appendix of Tybout & Westbrook (1995)

chemicals. Furthermore, when we compare the proportion of plants between 1986 and 1990, we can easily note that the share or number of plants varies little over time. In the meanwhile, Table

Table 3.1 Top 10 industries in the number of plants, 2-digit industry code.

Description	N in 1986	N in 1990	% in 1986	% in 1990
Clothing Garments	232	229	7.53%	7.37%
Plastic Articles	184	194	5.97%	6.25%
Non-Electrical Machinery And Equipment	178	174	5.77%	5.60%
Yarns And Tissues Of Soft Fibers	155	158	5.03%	5.09%
Products Based On Non-Metallic Minerals	145	143	4.70%	4.60%
Paper And Carton	127	130	4.12%	4.19%
Wheat Milling	116	116	3.76%	3.73%
Bodywork, Engines, Parts And Accessories For Automobiles	116	120	3.76%	3.86%
Other Chemical Products	103	104	3.34%	3.35%
Basic Industries Of Iron And Steel	100	102	3.24%	3.28%
Total	1,456	1,470	47.23%	47.33%

3.2 compares how the top 10 ranking industries in terms of the output value shares change from 1986 to 1990. Contrast to the number of plants, the output value shares show notable changes over time. First, the fraction of 'Automobiles' industry expanded from 6.99% to 12.03%, by about 5.31%. The slightly enlarged sectors encompass 'Basic Industries of Iron & Steel', 'Soaps, Detergents & Cosmetics', and 'Meat & Milk', while other segments reduced in terms of proportion in whole. 'Electronic Equipment & Appliances' ranked below 10th in 1990 and instead, 'Basic Chemistry' became a new entrant at the 10th rank.

3.3.2 Definition of Variables

3.3.2.1 Dependent Variables

Dependent variables, in this paper's analysis, employ the form of eq. (3.3), and μ is replaced in each specification with the relative wage bill, skilled wage premium, and the fraction of skilled workers' hourly wage over production workers'. Furthermore, for the labor input quantity estimations, we

Table 3.2 Top 10 industries in output shares, 2 digit industry code.

Year of 1986		
Rank	2 digit industry	Share of output
1	Bodywork, Engines, Parts And Accessories For Automobiles	9.39%
2	Basic Industries Of Iron And Steel	8.62%
3	Automobiles	6.99%
4	Basic Industries Of Non-Ferrous Metals	4.15%
5	Paper And Carton	4.13%
6	Synthetic And Artificial Resins	3.85%
7	Meat And Milk	3.71%
8	Soaps, Detergents And Cosmetics	3.40%
9	Beer And Malta	3.25%
10	Electronic Equipment And Appliances	3.25%
	Total	50.73%

Year of 1990		
Rank	2 digit industry	Share of output
1	Automobiles	12.03%
2	Basic Industries Of Iron And Steel	9.18%
3	Bodywork, Engines, Parts AndAccessories For Automobiles	7.85%
4	Soaps, Detergents And Cosmetics	3.83%
5	Meat And Milk	3.81%
6	Paper And Carton	3.72%
7	Basic Industries Of Non-Ferrous Metals	3.42%
8	Beer And Malta	3.39%
9	Synthetic And Artificial Resins	3.11%
10	Basic Chemistry	2.81%
	Total	53.15%

use the number of employees and hours of work in place of μ

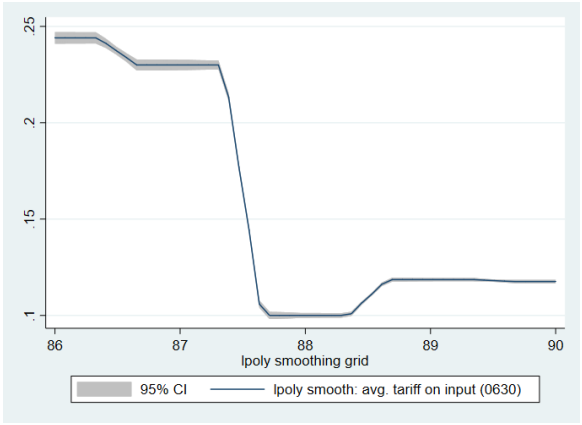
$$log(\mu^{w}_{i,t}/\mu^{b}_{i,t}) \tag{3.3}$$

Monetary variables in this dataset is recorded in 1,000 Mexican peso, and deflated with appropriate price indices as in Tybout & Westbrook (1995). Annual wage bills for non-production workers and production workers are recorded in the panel. The annual individual wages are wage bills divided by the number of each category of workers. Hourly wage is the fraction of wage bills over working hour inputs. Annual working hours are surveyed in the unit of 1,000 hours for each segment of employment. The skill share is defined as skill share$_{i,t}$ is the number of white collar workers$_{i,t}$ divided bythe number of blue collar workers$_{i,t}$.

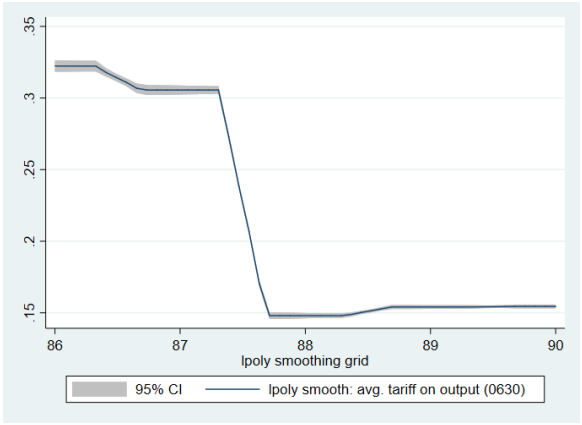
3.3.2.2 Trade Variables

While estimations in this paper follow those in Amiti & Cameron (2012), the research utilizes the variation in tariffs on input and output and license coverage on input and output, as well. Tariffs and license coverages vary at the 4-digit level of industrial segments. The patterns of the changes in tariffs and license coverage in the Mexican case are also different. Both average tariffs on input and output show dramatic decline in the period between 1987 and 1988 as presented in Fig. 3.3 and 3.4. However, license coverage on input and output depicts rather steady and step-wise fall through the sample period. If we only utilize the tariffs, it is probable that models would only capture dynamics between the period before and after 1987. Thus, we can expect to extract the effect of trade opening in the whole period by incorporating license coverage.

I also make use of import shares and export shares for a firm with the interaction terms. Including the interactions of the trade variables allows us to distinguish between channels in which the tariffs or license coverage can affect the demand for skilled workers. I use two versions of import shares. First, the imports of primary and raw materials over the value of output is used and then I replaced the denominator with the total cost of materials consumed. Exports share is defined as exports over output values. Fig. 3.5a presents the smooth upward trends in both versions of import shares. In the

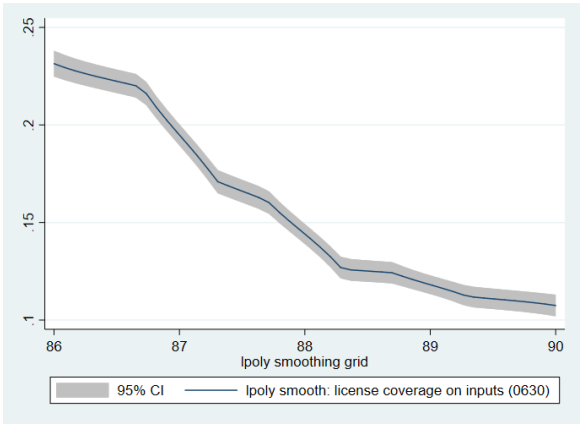


(a) Average tariff on input.

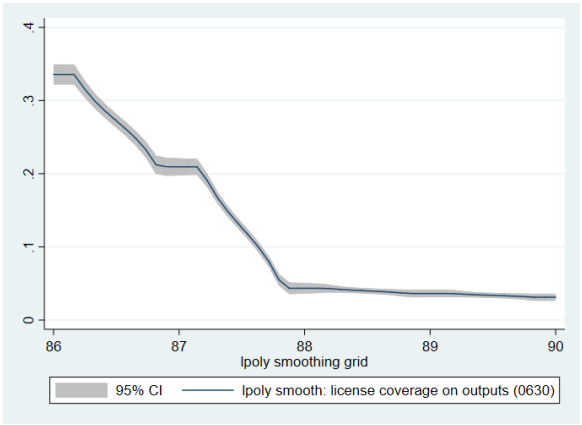


(b) Average tariff on output.

Figure 3.3 Average tariff on input and output. (Source: Mexico Industrial Survey, %)



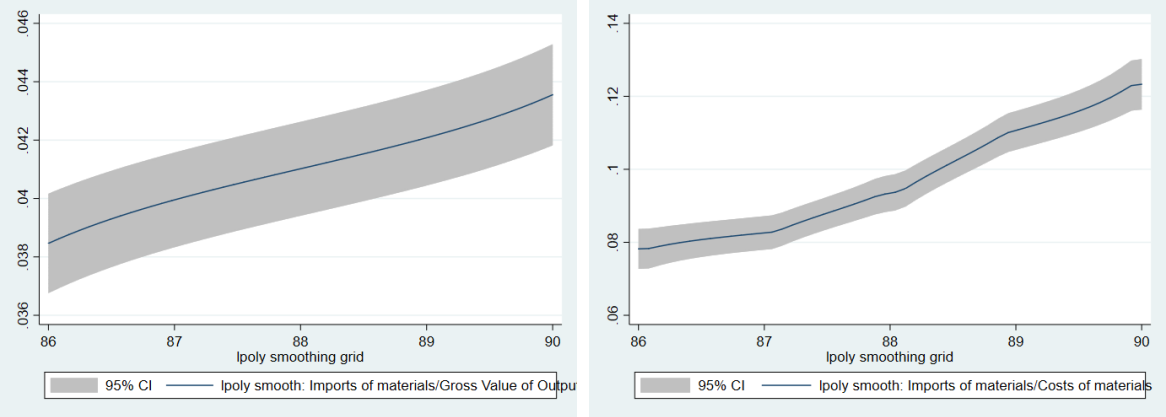
(a) Average license coverage on input.



(b) Average license coverage on output.

Figure 3.4 Average License coverage on input and output. (Source: Mexico Industrial Survey)

meanwhile, imports share in costs exhibit more variation compared to the imports share in output value.



(a) Imports/Output value. **(b)** Imports/Cost of materials and machineries.

Figure 3.5 Import shares. (Source: Mexico Industrial Survey)

3.3.3 Deflation of Monetary Variables

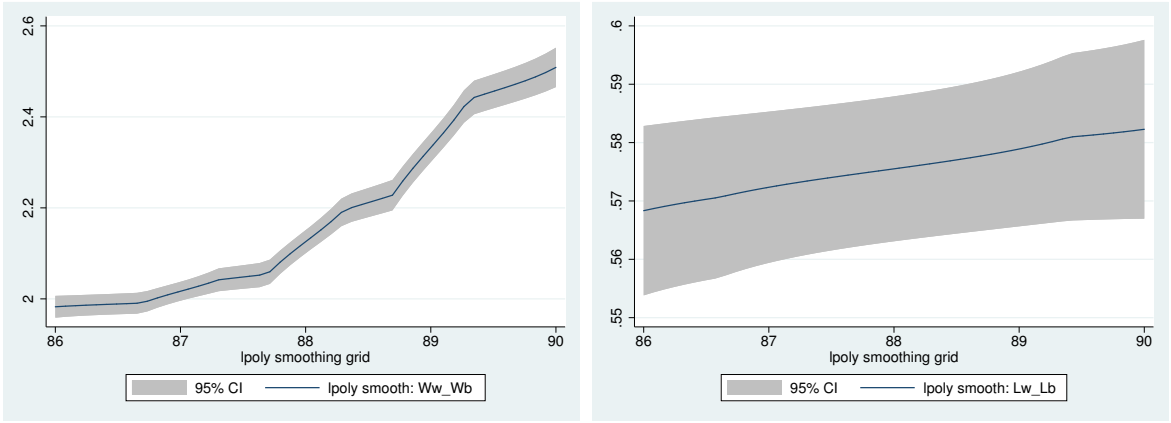
Since Mexico's economy experienced inflation and currency devaluation during the sample period, I needed to deflate all the monetary variables with corresponding price indices. This section explains how deflation has been applied. The data itself provides various versions of prices information such as annual wholesale price index, producer price indices at 4—digit industry level, price index for primary and raw materials. Wage variables are divided by the annual wholesale price index. Output and the exports are deflated using 4—digit industry level producer price indices. Finally, imports and costs of materials consumed are converted into real using the primary material price index.

3.3.4 Sample

I performed winsorization at the 99% for variables included in the specifications in order to reduce the extreme values effect. I also filtered off 553 observations that has the eccentric values of imports,

which is defined as observations whose imports of primary and raw materials exceed total costs.

3.3.5 Descriptive Data



(a) white collar wage/blue collar wage. **(b)** white collar workers/blue collar workers.

Figure 3.6 Skill-wage premium and relative skill-labor. (Source: Mexico Industrial Survey)

Table 3.3 presents the summary statistics in the sample of 1986 and 1990, which shows that the economy-wide skill premium for non-production workers jumped from 1.96 in 1986 to 2.55 in 1990. The wage bill of white collar was 1.04 in 1986 and it had risen up to 1.32 in 1990.

The steady and clearly growing pattern can be confirmed from the figure 3.6a. Combining the dynamics of the skill-wage premium and the relative non-production employment, it is noteworthy that while the individual skill-wage premium ascended significantly, the skill share increased from 0.53 to 0.54. The almost non-increasing pattern of relative input from non-production workers becomes more distinct when we take account of work hours, which stepped up only 0.001 from 0.532 in 1986. Thus, the relative wage bill increase from 1.04 to 1.31 is mainly driven by the comparative growth of white collar workers' wage.

Trade variables indicate that there was sharp trade liberalization in the sample period. Input and output tariff have been cut almost in half and license coverage decreased sharply, it is especially

dramatic for the output license coverage, which reached 3.12% from 33.56%. The sharp decline in tariffs after 1987 is presented in figure 3.3. Table 3.3 also confirms that firms have been expanding trade in the sample period. Both versions of import shares increased significantly and average exports share as well. The firms that take part in imports activity grew from 20.18% in 1986 to 34.39% in 1990, while exporters increased in portion from 14.56% to 23.41%.

While considering that the GER from the sample period does not show clear evidence of increasing supply of skilled workers and the exporting sector has largely expanded, the increase of skilled labor demand due to the exports expansion was not accompanied by enough supply of skilled labor in the sample period. It is in line with Atkin (2016)'s explanation on the endogenous human capital accumulation in Mexico.

Table 3.3 Descriptive data from 1986 and 1990.

year	1986			1990		
variable	mean	sd	N	mean	sd	N
wage bill (white)/(blue)	1.039	1.161	2,950	1.316	1.476	2,741
wage (white)/(blue)	1.963	0.820	2,924	2.552	1.368	2,709
hourly wage (white)/(blue)	2.011	0.876	2,926	2.599	1.392	2,713
employment (white)/(blue)	0.529	0.528	2,977	0.540	0.573	2,760
working hour (white)/(blue)	0.532	0.558	2,966	0.533	0.567	2,752
total employment	275.026	405.821	3,083	278.918	492.074	3,106
log(wage (white)/(blue))	0.602	0.381	2,917	0.821	0.467	2,709
log(wage bill (white)/(blue))	-0.386	0.942	2,920	-0.152	0.936	2,714
log(hourly wage (white)/(blue))	0.620	0.395	2,919	0.837	0.472	2,713
log(employment (white)/(blue))	-0.993	0.858	2,951	-0.978	0.862	2,728
log(working hour (white)/(blue))	-1.005	0.878	2,942	-0.992	0.863	2,723
Imports of materials/Value of Output	3.18%	0.079	2,254	5.07%	0.094	2,277
Imports of materials/Costs of materials	7.52%	0.184	2,253	13.38%	0.267	2,233
Exports/Value of Output	3.38%	0.122	2,254	4.64%	0.138	2,277
importer	20.18%	0.401	3,083	34.39%	0.475	3,106
exporter	14.56%	0.353	3,083	23.41%	0.423	3,106
Input tarriff (mid of year)	24.40%	0.086	3,076	11.76%	0.026	3,096
Output tarriff (mid of year)	32.23%	0.115	3,076	15.45%	0.037	3,096
Input license coverage (mid of year)	24.38%	0.247	3,076	10.28%	0.202	3,096
Output license coverage (mid of year)	33.56%	0.400	3,076	3.12%	0.134	3,096

3.4 Results

3.4.1 Basic Results

Table 3.5, Table 3.6, and Table 3.7 present the results from the main estimations using the relative wage bill, the skilled wage premium, and the skilled wage premium in hourly wage terms. Coefficients on the input tariff yield positive and quite significant values. For example, from the first column of Table 3.5, when a 10% decrease in the input tariff occurs, the relative wage bill declines from about 1.1 to about 1.03 or by 6.36%, all else constant. The coefficients on the input tariff consistently exhibit values around 0.5 and strong statistical significance. This indicates the mechanism of substituting domestic intermediates for imported input leads to a decline in the skilled wage premium for non-importers. However, the coefficients on the interaction terms between the input tariff and the import shares show all negative values that are statistically insignificant. We cannot confirm that reduced tariffs impacted differentially importers using this specification.

The coefficient on the output tariff consistently yields negative signs and it is only significant in the simpler specifications presented in the first columns in Table 3.5 and 3.7. Since Mexico is considered a country where unskilled labor is relatively abundant, reducing the output tariffs will likely decrease the demand for skilled labor. It is because import competition from advanced countries' skill-intensive products leads firms in the sector to turn towards non-skill intensive production based on the comparative advantage. In other words, they avoid the quality competition with products from advanced partners and focus on wage competition. However, the empirical results in this section provides evidences in the opposite direction. The potential mechanism that goes against the presumed context is that where the cut in output tariff induces expansion of skill-intensive sectors. When we checked with Table 3.8, we may rule out the channel that the output tariff cut is associated with exports expansion. Another mechanism that the output tariff cut can increase the skilled wage premium is import competition with imports of less skill intensive products due to the trade liberalization. Small but notable evidence supporting increased import competition from other developing countries is that imports from China were 0.37% of total imports and they jump

to 0.85% in 1990. Additionally, the top 20 origins of Mexican imports in 1990 include developing countries in Asia such as Korea and Hong-Kong while those were not in the 1986 top 20 rank in Table 3.4.

Table 3.4 Top 20 origins of Mexican imports.

Rank	1986	1987	1988	1989	1990
1	USA	USA	USA	USA	USA
2	JPN	DEU	JPN	DEU	DEU
3	DEU	JPN	DEU	JPN	JPN
4	FRA	CAN	FRA	FRA	FRA
5	CAN	FRA	GBR	CAN	GBR
6	GBR	GBR	CAN	ITA	ESP
7	ITA	ESP	BRA	ESP	ITA
8	ESP	BRA	ITA	CHE	CHE
9	ARG	ITA	CHE	BRA	CAN
10	SWE	CHE	ESP	GBR	SWE
11	CHE	SWE	BLX	SWE	ARG
12	BRA	BLX	ARG	KOR	BRA
13	BLX	NLD	SWE	PAN	CHN
14	NLD	PAN	CHN	CHN	HKG
15	CHN	ARG	KOR	ARG	NLD
16	AUS	CHN	NLD	HKG	NZL
17	SGP	IRL	HKG	BLX	KOR
18	IRL	PER	PAN	NLD	IRL
19	NZL	NOR	NZL	IRL	BLX
20	AUT	HKG	PRK	NZL	PAN

Source: WITS, World Bank

Therefore, I performed separate regressions of each skill level wage on the trade policy instruments to examine whether output tariff reduction has reduced unskilled workers wage and increased the skilled wage. The estimation including tariffs and license coverage shows that output tariff reduction, if any, increased white collar workers' wage. Blue collar wages were static but among various specifications, the model with hourly wage and state and year effect showed some evidence that the output tariff fall is associated with lower wages for production workers. On the other hand, input

tariff decline clearly is associated with a fall in the skilled wage as we already confirmed in the skilled wage premium estimation.

Table 3.5 Estimations on log of relative wage bill with trade shares.

	Dep. Var. = log(wage bill(white)/wage(blue))							
	Import share out of output					Import share out of costs		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Input tariff	0.636***	0.555**	0.503**	0.514**	0.509**	0.504**	0.519**	0.524**
	(0.224)	(0.223)	(0.232)	(0.233)	(0.232)	(0.232)	(0.232)	(0.232)
impshare					-0.0630			0.0224
					(0.150)			(0.0598)
Input tariff*impshare			-0.196	-0.410	-0.193	-0.105	-0.219	-0.320
			(0.486)	(0.523)	(0.697)	(0.184)	(0.208)	(0.326)
Output tariff	-0.233*	-0.193	-0.120	-0.128	-0.127	-0.113	-0.121	-0.125
	(0.132)	(0.137)	(0.143)	(0.150)	(0.150)	(0.143)	(0.150)	(0.150)
expshare					-0.0304			-0.0447
					(0.0965)			(0.0965)
Output tariff*expshare			-0.133	-0.0268	0.0626	-0.129	-0.0215	0.122
			(0.225)	(0.261)	(0.370)	(0.225)	(0.261)	(0.372)
Input license coverage		0.000825		0.00422	0.00125		0.00523	0.00470
		(0.0963)		(0.0951)	(0.0952)		(0.0954)	(0.0954)
Input license*impshare				0.310	0.351		0.199	0.188
				(0.274)	(0.314)		(0.154)	(0.161)
Output license coverage		0.0289		0.00126	0.00217		0.000891	0.000960
		(0.0249)		(0.0264)	(0.0265)		(0.0264)	(0.0265)
Output license*expshare				-0.111	-0.119		-0.117	-0.125
				(0.139)	(0.138)		(0.139)	(0.138)
Log(labor)	-0.111***	-0.111***	-0.100***	-0.101***	-0.101***	-0.101***	-0.102***	-0.102***
	(0.0238)	(0.0238)	(0.0241)	(0.0241)	(0.0241)	(0.0243)	(0.0243)	(0.0242)
Constant	0.174	0.169	0.150	0.150	0.150	0.152	0.152	0.152
	(0.170)	(0.170)	(0.181)	(0.181)	(0.181)	(0.182)	(0.182)	(0.182)
Observations	13,855	13,855	11,072	11,072	11,072	11,057	11,057	11,057
R-squared	0.115	0.115	0.128	0.129	0.129	0.129	0.129	0.129
Number of pid	3,057	3,057	2,337	2,337	2,337	2,337	2,337	2,337
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
State and Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry*τ_t	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The interaction between the import share and the input tariff appears negative across all specifications of wages and the empirical significance is not enough to confirm that importers are

Table 3.6 Estimations on log of relative wage with trade shares.

	Dep. Var. = log(wage(white)/wage(blue))							
	Import share out of output					Import share out of costs		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Input tariff	0.653***	0.530***	0.530***	0.438**	0.441**	0.527***	0.435**	0.441**
	(0.166)	(0.170)	(0.181)	(0.184)	(0.184)	(0.181)	(0.184)	(0.184)
impshare					0.0326			0.0271
					(0.102)			(0.0420)
Input tariff*impshare			-0.141	-0.208	-0.320	-0.149	-0.180	-0.294
			(0.339)	(0.358)	(0.481)	(0.125)	(0.141)	(0.222)
Output tariff	-0.154	-0.0984	-0.0534	-0.0204	-0.0191	-0.0490	-0.0160	-0.0163
	(0.104)	(0.107)	(0.114)	(0.118)	(0.119)	(0.114)	(0.118)	(0.118)
expshare					0.0750			0.0705
					(0.0668)			(0.0665)
Output tariff*expshare			0.0499	0.308	0.0790	0.0587	0.318	0.106
			(0.169)	(0.194)	(0.271)	(0.168)	(0.194)	(0.270)
Input license coverage		0.0338		0.0307	0.0339		0.0340	0.0371
		(0.0655)		(0.0726)	(0.0728)		(0.0726)	(0.0725)
Input license*impshare				0.107	0.0887		0.0546	0.0428
				(0.170)	(0.186)		(0.109)	(0.112)
Output license coverage		0.0371**		0.0379*	0.0368*		0.0373*	0.0361*
		(0.0183)		(0.0210)	(0.0210)		(0.0210)	(0.0210)
Output license*expshare				-0.270***	-0.253**		-0.272***	-0.255***
				(0.0995)	(0.0984)		(0.0995)	(0.0984)
Skill share	-0.246***	-0.246***	-0.281***	-0.280***	-0.279***	-0.279***	-0.278***	-0.278***
	(0.0237)	(0.0237)	(0.0270)	(0.0270)	(0.0270)	(0.0268)	(0.0268)	(0.0268)
Log(labor)	0.0182	0.0180	0.0167	0.0157	0.0152	0.0149	0.0139	0.0133
	(0.0139)	(0.0139)	(0.0157)	(0.0157)	(0.0157)	(0.0156)	(0.0156)	(0.0156)
Constant	0.542***	0.532***	0.604***	0.596***	0.597***	0.611***	0.604***	0.605***
	(0.100)	(0.100)	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)
Observations	13,845	13,845	11,064	11,064	11,064	11,049	11,049	11,049
R-squared	0.168	0.168	0.187	0.188	0.189	0.187	0.188	0.188
Number of pid	3,057	3,057	2,337	2,337	2,337	2,337	2,337	2,337
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
State and Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry*τ_t	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.7 Estimations on log of relative hourly wage with trade shares.

	Dep. Var. = log(hourly wage(white)/wage(blue))							
	Import share out of output					Import share out of costs		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Input tariff	0.670***	0.600***	0.534***	0.473**	0.478**	0.528***	0.462**	0.474**
	(0.183)	(0.188)	(0.199)	(0.203)	(0.203)	(0.199)	(0.203)	(0.203)
impshare					0.0518			0.0503
					(0.111)			(0.0449)
Input tariff*impshare			-0.270	-0.200	-0.378	-0.130	-0.0736	-0.290
			(0.346)	(0.369)	(0.517)	(0.143)	(0.163)	(0.243)
Output tariff	-0.244**	-0.207*	-0.132	-0.121	-0.121	-0.129	-0.118	-0.121
	(0.115)	(0.118)	(0.124)	(0.128)	(0.128)	(0.124)	(0.128)	(0.128)
expshare					0.0518			0.0467
					(0.0741)			(0.0739)
Output tariff*expshare			0.103	0.296	0.140	0.103	0.297	0.164
			(0.169)	(0.198)	(0.305)	(0.168)	(0.197)	(0.303)
Input license coverage		-0.0125		0.0620	0.0652		0.0654	0.0688
		(0.0717)		(0.0791)	(0.0793)		(0.0790)	(0.0790)
Input license*impshare				-0.106	-0.138		-0.102	-0.125
				(0.177)	(0.197)		(0.120)	(0.123)
Output license coverage		0.0279		0.0140	0.0130		0.0138	0.0124
		(0.0203)		(0.0227)	(0.0228)		(0.0228)	(0.0228)
Output license*expshare				-0.200*	-0.188*		-0.198*	-0.185*
				(0.105)	(0.104)		(0.105)	(0.104)
Skill share	-0.151***	-0.151***	-0.173***	-0.172***	-0.172***	-0.171***	-0.170***	-0.170***
	(0.0281)	(0.0281)	(0.0280)	(0.0280)	(0.0280)	(0.0278)	(0.0278)	(0.0278)
Log(labor)	0.0375***	0.0374***	0.0359**	0.0352**	0.0348**	0.0349**	0.0344**	0.0337**
	(0.0143)	(0.0143)	(0.0150)	(0.0150)	(0.0150)	(0.0149)	(0.0149)	(0.0149)
Constant	0.451***	0.448***	0.540***	0.533***	0.534***	0.543***	0.536***	0.537***
	(0.108)	(0.108)	(0.116)	(0.117)	(0.117)	(0.117)	(0.117)	(0.117)
Observations	13,850	13,850	11,069	11,069	11,069	11,054	11,054	11,054
R-squared	0.138	0.139	0.158	0.159	0.159	0.158	0.158	0.159
Number of pid	3,057	3,057	2,337	2,337	2,337	2,337	2,337	2,337
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
State and Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry*τ_t	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.8 Estimations on potential mechanisms through trade instruments.

VARIABLES	(1) Output	(2) Imports	(3) Exports	(4) Imports/Output	(5) Imports/Costs	(6) Exports/Output
Input Tariff	-4.326	-0.816	-4.329**	-0.0850**	-0.243***	-0.0709
	(3.273)	(1.486)	(2.023)	(0.0340)	(0.0806)	(0.0498)
Intput License	3.155*	0.810	2.076**	0.0179	0.0766**	-0.00899
	(1.634)	(0.823)	(0.964)	(0.0119)	(0.0336)	(0.0178)
Output Tariff	0.818	0.523	1.662*	0.0511**	0.113*	0.0942***
	(1.357)	(0.600)	(0.849)	(0.0210)	(0.0596)	(0.0353)
Output License	-0.0138	-0.0879	-0.0471	-0.00104	-0.00748	0.00710
	(0.153)	(0.0771)	(0.130)	(0.00265)	(0.00783)	(0.00528)
Constant	-3.179**	-0.307	-0.273	0.0239	0.0175	0.00607
	(1.435)	(0.210)	(0.339)	(0.0163)	(0.0442)	(0.0244)
Observations	14,249	11,207	11,207	11,207	11,189	11,207
R-squared	0.318	0.174	0.145	0.095	0.080	0.070
Number of pid	3,117	2,354	2,354	2,354	2,354	2,354
Firm FE	YES	YES	YES	YES	YES	YES
State and Year FE	YES	YES	YES	YES	YES	YES
Industry*τ_t	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

affected disproportionately. It implies that the wage premium for skilled labor is generally set at the industry level and firms that redirected their source of input towards imports show little evidence on differential demand for non-production workers. Negative signs would be interpreted as such when importers depend more on imports, the effect from the falling input tariff on the skilled wage premium would be mitigated. If that is true in reality, it implies that importers usually pay higher premium than non-importers.

Skilled workers in firms that import more suffered less from the input tariff decline. Why? Let's compare two firms that produce the same variety of products where one uses imported inputs and the other employs domestic sourced input. If we think of imported inputs from the more advanced economy as skill-intensive, it should be costly to use imported inputs even after the trade liberalization compared to using inputs from domestic sources. If a firm cannot afford to replace domestic input with imported inputs, it could be the less productive firm than the importer. The more productive firms can pay higher premium.

The output license coverage and the associated interaction term in Table 3.6 show evidence on that whereas the shrinking output license coverage is strongly associated with lower skill-wage premium for non-exporters, exporters have less of a tendency to reduce the skilled wage premium as they export more. Abolishing output license coverage leads firms to confront import competitors, which make the skill-wage premium fall by the influx of skill intensive output products from the advanced economy. However, since it is likely that exporters are more productive ones than other firms, they show less reduction of the skilled wage premium compared to non-exporters. This is consistent with Bernard & Jensen (1997) and Verhoogen (2008). License coverage is often considered as a more distortionary than price regulation in that a quota is not allocated based on productivity but on discretion from a central authority. If the license is not distributed efficiently, a binding quota will lead to inefficiency. Khandelwal et al. (2013) studied the exports quota abolishment in the Chinese clothing and textile industry and they found that the empirical results go against the model prediction where the quota allocation is based on productivity.

The firms' scale effects measured as the total number of employees yield the strong evidence

that as a firm's scale grows bigger, the relative wage bill of white collar workers is reduced. This result on the wage bill is in line with the results in Brown & Medoff (1989), which explained the negative association as the effect of bigger difference among blue collar wages but small in highly skilled group of workers. However, the individual wage and the hourly wage equations show the opposite results. Especially, Table 3.7 presents strong evidence that bigger firms pay relatively higher wages for non-production workers. Brown & Medoff (1989) considered skilled workers as a group of workers that are highly technical and professional. Thus, the criteria of non-production and production may not be suitable for the interpretation in the context of Brown & Medoff (1989). Rather, we should interpret this as a result where the scale is usually associated with exporters or more productive firms, and those firms pay more of skilled wage premium. The difference between the results from the wage bill equation and the personal wage is due to the decline in the relative employment of non-production workers in larger plants as in Table3.9 and Table 3.10.

Larger skill shares, defined as a relative employment of non-production workers, are consistently associated with lower skilled wage premium. The strong negative signs of the export share from columns (5) and (9) in Table 3.9 indicate that as a firm is more involved in exporting activity, it hires more production workers. The separate regressions on each group's wage also confirms that relative employment of skilled workers is associated with lower skilled-wage and higher production wages. If exporters are generally bigger in scale and employ more production workers then, they are highly likely to have higher skilled wage premium. Furthermore, the coefficients on the output license in Table 3.9 show strong evidence that the output quota removal increased non-production workers' proportion for non-exporters but the effect is smaller for heavy exporters. Column (7) and (8) in Table 3.10 show that while reducing input license coverage has no significant impact on relative working hour inputs for non-importers, it induced heavier importers to reduce the input of skilled workers' hours.

Table 3.9 Estimations on log of skill share with trade shares.

	Dep. Var. = log(No. of employees(white)/wage(blue))							
	Import share out of output					Import share out of costs		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Input tariff	0.00143	0.0472	-0.0493	0.0789	0.0682	-0.0435	0.0922	0.0859
	(0.177)	(0.181)	(0.179)	(0.184)	(0.183)	(0.179)	(0.183)	(0.183)
impshare					-0.122			-0.0268
					(0.144)			(0.0550)
Input tariff*impshare			0.0818	-0.0284	0.391	0.0537	-0.0271	0.0797
			(0.435)	(0.470)	(0.706)	(0.156)	(0.171)	(0.317)
Output tariff	-0.0493	-0.0626	-0.0218	-0.0766	-0.0775	-0.0194	-0.0749	-0.0777
	(0.105)	(0.111)	(0.115)	(0.119)	(0.119)	(0.115)	(0.119)	(0.119)
expshare					-0.159**			-0.168**
					(0.0759)			(0.0753)
Output tariff*expshare			-0.0464	-0.234	0.250	-0.0439	-0.231	0.284
			(0.173)	(0.196)	(0.276)	(0.173)	(0.197)	(0.275)
Input license coverage		-0.0557		-0.0248	-0.0335		-0.0296	-0.0355
		(0.0746)		(0.0680)	(0.0679)		(0.0688)	(0.0687)
Input license*impshare				0.142	0.216		0.137	0.147
				(0.239)	(0.286)		(0.115)	(0.123)
Output license coverage		-0.00464		-0.0491**	-0.0462**		-0.0490**	-0.0467**
		(0.0200)		(0.0206)	(0.0207)		(0.0206)	(0.0207)
Output license*expshare				0.196**	0.160		0.192*	0.154
				(0.0994)	(0.0972)		(0.0993)	(0.0971)
Log(labor)	-0.144***	-0.144***	-0.134***	-0.134***	-0.132***	-0.133***	-0.132***	-0.131***
	(0.0257)	(0.0257)	(0.0289)	(0.0289)	(0.0288)	(0.0287)	(0.0287)	(0.0286)
Constant	-0.206	-0.198	-0.268	-0.259	-0.260	-0.278*	-0.269	-0.271*
	(0.150)	(0.151)	(0.166)	(0.165)	(0.165)	(0.165)	(0.165)	(0.164)
Observations	13,928	13,928	11,068	11,068	11,068	11,053	11,053	11,053
R-squared	0.066	0.066	0.070	0.071	0.072	0.070	0.071	0.071
Number of pid	3,073	3,073	2,337	2,337	2,337	2,337	2,337	2,337
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
State and Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry*τ_t	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.10 Estimations on log of relative working hours with trade shares.

	Dep. Var. = log(Working hours (white)/wage(blue))							
	Import share out of output					Import share out of costs		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Input tariff	-0.00689	-0.0182	-0.00927	0.0807	0.0699	-0.00154	0.0990	0.0893
	(0.206)	(0.207)	(0.205)	(0.208)	(0.208)	(0.205)	(0.208)	(0.207)
impshare					-0.124			-0.0426
					(0.149)			(0.0561)
Input tariff*impshare			0.137	-0.112	0.313	0.0270	-0.134	0.0422
			(0.440)	(0.477)	(0.717)	(0.162)	(0.180)	(0.322)
Output tariff	0.0818	0.0865	0.0727	0.0433	0.0429	0.0765	0.0466	0.0456
	(0.116)	(0.120)	(0.123)	(0.128)	(0.128)	(0.123)	(0.128)	(0.128)
expshare					-0.142*			-0.150*
					(0.0803)			(0.0795)
Output tariff*expshare			-0.0609	-0.153	0.279	-0.0536	-0.145	0.311
			(0.180)	(0.212)	(0.297)	(0.180)	(0.212)	(0.295)
Input license coverage		0.00573		-0.0612	-0.0695		-0.0651	-0.0713
		(0.0867)		(0.0765)	(0.0764)		(0.0770)	(0.0769)
Input license*impshare				0.358	0.434		0.280**	0.298**
				(0.252)	(0.300)		(0.127)	(0.135)
Output license coverage		0.00287		-0.0205	-0.0178		-0.0207	-0.0183
		(0.0203)		(0.0204)	(0.0205)		(0.0204)	(0.0204)
Output license*expshare				0.0955	0.0629		0.0884	0.0533
				(0.103)	(0.101)		(0.102)	(0.100)
Log(labor)	-0.153***	-0.153***	-0.146***	-0.145***	-0.144***	-0.145***	-0.145***	-0.144***
	(0.0235)	(0.0235)	(0.0249)	(0.0249)	(0.0248)	(0.0248)	(0.0248)	(0.0247)
Constant	-0.234	-0.235	-0.301**	-0.292*	-0.293*	-0.305**	-0.296*	-0.298*
	(0.146)	(0.146)	(0.153)	(0.153)	(0.152)	(0.153)	(0.153)	(0.153)
Observations	13,884	13,884	11,075	11,075	11,075	11,060	11,060	11,060
R-squared	0.063	0.063	0.072	0.073	0.073	0.072	0.073	0.074
Number of pid	3,063	3,063	2,337	2,337	2,337	2,337	2,337	2,337
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
State and Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry*τ_t	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.4.2 Results with Initial Importing Status

This section investigates the trade liberalization impact on the relative wage and employment using initial trade activity. Equation (3.4) replaced trade share with the initial trade shares in 1986, the beginning of the sample period, in the interaction terms. Inclusion of initial trade status can capture time-invariant trade characteristics of firms. The effect of abolishing trade barriers would have affected disproportionately plants with larger initial trade shares. For example, firms that were initially exporting are considered more competitive plants even before the trade liberalization and those will be competing more easily in global markets in the post-liberalization period than the non-initial-exporters. This mechanism is highlighted in Verhoogen (2008)– initial exporters will engage in quality competition as well so that leads to increase in the demand for skilled workers. When the input tariff fell, if a firm were importing their inputs initially, it would benefit from the lower costs of production more than non-importers. Meanwhile, non-importers are affected only by indirect mechanism that the tariff reduction induced for the industry. We can interpret trade shares as a measure of distance from global trade. If a firm is located far from trade, then the effect from trade liberalization can be small.

$$
\begin{aligned}
\ln\left(\frac{\mu^w}{\mu^b}\right)_{it} =& \beta_0 + \beta_1 * \text{input tariff}_{jt} + \beta_2 * \text{input tariff}_{jt} * \text{import share}_{i,86} \\
&+ \beta_3 * \text{output tariff}_{jt} + \beta_4 * \text{output tariff}_{jt} * \text{export share}_{i,86} \\
&+ \beta_5 * \text{input license}_{jt} + \beta_6 * \text{input license}_{jt} * \text{import share}_{i,86} \\
&+ \beta_7 * \text{output license}_{jt} + \beta_8 * \text{output license}_{jt} * \text{export share}_{i,86} \\
&+ Z_{it} * \gamma + I(state)_{it} * I(Year)_t + I(industry)_{jt} * \tau_t + \text{firm FE}_i + \epsilon_{it} \\
&\text{, where subscript } i \text{ indicates firms, } j \text{ is for industries, and } t \text{ is for years}
\end{aligned}
\tag{3.4}
$$

The results in Tables 3.11 to 3.15 show similar pattern of the impact from trade. Input tariff reduction has a strong effect on the skilled wage premium as in the previous analysis with current trade shares across all specifications. The coefficients on the interaction term between the input

tariff and the import share yield similar implication as well. Columns (2) and (3) in Table 3.13 show that firms that depend more on imports initially increased non-production workers' relative hourly wage more. Moreover, as a firm is more involved in exports in 1986, output license coverage reduction led to a higher skilled-wage premium. Thus, it is notable that initially, more exports-engaged firms rather increased their skilled wage premium in terms of the hourly wage and the effect is more notable than that of tariff measures.

The effect of reducing output license coverage is presented in Table 3.14. Non-exporters in 1986 increased the share of non-production workers as output license coverage decreases and as a plant exported more in 1986, the effect of increasing skill shares was smaller. But this pattern is not confirmed with relative working hour input of skilled labor. In terms of firm-size effect, bigger firms pay more of skilled wage premium and hire less of non-production workers.

3.5 Conclusion

I investigated how trade policy instruments affect the skill-wage premium and the relative employment of skilled workers using the Mexican industrial survey from 1986 to 1990 when Mexico joined GATT in the middle of 1986. While quotas and tariffs for inputs and outputs were all decreased dramatically during the sample period, we found that the input tariff decline had a strong effect on narrowing the gap between production and non-production workers across all specifications. Even though Mexico is not a country that it is extremely unskilled labor abundant as Indonesia in Amiti & Cameron (2012) analysis, Mexico, as one of less skill abundant country than its major trading partners, experienced decreasing skill-wage premium due to the input tariff reduction. However, it is not clear that the decline in the tariffs affects firms differently according to their trade status. It appears that the input tariff affects the industry level rather than the individual firms. However, if a firm is not engaged in trade, as input tariffs decline, firms in the industry turn their resources to less skill intensive production.

Inclusion of license coverage measures is one of the distinct feature of this research, even though output trade barriers measured by the output tariff did not exhibit notable impact, the quota and its

Table 3.11 Estimations on log of relative wage bills with initial trade status.

	Dep. Var. = log(wage bill(white)/wage(blue))					
	Import share out of output			Import share out of costs		
	(1)	(2)	(3)	(4)	(5)	(6)
Input tariff	0.501**	0.488**	0.488**	0.502**	0.496**	0.503**
	(0.232)	(0.233)	(0.234)	(0.231)	(0.233)	(0.233)
impshare_86			-3.220			-1.167
			(2.836)			(1.596)
Input tariff*impshare_86	-0.0980	0.0213	0.230	-0.0886	-0.123	-0.0923
	(0.874)	(1.017)	(1.043)	(0.395)	(0.466)	(0.468)
Output tariff	-0.115	-0.119	-0.120	-0.115	-0.119	-0.125
	(0.143)	(0.149)	(0.149)	(0.143)	(0.149)	(0.149)
expshare_86			1.864			1.771
			(1.160)			(1.188)
Output tariff*expshare_86	-0.522	-0.391	-0.433	-0.515	-0.393	-0.455
	(0.421)	(0.441)	(0.453)	(0.422)	(0.441)	(0.451)
Input license coverage		0.0312	0.0286		0.0203	0.0202
		(0.0956)	(0.0957)		(0.0958)	(0.0958)
Input license*impshare_86		-0.180	-0.150		0.0509	0.0708
		(0.815)	(0.820)		(0.395)	(0.403)
Output license coverage		-0.000785	-0.000235		-0.000626	-0.000256
		(0.0267)	(0.0267)		(0.0267)	(0.0267)
Output license*expshare_86		-0.0944	-0.122		-0.0964	-0.119
		(0.158)	(0.162)		(0.158)	(0.161)
Log(labor)	-0.101***	-0.101***	-0.101***	-0.101***	-0.101***	-0.101***
	(0.0241)	(0.0241)	(0.0241)	(0.0241)	(0.0241)	(0.0241)
Constant	0.153	0.152	0.185	0.154	0.152	0.175
	(0.181)	(0.181)	(0.200)	(0.181)	(0.181)	(0.214)
Observations	11,072	11,072	11,072	11,072	11,072	11,072
R-squared	0.129	0.129	0.129	0.129	0.129	0.129
Number of pid	2,337	2,337	2,337	2,337	2,337	2,337
Firm FE	YES	YES	YES	YES	YES	YES
State and Year FE	YES	YES	YES	YES	YES	YES
Industry*τ_t	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.12 Estimations on log of relative wage with initial trade status.

	Dep. Var. = log(wage(white)/wage(blue))					
	Import share out of output			Import share out of costs		
	(1)	(2)	(3)	(4)	(5)	(6)
Input tariff	0.534***	0.422**	0.427**	0.535***	0.428**	0.437**
	(0.181)	(0.184)	(0.185)	(0.181)	(0.184)	(0.184)
impshare_86			-1.987			-0.837
			(2.154)			(1.307)
Input tariff*impshare_86	-0.597	-0.254	-0.109	-0.389	-0.314	-0.287
	(0.563)	(0.623)	(0.643)	(0.247)	(0.292)	(0.294)
Output tariff	-0.0468	-0.0103	-0.0137	-0.0489	-0.0125	-0.0183
	(0.114)	(0.118)	(0.118)	(0.114)	(0.118)	(0.118)
expshare_86			2.123*			2.043*
			(1.159)			(1.192)
Output tariff*expshare_86	-0.347	-0.0187	-0.0807	-0.330	-0.0151	-0.0880
	(0.297)	(0.319)	(0.328)	(0.296)	(0.316)	(0.324)
Input license coverage		0.0568	0.0551		0.0440	0.0440
		(0.0739)	(0.0741)		(0.0733)	(0.0734)
Input license*impshare_86		-0.469	-0.458		-0.0943	-0.0832
		(0.368)	(0.373)		(0.226)	(0.229)
Output license coverage		0.0343	0.0348*		0.0345	0.0349*
		(0.0210)	(0.0211)		(0.0210)	(0.0210)
Output license*expshare_86		-0.237**	-0.266**		-0.237**	-0.262**
		(0.109)	(0.112)		(0.108)	(0.111)
Skill share	-0.281***	-0.280***	-0.280***	-0.281***	-0.280***	-0.279***
	(0.0270)	(0.0270)	(0.0270)	(0.0270)	(0.0270)	(0.0270)
Log(labor)	0.0162	0.0153	0.0153	0.0161	0.0155	0.0154
	(0.0157)	(0.0157)	(0.0157)	(0.0157)	(0.0157)	(0.0157)
Constant	0.610***	0.602***	0.590***	0.612***	0.603***	0.594***
	(0.113)	(0.113)	(0.135)	(0.113)	(0.113)	(0.149)
Observations	11,064	11,064	11,064	11,064	11,064	11,064
R-squared	0.188	0.189	0.189	0.188	0.189	0.189
Number of pid	2,337	2,337	2,337	2,337	2,337	2,337
Firm FE	YES	YES	YES	YES	YES	YES
State and Year FE	YES	YES	YES	YES	YES	YES
Industry*τ_t	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.13 Estimations on log of relative hourly wage with initial trade status.

	Dep. Var. = log(hourly wage(white)/wage(blue))					
	Import share out of output			Import share out of costs		
	(1)	(2)	(3)	(4)	(5)	(6)
Input tariff	0.538***	0.458**	0.458**	0.538***	0.459**	0.466**
	(0.200)	(0.203)	(0.204)	(0.199)	(0.203)	(0.203)
impshare_86			-3.191			-1.257
			(2.287)			(2.006)
Input tariff*impshare_86	-0.638	-0.0266	0.182	-0.396	-0.175	-0.144
	(0.609)	(0.675)	(0.689)	(0.274)	(0.324)	(0.320)
Output tariff	-0.127	-0.116	-0.118	-0.129	-0.119	-0.124
	(0.124)	(0.128)	(0.129)	(0.124)	(0.128)	(0.128)
expshare_86			1.824			1.718
			(1.148)			(1.189)
Output tariff*expshare_86	-0.224	0.0748	0.0332	-0.209	0.0731	0.0129
	(0.327)	(0.358)	(0.369)	(0.325)	(0.355)	(0.366)
Input license coverage		0.0929	0.0903		0.0785	0.0784
		(0.0812)	(0.0814)		(0.0805)	(0.0805)
Input license*impshare_86		-0.873**	-0.844**		-0.320	-0.297
		(0.391)	(0.394)		(0.241)	(0.248)
Output license coverage		0.0124	0.0129		0.0130	0.0134
		(0.0229)	(0.0229)		(0.0228)	(0.0229)
Output license*expshare_86		-0.202*	-0.229*		-0.199*	-0.221*
		(0.117)	(0.117)		(0.116)	(0.117)
Skill share	-0.172***	-0.172***	-0.173***	-0.172***	-0.172***	-0.171***
	(0.0280)	(0.0280)	(0.0280)	(0.0280)	(0.0280)	(0.0280)
Log(labor)	0.0355**	0.0345**	0.0345**	0.0354**	0.0347**	0.0346**
	(0.0149)	(0.0150)	(0.0150)	(0.0149)	(0.0150)	(0.0150)
Constant	0.545***	0.540***	0.573***	0.547***	0.542***	0.572***
	(0.116)	(0.117)	(0.140)	(0.116)	(0.117)	(0.179)
Observations	11,069	11,069	11,069	11,069	11,069	11,069
R-squared	0.158	0.159	0.160	0.158	0.159	0.159
Number of pid	2,337	2,337	2,337	2,337	2,337	2,337
Firm FE	YES	YES	YES	YES	YES	YES
State and Year FE	YES	YES	YES	YES	YES	YES
Industry*τ_t	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.14 Estimations on log of skill shares with initial trade status.

	Dep. Var. = log(no. of workers(white)/wage(blue))					
	Import share out of output			Import share out of costs		
	(1)	(2)	(3)	(4)	(5)	(6)
Input tariff	-0.0605	0.0639	0.0557	-0.0595	0.0667	0.0654
	(0.179)	(0.186)	(0.186)	(0.179)	(0.186)	(0.186)
impshare_86			-2.097			0.564
			(2.339)			(1.351)
Input tariff*impshare_86	0.875	0.769	0.882	0.477	0.409	0.398
	(0.875)	(1.035)	(1.066)	(0.380)	(0.434)	(0.433)
Output tariff	-0.0206	-0.0752	-0.0721	-0.0188	-0.0730	-0.0714
	(0.115)	(0.119)	(0.119)	(0.115)	(0.119)	(0.119)
expshare_86			-0.438			-0.461
			(0.861)			(0.860)
Output tariff*expshare_86	0.0390	-0.209	-0.176	0.0297	-0.215	-0.199
	(0.293)	(0.312)	(0.313)	(0.293)	(0.311)	(0.314)
Input license coverage		-0.0200	-0.0218		-0.0215	-0.0214
		(0.0704)	(0.0704)		(0.0702)	(0.0702)
Input license*impshare_86		0.111	0.141		0.0771	0.0657
		(0.859)	(0.863)		(0.349)	(0.362)
Output license coverage		-0.0472**	-0.0471**		-0.0470**	-0.0471**
		(0.0209)	(0.0209)		(0.0209)	(0.0209)
Output license*expshare_86		0.187*	0.189*		0.184*	0.190*
		(0.105)	(0.106)		(0.106)	(0.106)
Log(labor)	-0.134***	-0.133***	-0.133***	-0.134***	-0.133***	-0.133***
	(0.0289)	(0.0289)	(0.0289)	(0.0289)	(0.0289)	(0.0289)
Constant	-0.274*	-0.265	-0.189	-0.276*	-0.266	-0.290
	(0.166)	(0.165)	(0.184)	(0.166)	(0.165)	(0.192)
Observations	11,068	11,068	11,068	11,068	11,068	11,068
R-squared	0.070	0.071	0.071	0.070	0.071	0.071
Number of pid	2,337	2,337	2,337	2,337	2,337	2,337
Firm FE	YES	YES	YES	YES	YES	YES
State and Year FE	YES	YES	YES	YES	YES	YES
Industry*τ_t	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.15 Estimations on log of relative working hours with initial trade status.

	Dep. Var. = log(working hour(white)/wage(blue))					
	Import share out of output			Import share out of costs		
	(1)	(2)	(3)	(4)	(5)	(6)
Input tariff	-0.0189	0.0662	0.0632	-0.0182	0.0722	0.0721
	(0.205)	(0.210)	(0.211)	(0.205)	(0.210)	(0.210)
impshare_86			-0.546			0.656
			(2.588)			(1.846)
Input tariff*impshare_86	0.746	0.343	0.370	0.410	0.199	0.188
	(0.882)	(1.057)	(1.092)	(0.383)	(0.444)	(0.445)
Output tariff	0.0751	0.0497	0.0509	0.0767	0.0520	0.0532
	(0.123)	(0.128)	(0.128)	(0.123)	(0.128)	(0.128)
expshare_86			-0.268			-0.258
			(1.120)			(1.116)
Output tariff*expshare_86	-0.0456	-0.223	-0.209	-0.0542	-0.224	-0.216
	(0.305)	(0.338)	(0.343)	(0.304)	(0.336)	(0.343)
Input license coverage		-0.0634	-0.0639		-0.0611	-0.0610
		(0.0796)	(0.0796)		(0.0789)	(0.0789)
Input license*impshare_86		0.559	0.568		0.301	0.287
		(0.908)	(0.913)		(0.380)	(0.391)
Output license coverage		-0.0206	-0.0206		-0.0209	-0.0210
		(0.0207)	(0.0207)		(0.0207)	(0.0207)
Output license*expshare_86		0.121	0.123		0.115	0.120
		(0.110)	(0.109)		(0.110)	(0.109)
Log(labor)	-0.145***	-0.145***	-0.145***	-0.145***	-0.145***	-0.145***
	(0.0249)	(0.0249)	(0.0249)	(0.0249)	(0.0249)	(0.0249)
Constant	-0.305**	-0.298*	-0.273	-0.307**	-0.300**	-0.337*
	(0.152)	(0.153)	(0.174)	(0.152)	(0.153)	(0.202)
Observations	11,075	11,075	11,075	11,075	11,075	11,075
R-squared	0.072	0.073	0.073	0.073	0.073	0.073
Number of pid	2,337	2,337	2,337	2,337	2,337	2,337
Firm FE	YES	YES	YES	YES	YES	YES
State and Year FE	YES	YES	YES	YES	YES	YES
Industry*τ_t	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

interaction with the export share yielded some evidence on that it captured import competition from the skill-intensive goods from more advanced trading partners. Furthermore, unlike the input tariff, the output license coverage reduction appeared to have less of an effect in reducing the skilled wage premium for heavier exporters.

Generally, it is less evident that the trade liberalization affected skill composition among workers as Hoekman et al. (2005) found. We also tried to find evidence on the size effect that is discussed in Brown & Medoff (1989) where bigger firms pay a smaller skill premium. But the result turned out to be the opposite. The reason likely is twofold. First, Brown & Medoff (1989) grouped skilled workers as highly professional and intellectual workers, while this research can only discern production and non-production workers. Second, larger firms tend to export more and they are more competitive in the global economy, and exporters pay a higher skill premium Verhoogen (2008).

CHAPTER

4

POLICY IMPACT OF MATERNITY PROTECTION ON FEMALE LABOR MARKET IN KOREA

4.1 Introduction

In Korea, there have been consistent efforts to expand maternity protection by legislation. Major recent policy changes for firms with less than 300 workers were enacted in November 2001 and January 2006. The first were to include expansion of paid maternity leave up to 90 days from 60 days and subsidization towards new working mothers for the last 30 days of leave. The second legislation increased the duration of subsidies for the whole 90 days.

Kim (2011) is a study that is closely related to my research. The author analyzed only 2001 Korean maternity expansion effect using Korean Labor and Income Panel Studies from 1998 to 2005. The research employed a difference-in-difference-in-differences(DDD) scheme to incorporate age and gender at the same time. Results suggest that the Korean labor reform in 2001 was not effective in terms of labor market outcomes since the author didn't find significant evidence for change of employment and wage after maternity benefit expansion.

In this research, I will incorporate 2006 legislation in Korean labor market as well since it lessens burden for employers to hire young females and more extensive in terms of protection compared to that of 2001 so that we can expect clearer results. This chapter compares impacts on female labor market outcomes from each policy reform. The 2001 and 2006 legislation were different in that the former focused more on increasing the duration of maternity leave and the later increased the coverage of monetary compensation subsidies. While both of protection expansions are expected to induce more of female labor supply, the former legislation increased costs of hiring female workers and the later buffered cost burden for firms to hire women. The analysis utilizes Korean Labor Income Panel Survey(KLIPS) that can cover the before and after each policy changes. The panel regressions in difference-in-differences fashion show that the labor market outcomes such as wages and employment respond more to later reform than to the former only among certain age group, namely female who ages from 26-30. Furthermore, I will tackle if simply setting the comparison group of older women and male is appropriate. It is because economy-specific context sometime do not allow such groups to be appropriate control groups by violating identifying assumptions of difference-in-differences(DD).

The rest of this chapter is organized as follows. Section 4.2 introduces the literature reviews on maternity leave protection in various contexts. Section 4.3 reasons why maternity benefit expansion has been issue in the South Korean context and introduce motivations. Further, in the section I present the associated parental care policy in detail. Section 4.4 presents the empirical specifications of difference-in-differences formats and explains the variables. Section 4.5 provide information on how samples from Korean Labor and Income Panel Study(KLIPS) is comprised and its descriptive

data. Section 4.6 explores identifying assumptions underlying difference-in-differences analysis as explained in Angrist & Krueger (1999). Section 4.7 and 4.8 interprets each specification's implications. Finally, Section 4.9 summarizes the estimation results and suggest further reasoning why the results could deviate from the ex-ante hypothesis.

4.2 Literature

Researches on maternity leave entitlement has been performed in various regions of North America, Europe, and Eastern Asia. Maternity leave policy designs and are various across these regions. Western Europe and Northern European countries began their maternity leave program earlier than other regions. According to the OECD statistics as of 1970[1], all of Denmark, France, Germany, Norway, Sweden, and United Kingdom already implemented the maternity leave. On the other hand, Canada started the program since 1971 and United States enacted Family and Medical Leave Act only after 1993[2]. Korean maternity leave started from 1988. In terms of length of the leave, most countries offer 12 weeks to 18 weeks. while Canada has relative longer leave of 17 weeks. Canada, Germany, Norway already offered paid leave as of 1971, while Korea started paid leave in 1988. U.S. did not offer any of Federal level paid leave policy. California introduce California's Paid Family Leave program(CA-PFL) in 1997.

While most of the interests were leave usage and the impact on labor market, frequently used dependent variables are leave take-ups, its duration, mothers' return-to work, wage and employment. There are also a group of researches on the effect of maternity protection and child development. The general theoretical expectations suggest that the labor supply of women in child-bearing age would increase but labor demand would shrink due to increased costs for hiring young females. The new equilibrium in the labor market would result in lower wage but it is not clear for employment. However, many case studies do not exhibit the clear expectations as theories do and the results vary over each country's social context and the policy scheme itself. In this section, I shall explore event

[1] Data on maternity leave from OECD is available from 1970

[2] U.S. policy is different from other regions' maternity policy in that it is not mandatory

studies on consequences from countries' maternity protection expansion.

Waldfogel[3] contributed to a series of researches on the factors that induce lower wages for female workers, such as family status or maternity benefits using various data sources before Family and Medical Leave Act(FMLA). Waldfogel (1996) investigated the source of gender-wage gap using two cohorts of 1980 and 1991 in NLSY data. The research attributed the cause of lower female wage to educational attainment and family status such as marriage and child birth. In Waldfogel (1998), they employed NLSY data for U.S. cohort and the National Child Development Survey(NCDS) for a British cohort[4]. The results for both cohorts indicate that women earn less than men, while mothers earn twenty percent points less than non-mothers do, when male wage is set as 100%. In particular, female workers at a job with maternity benefits enjoy higher payment and probability of return-to-work.

Subsequently, Waldfogel (1999) studied directly the effect of maternity leave(FMLA in 1993) on labor market outcomes with employer survey data from Current Population Survey(CPS). The United States government enacted Family and Medical Leave Act(FMLA) in 1993 that allows new mothers to leave the job for twelve weeks unpaid. While it comparably shorter than European countries or Canada, the author found that female workers used more and longer of leave after the FMLA and the legislation did not have negative impact on female labor outcomes such as wage and employment as usual theories expected. Another track of researches on the effect of the FMLA is done by Baum (2003a,b, 2004). Baum (2003b) and Baum (2004) using National Longitudinal Survey of Youth (NLSY), found that it only increased the probability of return-to work for female workers but had no effect on leave take-ups. Authors focused on labor market outcomes of the FMLA in Baum (2003a) that also utilized NLSY data and concluded that the FMLA had no significant effects on wages and employment. They explained it is because the twelve weeks duration of the maternity

[3]Waldfogel also contributed in Berger et al. (2005) where authors found the relationship between early return-to work and child development out of NLSY data. Particularly, return-to-work in twelve weeks after birth yielded stronger negative effects. They used Propensity matching score method to overcome sample selection bias because mothers returning to work more shortly could be different from others

[4]the NLSY cohort comprises women with wage information in 18-25 in 1979-1983 and the author compares their early earnings to late earnings observed at their age of 26-34 from 1987 to 1991. British NCDS cohort includes women whose age are 33 in 1991 and the author compares the earnings in 1981 to that of 1991.

leave in the FMLA is not long enough to have an impact, the workers lose incomes during the leave, and a substantial number of firms already allowed workers to have maternity leave.

Rossin-Slater et al. (2012) identified the positive association between California's Paid Family Leave program(CA-PFL) in 1997 and leave usage(both of incidents and duration). The interesting results that is related to my research is that the CA-PFL induced increased 10 to 17 percent in wage and employment. Baum & Ruhm (2016) also highlighted the effect of paid leave feature in the CA-PFL. Unlike the federal FMLA, California's program induced longer duration and higher probability of leave-take-ups for both of mothers and fathers. Post-birth return-to-work was facilitated by the program and the employment rate for mothers in nine to twelve months after birth events were higher. The CA-PFL enactment exhibited positive but insignificant effects on wages. This research has common in that they concluded the CA-PFL induced more usage of maternity leave. Results on the labor market outcomes are different. While employment rates for new mothers increased after the protection in both of studies, but Baum & Ruhm (2016) did not yield any evidence on wage effect, while Rossin-Slater et al. (2012) shows wage effects as much as employment effect. The series of researches on maternity leave in the United States well contrasts the FMLA and the CA-PFL.

Baker & Milligan (2008) studied the effect of statutory maternity leave differences on leave usage of new mothers and the probability of return to work. They utilized the monthly rotating panel data of Canadian Labor Force Survey(LFS) from 1976 to 2002. the results show that the shorter leave entitlement did not yield significant effect on leave take-ups or its duration. However, the longer statutory maternity leave increased the time spent at home post-birth. Furthermore, all maternity leave expansion had positive impact on the probability of young mothers continuing the job after their birth events.

Both of Dahl et al. (2016) on Norway and Ondrich et al. (2003) on Germany concluded in somewhat negative perspective on maternity leave expansions. Dahl et al. (2016) focused on whether the paid maternity leave expansion actually had substantial social effects such as child education, parental income, and family structure stability. They performed a case study for Norwegian maternity benefit expansions that started from 1977. The results indicate that while parents spend more

time at home due to the enhanced leave without much loss of income, expected social benefits were negligible compared to the huge cost of the protection. Ondrich et al. (2003) built a theoretical model and estimates for the return-to-work effect of German maternity leave expansion in 1985 with German Socio-Economic Panel(GSOEP). Theoretical implication in this research states that the return-to-work will not decrease without change in employment conditions or career expectation. However, since the empirical evidence shows that mothers are returning to work less after leave expansion, which can be explained by peer pressure that suggests female role in households. We should be careful of comparing these results to that of United States, because Western and Northern Europe has much more extensive leave duration and benefits.

As an aggregated study for European region, Ruhm (1998) investigated the nine European countries. When the women in child-bearing age are compared to older women and men, the effect of maternity protection increase is generally associated with increased in employment of young women but decreased earnings in the long-run.

Taiwanese government enacted protection measures on female labor that include working hour limits and maternity leave in 1984 and enforcement of the law in 1987. Zveglich & Meulen Rodgers (2003) studied effects of these enactments using repeated cross-sectional household data from Taiwan using industrial variation(industry and services). As expected in theory, working hour restriction negatively impacted on female employment, while maternity leave induced increased female labor inputs. Authors stated that maternity leave entitlement that guarantees the return-to-work particularly increased female labor supply. Effects on wage seems unclear due to the mixed effect of the reform on labor demand and supply. Another research on the Taiwanese case study of Labor Standards Law is Lai & Masters (2005). Their results on labor market outcomes contrast to those from Zveglich & Meulen Rodgers (2003), in that Lai & Masters (2005) concluded that the Taiwanese labor reform affected negatively both of wages and employment.

4.3 Maternity Protection in Korea

The Korean government has consistently extended its maternity protection coverage out of concerns that the society is aging fast. Figure 4.1 shows cumulative rates of first marriage and first birth among females who experienced those events. We can easily note that the age of these first events is increasing, and the age of first birth is more notable. The trend of new mothers' aging is also confirmed by the numbers from Vital Statistics by Statistics Korea. For example, the average age of birth giving mother were 29.03 in 2000 and 32.6 in 2017. Consequentially, the number of new born babies were 640,089 in 2000 and it decreased down to 357,771 in 2017. Overall, the total fertility rate of 1.191 in 2003 shrank to 1.052 in 2017. Table 4.1 shows the change of maternity related events in specific 5-year age bins. The most active age group in birth events were late 20's in 2000 but it changed to early 30's in 2013. Moreover, while 1,000 women in their ages in 20-24 gave birth to 39.2 babies in 2000, the number dropped to 14.0 in 2013. In contrast, fertility rate of women in their late 30's increased from 17.6 in 2000 to 39.5 in 2013. Similar aging pattern is also observed for the age-specific marriage rates, which are presented in Table 4.2. Korean Society has very row population of unmarried parents. Since 2015 Vital Statistics began to include information associated with single-parents, which shows only 24,487 unmarried mothers are recorded in 2015. All in all, while Korean fertility rate itself is decreasing rapidly compared to other countries[5], the marriage and birth events occur in older age groups of women. Furthermore, the trends are notably different across five-year age bins.

4.3.1 Maternity Leave

Paid maternity leave in Korea was introduced in 1953, which offers up to 60 days as a part of labor standard act and it was extended up to 90 days in November 2001. Among the 90 days, employers pay the compensation for the first 60 days, and the Employment Insurance pays for the remaining 30 days. The maternity leave is present in Korea as a form of a paid vacation, which employers cannot

[5] see Table 4.12

Table 4.1 Age specific fertility rate (per 1,000 women)

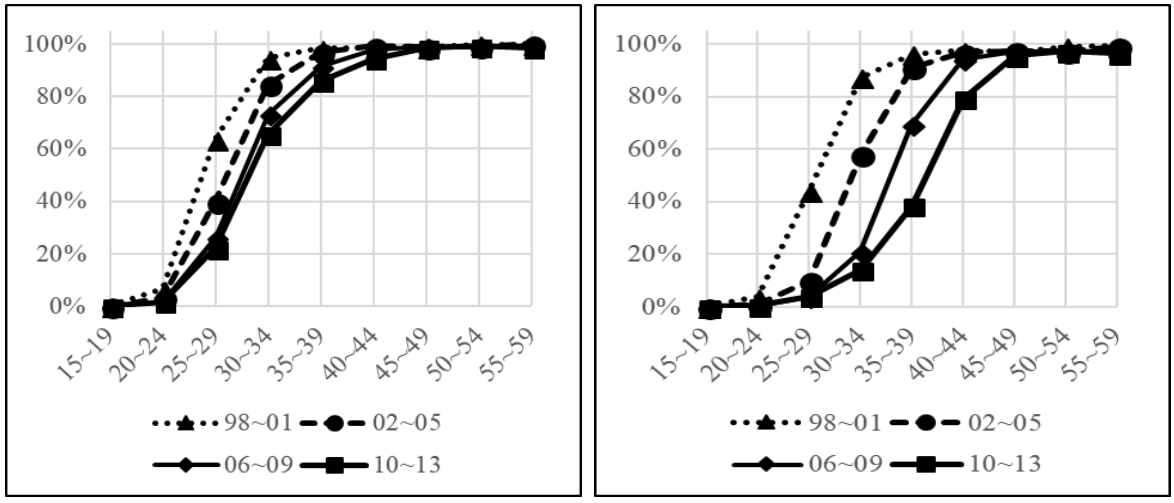
By age	2000	2006	2010	2013
15-19	2.6	2.2	1.8	1.7
20-24	39.2	17.8	16.5	14.0
25-29	150.3	89.9	79.7	65.9
30-34	84.1	90.0	112.4	111.4
35-39	17.6	21.5	32.6	39.5
40-44	2.7	2.7	4.1	4.8
45-49	0.2	0.2	0.2	0.1

Source: Statistics Korea, Vital Statistics

Table 4.2 Rate of new wives in each age bins (per 1,000 women)

By age	2000	2006	2010	2013
15 - 19	4.4	5.1	3.5	2.7
20 - 24	44.8	28.1	21.5	17.6
25 - 29	74.9	81.8	79.1	79.9
30 - 34	17.4	29.7	42.0	51.7
35 - 39	7.8	10.3	12.2	14.0
40 - 44	5.0	6.6	6.4	6.2
45 - 49	3.4	4.6	5.0	4.6

Source: Statistics Korea, Vital Statistics



(a) Rate of Ever-Married Female. **(b)** Rate of Birth Experience.

Figure 4.1 Life time rate of marriage and birth experience.

reject employees' request to use it. Pregnant workers are eligible to request the leave. The amount of payment is up to KRW 1,350,000 (USD 1,350) and above the minimum wage. First of several notable regulations is that the applicants must allocate more than 45 days of maternity leave after birth. The second is that the leave is only available for workers who have worked more than 6 months prior to taking end of leave. Even though the consistent public efforts, the rate of maternity leave vacation is still lower in Korea than other OECD countries (Ko, 2014). Table 4.13 compares the weeks of maternity leave across countries, and which shows that Korea has the shortest duration except the United States and below the OECD average.

Table 4.3 Major changes in Korean maternity protection.

1953-08-09	Introduction of Paid Maternity leave for 60 days
2001-11-01	Extension of Maternity leave up to 90 days EIP is provided for leave after first 60 days (Paid leave) ⇒ After employer pays first 60 days, EIP pays for the 30days (Normal wage; Min: wage 1350,000 KRW)
2006-01-01	EIP (Normal wage 90 days) is provided for workers at business under 300 workers
2008-03-28	Workers must be assigned to same jobs or jobs with equivalent wage after leave

4.3.2 Childcare Leave

Childcare leave is entitlement of female workers with children younger than one year old to return to their previous employers after their leave. Childcare leave is used after maternity leave. This was introduced in Korea in 1988 as a part of a gender equality act of employment. With introduction, it offered leave up to one year including the maternity leave. In 1995, it extended the subjects to fathers and the policy requires only one of the parents to use the leave at the same time. It was not paid leave in the early stage, but in November 2001, the government amended the Act of employment insurance so that the employment insurance can provide monthly compensation as much as KRW

200,000 (USD 200)[6]. Further, the amount of compensation kept increasing to KRW 300,000 (USD 300) in December 2002 and KRW 400,000 (USD 400) in February 2004. Then in April 2007, it reached to KRW 500,000 (USD 500). Finally, the compensation calculation was changed to vary with the regular wage of the worker so that the compensation is 40% of regular wage up to KRW 1,000,000 (USD 1,000) and the minimum is KRW 500,000 (USD 500).

4.3.3 In-home Childcare Subsidy

In June 2011, the Korean congress passed the amendment of Childcare Act to include the beneficiaries of the service parents who do not use external childcare services. According to the amendment, from March 2013, subsidy for in-home childcare is introduced for parents who have children from newborn to five years old. Before the amendment, in-home child care subsidy was provided by the government only for parents whose child is below two years old and whose income is below 120% of minimum cost of living.

4.3.4 Research Question & Background

This research seeks to estimate the difference in the effects between the 2001 policy package and the 2006 policy, where former policy focused on extension of maternity leave and the later increased significant the amount of the subsidy. Mandated maternity leave in 2001 could increase employers' cost such as health insurance coverage during leave, replacement, cost and coworkers' workload. As a result, the labor demand curve shifts leftwards, while female labor supply grows due to the increase in benefits. There are two different channels that can affect the equilibrium wage in opposite way. First, female workers who put high weight on maternity leave benefits will trade off lower wages for benefits and the average wage will decrease. On the other hand, the maternity leave expansion will also facilitate the return to work. If the return to work effect is large enough, workers who return after birth of their children can command higher wage because of accumulated skill at the same job, compared to (switching to) a new job. Meanwhile, the significant subsidy increase in 2006 reduces

[6] The exchange rate is roughly assumed to be 1,000 KRW/USD, it is 1136.55KRW/USD as of October 23rd, 2015

the employers' cost of maternity leave for eligible firms while the benefits are not changing for female workers.

Thus, considering the differences between two policy changes, we can set the research questions as follows. First, does the introduction of paid leave decrease the equilibrium wage for potential mothers? Perhaps, we can expect a more significant effect compared to the FMLA in the United States, which is unpaid leave. Since the employment insurance subsidy expansion reduces the employer's expected cost for employing young female, it should buffer the wage decrease that we would expect from the benefit introduction earlier.

4.4 Empirical Strategy

4.4.1 Regression Model

We investigate the effect of the two maternity leave expansions in a difference-in-differences framework using three age groups of young female workers as treated groups and older women from 36 to 59 as a control group. We separated treated groups of young female workers into three age bins because each age bin likely has a different sensitivity to the maternity policy. Considering the age of first marriage and birth event, female workers in their late 20's and early 30's would be more sensitive to the maternity benefits since their probability of marriage and birth is higher.

$$
\begin{aligned}
Y_{it} = {} & \beta_0 + \beta_1 * TR1_{it} + \beta_2 * TR2_{it} + \beta_3 * TR3_{it} \\
& + \beta_4 * TR1_{it} * policy1_t + \beta_5 * TR2_{it} * policy1_t + \beta_6 * TR3_{it} * policy1_t \\
& + \beta_7 * TR1_{it} * policy2_t + \beta_8 * TR2_{it} * policy2_t + \beta_9 * TR3_{it} * policy2_t \\
& + \beta_{10} * policy1_t + \beta_{11} * policy2_t + X_{it} * \gamma + \delta * \big(year_t * industry_{it} \text{ or } year_t\big) + \epsilon_{it}
\end{aligned}
\tag{4.1}
$$

Y_{it} indicates whether the female worker is employed or not, $(Y_{it} = 1 | Employed = 1)$ in the employment specifications and Y_{it} is the log(real wage) or log(hourly real wage) in the wage equations. I deflate those monetary variables with the consumer price index. Each treated group falls into

age bins as follows: TR1 is age 21-25, TR2 is age 26-30, and TR3 is age 31-35. Naturally, the remaining group whose age is from 36 to 59 became the control group. PolicyK_{it} is the indicator for the policy windows (2002-2005 | K=1) and (2006-2008 | K=2). It is noteworthy that the effect of each policy window $policy1_t$, $policy2_t$ will be perfectly absorbed by the year fixed effect in employment specifications. However, exclusion of policy window dummies in wage equations cause sensitive change in coefficients of interests, because wage equations include year and industry fixed effect instead of year fixed effects (nationwide annual economic effects). On the other hand, inclusion of policy window dummies does not change any of other parameters of interests or others, which indicate that year fixed effect perfectly absorbed the policy window dummies' effects.

The vector X_{it} includes individual characteristics such as years of education, age, age squared, years of experience, years of experience squared and, marital status. Job experiences should be included because it reflects whether a working mother has invested in her human capital through her career. If it is not considered it can cause bias that working mothers are systematically different from non-mothers, which Waldfogel (1998) explained. Wage specifications include the interaction between industrial dummy and year dummies to control industry year specific economic performances, union, and tenure. Year fixed effects, information on children and HH income of other members are included in the employment probability equations. Inclusion of actual job experience reduced child penalties effect.

4.4.2 Separate Regressions

When we employ regression (4.1) above using the long period that include before and after the first treatment and the second treatment, we could face the problem that the second treatment effect is over-identified since the base is the period before both of treatment. To solely identify the second treatment effect comparing policy windows of 2002∼ 2005 and 2006∼ 2009, this section performs the separate regressions as shown in equation (4.2). K is 1 if the specification estimates the treatment effect of the first policy change with the sample period from 1999 to 2005 and K is 2 if it estimates the second treatment with the period of from 2002 to 2009.

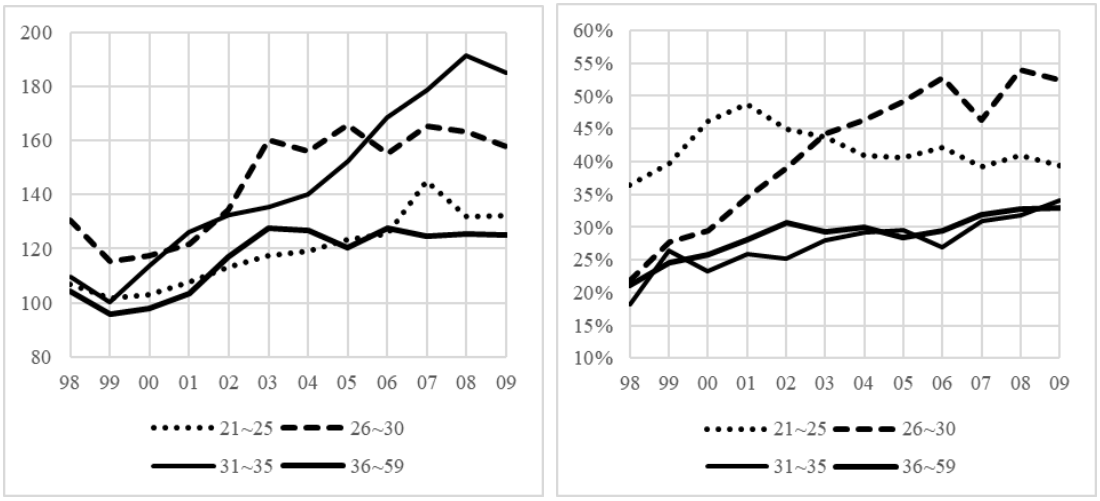
$$
\begin{aligned}
Y_{it} = {} & \beta_0 + \beta_1 * TR1_{it} + \beta_2 * TR2_{it} + \beta_3 * TR3_{it} \\
& + \beta_4 * TR1_{it} * policyK_t + \beta_5 * TR2_{it} * policyK_t + \beta_6 * TR3_{it} * policyK_t \\
& + \beta_{10} * policyK_t + X_{it} * \gamma + \delta\left(year_{it} * industry_{it} \text{ or } year_{it}\right) + \epsilon_{it}
\end{aligned}
\tag{4.2}
$$

4.5 Data: Korean Labor and Income Panel Survey

There are two candidates for datasets for research on working mothers in Korea. One is the Korean Labor Income Panel Survey (KLIPS) and the other is the Korean Longitudinal Survey of Women and Family (KLoWF). Even though KLoWF is more specialized in female worker behavior, KLIPS has several advantages compared to KLoWF. First, KLIPS is annual data whereas KLoWF is biannual and KLIPS covers from 1998 to 2014, that encompasses policies of interest such as the 2001 maternity leave expansion and the compensation increase in 2006. Therefore, we utilize KLIPS for studying the leave expansion impact on the labor market outcomes for female workers. It would be ideal if we can use the information on how many workers applied for maternity leave and the duration surrounding the policy changes, but it is not viable since compensations during the maternity leave and childcare leave are recorded only since 2007. Days of leave take-ups are available after 2009, while information if a worker is insured by employment insurance is recorded since 1999.

At the individual level, characteristics associated with work status are provided in detail such as education, income, family status and maternal history so that we could use them as individual control variables. One group of important variables that we can use to proxy for the impact of Korean labor market regulations is the number of employees in the workplace where an individual is hired. This can be meaningful in the country where many labor market regulations are applied asymmetrically to small companies with less than 300 workers. We also utilize the household level data such as family assets, income, and family structure. Since young working mothers in Korea suffers from shortage of affordable outside childcare services and many working mothers receive

help from other family members such as grandmothers[7].



(a) Real wage(10,000 KRW). **(b)** Employment rate.

Figure 4.2 Trends of labor market outcomes over time.

The trends of wages and employment rate in the periods of interest are presented in Figure 4.2. While other age groups show similar trends of wage growth over time, the group of early 30's show distinct increase in the late 2000's. In terms of the employment rate the group of late 20's shows the notable increase in early of 2000's. We can infer that the age of entering the labor market increased during the 2000's and that the workers in early 30's during the late 2000's are paid higher because they have been at the job for longer period of time. We should note that the Asian currency crisis hit the country in 1997 and the nationwide public employment insurance program was enacted in October 1998 due to the need to take care of unprecedented unemployment in the economy. Thus, we drop the data in 1998 to get rid of confounding effect of employment insurance.

[7] There are also subsidies for grandmothers who help to take care of their grandchildren

4.5.1 Sample

Individual's age in the sample varies from 21 to 59 because the earliest age that is eligible for the national pension payments is 60. We excluded industries where employment insurance policy is not applied. Those industries include Agriculture, fishery, forestry, private household services public administration, and public education.

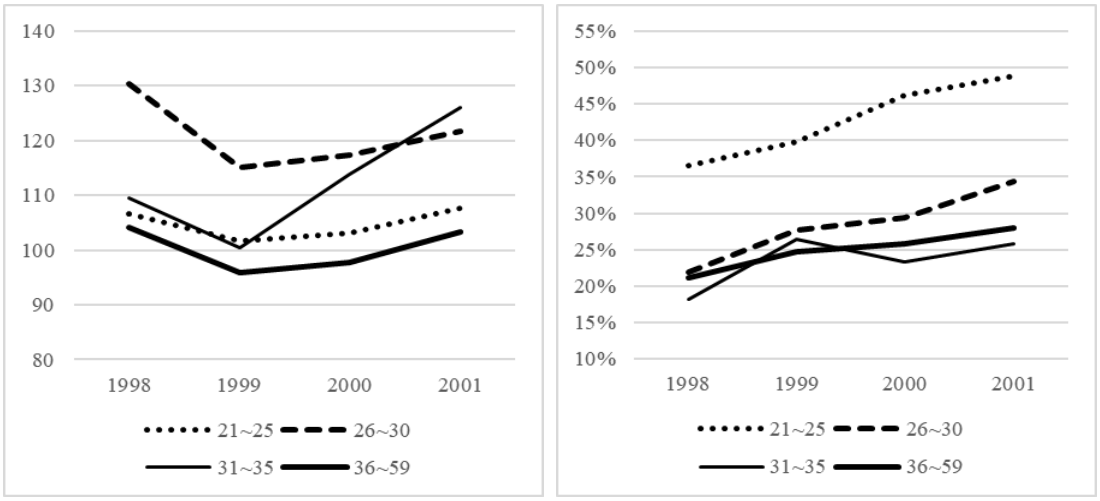
Table 4.4 Descriptive data.

Periods	1999-2001			2002-2005			2006-2009		
Variables	Mean	N	S.D	Mean	N	S.D	Mean	N	S.D
Age	38.02	11,209	10.01	38.78	15,176	10.11	40.09	15,863	10.55
Year of educ.	11.46	11,209	3.46	11.97	15,176	3.3	12.49	15,863	3.09
Real monthly wage(10,000KRW)	104.96	3,449	57.48	129.17	5,069	80.22	137.54	5,421	81.76
Employed	29.09%	11,209	0.45	32.68%	15,176	0.47	34.90%	15,863	0.48
Economically Active	45.71%	11,209	0.5	49.95%	15,176	0.5	52.38%	15,863	0.5
Employment Insurance	36.68%	3,489	0.48	44.01%	5,099	0.5	57.83%	5,443	0.49
Years of Tenure	3.73	5,179	4.91	4.02	7,354	4.97	4.52	7,770	5.2
Years of work experience	1.78	11,209	4.07	2.37	15,176	4.63	2.93	15,863	5.3
Other annual HH income(10,000KRW)	3,367	11,209	3435.06	4,355	15,176	4155.17	5,008	15,863	4951.1
Married	23.7%	8,607	3.06	23.97%	11,150	3.04	24.25%	11,410	3.2
Age of giving birth	25.15	8,234	3.27	25.23	9,905	3.16	25.33	9,436	3.22
HH head	7%	11,209	0.25	8%	15,176	0.27	10%	15,863	0.3
Weekly working hours	51.91	5,187	20.49	49.87	7,357	18.39	47.39	7,800	16.57
Unionization rate	3.47%	11,209	0.18	4.20%	15,176	0.2	4.11%	15,863	0.2
Real hourly wage(10,000KRW)	0.63	4,225	0.79	0.84	6,232	1.89	0.85	6,870	0.73
Seoul	30.47%	11,209	0.46	28.36%	15,176	0.45	27.91%	15,863	0.45

As of 2018, KRW/USD is around 1,140

4.6 Identifying Assumption

Key identifying assumptions for the difference-in-differences setting includes three criteria. First, similar pre-treatment pattern: Angrist & Krueger (1999) stated that the pre-treatment pattern should be verified to be similar between treated and control group. Second, Parallel Path Assumption: The pre- and post-treatment difference of outcomes should have been the same for both treated and control groups in the absence of treatment. Finally, no concurrent policy change: There is not secular alteration that affects the difference of outcomes between groups.



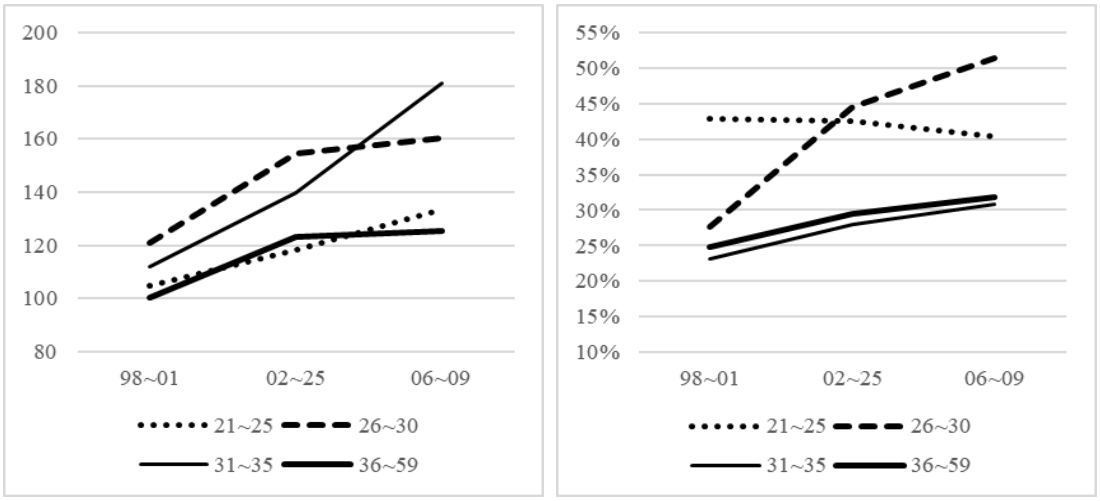
(a) Pre-treatment trend of real wage. **(b)** Pre-treatment trend of employment rate.

Figure 4.3 Pre-treatment trends of wage and employment.

The first is pre-treatment trends, which should be similar between treated and control groups. Figure 4.3 compares the labor market outcomes' trends across age groups. While other groups exhibit similar trends, the age group from 31 to 35 appears to show distinguishable increase in wage growth. And the early 30's group shows a peak of employment rate in 1999 temporarily. But the overall increasing trend is common in all groups.

The second identifying assumption that needs parallel path in the absence of treatment is not easily verifiable with simple 2-dimensional graphs. By comparing the trends, however, we can procure some hint for what confounding factors to control. Figure 4.4 shows that real wages of female workers in their early 30's have increased more than other groups. It implies that the quality of jobs for them is better than before. Furthermore, the employment rate of the late 20's crossed that of the early 20's, which indicates that in early 20's female workers delay the entrance to the labor market.

Figure 4.5 shows the female workers' cohorts in each time frame. While the real wage improved similarly over time between the period from 1998 to 2001 and from 2002 to 2005, after 2005, the real wage in the age group of the early 30's increased distinctively. The employment rate of age groups



(a) Path of real wage.

(b) Path of employment rate.

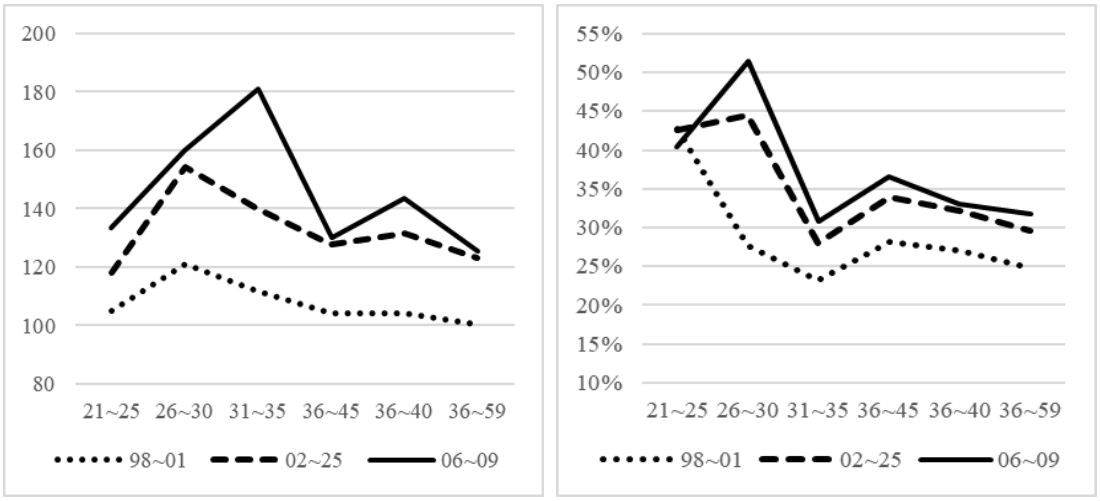
Figure 4.4 Paths over time (wage, employment rate).

over 30's show similar pattern of upward shifts, but the increase in the late 20's through the early 2000's is notable.

4.7 Results for Wages

4.7.1 Baseline Regression for Wages (A Long Period)

Table 4.5 present the basic regression results. Columns (1) and (2) employ the log(wage) as the dependent variable while columns (3) and (4) used log(hourly wage). I also included individual fixed effects in columns (2) and (4). Across all treatment groups, it is shown that the second policy change has increased the equilibrium wage more than the first maternity protection enhancement(the coefficients on the interaction terms between each age-bin and year-bin dummy). Dummies for policy windows alone are shown insignificant because its effect is absorbed by the year-industry fixed effects. Inclusion of individual fixed effects magnified the effects for younger females more. But whether we used the log of the real wage or the real hourly wage did not affect the result significantly. One concern about this result is that the age variable is not significant. If the linearity is absorbed by



(a) Real wage. **(b)** Employment rate.

Figure 4.5 Vintage over time.

the age-bin treatment variables, then we could consider other means to control for the age effect such as including non-linear terms. To check the robustness across the age spectrum of control groups, I included another version of this results in the appendix, which shows fundamentally the same implications.

Inclusion of non-linear explanatory variables such as age squared and the square of the years of job experience attenuated the coefficients of interest. Table 4.6 exhibits the results where columns (2) and (4) with individual fixed effects do not show any statistical significance for the DD estimator. This might be due to the fact that age and age squared absorb the age-bin effect (the treatment group effect). However, columns (1) and (3) tells us that the results are consistent in that the second policy change had larger positive effect on wages.

4.7.2 Separated Regression for Wages

As mentioned in the section 4.4.2, one concern arising from the baseline regression with long period encompassing both policy changes is that it might overestimate the effect of the second policy change. Thus, this section presents the results using the periods surrounding each policy enactment

Table 4.5 Wage estimation basic sample (age 21-59).

VARIABLES	$log(wage)$		$log(hourlywage)$	
age 21-59	(1)	(2)	(3)	(4)
D(age 21-25)	-0.105***	-0.288***	-0.174***	-0.291***
	(0.0339)	(0.0493)	(0.0350)	(0.0540)
D(age 26-30)	-0.0880**	-0.258***	-0.128***	-0.235***
	(0.0381)	(0.0517)	(0.0404)	(0.0546)
D(age 31-35)	-0.0717*	-0.0801***	-0.0437	-0.0421
	(0.0391)	(0.0296)	(0.0421)	(0.0346)
D(year 02-05)	-0.0688	0.478	-0.0198	0.492
	(0.135)	(0.600)	(0.141)	(0.590)
D(year 06-09)	-0.0208	0.787	-0.0260	0.876
	(0.133)	(0.921)	(0.140)	(0.902)
D(age 21-25)*D(year 02-05)	0.0171	0.107***	0.0545	0.124***
	(0.0316)	(0.0333)	(0.0337)	(0.0375)
D(age 21-25)*D(year 06-09)	0.132***	0.276***	0.184***	0.267***
	(0.0327)	(0.0423)	(0.0338)	(0.0465)
D(age 26-30)*D(year 02-05)	0.177***	0.135***	0.168***	0.136***
	(0.0382)	(0.0379)	(0.0419)	(0.0467)
D(age 26-30)*D(year 06-09)	0.214***	0.243***	0.196***	0.196***
	(0.0375)	(0.0447)	(0.0400)	(0.0527)
D(age 31-35)*D(year 02-05)	0.0445	0.00624	0.0171	-0.00842
	(0.0441)	(0.0360)	(0.0476)	(0.0448)
D(age 31-35)*D(year 06-09)	0.263***	0.0517	0.195***	0.0392
	(0.0445)	(0.0427)	(0.0474)	(0.0484)
Observations	13,880	13,880	13,880	13,880
Number of pid	3,622	3,622	3,622	3,622
R^2	0.461	0.823	0.435	0.763
Individual FE	no	yes	no	yes
Year X Industry FE	yes	yes	yes	yes

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Note: Age, Years of tenure, Years of experience, Weekly working hours,Year of education, Married, and Union are included as control variables

Table 4.6 Wage estimation with non-linear variables.

	One big regression with nonlinear vars.			
VARIABLES	$log(wage)$		$log(hourlywage)$	
age 21-59	(1)	(2)	(3)	(4)
D(age 21-25)	0.0950*	0.0173	0.0173	-0.0700
	(0.0555)	(0.0570)	(0.0584)	(0.0673)
D(age 26-30)	0.0585	-0.0136	-0.0136	-0.0571
	(0.0465)	(0.0514)	(0.0542)	(0.0585)
D(age 31-35)	-0.0121	0.0190	0.0190	0.0130
	(0.0450)	(0.0345)	(0.0379)	(0.0398)
D(year 02-05)	-0.0621	0.653	0.653	0.689
	(0.150)	(0.574)	(0.494)	(0.592)
D(year 06-09)	-0.0138	1.050	1.050	1.102
	(0.146)	(0.883)	(0.741)	(0.909)
D(age 21-25)*D(year 02-05)	-0.00460	-0.0237	-0.0237	0.0148
	(0.0314)	(0.0359)	(0.0364)	(0.0400)
D(age 21-25)*D(year 06-09)	0.104***	-0.00297	-0.00297	0.0655
	(0.0326)	(0.0508)	(0.0498)	(0.0579)
D(age 26-30)*D(year 02-05)	0.139***	0.0299	0.0299	0.0599
	(0.0372)	(0.0392)	(0.0380)	(0.0499)
D(age 26-30)*D(year 06-09)	0.163***	0.00495	0.00495	0.0226
	(0.0363)	(0.0508)	(0.0495)	(0.0610)
D(age 31-35)*D(year 02-05)	0.0272	-0.0218	-0.0218	-0.0251
	(0.0465)	(0.0381)	(0.0424)	(0.0471)
D(age 31-35)*D(year 06-09)	0.247***	-0.0351	-0.0351	-0.000521
	(0.0466)	(0.0459)	(0.0464)	(0.0525)
Observations	12,536	12,536	12,536	12,536
Number of pid	3,274	3,274	3,274	3,274
R^2	0.466	0.834	0.447	0.778
Individual FE	no	yes	no	yes
Year X Industry FE	yes	yes	yes	yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Age, Age^2, Years of tenure, Years of experience, Experience^2, Weekly working hours,Year of education, Married, and Union are included as control variables

separately. The results that are presented in Table 4.7 are mixed. The female workers from age 26 to 30 show relatively weak evidence on wage increase for the second maternity policy amendment and the other two age groups show the more evident increase for the second reform.

Overall, as maternity protection is enhanced through the first and the later legislation, it is more evident that the second maternity protection expansion increased the equilibrium wage. The result is consistent with the ex-ante expectation that the subsidization buffers the labor demand contractions because the cost is transferred to the employment insurance, which is a public institution, from private employers.

Column (1) in Table 4.7 is most similar to Kim (2011) in that it deals with only the first amendment(first period). If we consider the fact that we divided the treatment group of young women defined as the age group of 21-35 in Kim (2011), results are similar in that the wage effect is not that evident for the first reform. However, with dismantling the treatment group, we can now notice that a certain age-group, 26-30 in Table 4.5, is sensitive to the policy change in 2001 as we expected.

4.8 Results For Hours, Employment and Labor Force Participation

4.8.1 Regression with Long Period (Labor inputs)

This section describes the results from the regression of labor quantity using various measures such as hours of work, employment, and labor force participation(LFP). Weekly working hours are estimated in pooled cross section and panel fixed effect settings. Column (1) in Table 4.8 shows that after the first maternity protection expansion, working hours of female workers decreased for the treatment group whose age is from 21 to 25. It was higher than the control group before the first treatment. i.e., 7.16 hours higher than the control group before any treatment. Women in their early 20's reduced their hours less than the control group after 2005 ($-6.61 \leq (7.16-6.61-3.31)$) so that the difference in the working hours between the treatment group of age 21-25 and the control group of age 36-59 grew. We should also note that overall working hours are in a diminishing phase

Table 4.7 Wage estimation in separated policy windows.

VARIABLES	log(hourly wage)			
age 21-59	(1)	(2)	(3)	(4)
D(age 21-25)	-0.0610	-0.0188	-0.0715	-0.0708
	(0.0778)	(0.0872)	(0.0627)	(0.0654)
D(age 26-30)	-0.0349	-0.0388	0.0689	-0.00449
	(0.0599)	(0.0711)	(0.0463)	(0.0507)
D(age 31-35)	0.00396	0.00717	-0.0221	0.00619
	(0.0511)	(0.0425)	(0.0337)	(0.0398)
D(year 02-05)	0.0368	-0.104		
	(0.155)	(0.722)		
D(year 06-09)			-0.469**	0.634
			(0.189)	(0.593)
D(age 21-25)*D(year 02-05)	0.0177	-0.0303		
	(0.0338)	(0.0473)		
D(age 26-30)*D(year 02-05)	0.126***	0.0381		
	(0.0423)	(0.0596)		
D(age 31-35)*D(year 02-05)	-0.00897	-0.0482		
	(0.0495)	(0.0591)		
D(age 21-25)*D(year 06-09)			0.143***	0.0377
			(0.0311)	(0.0421)
D(age 26-30)*D(year 06-09)			0.0303	-0.0652*
			(0.0307)	(0.0372)
D(age 31-35)*D(year 06-09)			0.190***	0.00107
			(0.0370)	(0.0360)
Observations	7,572	7,572	9,510	9,510
Number of pid	2,437	2,437	2,843	2,843
R^2	0.424	0.789	0.456	0.811
Individual FE	no	yes	no	yes
Year X Industry FE	yes	yes	yes	yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Age, Age^2, Years of tenure, Years of experience, Experience^2, Year of education, Married, and Union are included as control variables

since the working hours by law[8] are decreasing sequentially. Table 4.9 shows the time line of how the working hours are reduced.

In column (2) of Table 4.8 where the estimation includes the individual fixed effects, the results show that the difference between the treatment group in their early 20's and the control group has narrowed after each treatment since the group of older women did not show significant decrease in working hours after each treatment. Female workers in their late 20's exhibit similar tendency in that the difference from that of control group (older women) narrowed. However, younger 20's female workers had the more sensitive response after the second treatment.

Column (3) is the employment probability estimation using a logit model. The equilibrium employment after the second treatment is higher than its response to the first treatment among the late 20's and the early 30's treated workers. It is noticeable that the control group's employment probability decreased after each treatment. Column (4) that estimates the probability of labor force participation supports the conclusion that labor supply increased among early 20's female workers after each treatment whereas the control groups' labor market participation decreased for each policy revision.

In summary, this section's analysis presents evidence on that the second labor reform generally affects young women more than the first one. The second reform reduced working hours for women aged 21 to 25. The employment probability increased more after the second policy change, especially among women in their late 20's. The regression equation using labor force participation as the dependent variable yields similar results as the one using the employment probability, which suggests employment increase may have been driven by labor supply.

4.8.2 Separated Regressions (Labor inputs)

Working hours estimations surrounding each policy revision in Table 4.10 shows that the first maternity protection expansion did not yield statistical significance of any difference-in-differences estimators. The result is similar to that in Kim (2011) in that the analysis of the 2001 legislation

[8] Hours that exceeds the standard working hours must be compensated by replacement vacation or payments

Table 4.8 Working hours, employment, and LFP in one regression.

			1999-2009	
	Working hours		Pr($employed=1$)	Pr($LFP=1$)
VARIABLES	(1)	(2)	(3)	(4)
D(age 21-25)	7.159***	5.768***	1.450***	1.482***
	(1.724)	(1.991)	(0.189)	(0.180)
D(age 26-30)	4.778***	4.130***	0.728***	0.665***
	(1.383)	(1.583)	(0.134)	(0.129)
D(age 31-35)	0.0781	0.878	-0.0713	0.0587
	(1.211)	(1.213)	(0.125)	(0.113)
D(year 02-05)	-1.725	5.863		
	(5.205)	(21.75)		
D(year 06-09)	-6.068*	0.637		
	(3.224)	(33.96)		
D(age 21-25)*D(year 02-05)	-0.961	-2.658**	-0.0380	-0.0152
	(1.029)	(1.236)	(0.0995)	(0.0947)
D(age 21-25)*D(year 06-09)	-3.308***	-5.583***	0.112	0.0619
	(1.069)	(1.776)	(0.103)	(0.0985)
D(age 26-30)*D(year 02-05)	-0.529	-2.894**	0.260**	0.299***
	(1.141)	(1.391)	(0.110)	(0.105)
D(age 26-30)*D(year 06-09)	-0.832	-3.583**	0.353***	0.360***
	(1.077)	(1.766)	(0.112)	(0.107)
D(age 31-35)*D(year 02-05)	0.820	0.128	0.177	0.0628
	(1.306)	(1.386)	(0.141)	(0.128)
D(age 31-35)*D(year 06-09)	1.745	-2.361	0.278**	0.0907
	(1.250)	(1.634)	(0.139)	(0.126)
Observations	12,622	12,622	36,139	36,139
Number of pid	3,290	3,290	6,690	6,690
R^2	0.144	0.628		
Individual FE		yes		
Year X Industry FE	yes	yes		
Year FE			yes	yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: In column (1) and (2), Age, Age^2, Years of tenure, Years of experience, Experience^2, Year of education, Married, dummies for young children, Household head dummy and Other household income are included as control variables. Column(3) and (4) did not include experiences and its square. Instead, a dummy for job experience is included.

Table 4.9 Time table of reduced hours of work.

Working hours reduced from 44 hrs. to 40hrs		
Public sector	All	July 1st 2004
Private institutions	$N \geq 1000$	July 1st 2004
	$N \geq 300$	July 1st 2005
	$N \geq 100$	July 1st 2006
	$N \geq 50$	July 1st 2007
	$N \geq 20$	July 1st 2008
	$N \geq 5$	July 1st 2011
	$N < 5$	N/A

did not yield sufficient evidence for effects on labor market outcomes. But when we estimate the treatment effect from the second maternity protection enhancement, female workers whose ages are 21-25 experienced a decreased in their hours. As a result, the difference between the group of early 20's and the control group declined. However, we should still doubt that this result is solely from the treatment effect because the reduction of working hours by law started in July 2004 as noted in Table 4.9. Nevertheless, it is noteworthy that the early 20's female workers are shown to reduce their working hours consistently across specifications compared to the other groups. Not only female workers are delaying their entrance into the labor market, but they also start working part-time. Data from Statistics Korea indicates that female advance rate to tertiary education increased fast so that it outgrew male. The rate was 67.6% in 2001 and 74.5% in 2013. Meanwhile, male students' college enrollment rate was 73.1% in 2001 and 67.4% in 2013.

Columns (1) and (2) in the Table 4.11 present estimation results using the probability of being employed and being economically active before and after the 2001 legislation as dependent variables. Female workers in their late 20's show increased employment rate and labor force participation after the first treatment. And the second legislation (columns (3) and (4)) do not appear to lead to any effects on the economically active population. This is in line with expectations based on the nature of the policy treatments because the first and the second maternity protection expansions are basically the same for the individual labor force suppliers so that labor supply itself is not likely

Table 4.10 Regression on working hours surrounding each policy revision.

	Working hours			
	1999-2005		2002-2009	
VARIABLES	(1)	(2)	(3)	(4)
D(age 21-25)	9.868***	4.038	3.859**	2.237
	(2.192)	(2.672)	(1.798)	(2.048)
D(age 26-30)	6.582***	3.070	2.668**	0.594
	(1.658)	(2.015)	(1.345)	(1.818)
D(age 31-35)	1.245	1.097	-0.140	-0.00755
	(1.315)	(1.327)	(1.018)	(1.125)
D(year 02-05)	-1.591	0.0191		
	(5.205)	(31.15)		
D(year 06-09)			4.059	5.841
			(5.546)	(15.45)
D(age 21-25)*D(year 02-05)	-1.023	-0.961		
	(1.031)	(1.575)		
D(age 26-30)*D(year 02-05)	-0.603	-2.661		
	(1.147)	(1.837)		
D(age 31-35)*D(year 02-05)	0.761	0.582		
	(1.308)	(1.865)		
D(age 21-25)*D(year 06-09)			-2.248***	-2.897**
			(0.853)	(1.160)
D(age 26-30)*D(year 06-09)			-0.224	-0.763
			(0.815)	(1.071)
D(age 31-35)*D(year 06-09)			1.064	-2.255*
			(0.962)	(1.252)
Observations	7,630	7,630	9,561	9,561
Number of pid	2,445	2,445	2,858	2,858
R^2	0.149	0.680	0.144	0.662
Individual FE	no	yes	no	yes
Year X Industry FE	yes	yes	yes	yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Age, Age^2, Years of experience, Experience^2, Year of education, Married, dummies for young children, Household head dummy and Other household income are included as control variables.

to change.

Table 4.11 Regression on probability of being employed and being economically active.

	1999-2005		2002-2009	
	employed	EAP	employed	EAP
VARIABLES	(1)	(2)	(3)	(4)
D(age 21-25)	1.238***	1.354***	1.635***	1.733***
	(0.224)	(0.214)	(0.218)	(0.207)
D(age 26-30)	0.594***	0.577***	1.139***	1.138***
	(0.154)	(0.147)	(0.146)	(0.138)
D(age 31-35)	-0.141	0.00682	0.205*	0.230**
	(0.131)	(0.120)	(0.112)	(0.105)
D(age 21-25)*D(year 02-05)	-0.0435	-0.0218		
	(0.0993)	(0.0945)		
D(age 21-25)*D(year 06-09)			0.153	0.0803
			(0.100)	(0.0949)
D(age 26-30)*D(year 02-05)	0.258**	0.298***		
	(0.110)	(0.105)		
D(age 26-30)*D(year 06-09)			0.0976	0.0644
			(0.105)	(0.0992)
D(age 31-35)*D(year 02-05)	0.170	0.0576		
	(0.140)	(0.127)		
D(age 31-35)*D(year 06-09)			0.102	0.0280
			(0.123)	(0.114)
Observations	22,539	22,539	19,491	19,491
Number of pid	5,384	5,384	5,304	5,304
Year FE	yes	yes	yes	yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: Age, Age^2, Dummy for job experience, Year of education, Married, Dummies for mother of young children, Household head dummy and Other household income are included as control variables.

Comparing the results with those from the model with the whole period, the impact of the maternity policy revision in 2006 is exaggerated in the regression with the longer period. Furthermore, even though overall working hours are decreasing across groups due to the working hours regulation, the hours for those in their early 20's decreased more compared to those for the other groups.

4.9 Conclusion

In this research, I use a difference-in-differences model to identify the distinct effects of the Korean maternity leave expansions in 2001 and 2006. I also identify the effects of these expansions separately on female workers in their early 20's, late 20's and early 30's. Furthermore, I compare the results from a single specification with a long time period to those of a set-up with two separate periods. This exercise indicated that the estimation with a single equation did not provide us with clear implications on how the second maternity protection affected labor market outcomes.

The most notable distinction between maternity benefits in 2001 and 2006 legislation is that the later transferred increased cost of benefits from private employers to the public sector. Hence, employers are expected to decrease their labor demand as a response to the first regulation and they are also expected to see a decline in the cost of hiring young women following the second regulation. Meanwhile, labor supply should not be affected by the second maternity policy revision as it was by the first.

Using the long time period specification, we find that the 2006 change appeared to increase wages across all age groups more than the 2001 regulation did. However, separate regressions for each reform window show a differential impact on each age group. While the first reform increased wages of female workers in their late 20's, the second in 2006 increased wages of those in their early 20's and the late 30's significantly. It is important to note that the initial maternity benefit expansion is not supposed to increase female wages since it expands labor supply and shrinks labor demand. The estimations with individual fixed effects across all versions of the econometric model suggest that the wage response might be exaggerated without incorporating unobservable individual characteristics using the fixed effects. Models with individual fixed effects showed that the increase in wages is similar. All in all, the first maternity policy revision did not change young women's wages, and the second policy change reduced wages of female workers in their late 20's.

The estimation results for employment and labor supply reveal that labor supply for women in late 20's increased as a result of the 2001 maternity benefit expansion; equilibrium employment also

increased. On the other hand, it is not evident that the employment and labor supply responded to the second policy change.

In summary, the 2001 revision did not increase wages or labor input measures significantly for any of the treated age groups. However, only the women in their late 20's experienced increase in labor supply and employment. While the results are similar to Kim (2011) among groups of early 20's and early 30's, women in their late 20's could be affected by the policy. This is possible if labor demand for the specific age group is highly elastic or labor demand for this group expanded, as well. Considering that Korean women have delayed their entry to jobs due to various social changes [9], the highlighted age groups of late 20's are more likely to search for entry jobs for their lifetime career.

The later revision in 2006 appears to negatively impact wages of women whose ages are between 21 and 25. Further, it did not induce significant employment response. Unlike the ex-ante prediction, the results suggest that labor demand shrank for this age group after the 2006 enactment. This result can happen when the increased cost of hiring women is perceived by employers only after 2006 even though large number of firms benefit from extended subsidy coverage. The rate of female workers' leave usage is also a main factor that decides the amount of potential costs. Korea has been a society where the maternity benefit usage was not frequent because of peer pressure. If initially, employers expected low tendency of maternity benefit use, but social consensus on leave usage changed over time, then the realization of potential costs is delayed. This is possible in any fast paced and dense-network society where peer pressure is strong.

[9] These include increased enrollment of women in tertiary education, lengthened average period of job searching and preparation, and larger number of women applying to the permanent public administration

4.10 Auxiliary Tables and Figures

Table 4.12 International comparison of total fertility rates

By Country	1995	2000	2005	2010	2015	2020*
ASIA						
Korea, Rep. of	1.68	1.50	1.21	1.17	1.23	1.32
Japan	1.48	1.37	1.30	1.34	1.41	1.48
NORTH & SOUTH AMERICA						
Canada	1.69	1.56	1.52	1.64	1.61	1.56
United States	2.03	2.00	2.04	2.05	1.88	1.89
Mexico	3.23	2.85	2.61	2.40	2.29	2.14
Chile	2.43	2.21	2.03	1.94	1.82	1.76
EUROPE						
Austria	1.48	1.39	1.38	1.40	1.45	1.51
Czech Rep.	1.65	1.17	1.19	1.43	1.48	1.57
Finland	1.82	1.74	1.75	1.84	1.77	1.78
France	1.71	1.76	1.88	1.98	1.98	1.97
Germany	1.30	1.35	1.35	1.36	1.43	1.47
Greece	1.42	1.35	1.33	1.46	1.34	1.30
Italy	1.27	1.22	1.30	1.42	1.43	1.49
Norway	1.89	1.86	1.81	1.92	1.82	1.83
Poland	1.95	1.51	1.26	1.37	1.33	1.29
Portugal	1.48	1.46	1.45	1.37	1.28	1.24
Spain	1.28	1.19	1.29	1.39	1.33	1.39
Sweden	2.01	1.56	1.67	1.89	1.90	1.91
Turkey	2.90	2.65	2.37	2.20	2.12	2.02
United Kingdom	1.78	1.74	1.66	1.87	1.88	1.87
OCEANIA						
Australia	1.86	1.79	1.77	1.95	1.89	1.83
New Zealand	2.07	1.95	1.95	2.14	2.04	1.97

Source: Annual International Statistics, Statistics Korea
* Estimates

Table 4.13 Length of maternity leave (weeks).

Country	AU	CA	DE	KO	SZ	UK	US	OECD
1993	0	17	14	8.5	8	40	0	15.1
1994	0	17	14	8.5	8	40	0	15.1
1995	0	17	14	8.5	8	40	0	15.5
1996	0	17	14	8.5	8	40	0	15.5
1997	0	17	14	8.5	8	40	0	15.5
1998	0	17	14	8.5	8	40	0	15.5
1999	0	17	14	8.5	8	40	0	15.5
2000	0	17	14	8.5	8	40	0	15.8
2001	0	17	14	8.5	8	40	0	16.4
2002	0	17	14	12.9	8	40	0	16.3
2003	0	17	14	12.9	8	52	0	16.8
2004	0	17	14	12.9	8	52	0	16.8
2005	0	17	14	12.9	8	52	0	16.8
2006	6	17	14	12.9	14	52	0	17.5
2007	6	17	14	12.9	14	52	0	17.9
2008	6	17	14	12.9	14	52	0	18.7
2009	6	17	14	12.9	14	52	0	18.4
2010	6	17	14	12.9	14	52	0	18.5
2011	6	17	14	12.9	14	52	0	18.7
2012	6	17	14	12.9	14	52	0	18.8
2013	6	17	14	12.9	16	52	0	18.9
2014	6	17	14	12.9	16	52	0	19.2
2015	6	17	14	12.9	16	52	0	19.1

Source: OECD

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