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International Trade and Wage Discrimination

Evidence from East Asia

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Abstract

This study explores the impact of competition from international trade on wage discrimination by sex in two highly open economies. If discrimination is costly, as posited in neoclassical theory based on Becker (1959), then increased industry competitiveness from international trade reduces the incentive for employers to discriminate against women. Alternatively, increased international trade may contribute to employment segregation and reduced bargaining power for women to achieve wage gains. The approach centers on comparing the impact of international trade on wage discrimination in concentrated and nonconcentrated sectors. The effect of international trade competition is expected to be more pronounced in concentrated sectors, where employers can use excess profits in the absence of trade to cover the costs of discrimination. Wage discrimination is proxied by the portion of the wage gap that cannot be explained by observable skill differences between men and women. The empirical model is estimated using a rich panel data set of residual wage gaps, trade ratios, and alternative measures of domestic concentration for Taiwan (China) and the Republic of Korea during the 1980s and 1990s. Results indicate that in contrast to the implications of neoclassical theory, competition from foreign trade in concentrated industries is positively associated with wage discrimination. These results imply that concerted efforts to enforce equal pay legislation and apply effective equal opportunity legislation are crucial for ensuring that women's pay gains will match those of men in a competitive environment.

This paper—a product of the Gender Division, Poverty Reduction and Economic Management Network—is part of a larger effort in the network to understand the impact of trade on labor markets. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Max Ponglumjeak, room MC4-426, telephone 202-473-1060, fax 202-522-3237, email address mponglumjeak@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. Yana Rodgers may be contacted at yvrodg@wm.edu. August 2003. (37 pages)

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International Trade and Wage Discrimination:

Evidence from East Asia

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I. Introduction

Growth in international trade can entail beneficial effects for workers in developing countries. Based on neoclassical trade theory, trade expansion is expected to increase the demand for relatively abundant, lower-skilled labor and reduce wage disparities among groups of workers. A growing number of empirical studies have used partial-equilibrium approaches to estimate the impact of international trade—as measured by import penetration, exchange rates, protection rates, trade reform, and export orientation—on wage dispersion in developing countries.[1] Changes in overall wage inequality vary across countries and regions, partly reflecting the complexity of changes in the overall macroeconomic environment and in the underlying labor market dynamics. Moreover, the use of firm-level or industry-level data in most of this research provides limited information on worker productivity characteristics, making it more difficult to disentangle reported trade impacts from other exogenous changes in worker characteristics and their associated market returns.[2]

Because women tend to cluster in lower-skill jobs and men cluster in higher-skill jobs, neoclassical theory similarly predicts trade-induced changes in skill demand to reduce pay differentials between men and women. Yet international trade can affect women's relative pay through another channel whereby trade acts as an instrument of industry competitiveness. In particular, rising competition associated with international trade can generate increased pressure on firms to engage in cost-cutting practices. Reinterpreting Becker's (1959) theory in an open economy context, one would expect that costly discrimination could not persist in the face of long-run competition. Hence rising competition from international trade is expected to eliminate any discriminatory pay differentials between men and women in the long run.

In contrast, according to the non-neoclassical approach, discrimination can actually be a tool of competition among firms and industries. Far from becoming an equalizing force, trade may well perpetuate or exacerbate wage disparities. In this approach, wages are determined by not only worker skills but also industry characteristics, which shape the respective bargaining power of groups of workers. In the context of a hierarchy of jobs and the specter of joblessness, both characteristics of a typical capitalist economy, certain groups of workers are better placed to bargain for and maintain favorable employment conditions. Firms may also find it advantageous to maintain a lower wage workforce with a weaker bargaining power while paying higher wages to groups of workers with better options. In such a context, trade competition may cause the decline of certain groups of industries and rise of others, leaving workers in declining industries at a disadvantage in bargaining for higher wages in new jobs. The dislocations caused by trade competition could well widen the wage disparities among groups of workers.

Adopting the neoclassical framework, a number of empirical studies have examined how discrimination changes in response to the competitive environment. Much of this work has focused on domestic industry structure using data for the United States. For example, Black and Strahan (2001) find that by reducing rents that previously accrued to men, banking-sector deregulation leads to improvements in women's relative wages beyond what can be explained by improvements in women's skill characteristics. In contrast, Hellerstein, Neumark and Troske (1997) argue that market forces over time have little impact on reducing discrimination. Although plants with higher levels of market power show evidence of wage discrimination by sex compared to plants with less market power, the plants with more market power experience no growth penalty over time. Racial discrimination has also been examined in the context of industries that have greater or lesser levels of concentration, with mixed results. For example, deregulation in the trucking industry has led to lower real wages for white workers, resulting in reduced wage disparities between whites and blacks (Peoples and Saunders 1993, Peoples and Talley 2001). However, findings in Agesa et. al (2001) actually contradict the idea that firms in concentrated industries can afford to engage in earnings discrimination against minority workers. On the employment side, Coleman (2002) also finds little evidence to support the neoclassical framework, as minority employment is positively related to market concentration in urban areas.

Most of this work conceptualizes competition on an industry-by-industry basis. An alternative set of studies has expressed competition as an economy-wide tendency for rates of profit to equalize across industries under conditions of capital mobility.[3] Because concentration may facilitate capital mobility and the tendency for uniform profits to emerge, this alternative approach allows for the idea that competition encompasses monopoly and industrial concentration. Rather than see competition necessarily driving out discrimination, discrimination can actually remain as a viable by-product of competition among firms and groups of workers, each behaving in economically rational ways. This alternative view of competition, although difficult to operationalize and use in empirical research, may help to reconcile the observance of persistent discrimination in the face of growing competition.

The present study contributes new evidence on the link between industry competitiveness and wage discrimination, with international trade acting as the agent for increased competitiveness. Just a small number of existing studies have explicitly tested the impact of international trade on wage discrimination. Black and Brainerd (2002) find that U.S. manufacturing industries that are relatively less competitive domestically but exposed to increasing competition from imported goods show evidence of reduced wage discrimination against women.[4] However, the application to data from a fairly closed economy weakens the generality of these results. Artecona and Cunningham (2001) find similar but statistically insignificant results for Mexico. Our study uses a similar approach in isolating the impact of international trade competition on discrimination by estimating the effect of international trade openness on the residual wage gap in concentrated industries. The residual wage gap—the portion of the wage gap that cannot be explained by observed skill differences between men and women—is commonly attributed to wage discrimination. Our use of a rich panel data set by industry and year for Taiwan (China) and South Korea, two highly open economies, improves the generality and potential robustness of the results in this line of research.

II. Stylized Facts for Taiwan (China) and Korea

With their status as major international trade partners and their notably high degree of outward orientation, Taiwan (China) and Korea are excellent candidates for contributing new evidence on how industrial competitiveness through international trade affects employers' pay practices. Taiwan (China)'s total manufactured trade to output ratio has risen continuously from a low of 48% in the early 1980s to a high of almost 90% by the late 1990s. Korea's international openness in manufactured goods, while high by most standards, has declined during much of this period, from a high of 56% in 1985 to a low of 45% in 1993. In both economies, these trends in international trade have been accompanied by structural changes in manufacturing. Industry and export mixes have shifted toward higher-skill products, while lower-skill industries have been moving abroad. Both economies are known for their governments' active roles in guiding development and the extensive use of subsidized credit, tax privileges, and protectionism, particularly for firms that produced export goods. Between the two, Taiwan (China) has experienced a more competitive industrial structure characterized by numerous small and medium-sized firms, while Korea's industrial structure has been dominated by the activities of very large firms.[5]

Figure 1 provides more information on movements in export and import ratios by industries according to a broad grouping by firm concentration within manufacturing sectors. For Taiwan (China), consistent with the aggregate trend in overall trade, import and export ratios rose over time for both concentrated and less concentrated industries. One factor that helps to explain the increases in import shares is Taiwan (China)'s foreign direct investment in East and Southeast Asia, particularly mainland China. As labor-intensive industries left Taiwan (China), these products then became imports into Taiwan (China), accounting for an increase in their import share. At the same time, the export-oriented industries switched toward higher-skill products that were not competing with the imports. Within the broad concentration groupings, the median manufacturing sector had import ratios that averaged 20% for the period and export ratios that averaged 40%. In contrast, Korea's export ratio in non-concentrated industries dropped considerably during the 1980s and much of the 1990s, while the export ratio in concentrated industries exhibited more fluctuation.[6] Korean import ratios across most manufacturing sectors stagnated. Overall, Korean trade ratios are lower than those of Taiwan (China).

Two decades of structural change in both economies also saw major changes in the labor market. In both economies, labor force participation rates for men have fallen and for women have risen. In Taiwan (China) between 1980 and 1999, the labor force participation rate for men dropped from 77% to 70%, while for women it rose from 39% to 46%. Changes for Korea during the 1980s and 1990s are similar albeit not quite as dramatic. At the same time, women's average skills and educational attainment relative to that of men have risen considerably. For example, in Korea, just 23% of women and 54% of men attained high school or above in 1980; these shares had risen to 77% for women and 87% for men by 1998.[7] Despite women's relative gains in labor-market qualifications, Taiwan (China)'s average female-male wage ratio in manufacturing dropped from 66% in 1981 to 60% in 1993, with a reversal to 67% by 1999. Recent figures for Taiwan (China) compare favorably with other East Asian economies but stand below those of most industrialized countries along the Pacific Rim, including Australia, New Zealand, and the United States. Unlike Taiwan (China), Korea's female to male wage ratio rose fairly steadily throughout the period, from 47% in 1980 to 58% by 1998. Despite this progress, Korea still shares with Japan the distinction of having one of the world's lowest female to male wage ratios.

Some of the observed wage differentials may be explained by wage discrimination against female workers. Because it is difficult to measure, wage discrimination by sex is commonly proxied by the residual wage gap—the portion of the wage gap which cannot be explained by observed productivity differences between men and women.[8] Figure 2 shows how the residual wage gap in manufacturing has changed over time in both economies. Trends in wage gaps are separated by concentrated and less concentrated industries. For Taiwan (China), the residual wage gap is lower in concentrated industries than in non-concentrated industries. This observation actually counters the static implications of Becker's theory. However, our primary interest is whether international trade generates pressures to reduce discriminatory pay differentials in concentrated industries. In both concentrated and less concentrated industries, the residual wage gap rises sharply until the mid-1990s and diminishes somewhat during the late 1990s. When superimposed on trends in the trade ratios, the period of rising residual wage gaps coincides with a fairly steady increase in both export and import ratios, while the narrowing in the residual wage gap toward the end of the period coincides with a flattening in trade ratios. These patterns suggest that greater openness to foreign trade is associated with a larger differential between male and female wages, even after controlling for skill characteristics. Further analysis shows that real wage levels for both men and women are higher in concentrated industries than non-concentrated industries—though men in non-concentrated industries earn substantially more than women in concentrated industries. The most likely explanation is the ability of firms in concentrated industries to pay higher wages to all workers.

For Korea, the residual wage gap in concentrated industries is above that in non-concentrated industries in the 1980s and below after 1992, reflecting the near continuous drop in the residual wage gap in concentrated industries that accompanied a relatively flat wage gap trend in non-concentrated industries. When superimposed on the trade series, the decline in the residual wage gap among concentrated industries coincides with trade ratios that are either stagnating or declining somewhat. Similar to Taiwan (China), men and women in Korea's concentrated industries earn higher wage levels than their counterparts in non-concentrated industries.

A brief look at employment changes provides more insight on how well the Taiwan (China) and Korean cases support Becker's (1959) theory, since Becker predicts that stronger competition will reduce the wage gap in concentrated industries via an expansion in demand for female labor. That is, in principle, competitive cost cutting translates into the substitution of cheaper female labor for more expensive male labor. The expansion in relative demand for female labor should then bid up the female wage. For Taiwan (China), evidence indicates that over time, the residual wage gap widens with import competition via a relative loss of employment for women, particularly in concentrated sectors. Import growth appears to be reducing the demand for female labor as women's share of industry employment declines. This employment loss could be translating into less bargaining power for female workers. For example, in 1981 female workers tended to cluster in textiles and garments, the largest employer in manufacturing, while male workers tended to cluster in basic and fabricated metals. Three quarters of the textiles and garments workforce was female in 1981. That said, substantial movement occurred over time across industries for both female and male workers, with a large shift out of textiles and apparel into the electrical equipment and electronics industry. By 1999, electrical equipment and electronics had become the leading employer of women, employing 34% of women, while basic and fabricated metals continued to be the largest employer of men, employing 22% of men. This shift, however, has not entailed a dramatic increase in women's representation among all workers in the electrical and electronics industry. In fact, Figures 3 and 4 show that the percent female in industry employment in textiles and apparel and in the electrical equipment and electronics industries has declined over this period alongside a widening of the residual wage gap and growing import shares in both sectors.

Industry-level descriptive statistics for Korea generate similar conclusions for employment patterns. With 49% of the female workforce, textiles and apparel employed the most female workers in 1980, while electrical equipment, electronics, and transport equipment employed high shares of male workers. Among all sectors, textiles and apparel recorded the highest representation of female workers among total workers. Similar to Taiwan (China), over time both women's and men's employment shifted out of textiles and apparel and into electrical equipment and electronics. By 1998 electrical equipment and electronics had become the leading employer of both women and men, accounting for 27% of female and 18% of male employment. Also similar to Taiwan (China), all three industries recorded lower female shares of employment over time (Figure 3).[9] Yet in the electrical equipment and electronics industry, Korea's wage gap actually narrowed in the face of relatively constant export and import shares over time, whereas the Korean textiles and apparel sectors experienced no consistent relationship between trade shares and wage gaps (Figure 4). In closing, the largest employers in neither the Taiwan (China) nor Korean manufacturing sectors experienced trends that are consistent with the dynamic implications of Becker's theory.

III. Empirical Model

The empirical model tests the degree to which increased industry competitiveness through international trade affects wage discrimination by sex. Under the null hypothesis, increased industry competitiveness from international trade places pressure on firms to reduce costly discrimination against women. The key challenge in testing this hypothesis is to isolate the impact of increased trade competition from other contemporaneous events that are unrelated to participation in international markets. To do so, the analysis controls for differences in domestic market structure across industries. In particular, firms in industries that are relatively concentrated arguably face less domestic competition and hence less pressure to reduce costs, while firms in relatively non-concentrated industries arguably face greater domestic pressure to cut costs. Hence any observed reduction in discrimination against female workers in relatively concentrated industries should be attributed to the competitive forces from international trade rather than to domestic pressures. The empirical approach thus identifies the impact of international competition on wage discrimination by comparing the residual wage impact of trade openness in more concentrated industries to the impact in less concentrated industries.

Let W_{imt} - $W_{ift,}$ the dependent variable, denote the difference between men and women in average log residual wages in industry i and year t. The estimation equation is expressed as:

$$W_{imt} - W_{ift} = \beta_0 + \beta_1 C_i + \beta_2 M_{it} + \beta_3 C_i M_{it} + \varepsilon_{it}, \tag{1}$$

where C_i is a measure of domestic concentration by industry, and M_{it} is the import ratio (and alternatively the export ratio) by industry and year. The final variable—the interaction between industry concentration and the import ratio—is the key variable of interest in examining the dynamic implications of Becker's theory. Its coefficient represents the impact of international trade competition on the average residual wage gap in concentrated industries. The Data Appendix discusses all data used to estimate the model.

The dependent variable is constructed from panel data on average residual wages by industry and year.[10] To construct the residual gap, a fairly standard wage equation is estimated for male workers in each year. The observable characteristics include education, experience, regional location, and worker status.[11] These regressions exclude occupation variables since labor market discrimination may play a role in occupational attainment. Predicted log wages for male and female workers are then calculated using coefficients from the male wage regression.[12] The difference between actual log wages and predicted log wages yields residual wages, and the difference between male and female residual wages yields the residual gender wage gap.

The independent variable C_i is measured with alternative concentration indices commonly found in the industrial-organization literature. Robustness tests are then conducted using these different measures. First, C_i is constructed from Pareto-function estimates of concentration across size categories and industries (Curry and George 1983).[13] In each industry, the number of firms of size s or bigger can be expressed as a Pareto distribution of the form:

$$P(s) = (s_0 / s)^{\alpha} \quad \textit{for } s \textit{ greater than a minimum size } s_0, \tag{2}$$

where α is a constant. Taking the logarithm of both sides gives the estimation equation:

$$\log P(s) = \alpha \log s_0 - \alpha \log s. \tag{3}$$

Hence the frequency distribution of firms across increasing size groups is specified on a log-log scale as a line with slope -α. The steeper the slope coefficient, the less concentrated the industry. The Pareto-function estimates are used to construct both binary and continuous variables for domestic concentration. For the binary specification, industries are ranked in ascending order of concentration. Industries below a critical breakpoint are assigned a value of one for concentrated, while industries above a critical breakpoint are assigned a value of zero for non-concentrated.

Table 1 presents concentration rankings based on the Pareto-function estimates in which size categories are proxied by operating receipts for Taiwan (China) in 1981 and by shipments for Korea in 1983. These rankings are quite robust, as indicated by a series of tests based on Spearman coefficients of rank correlation using a later year of data and using assets to measure size categories. For Taiwan (China), certain industries are consistently less concentrated than others both in 1981 and in 1996, no matter which measure is used. These industries include basic metals, wood products and furniture, and machinery. The correlation coefficient between the 1981 and 1996 estimates is 0.78 using operating receipts and 0.75 using assets. Hence fixing an industry's concentration status at the beginning of the period is a reasonable indicator of concentration since the rankings do not change much over time.[14] Furthermore, the Pareto-function rankings are robust to classifying concentration by the number of industry-specific enterprises divided by industry output. For example, the correlation coefficient between the asset-based ranking and the number of enterprises/output ranking is 0.71 in 1981 and 0.92 in 1996. As with the Pareto-function estimates, rankings according to the number of enterprises/output have not changed much over time, as demonstrated by a Spearman coefficient of 0.83 between 1981 and 1996.

Alternatively, the K-firm concentration ratio expresses the cumulative market share of the Kth firm in an industry (Curry and George 1983). The greater this market share, the more concentrated the industry. This method is applied to Taiwan (China) data on gross value of production by 4-digit SIC codes from the 1986 *Industrial and Commercial Census* (Chou, 1988). Averaging the concentration ratios within 2-digit level industries and sorting by market share produces a ranking that corresponds closely with that of the Pareto-function estimates. Two other techniques for measuring concentration include the Herfindahl index and the profit rate by industry. The Herfindahl index is expressed as the summation of the squared market shares of each firm in an industry. The profit rate is expressed as annual profits divided by annual total sales, with the assumption that the higher the concentration, the higher the profit. For Taiwan (China), these techniques produce rankings that correspond less closely with those produced by the Pareto-function estimates. The Herfindahl index may be a noisy measure of concentration for Taiwan (China), which is characterized by thousands of small firms each with a tiny share of the market. The profit rate measure suffers from cyclical effects: if applied to data from a recession year, such as 1981 in Taiwan (China), a disproportionate reduction in profits may distort the profit ranking.

For Korea, the rankings are fairly comparable across measures, but they are less robust than those in Taiwan (China).[15] Again certain industries are consistently less concentrated than others, no matter which measure is used. These industries include miscellaneous products, printing and publishing, and fabricated metal products. The Spearman coefficients between the 1983 and 1998 estimates using assets to proxy for size is 0.83, which provides some evidence that industry rankings remain consistent over the period.[16] The shipments-based measure is less closely correlated with the assets measure, with a Spearman coefficient of 0.67 using the 1983 data. However, assets may be a poor basis for concentration estimates when firms have small assets but very large debts, as is likely to be true in Korea. The ranking for Korea in Table 1 is fairly robust to a ranking based on the number of establishments divided by output per industry. This latter ranking has also not changed much over time, as demonstrated by a Spearman coefficient of 0.93 between 1981 and 1996.

In equation (1), the independent variable M_{it} is measured using panel data on the ratio of imports to domestic production (and alternatively, the ratio of exports to domestic production). Trade shares are specified as natural logs, so their coefficients are interpreted as elasticities. Trade shares may measure competition from international trade less precisely than indicators based on trade policies. However, even though the traded-goods sectors in Taiwan (China) and Korea benefited from government protection, the protection was linked to a systematic structure of incentives to compete.[17] Furthermore, the empirical strategy tests the idea that international trade is acting as an agent for increased industry competitiveness in the absence of domestic pressure. The use of trade shares is appropriate for such a test.

IV. Estimation Results

Equation (1) can be estimated with alternative methods that vary in treatment of the underlying dynamics over time. One approach, as employed in Black and Brainerd (2002), applies Ordinary Least Squares to a cross-section of long-differenced data. Using this approach, the coefficient on the interaction term in Equation (1) measures the impact of the change in international competitiveness on the change in the gender wage gap in concentrated industries over a specified time period. To ensure robust standard errors in the event that the variance of the error term is not constant across industries, we weight regressions using probability weights based on average-period employment levels by industry. Table 2 presents the OLS results for

Taiwan (China) and Korea. Results are reported as male-female residual wage gaps measured in log points $\times$ 100. The columns vary as follows: column 1 specifies domestic concentration as a binary variable based on Pareto-function estimates, column 2 as a binary variable based on enterprises/output, column 3 as a continuous variable based on Pareto-function estimates, and column 4 as a continuous variable based on enterprises/output.

The OLS results for Taiwan (China) tell a compelling story: increased openness to imports over time in concentrated industries is positively and significantly associated with a larger residual wage gap, and, by implication, increased discrimination against female workers. This result holds across the table's alternative measures of industry concentration, and it also holds when assets-based Pareto-function estimates are used to measure concentration (not reported). In addition, to avoid possible distortions from the East Asian financial crisis, further robustness tests are conducted for periods ending in 1996 and 1997. The positive coefficient on the interaction term between concentration and imports maintains its positive sign and precision in these tests, implying that the main result is not sensitive to effects from the financial crisis.[18] In Taiwan (China), industry competitiveness associated with imports appears to have a stronger impact on the residual gap than competitiveness associated with exports. While the coefficient on the interaction term between concentration and exports is also positive, it is weakly significant in just one of the specifications reported in Table 2 and insignificant in most other robustness tests.

OLS results for Korea indicate that higher export ratios in concentrated industries are positively associated with the residual gender wage gap. However, the positive coefficient on the interaction term with exports is precisely estimated for just two of the four concentration specifications. Further robustness tests that control for spillover effects from the financial crisis by ending the sample in 1996 also yield a positive coefficient on the interaction term with exports, but it is statistically significant in only one of the four specifications.[19] Although the precision of the Korean results is not as high as it is for Taiwan (China), the Korean results similarly do not support the dynamic implications of Becker's theory of discrimination.

While the simplicity of applying Ordinary Least Squares to cross-section data is appealing, its restriction to data that is long-differenced between an end year and beginning year may be inadequate in capturing the full impact of trade openness. In the East Asian economies, production of most industrial sectors is either imported or exported to a large degree, reflecting the highly open nature of these economies. Yet in the long-differenced formulation, trade would have just as much an impact on an industry that rose from 2% to 4% as one that rose from 92% to 94%, and a sector would be considered as becoming less open if its trade ratio dropped from 94% to 92%. This observation implies that a panel data set of industry-level observations over time, rather than a cross-section of long-differenced observations, may better capture the degree of industry-level competition associated with trade openness. A panel data set can provide a richer source of information about movements in wage gaps and allow for more flexibility in estimating the effects of trade openness across industries. Panel data are less sensitive to the choice of beginning and end years, and the use of annual data series across industries allows for more degrees of freedom than the use of a single cross-section.[20] This feature is advantageous for the East Asian sample because of the relatively small number of industry categories.

Because the industry-level gender wage gaps are averages of wages that were sampled from a larger population, it is likely that the industry-specific constant terms are randomly distributed across industries (Greene 1997). To handle this issue, a Generalized Least Squares estimation procedure that corrects for random effects is applied to the panel data set. The random-effects estimator is a matrix-weighted average of estimates produced by the fixed-effects estimator (which uses OLS for a regression that differences out fixed effects within industries), and the between estimator (which uses OLS for a regression that averages each industry's observations over time). Compared to the OLS application to long-differenced data, the GLS application to panel data retains more information on wage gaps and trade ratios over time.

Table 3, which has the same organizational set-up as the preceding table, presents the GLS results. The overall conclusions are similar to those made for the OLS results. For Taiwan (China), trade competition from imports is positively and significantly associated with wider residual wage gaps between men and women, no matter how domestic concentration is defined. Results are also robust to shortening the sample period to eliminate potential spillover effects from the financial crisis. For Korea, the positive relationship between trade openness in concentrated industries and the residual wage gap continues to be evident for exports, but only one out of four of the coefficients on the interaction term is precisely estimated. Finally, serial correlation over time in the panel data series may bias the results. A final set of specification tests is based on GLS regressions that correct for random effects and for autocorrelation of degree one. Results (not reported) indicate that the coefficient on the interaction term between concentration and imports maintains its positive sign and precision for Taiwan (China). For Korea, the interaction term with exports maintains its positive sign across specifications but is not statistically significant.

V. Conclusion

International trade acts as an agent for industry competitiveness, with direct repercussions for how female and male employees are treated in the labor market. Two longstanding theoretical approaches to labor market discrimination generate opposing predictions on the impact of international trade on wage discrimination against female workers. If discrimination is costly, as posited in neoclassical theory based on Becker (1959), then increased industry competitiveness from international trade reduces the incentive for employers to discriminate against women. Competitive forces from international trade should then eliminate discriminatory pay differentials in the long run. In contrast, the non-neoclassical approach views discrimination as entirely consistent with industry competitiveness, particularly if women are segregated into low-paying jobs and face other impediments to their bargaining positions in pay negotiations.

The study has explicitly tested Becker's theory that discrimination is incompatible with rising competitiveness. The approach centers on comparing the impact of international trade on wage discrimination in concentrated and non-concentrated sectors. The effect of international trade competition is expected to be more pronounced in concentrated sectors, where employers can use excess profits in the absence of trade to cover the costs of discrimination. Wage discrimination is proxied by the portion of the wage gap that cannot be explained by observable skill differences between men and women. The empirical model is estimated using a rich panel data set of residual wage gaps, trade ratios, and alternative measures of domestic concentration for two highly open East Asian economies during the 1980s and 1990s.

Results indicate that in contrast to the implications of neoclassical theory, competition from foreign trade in concentrated industries is positively associated with wage discrimination against female workers. In Taiwan (China), greater trade openness in concentrated industries is associated with wider residual wage gaps between men and women, particularly when openness is measured by the manufacturing-sector import ratio. Import competition appears to widen the wage gap by adversely affecting women's relative employment prospects, leading to a loss of bargaining power for women. Women thus appear to be bearing the brunt of employers' competitive cost-cutting efforts. This finding lends support to the non-neoclassical approach that wage and employment discrimination are consistent with rising industry competitiveness. In Korea, a slight reduction in export openness appears to be associated with less wage discrimination by gender in concentrated industries. Results for both economies imply that concerted efforts to enforce equal pay legislation and apply effective equal opportunity legislation are crucial for ensuring that women's pay gains will match those of men in a competitive environment.

Data Appendix

The study categorizes manufacturing industries by two-digit codes for Taiwan (China) and three-digit codes for Korea since the labor data record industry at that level. Both the Taiwan (China) and Korea industry classification systems are based on international standards. Taiwan (China)'s system has undergone six revisions since its inception in 1967. The first year of data used in this study is based on the second revision. Revisions 3 (1983), 4 (1987), and 6 (1996) contain changes primarily at the three-digit level, which are readily reconcilable with earlier versions for the two-digit classifications. Only the fifth revision, published in 1991, contains major changes at all levels, but this revision only affects the labor data from 1993 onwards. Korea's classification system has undergone seven revisions since its establishment in 1963. The first year of data used in this study is based on the fourth revision. Revisions 5 (1984) and 7 (1998) contain changes primarily at the four-digit and five-digit levels, which are readily reconcilable with earlier versions for three-digit classifications (Kang, 2001). Only the sixth revision, published in 1991, contains major changes at all levels, but this change only affects the labor data from 1993 onward. As reported in Appendix Table 1, a series of matching and aggregation steps were conducted to provide consistency over time and to avoid small cell sizes in the calculation of average wages by gender and industry.[21]

Appendix Table 2 summarizes the variables and their sources. The labor data for Taiwan (China) come from the Manpower Utilization Survey for the period 1981-1999. This household-level survey contains detailed information on earnings, employment, and worker characteristics. The Korean labor data come from the Occupational Wage Survey. Due to constraints on data availability, the sample is limited to the years 1980, 1983, 1986, 1989, 1992, 1994, 1996, and 1998. This establishment-level survey also contains comprehensive labor-market information for individual workers. Surveyed establishments are selected using a stratified random sampling method from establishments with at least 10 workers. The samples for both economies cover non-farm, civilian, paid employees; wages are deflated using the consumer price index.

The US-dollar value of exports and imports by 4-digit International Standard Industrial Category (ISIC) are from the International Economic Data Bank (IEDB) for the period 1980-1999 for both Taiwan (China) and Korea. IEDB converts UN trade data from Standard International Trade Categories to ISIC using concordance tables based on the structure of trade and production in the two economies. The trade ratios are relative to a measure of gross production by industry. For Taiwan (China), the data are gross receipts by 2-digit level Taiwan (China) industry codes (revision 6) in new Taiwan dollars. The production data are converted to US dollars using the annual average exchange rate. The trade data are regrouped according to 2-digit Taiwan (China) industry codes (revision 6) using a linking scheme based on concordance tables published by the United Nations and the government of Taiwan (China). For Korea, the production data are gross output in US dollars by 3-digit ISIC codes from the UNIDO Industrial Statistics Database.

For Taiwan (China), the data for estimating domestic competitiveness come from the Industrial and Commercial Census. This census, conducted once every five years, contains data by disaggregated industry on the number of enterprises in various operating-receipts categories of increasing size and in various asset-size categories. For Korea, domestic-competitiveness data come from the Korean Industrial Census. This census, conducted once every five years, contains data by disaggregated industry on the number of establishments in various shipment-value categories of increasing size and in various asset-size categories (as indicated by paid-in-capital).

In both economies, the alternative series are used in different estimates of domestic concentration for a base year and an end year to check for robustness.

Appendix Table 1: Consistent Manufacturing Aggregates by Standard Industrial Classification Codes, Taiwan (China) and Korea.

Taiwan (China) Manufacturing Industry Aggregates	*Rev. 2-4 (1981-92)*	*Rev. 5-6 (1993-99)*	*Korean Manufacturing Industry Aggregates*	*Rev. 4-5 (1980-92)*	*Rev. 6-7 (1993-98)*
1. Food, Beverage, and Tobacco Manufactures	20, 21	11, 12	1. Food Manufactures	311	151-154
2. Textile Industries; Manufacture of Wearing Apparel and Accessories	22, 23	13, 14	2. Beverage and Tobacco Manufactures	313, 314	155, 160
3. Manufacture of Leather, Fur, and Related Products	24	15	3. Textile Industries.	321	171-173
4. Manufacture of Wood Products, Bamboo Products, and Furniture	25	16, 17	4. Manufacture of Wearing Apparel	322	181
5. Manufacture of Paper and Paper Products; Printing	26	18, 19	5. Manufacture of Leather, Fur, Related Products, and Footwear (except Rubber or Plastic Footwear)	323, 324	182, 191, 192
6. Manufacture of Chemical Materials; Manufacture of Petroleum and Coal Products	27, 29	21, 23	6. Manufacture of Wood Products and Cork Products	331	201, 202
7. Manufacture of Chemical Products	28	22	7. Manufacture of Furniture and Fixtures	332	361
8. Manufacture of Rubber Products	30	24	8. Manufacture of Paper and Paper Products	341	210
9. Manufacture of Plastic Products	31	25	9. Printing and Publishing	342	221, 222
10. Manufacture of Non-metallic Mineral Products	32	26	10. Manufacture of Chemical Materials	351	241
11. Basic Metal Industries; Manufacture of Fabricated Metal Products	33, 34	27, 28	11. Manufacture of Chemical Products	352	242, 243
12. Manufacture and Repair of Machinery and Equipment	35	29	12. Manufacture of Petroleum and Coal Products	353, 354	231-233
13. Manufacture and Repair of Electrical and Electronic Machinery and Equipment	36	31	13. Manufacture of Rubber Products	355	251
14. Manufacture and Repair of Transport Equipment	37	32	14. Manufacture of Plastic Products	356	252
15. Manufacture of Precision Instruments	38	33	15. Manufacture of Pottery, China, and Glass Products	361, 362	261
16. Manufacture of Miscellaneous Industrial Products	39	39	16. Manufacture of Other Non-metallic Mineral Products	369	269
			17. Iron and Steel Basic Industries; Non-Ferrous Metal Basic Industries	371, 372	271-273
			18. Manufacture of Fabricated Metal Products	381	281, 289
			19. Manufacture of Machinery and Equipment	382	291-293
			20. Manufacture of Electrical and Electronic Machinery and Equipment	383	300, 311-315, 319, 321-323
			21. Manufacture of Transport Equipment	384	341-343, 351-353, 359
			22. Manufacture of Precision Instruments	385	331-333
			23. Manufacture of Miscellaneous Industrial Products	390	369, 371, 372

Sources: DGBAS (1987, 1991) and NSO (2001).

Appendix Table 2: Variable Definitions and Data Sources.

Variable	*Description*	*Date Source: Taiwan (China)*	*Date Source: Korea*
Real Wage:			
Nominal Wage	Average wages and average residual wages by sex and industry	Manpower Utilization Survey, DGBAS 1981-1999	Occupational Wage Survey, Ministry of Labor 1980, 83, 86, 89, 92, 94, 96, 98
Wage Deflator	Consumer price index	Monthly Bulletin of Statistics, DGBAS (various) 1981-1999	NSO Online Statistical Database, NSO 1980-1998
Trade Shares:			
Imports	CIF value by industry	International Economic Data Bank, ANU (2001) 1981-1999	International Economic Data Bank, ANU (2001) 1980-1998
Exports	FOB value by industry	International Economic Data Bank, ANU (2001) 1981-1999	International Economic Data Bank, ANU (2001) 1980-1998
Domestic Production	Gross receipts (Taiwan, China), gross output (Korea) by industry	National Income Accounts, DGBAS 1981-1999	Industrial Statistics Database, UNIDO (2000) 1980-1998
Exchange Rate	Average exchange rate	Financial Statistics (IMF), Central Bank of China (various) 1981-1999	Not applicable
Industry Concentration:	Pareto-function estimates by industry	Industrial and Commercial Census, DGBAS 1981, 1996	Korean Industrial Census, NSO 1983, 1998

Table 1: Pareto-Function Estimates of Domestic Competitiveness for Taiwan (China) and Korea. (Industry ranking in descending order of competitiveness)

Taiwan (China)	*1981*	*Korea*	*1983*
Non-Concentrated		*Non-Concentrated*	
1. Basic Metal Industries; Fabricated Metal Products	-0.77	1. Furniture and Fixtures	-0.75
2. Wood Products, Bamboo Products, and Furniture	-0.76	2. Miscellaneous Industrial Products	-0.73
3. Machinery and Equipment	-0.76	3. Wood Products and Cork Products	-0.73
4. Paper and Paper Products; Printing	-0.71	4. Printing and Publishing	-0.71
5. Miscellaneous Industrial Products	-0.71	5. Wearing Apparel	-0.66
6. Plastic Products	-0.67	6. Fabricated Metal Products	-0.65
Concentrated		7. Plastic Products	-0.61
7. Food, Beverage, and Tobacco Manufactures	-0.62	8. Machinery and Equipment	-0.58
8. Textile Industries; Wearing Apparel &Accessories	-0.61	9. Other Non-metallic Mineral Products	-0.57
9. Non-metallic Mineral Products	-0.61	10. Precision Instruments	-0.57
10. Chemical Products	-0.58	11. Leather, Fur, Related Products, and Footwear	-0.54
11. Leather, Fur, and Related Products	-0.56	12. Textile Industries	-0.54
12. Transport Equipment	-0.53	13. Pottery, China, and Glass Products	-0.53
13. Rubber Products	-0.52	*Concentrated*	
14. Electrical, Electronic Machinery & Equipment	-0.51	14. Food Manufactures	-0.47
15. Precision Instruments	-0.51	15. Beverage and Tobacco Manufactures	-0.45
16. Chemical Materials, Petroleum, and Coal Products	-0.26	16. Paper and Paper Products	-0.44
		17. Transport Equipment	-0.40
		18. Electrical, Electronic Machinery & Equipment	-0.37
		19. Rubber Products	-0.35
		20. Chemical Products	-0.24
		21. Iron and Steel, Non-Ferrous Metal Industries	-0.23
		22. Chemical Materials	-0.22
		23. Petroleum and Coal Products	-0.04

Note: Figures report the coefficient estimates of Pareto functions using data on number of enterprises by size categories of operating receipts (Taiwan, China) or shipments (Korea).

Table 2: OLS Results for Residual Wage Gap Using Cross-Sectional, Long-Differenced Data.
(in log points×100; standard errors in parentheses)

	(1)	*(2)*	*(3)*	*(4)*
Panel A: Taiwan (China)				
C	-6.86**	-5.42*	-20.28**	-64.77
	(3.00)	(2.79)	(8.08)	(37.60)
$\Delta_t M_t$	-1.17	-0.09	37.28**	11.75**
	(1.86)	(2.03)	(13.10)	(3.90)
$C\times\Delta_t M_t$	11.07**	9.41**	49.85**	131.35**
	(3.72)	(3.68)	(17.86)	(43.59)
constant	8.39***	7.57***	-8.31	1.23
	(1.72)	(1.87)	(5.91)	(2.48)
C	-2.01	-1.76	-20.44	-36.59
	(3.71)	(3.38)	(15.11)	(65.98)
$\Delta_t X_t$	-5.73	-6.64	14.73	3.17
	(3.73)	(3.80)	(9.38)	(5.27)
$C\times\Delta_t X_t$	8.64	11.77*	25.90	78.42
	(6.04)	(5.91)	(15.01)	(55.95)
constant	9.25***	9.08***	-4.85	6.37
	(2.53)	(2.08)	(9.26)	(3.88)
Panel B: Korea				
C	-10.66*	-4.15	-10.99	-4.87
	(5.38)	(6.47)	(18.38)	(4.63)
$\Delta_t M_t$	1.86	1.26	5.82	2.44
	(2.80)	(2.26)	(9.60)	(4.07)
$C\times\Delta_t M_t$	-1.36	3.03	6.36	0.50
	(3.80)	(4.18)	(15.94)	(2.78)
constant	-1.40	-3.93	-11.71	-10.52*
	(4.57)	(4.87)	(9.28)	(5.29)
C	-15.96***	-9.41	-37.39	-9.35**
	(4.93)	(6.16)	(22.41)	(4.32)
$\Delta_t X_t$	1.21	-5.05	14.06***	9.50**
	(5.25)	(5.80)	(3.60)	(3.40)
$C\times\Delta_t X_t$	7.05	15.09**	21.46*	6.30
	(6.34)	(6.41)	(10.45)	(4.97)
constant	-0.78	-4.52	-26.87**	-16.63***
	(3.88)	(4.84)	(11.45)	(4.55)

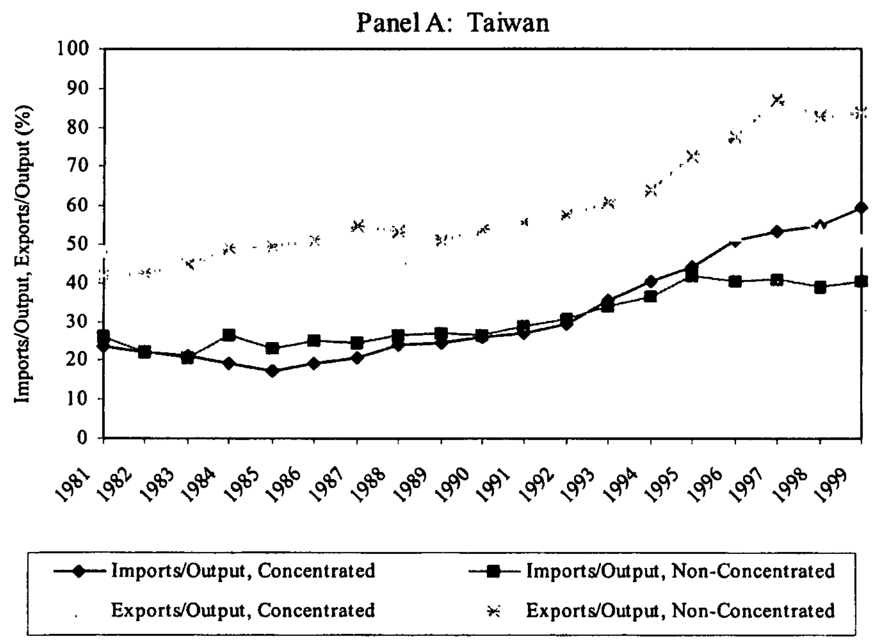
Note: Columns differ as follows: (1) C = Pareto-function estimates, dummy; (2) C = #enterprises/output, dummy; (3) C = Pareto-function estimates, continuous; and (4) C = #enterprises, continuous. Pareto functions are estimated with receipts data for Taiwan (China) and shipments data for Korea. The notation *** indicates statistically significant at the .01 level; ** at the .05 level; * at the .10 level. There are 16 observations for Taiwan (China) and 23 observations for Korea; regressions are weighted using probability weights based on average-period employment levels by industry. The R^2 statistics range from 0.07 to 0.38 for Taiwan (China) and from 0.07 to 0.34 for Korea.

Table 3: GLS Results for Residual Wage Gap Using Panel Data; Random Effects.
(in log points×100; standard errors in parentheses)

	(1)	*(2)*	*(3)*	*(4)*
Panel A: Taiwan (China)				
C	3.30	3.87	8.08	60.95
	(3.07)	(3.03)	(10.60)	(41.87)
M_t	-0.05	0.22	19.02***	6.65***
	(1.05)	(1.00)	(4.26)	(1.37)
$C \times M_t$	5.07***	5.30***	26.49***	77.45***
	(1.40)	(1.40)	(6.70)	(23.73)
constant	37.44***	37.07***	43.85***	42.69***
	(2.39)	(2.21)	(6.61)	(2.70)
C	-3.41	-1.30	-12.47	-10.46
	(3.17)	(3.12)	(12.26)	(42.31)
X_t	0.41	-0.01	4.95	2.63
	(1.70)	(1.38)	(4.47)	(1.81)
$C \times X_t$	1.01	3.12	6.63	29.66
	(2.12)	(2.03)	(7.17)	(28.59)
constant	37.88***	36.69***	28.15***	35.58***
	(2.42)	(2.27)	(7.76)	(2.81)
Panel B: Korea				
C	0.05	0.21	6.65	-1.15
	(3.45)	(3.42)	(10.97)	(2.97)
M_t	0.03	-0.13	1.62	-0.91
	(0.95)	(0.95)	(2.98)	(1.49)
$C \times M_t$	0.19	0.58	2.89	-0.93
	(1.56)	(1.54)	(5.36)	(1.27)
constant	27.09***	27.08***	30.46***	25.90***
	(2.22)	(2.23)	(5.81)	(3.25)
C	1.13	0.36	12.88	2.64
	(3.07)	(3.02)	(8.30)	(2.50)
X_t	-0.20	-0.21	3.08*	1.07
	(1.07)	(1.09)	(1.76)	(1.14)
$C \times X_t$	0.75	0.69	5.99*	0.92
	(1.40)	(1.40)	(3.50)	(1.08)
constant	26.73***	27.00***	33.61***	29.85***
	(2.00)	(2.11)	(4.35)	(2.79)

Note: Columns differ as follows: (1) C = Pareto-function estimates, dummy; (2) C = #enterprises/output, dummy; (3) C = Pareto-function estimates, continuous; and (4) C = #enterprises, continuous. Pareto functions are estimated with receipts data for Taiwan (China) and shipments data for Korea. The notation *** indicates statistically significant at the .01 level; ** at the .05 level; * at the .10 level. There are 304 observations for Taiwan (China) and 184 observations for Korea. The Wald χ^2 statistics ranges from 3.1 to 38.4 for Taiwan (China) and from 0.1 to 3.2 for Korea.

Figure 1: Trade Ratios by Industry Concentration, Taiwan (China) and Korea



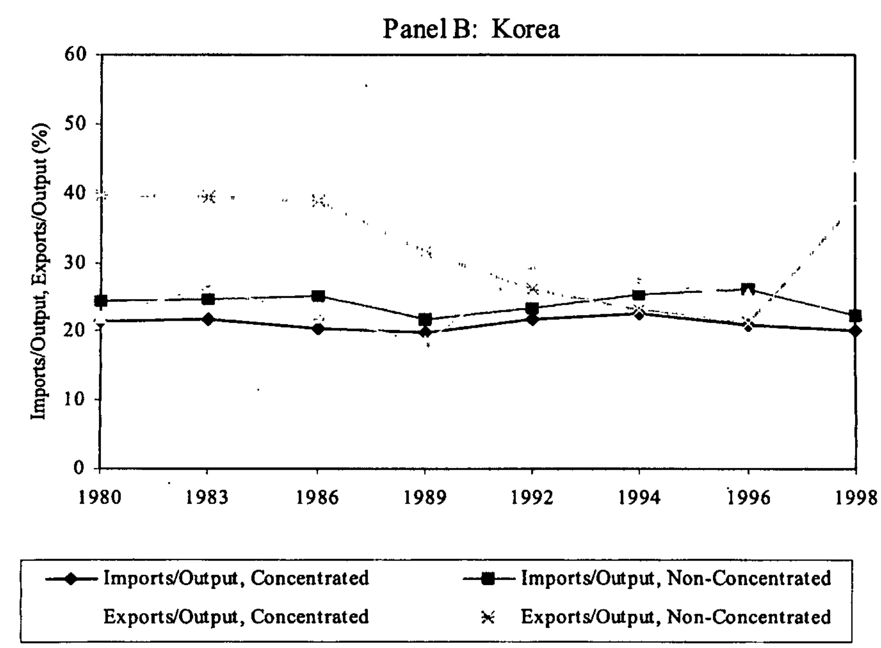


Figure 2: Residual Wage Gaps by Industry Concentration, Taiwan (China) and Korea

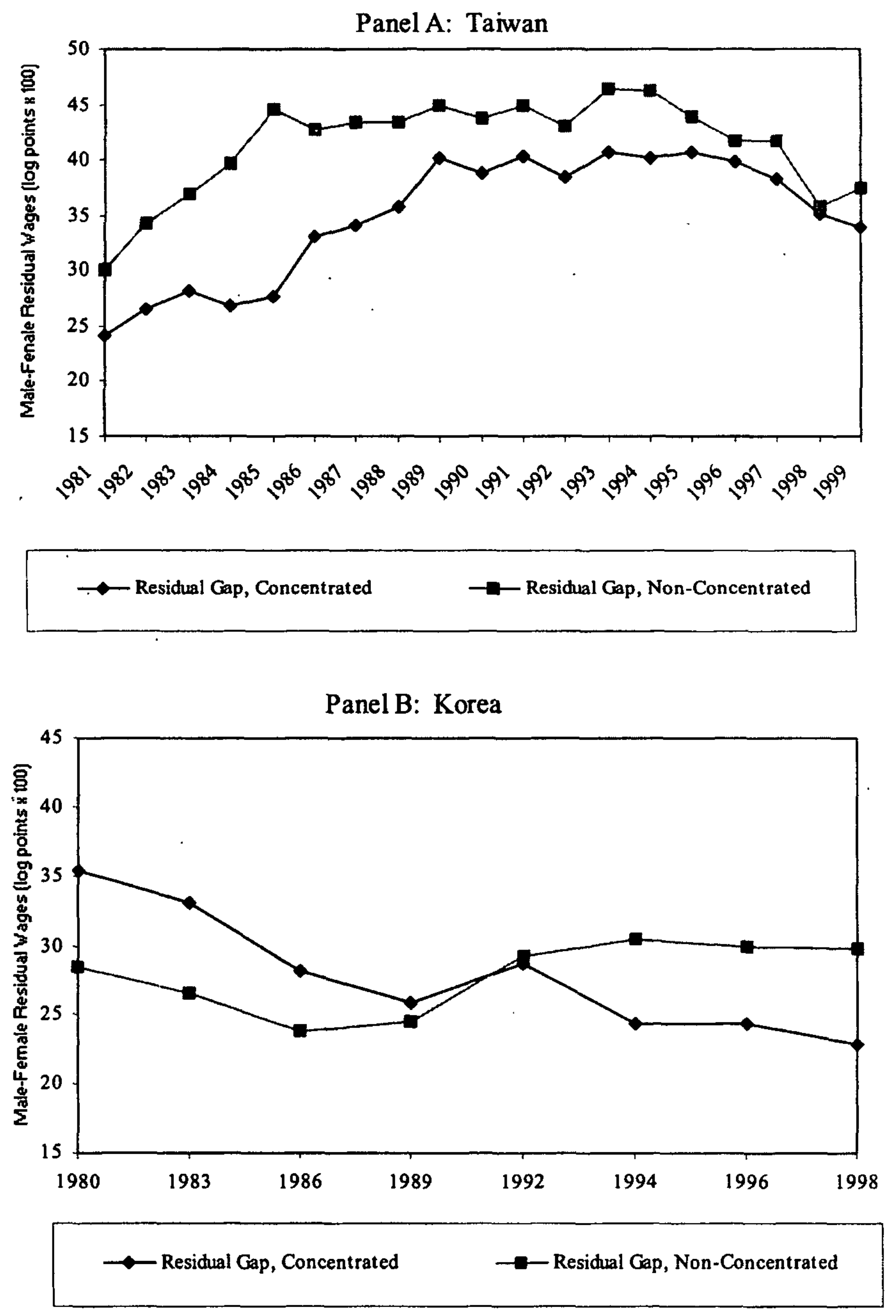
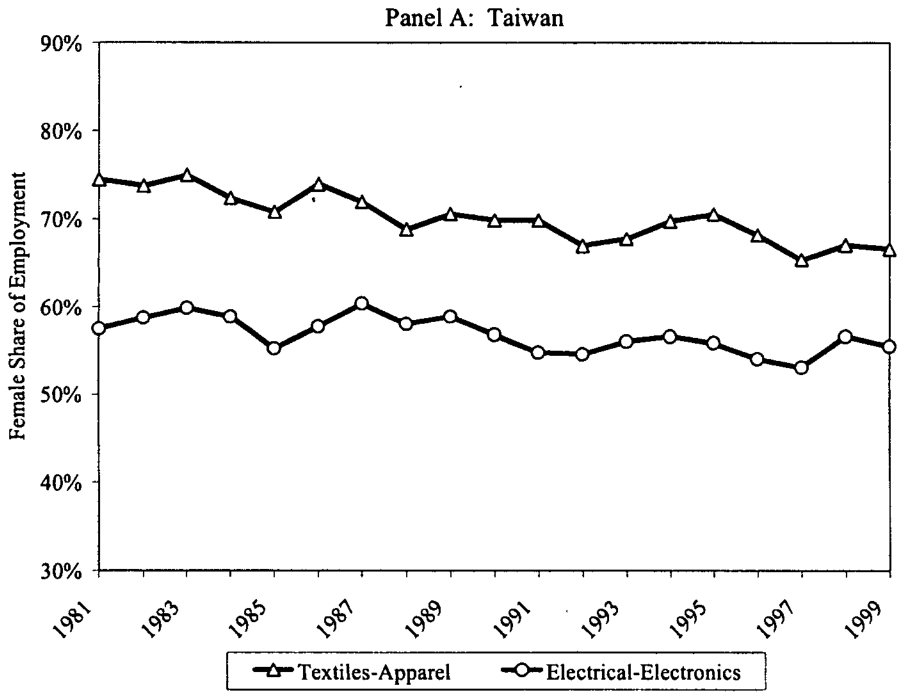


Figure 3: Female Share of Industry Employment, Taiwan (China) and Korea



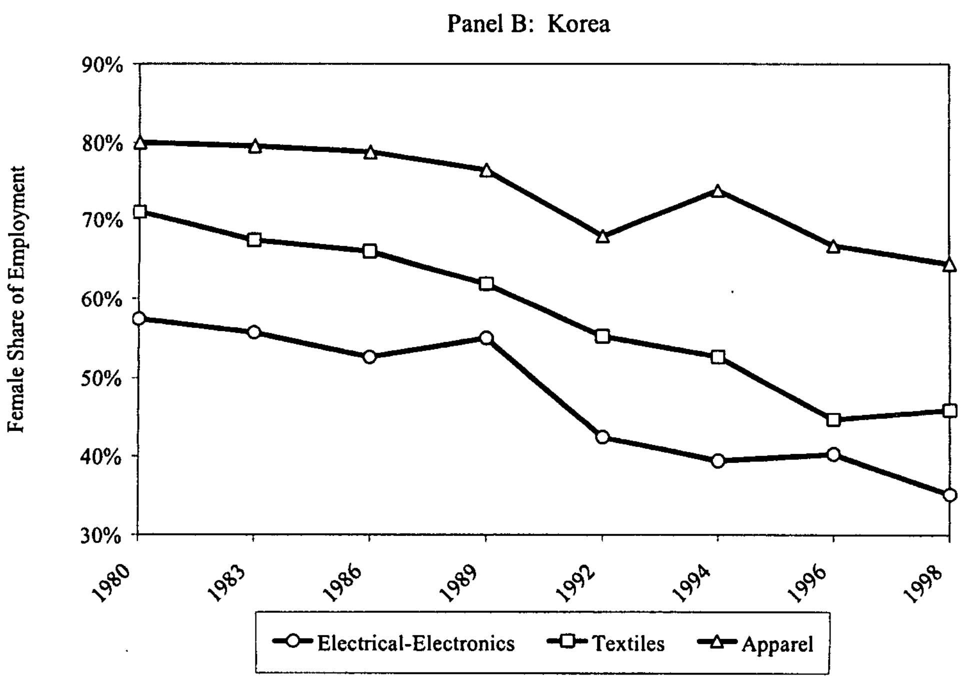
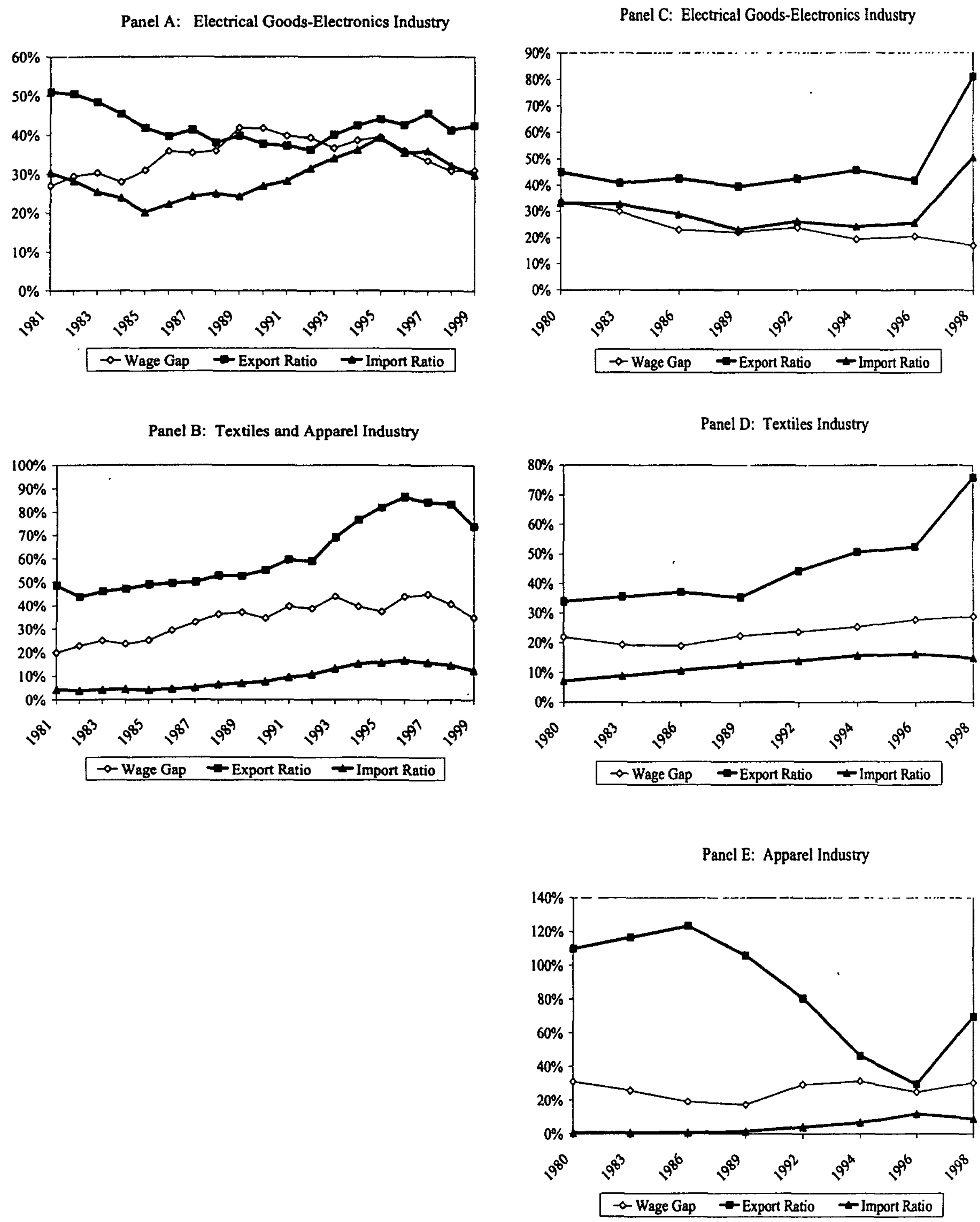


Figure 4: Residual Wage Gaps and Trade Ratios by Industry, Taiwan (China) and Korea

Taiwan (China) Korea



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Endnotes

[1] For example, international trade is associated with rising wage inequality or negative overall wage effects in Chile (Beyer, Rojas, and Vergara 1999), Mexico (Hanson and Harrison 1999; Revenga 1997), and in the public sector in Morocco (Currie and Harrison 1997). There is almost no wage effect for Uruguay (Rama 1994), while trade is associated with narrowing wage dispersion in East Asia (Wood 1997).

[2] One exception is Feliciano (2001), a study based on Mexican household survey data that finds a significant increase in overall wage dispersion as a result of trade reforms.

[3] For more discussion of this alternative approach to competition, see Darity (1989), Darity and Williams (1985), and Williams (1987).

[4] This approach of comparing the impact of foreign trade across concentrated and less concentrated sectors was developed in Borjas and Ramey (1995) in the context of overall U.S. wage inequality. This study finds that trade has a more adverse effect on the skilled-unskilled wage gap in concentrated industries.

[5] For example, in 1983, 63% of Taiwan (China)'s manufacturing sector workers were employed in establishments of 100 workers or less, compared with just 11% of workers in Korea's manufacturing sector in the same year. By 1998 these numbers had changed little, with 66% of Taiwan (China)'s manufacturing workers in establishment sizes of up to 100 workers and 12% of Korean workers.

[6] The sharp rise in the export ratios between 1996 and 1998 reflects the dramatic drop in output due to the Asian crisis.

[7] In Taiwan (China), in 1980 the female attainment of high school or above (39%) already exceeded that of men (36%); these shares rose to 71% for women and 66% for men by 1999.

Sample means also indicate a decline in the experience and tenure gaps between men and women, and in industry segregation by gender.

[8] A male-female wage gap may be converted to a ratio of female to male wages by exponentiating its negative.

[9] The Korean data report textiles and apparel as two separate industries.

[10] Equation (1) is also estimated using average unadjusted wage gaps by industry. In most cases results are similar, so for brevity, only the residual wage gap results are presented.

[11] Regressions for both Taiwan (China) and Korea include a dummy for part-time worker (less than forty hours per week for Taiwan (China) or 160 hours per month for Korea), dummies for education level attained, years of potential experience (age, minus education, minus six) and its square, years of establishment-specific tenure and its square, and dummies for regional locations. In addition, regressions for Taiwan (China) include dummies for major area of study and a dummy for urban status.

[12] The implicit assumption is that male coefficients more accurately reflect competitive returns to observable characteristics than female coefficients. An alternative approach combines coefficient estimates for both men and women following Oaxaca (1973). These two approaches yield the same measures for the total, predicted, and residual earnings gaps.

[13] The data source presents size categories as ranges. In the estimations, size levels are chosen to be the mid-point for each range. Because the final range has no upper bound, the size level is top coded as 1.2 times the lower bound.

[14] Further tests show that the operating receipts-based rankings are highly correlated with the assets-based rankings, with a Spearman coefficient of 0.95 in 1981 and also 0.95 in 1996.

[15] Despite their different natures in industrial structure, Taiwan (China) and Korea have considerable overlap in the concentration rankings. Some exceptions emerge due to the more detailed nature of the Korean sector classification.

[16] Korean data for shipments-based Pareto estimates in the end year (1998) are unavailable. Further robustness tests using K-firm concentration ratios, the Herfindahl index, and profit rates are not possible for Korea due to data unavailability.

[17] See Amsden (2001) and Stiglitz and Yusuf (2001) for discussions of the competitive environment within the export and import-competing sectors. Also, data constraints for measures related to trade policy in both Taiwan (China) and Korea limit our options for measuring international competitiveness.

[18] Robustness tests are conducted for six measures of concentration and three end years, for a total of 18 combinations. The coefficient on $C \times \Delta_t M_t$ is positive and statistically significant in all of these tests. The coefficient on $C \times \Delta_t X_t$ is positive and significant in just 2 of the 18 tests; in all other tests the coefficient is insignificant.

[19] Robustness tests are also conducted with assets-based Pareto-function estimates to measure concentration, in which none of the interaction terms with trade ratios are precisely estimated.

[20] For Taiwan (China), there are 16 observations (16 industries) in the cross-section data versus 304 observations (16 industries x 19 years) in the panel data. For Korea, there are 23 observations in the cross-section data versus 184 observations (23 industries x 8 years) in the panel data.

[21] The minimum cell size for a gender-industry group in the sample period was 13. Larger cell sizes would entail a tradeoff with degrees of freedom in the model estimations.

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