Chapter 2

Wage Implications of Trade Liberalisation: Evidence for Effective Policy Formation

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The relationship between trade and wages has been subject to intense scrutiny in the academic literature with no clear consensus emerging. This chapter adds to this body of research by moving beyond the single country analysis level to a panel including developed and developing countries and data through the mid 2000's. First we examine the relationship between wages and trade using the approach of Feenstra and Hanson to calculate mandated wage changes for our dataset. We find that imports have a significant and positive impact on wages while the sign on tariffs is negative and significant. We also look at the relationship of wage differentials at the occupation level between partner countries. We find that the difference in occupation wage is smaller for large trade partners. Finally, we discuss the potential role of NTMs in influencing the wage and trade relationship

2.1. Introduction

Economists have long explained the relationship between wages and trade within the framework of the Stolper Samuelson (SS) theorem (Stolper and Samuelson, 1941). Within neoclassical trade theory (the Heckscher-Ohlin or HO), SS shows that in the case of two goods and two factors, a decline in the relative price of a product reduces both the relative and absolute earnings of the factor used relatively intensively in its production. Correspondingly when a country opens up to trade, its most abundant factor gains and its scarce factor loses. Hence, a capital-abundant developed country would experience a relative and absolute rise (fall) in the returns to the owners of capital (labour), whereas the opposite would result in the case of a labour abundant developing country.

The HO/SS framework is useful because it predicts patterns of trade among countries and distributional changes from that trade. In this framework, the product prices of traded goods drive factor prices throughout the economy. In small, price taking countries changes in relative factor supplies have no effect at all on factor prices and in larger countries, supply changes have an impact only to the extent they affect world prices of traded goods. Since SS assumes that skilled and unskilled labour are perfectly mobile, its predictions are extremely powerful because mobility implies the forces affecting wages of workers producing the goods that compete directly in international trade have similar effects on workers who produce non-traded goods and services in the rest of the economy. Hence the popularity of Freeman's (1995) article entitled "Are your wages set in Beijing?" which concludes that they are not.

The policy implications of the SS theorem are highly significant. It implies that expanded trade with developing countries, other things equal, could be associated with increased wage inequality in the more developed countries. This connection between trade and wages became a major focus of attention particularly in the 1990s, following rising exports from low-skill labour abundant countries coupled with rising wage inequality in importing developed countries. Much of the empirical research has focused on the United States and United Kingdom, two countries who experienced this phenomenon earliest and ostensibly to the largest extent. However, other economies, mostly OECD, experienced similar trends.

Early investigations found little evidence that the two trends were causal. The majority of the findings were based on one or a combination of three basic arguments. First, the volume of trade between the United States and developing countries at the time was seen to be too small to lead to the observed wage changes. Krugman (1995) observed that many countries' trade to GDP ratios were still below their pre-World War I levels. This fact was true for most developed economies, including the United Kingdom, France, Germany and Canada (Feenstra and Hanson, 2001). Second, the movement of prices, again at that time, was shown to contradict the movement of relative wages. Prices for many low-skill intensive goods actually rose in the 1980s (Leamer, 1998). Lawrence and Slaughter (1993) showed that industries with some of the most low-skill intensive production actually experienced the highest price increases between 1980 and 1990. Finally, it was reasoned that international trade should affect workers moving between, rather than within, industries as different industries expand or contract due to foreign opportunities or competition. Berman, Bound and Griliches (1994) in an oft-cited paper, presented evidence clearly showing that most changes in this period were within industries, which could not be explained by cheaper imports displacing domestic production. The conclusion coming out of this body of research was that other factors, such as the decline in union membership and technology, in the form of skilled-bias technological change, were the main source of the observed disparity in the growth of skilled and unskilled wages.

Among the first papers to reconsider this position, Feenstra and Hanson (2001) observed that global production sharing changed not only the nature of trade but also the way we should think about connecting trade with wages. They argued that volumes aren't as important as what is being traded. The share of processing trade and intermediate inputs for US manufacturing, for example, increased from 6.5% in 1972 to 11.6% in 1990 and are estimated to be over 40% in 2006 (Miroudot *et al.* 2010). This growth of trade within industrial segments discounts the "within versus between industry" argument discussed above. Production fragmentation is entirely consistent with the within industry effects dominating the results of Berman, Bound and Griliches (1994). In addition, the growth in intermediate input trade also impacts the way we look at the price data. As more intermediate goods are imported from lower price alternatives, we would expect prices within each industry to be rising relative to import prices. Feenstra and Hanson (2001) report that this was indeed the trend during the 1980s for the United States, as well as for Japan and Germany. Thus, they argue, the price changes observed were not in contradiction to trade impacts at all.

Subsequent studies have been critical of these earlier findings for a number of other reasons. Krugman (2008) provided an overview of the evidence and argued that most empirical studies were based on data in the decades before developing/developed world trade really took off. He notes that in 1990, China's exports as a percent of US GDP were 6.7% while by 2006 they had reached 20%, a growth of almost 200%. The surge in developing country manufactures involves a particular concentration in apparently sophisticated products, which seems to be inconsistent with a trade driven effect on wage inequality. Yet there is good reason to believe the apparent sophistication of developing country exports is largely a statistical illusion, created by vertical integration in a world of low cost trade (Krugman, 2008).

Another argument calling into question the findings of early empirical studies is that they were mis-specified due to endogeneity problems. For example, it is likely that US prices depend both on trade-related and domestic forces. This would imply the sector bias of price changes may convey no information about the wage effects of trade-related forces given the importance of domestic factors. Haskel and Slaughter (2003) looked to see if the endogeneity problem was the reason behind the inability of early studies to establish a strong trade effect on relative wages. They pointed out that during the 1970s and 1980s declines in trade barriers were concentrated in unskilled-intensive sectors which is consistent with the observed rise in the US skill premium, assuming the price effects of this liberalisation changed product prices uniformly across sectors. When they tested for this, however, they found that the rise in skill premium mandated by price changes induced by tariffs or transport costs was mostly insignificant, even after controlling for potential endogeneity. They noted other trade-related factors, such as non-tariff measures (NTMs) may be important in driving these results, and that the effect of trade barriers on technical change may be another influence.

The rising number of empirical studies that followed did little to resolve the debate. There were those who argued (e.g. Krugman 2000) that "factor bias" implicit in trade is important when determining wages, and those who argued (e.g. Leamer, 1998 and 2000) that it is the "sector bias" technical change that matters. The thrust of many studies (surveyed in Slaughter 1999) is that the skill premium tends to rise if price increases are concentrated in skill-intensive industries, that is, if price increases are sector biased towards skilled-intensive industries. Feenstra and Hanson (1999) estimated the relative influence of trade versus technology on wages in the United States, by focusing on whether foreign outsourcing of intermediate inputs was the primary source of wage declines in the United States. They found that technology (proxied by computers) had a larger impact on relative wages of non-production workers than outsourcing.

In their review of the empirical literature, Feenstra and Hanson (2001) conclude that existing studies have just begun to scratch the surface of how the globalisation of production changes industry structure and factor demand in both advanced and emerging economies. Anecdotal evidence suggests foreign outsourcing is an important mechanism through which countries integrated themselves into the world economy. Amiti and Davis (2008) find that the degree to which firms are engaged internationally matters to measure outcomes of trade impact on wages. They estimated that a 10% cut in tariffs on outputs decreased wages in firms oriented exclusively to the domestic market but increased exporting firm's wages. The same tariff reduction on inputs had no significant impact on the wages of firms that did not import, but raised the wages of those that did. Thus, integration into the global economy plays a role in determining wage effects, and this impact is differentiated across firms.

Our work will contribute to this body of evidence by expanding the level of analysis beyond the single-country framework. We will examine the extent to which there is evidence of a relationship, broadly using the SS framework, across a number of economies. We capture the effect of the economy's structural variables on prices and then use these estimates to determine the wage changes corresponding to capital and labour used in production. The methodology we employ provides a tractable way to combine the SS framework with multiple countries. Section 2.2 sets the stage for the investigation of the relationship between trade and wages. Section 2.3 briefly describes the methodology and data. Section 2.4 presents a graphical analysis and our results regarding the relationship between trade and wages. Section 2.5 concludes and puts forth policy implications.

2.2. Deviations from underlying theoretical assumptions?

The literature has shown that evidence of the influence of trade on wages depends on the time period examined as well as the level of aggregation. Another important factor is the degree of specialisation in the economy after trade. Wood (1994) argued that any trade impact on unskilled workers in developed countries would be diminishing because additional downward pressure on the prices of most unskilled-labour intensive products would not put pressure on the wages of domestic unskilled workers more generally once that country no longer produced the competing goods. Edwards and Lawrence (2010) present empirical evidence that this standard assumption of the HO/SS framework – the same goods that are imported are also produced domestically – does not hold in actual practice. They show that specialisation can and does occur in international trade and such deviations from the underlying model imply a divergence in its predicted outcomes.

Grossman and Rossi-Hansberg (2008) provide further arguments as to why trade effects on wages may not be consistent with SS. They identify three channels through which imported inputs can affect domestic factor prices: (1) the price effect (along traditional SS lines); (2) the labour-supply effect (which results from displacement of activities through changing specialisation); and (3) a productivity effect. The productivity effect operates as a sector-biased technical change that raises returns to factors used intensively in the importing sector. In this sense, domestic factors are complements to imports rather than substitutes.

Implications for policy

Despite these deviations, broadly speaking the SS framework does provide relevant guidance on our expectations on the wage and trade relationship. Thus, in a framework of policy analysis that implies such a strong influence of trade on domestic factor returns (as the HO/SS framework does), it is important to understand clearly the exact mechanisms through which trade and wages are linked. This will help devise effective policies to deal with anticipated adjustment costs associated with trade-induced changes. Establishing causality is of the essence; a concomitant rise in imports and inequality does not necessarily suggest causation and without careful empirical analysis serious policy mistakes can be made. For example, previous studies (e.g. Keller, 2004; Stone and Shepherd, 2010) have shown the potentially beneficial impact of imports on domestic economies, a result that should assuage concerns regarding the effect of trade on economic outcomes. Providing clear and robust analysis of the underlying nature of these relationships and the trade-wages links should help inform policy and clear up misconceptions regarding the role of international trade in growth and development. This is the principal objective of this chapter.

2.3. Measuring the trade effect: methodology and data

Method

In order to investigate the relationship between trade and wages we follow the approach originally outlined in Leamer (1998) and applied in Feenstra and Hanson (1999) and more recently in Edwards and Lawrence (2010). We follow the standard approach to derive price regressions by totally differentiating the zero-profit condition for each industry. We can express this in first-differences as follows:

$$\Delta\ln(p_{it}) = -TFP_{it} + 1/2(s_{it} + s_{it-1})'\Delta lnw_{it} \quad (1)$$

In this equation, p denotes the value-added price in industry i at time t, TFP is the total factor productivity, w is the vector of factor prices and s is the primary factor shares averaged over two periods.[1] This equation expresses the relationship between the movement in value-added prices and productivity, with primary factor prices at given factor shares. In order to isolate changes in trade on factor prices, we must disentangle the effects of general structural variables on prices and productivity. We can do this by conducting regressions in two steps. In the first step we regress changes in prices and productivity on an identified set of structural variables. In the second step we use the first step estimation results to decompose "mandated" changes in primary factor prices attributable to each structural variable's impact on value-added prices. We have to employ a two-step procedure because the relationships we seek, the set of dependent variables for the second stage, are not directly observable and need to be estimated in the first stage. We can model the system with the following two equations: [2]

$$\Delta lnP_{it} + TFP_{it} = \gamma'\Delta z_{it} + \eta_{it} \quad (2)$$

$$\gamma_k \Delta z_{itk} = \delta'_k (s_{it} + s_{it-1})/2 + \upsilon_{itk} \quad (3)$$

Here, the δ_k obtained from the regression in (3) are interpreted as the change in primary factor prices that are explained by structural variable k contained in z. In other words, the regression coefficients in (3) can be interpreted as the changes in factor prices that would have occurred if changes in each structural variable had been the only source of change in value added prices and productivity. This specification allows us to measure the structural variables' direct impact on prices over and above the indirect impact via productivity. It also means that

1. Primary factor shares are defined here as the share of labour and capital used in production. They are measured as the share of each factor in total cost.

2. For complete details of the derivation of this system see Feenstra and Hanson (1999).

the estimated coefficient in (3) can be interpreted as the change in the factor prices mandated by changes in the value-added price due to each structural variable, including trade variables.

Data

As stated above, we intend to extend the work most recently exemplified for the United States in Edwards and Lawrence (2010) by broadening country coverage.[3] Thus, for equations (1) through (3) an additional subscript j should be added to indicate country. This provides us with a panel dataset that covers industry and country as a group, against time. The Data Annex provides details of the individual data series used in this paper. While expanding the number of countries provides a much greater range of economic conditions to test the SS relationship, it is costly in terms of data quality and detail. We discuss below those complicating factors which deviate from the theoretical derivation.

The original work by Feenstra and Hanson (1999) adjusts TFP by changes in wage differentials, but not all studies do this. For example, Edwards and Lawrence (2010) make no adjustment and report regressions with what they call 'primal' TFP. Given that we do not have the necessary detail of wage information to make this adjustment across our sample of countries we use the "primal' TFP as well. By not making the adjustment, we potentially overstate TFPs impact on wages. However, as TFP does not play a major part in our results, we believe that the bias, if any, is small.

Most authors, including Haskel and Slaughter (2003) for the United States and Abrego and Edwards (2004) for the United Kingdom, use value-added unit prices at the industry level. One goal of our paper is to examine a range of countries, covering both sides of the trade equations, i.e. low cost as well as higher value-added, exporters. Value-added prices at the industry level are not available for the majority of the countries in our sample, thus we need to proxy this price series. We have done this by collecting unit import values at the industry level for 65 economies.[4] Once imported goods enter the domestic market, they compete fully. Thus, import prices could be a good proxy for domestic prices in a competitive market. However, proxying domestic value-added prices with import unit prices means, to the degree these two price series diverge, that we are potentially introducing noise into our estimation.[5] Given that the purpose is to ascertain the trade variable's effect on wages as they pass through observed price changes, using import prices could potentially bias the results in favour of finding no effect as import prices are less likely to encompass more relevant domestically-based price impact. Thus any results we do find using import prices are more likely to be robust.[6]

3. We follow Edwards and Lawrence's (2010) empirical specification. However, we note that Edwards and Lawrence have a different objective, and thus ultimately, a different specification, in their paper. They look in more detail at the incomplete specialisation assumption in the HO/SS framework as well as using more detailed information for the United States.

4. As detailed in the Data Annex, this series was obtained using the CEPII-BACI database.

5. We investigate the degree to which this may influence our results by using a variety of specifications in a two-stage least squares approach, including using instrumental variables in the estimation of the price equation. Our results are broadly consistent with what is reported below and are available upon request.

6. In theoretical terms by extending the data to cover more countries which have less detailed information we introduce potential measurement error into our analysis. The consequences of measurement error, when it causes us to fail to capture the actual measure, could lead to a misinterpretation of the behavioural response. More specifically, measurement error may inflate the error term's variance when the error of measurement is correlated with the explanatory variable. On the other hand, when we consider errors-in-variables and assume the error in measurement is uncorrelated with the true explanatory variable

Tables 2.A1.1 and 2.A1.2 in the Data Annex of this chapter outline the countries and industries included in the study. Actual country/industry coverage in each regression depends on relevant variable availability. The time period encompasses 1988 through 2007, but most of the core regressions are based on complete information from 1995 through 2004.

We utilise the "Occupational Wages around the World" (OWW) database, provided by Freeman and Oostendorp[7], which contains occupational wage data for 161 occupations in over 150 countries from 1983 to 2003. We matched information on wages for occupations in 25 industries with imports, exports and bilateral tariffs for 93 countries for the years 1988 to 2007.[8] Industries were divided into three groups: primary products, final consumer products, and intermediate products to look for different patterns due to the nature and characteristics of the goods involved. The figures on employment we use come from the Bureau of Labour Statistics and are disaggregated into four big sectors: agriculture, mining, manufacturing, and services for ten OECD countries.

Table 2.A1.3 presents the ISIC Code, industry name, and the occupations included in these groupings. The industries contain varying numbers of occupations within them as a result of the aggregation and merging of the information. This also provides variation among the wage information within the different ISIC categories.

2.4. Graphic analysis and regression results

We begin our analysis by examining the trends in trade (imports, exports, and tariffs), wages, and employment over time in order to provide context for our analysis. The graphs shown divide the countries in the sample into two groups comprising OECD countries and non-OECD countries to tease out and identify differences between them.[9]

Trade, both in terms of exports and imports, for OECD countries present an upward trend coming down in the last years of the period of interest (Figures 2.A1.1 and 2.A1.2). This increase is evident for trade in intermediate products when compared to final goods. In addition, tariff levels remained low for the three product categories (primary, intermediate, and final) and tariffs in intermediate products show a steady decline (Figure 2.A1.3).[10] The highest recorded average tariff for OECD countries in the final products category is around the 10% level. On the other hand, non-OECD countries' exports and imports in intermediates show an upward trend which declines by the end of the sample period. Primary and final products do not show much volatility (Figures 2.A1.4 and 2.A1.5). Tariffs in non-OECD countries, on the other hand, decline considerably. For example, the average tariff decreases from above 60% to under 20%

but correlated with the observed explanatory variable the parameter estimates will be biased towards zero. We believe much of the exposure to measurement error in this dataset would be country-specific and thus captured by the fixed effects. For a thorough and intuitive treatment of measurement error refer to Judge *et al*. (1985).

7. The OWW database is publicly available at *www.nber.org/oww/*. Accessed on 15 February 2011.

8. Details of the wage, occupation and industry groupings are reported in the Data Annex.

9. See Table 2.A1.1 for complete country listing.

10. Services trade was not included due to the problematic nature of services trade data.

for final products; from around a maximum above 35% to 10% for both primary and intermediate products (Figure 2.A1.6).[11]

Turning to real monthly wages for both country groupings we note (naturally) that OECD countries (Figure 2.A1.7) are above the non-OECD countries real wage monthly mean (Figure 2.A1.8). This is clear for those occupations in the final consumer goods in particular. A peculiar pattern is the U-shape depicted by the evolution of mean monthly wages in OECD countries: they decline until 1996 and then change direction and begin rising. Real monthly wages for non-OECD countries do not portray much movement in the three categories until around 1996 when they rise steadily for primary, intermediates, and final goods.

We explored the correlations among these variables to tie them together before moving into more detailed descriptions. We calculated these correlation coefficients separately for both OECD and non-OECD countries and present the results in Tables 2.A1.4 and 2.A1.5, respectively.[12] The correlation coefficients revealed interesting associations as imports and exports were positively correlated between themselves in a statistically significant way among OECD countries. This is not the case in non-OECD countries. This could be due to the more diverse nature of the underlying sample of developing economies which includes, for example, China, Malaysia and Zimbabwe (Table 2.A1.1). We observed the same sign and statistical significance between exports and wages and imports and wages in OECD countries, but not in non-OECD countries. Finally, there were negative relationships among tariffs and exports; tariffs and imports; and tariffs and wages, and all of these were statistically significant for both OECD and non-OECD economies. These correlations do not imply any causal relationships. They simply are useful observations to relate and tie together this part of the graphical descriptive analysis.

Trade, tariffs, and wages across time

By disaggregating the evolution through time of key variables such as exports, imports, tariffs, and real wages by countries and broad sector categories we are able to identify which sectors experienced more dynamic movements across the sample period. We also consider movements in tariff changes in OECD and non-OECD economies (Figures 2.A1.3 and 2.A1.6, respectively). We identify a general opening up via tariff reductions and observed a positive correlation between trade and real wage movements for the majority of the countries investigated. Of course, there are a number of domestic factors that are absent from the analysis; nevertheless, these results suggest strongly that openness is *not* correlated with a decline of wages.

We go into more detail to obtain insights from the disaggregated data relating trade flows, tariffs, and wages. The countries covered, the United States and the United Kingdom, and later their trading partners China and France, respectively, were chosen mainly because they provide a contrast between major developing/developed country and developed/developed country trade.

US exports are dominated by intermediate goods (Figures 2.A1.9 and 2.A1.10). The final goods category stays constant throughout the sample period. Tariffs experienced small declines for both final and intermediate products, even though tariff levels for these are already low at less than 8% (Figure 2.A1.11). Tariffs for primary products reached a level of zero by the end of

11. Currie and Harrison (1997) for Morocco, Hanson and Harrison (1999) for Mexico, and Attanasio, Goldberg, and Pavcnik (2004), for Colombia are country studies documenting tariff reductions of similar magnitude to the ones just described.

12. We also examine these relationships for the four categories presented but, in the interest of space; do not report the results here. They are available upon request.

the sample period. Simultaneously, wages for all categories show upward movements (Figure 2.A1.12). The rapid rise in US real wages post-1995 is evident in these graphs.

Disaggregating both by category and by trading partner we look at the relationship in bilateral trade between the United States and China in three different industries, textile manufacturing, manufacturing of electronic machinery, and printing and publishing, in relation to the wages of the different occupations within the category. Combining US exports and imports into US net exports for the category we identify the country's position and trade's correlation to wages.[13]

All three occupation categories present negative net exports and the correlation with wages is negative suggesting a trade deficit does not imply low wages (Figures 2.A1.13-2.A1.15). Occupations that correlate with net exports in the first two categories seem to be related with the operation of machinery and, thus we speculate, the production process is mechanised. For example, for textile manufacturing the occupation descriptions of thread and yarn spinner, loom fixer, and cloth weaver all mention the individual operating machinery; and manufacturing of electronic machinery was classified as an intermediate product and the individuals working in it also operate complex machinery.[14] Earlier discussion pointed to the increase in intermediate trade worldwide and thus it is not surprising occupations in this category have wages which are correlated with trade flows. In the printing and publishing category we find not all occupations respond to net exports. The journalist; stenographer-typist; and labourer do not seem to be correlated with net exports. On the contrary, the job descriptions for printing pressman; hand compositor; bookbinder; and machine compositor, which do respond to net exports, include the explicit mention of operating machinery.

We looked at the United Kingdom's trade to provide an example of a trading European nation. Its trade does not show much dynamism with regards to primary or final products (Figures 2.A1.16 and 2.A1.17). Exports of intermediate goods show a trend upward, but it declines slightly around 2003. Average tariffs are well under the 10% level and show a trend downwards for all categories (Figure 2.A1.18). Average monthly wages in the United Kingdom show a steady increase (Figure 2.A1.19).

We calculate net exports for the United Kingdom and perform the same disaggregation in the same categories as with the United States, but consider the United Kingdom's trade with France as an example of two European trading partners. In this example, we observe different relationships in the different product categories: textile manufacturing; manufacturing of electronic machinery; and printing and publishing (Figures 2.A1.20-2.A1.22). The only category where occupational wages show correlation with net exports is manufacturing of electric machinery (classified as intermediate product). In this case, we only have wage information for two occupations: electronic fitter and electronic equipment assembler. Note the United Kingdom has positive net exports in this category which could suggest higher productivity by the firms operating in this ISIC code. The other two categories, textile manufacturing and printing and publishing, show weak correlations between monthly average wages and net exports. This makes any inference from them difficult, but also could suggest the presence and importance of local conditions in the wage setting process as Freeman (1995) explains.

13. We leave tariffs aside for now to explore the relationship between trade flows and wages.

14. The occupation descriptions are available at *http://laborsta.ilo.org/applv8/data/to1ae.html* accessed on 7 February 2011.

Before moving to the mandated wages approach, we present some basic price, wage and employment regressions to help us in our understanding the fundamental relationships posed by this dataset. While the focus of this paper is on trade and wages, previous literature has found that labour market adjustment to trade shocks may occur through changes in employment depending on the flexibility of the domestic labour market and imperfectly competitive product markets (Currie and Harrison 1997; Green *et al.* 2001). Moreover, Harrison (1994) notes that many developing country markets have few players and high barriers to entry. In this case, firms may cut profit margins and raise productivity instead of dismissing workers as a response to international trade. Therefore, in an effort to be thorough we present initial regressions on these three dependent variables.[15]

Table 2.A1.6 reports the results of these preliminary regressions. The overall sample results are shown in columns (1) and (2). The coefficients on TFP, output and the capital/labour (K/L) ratio are all negative and while output and K/L are insignificant and both trade variables are significant. As expected, imports have a negative and significant impact while the effect of tariffs on prices is positive. When we remove TFP from the estimating equation, the outcome for imports and tariffs remains unchanged; however, output and K/L become significant (column 2). Output has a negative impact while capital intensity has a positive one. This result seems to validate the point alluded to above that the impact of TFP may not be fully captured in our price proxy.

The table also shows the breakdown in results for OECD economies (columns 3 and 4) and those industries with high import penetration (column 5).[16] Like the overall sample, for OECD economies, K/L is insignificant and negative, however output is now significant and TFP is not. The impact of tariffs on prices for OECD economies is positive and significant but the coefficient is smaller than that of the sample as a whole, implying tariffs have a smaller impact on price changes for OECD economies. Imports, on the other hand, have a larger negative coefficient than the overall sample, indicating a stronger quantity effect. OECD economies experience a similar outcome when TFP is removed from the equation (column 4), that is, the K/L ratio becomes significant and is shown to have a positive impact on prices. The results for high importers show that tariffs have the only statistically significant impact on prices, and this remains so with or without TFP in the equation.

Moving to the wage equations we see the three structural variables, TFP, output and the K/L ratio significantly affect wages in the total sample, as well as in the OECD sub-sample. Both TFP and output have positive impacts while increasing capital intensity seems to put downward pressure on wages. These results are not surprising. The effects of TFP and output describe a movement along the supply curve and the result on the K/L ratio describes the substitution effect between capital and labour. Neither of the trade variables significantly impacts wages for the entire sample nor the two sub-samples. Taken together we see that the structural variables are significant in explaining both price and wages.

15. We make the caveat that the employment data only cover ten OECD countries with four big sectors. The ten OECD countries are: Australia, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, United Kingdom, and United States. The four sectors are: agriculture, industry, manufacturing, and services.

16. We define high import penetration as those industries where imports are more than 50% of output. Like all blanket measures, this is an imperfect approach since we will not capture those industries which have no domestic production. However, given our data is relatively aggregate (3-digit ISIC) we believe that it will provide a valid differentiation between those industries facing a large degree of import competition and those that do not.

Finally, the table also reports regressions with employment figures as the dependent variable.[17] The results show movements in employment due to international trade which would suggest part of the adjustment takes place through employment allocations which would fall in line with the assumptions in the HO model. Note, increases in the amount of imports tend to decrease domestic employment and tariffs tend to increase domestic employment. One reason explaining the decrease in employment is the displacement of domestically produced goods by lower priced imports reducing domestic production of goods. On the other hand, the increase in consumer prices when a tariff is applied to the price of a good would be a reason explaining the increase in employment. Other explanatory variables, such as TFP and output, show the expected positive sign associated with the parameter estimates suggesting increases in productivity and increased production would tend to increase employment.

Mandated wage changes

We now turn to the empirical analysis. The regressions outlined in equations (2) and (3) are run using a fixed effects model. This controls for the variation across industry and country groupings. To the extent that the variation in industry value-added prices is mainly found within a country, rather than across countries, the fixed effects model may also help control for the noise introduced by proxying domestic value-added prices with import prices.

When estimating the first step equation we want to capture the structural variables' effect on prices over and above their impact through TFP. Yet the results of the empirical analysis above show TFP has little impact on our price variable. In order to determine the validity of applying the standard approach we regress import prices on TFP and the structural variables. The structural variables are jointly statistically significant which, following Krugman (2000) and Feenstra and Hanson (1999), suggests the structural variables contribute to non-neutral shifts in technology.[18] Thus we report the results using effective prices, i.e. price plus TFP, as outlined in equation (2).[19]

Table 2.A1.7 reports the results of the first stage regressions. Consistent with the argument of productivity above, both the K/L and output variables have positive coefficients; although none of the individual results are statistically significant. These results are consistent for the OECD and high importer sub-samples as well.

As described above, the second stage of the estimation decomposes the dependent variables from equation (2) into that part explained by each structural variable, and then uses these components as the dependent variable in (3), where the independent variables are the shares of primary factors in the industries over 1995-2004 sample period. The coefficients of these regressions are interpreted as predicted factor-price changes due to the price impact of each structural variable. Consider the K/L ratio in Table 2.A1.8. It is estimated to have decreased the (real) price of capital by 0.013% annually over the period. Thus the price changes induced by

17. Please refer to footnote 15 regarding the coverage of the employment data.

18. An assumption of the underlying model combining price and TFP is that changes in productivity are "passed-through" to industry prices either because the country in question is large in world markets or because the technology shocks are common across countries. (Krugman, 2000). Our sample contains countries meeting both these criteria.

19. While we have validated this approach, we also ran a second set of regressions using price alone and including TFP as a structural variable. These results yielded the same conclusions as the effective price equations. Results are available upon request.

changes in the K/L ratio have mandated a reduction in the price of capital. No significant impact is shown for wages of skilled labour.[20]

Turning to the variables of most interest, the results show that both imports and tariffs have significant effect on the price of factors for the overall sample. Imports have a positive and significant impact on both labour wages and returns to capital while tariffs impact both negatively. This is consistent with the correlation coefficients reported in Tables 2.A1.4 and 2.A1.5. According to these results, imports have mandated increases in both the real wages of workers and returns to capital while tariffs have mandated reductions in factor returns.

These outcomes would provide credible evidence that the productivity effect of imports dominates. We find this explanation particularly probable given the results of the previous sets of regressions. Imports were seen to have a positive, if not significant, impact on wages as shown in Table 2.A1.6 while they were shown to have a significant and negative impact on prices. The result in Table 2.A1.8 shows that these import-related effects have led to an increase in wages and returns to capital. Tariffs, being more of a direct cost, have a negative impact.

Turning to the sub-sample of OECD economies, we find no statistically significant relationship between factor prices and the K/L ratio, but there is a positive role for output. This would imply that greater output increases returns to factors through price effects. This may be interpreted as a size effect, where firms operating in large markets are able to pay workers higher wages.

When we turn to imports however, we find the impact is negative and significant on both factors. The impact on workers is -1.4%, implying that imports have reduced the return to skilled workers. The reduction to capital is 0.44%.These results are surprising given both the positive impact observed for the overall sample as well as the nature (i.e. large intermediate trade) of OECD trade. Given the composition of the sample used in these regressions, which is heavily dominated manufacturing sectors,[21] we must interpret the results in the context of the underlying sample. The majority of OECD imports come from other OECD economies and involve high value-added, skill-intensive production. To the extent that these industries are restricted in their ability to import, it would raise costs, relatively speaking, and lower returns to the factors used intensively in those industries, i.e. skilled workers and capital. This is evidenced by our tariff results. Thus, the negative impact of imports on factor returns could be due to non-measured trade barriers such as NTMs. Indeed, as noted above, Haskel and Slaughter (2003) suggested that NTMs may be playing a large role in the trade-wages link. This

20. Dumont *et al*. (2005) point out a statistical correction regarding the standard errors associated with the variables of interest in the second stage of the mandated wages approach. They show standard errors calculated in the way Feenstra and Hanson proceed are biased downwards. We investigated this issue and obtained negative variances. We accounted for this problem in two ways: 1) we calculated standard errors accounting for the correlation stemming from the product-country unit of observation which did not produce negative variances (which we present in the tables); 2) we calculated the standard errors in the way Dumont, *et al.* suggest and while we did not obtain negative variances, they differ from the ones obtained in 1). Further investigation of the differences between the standard errors associated with the parameter estimates in the second stage are out of the scope of this chapter.

21. In order to provide a consistent set of observations across both estimating equations, we had to drop many of those countries with incomplete or missing data for all variables under consideration. This reduced our sample from the original 60 economies listed in Table 2.A1.2 to 30, mostly EU economies. It also reduced our sample of industries in half.

explanation seems plausible given the positive association with import wages express in the overall sample results.[22]

We test this supposition by introducing an industry interaction term and re-estimating the equations.[23] We interacted factor cost shares with industry dummies to investigate which industries exhibited a negative relationship with mandated wage changes and imports. The results of the interaction terms are presented in Table 2.A1.9. Only those industry dummies that were found significant are shown. All of the five significant industries have a negative sign. We compared these industries with those reported in Dee *et al.* (2011) and find a consistency with highly ranked NTM industries.[24] This provides further evidence that NTMs may be playing a role in these results

For high import intensive industries, all factors with the exception of imports have a significant impact on wages and capital returns. While the import coefficient is not significant, its sign with respect to wages is positive, consistent with the overall results. The K/L ratio and output have positive impacts while tariffs negatively affect returns. While capital intensity drove down returns to capital in the total sample, in high importing industries, it has the opposite effect – raising returns to capital. This may be a reflection of quantity versus productivity impacts. Increasing capital intensity could be due to either increasing capital investment, or a decrease in the relative use of labour. It could be that in the overall sample, effects were dominated (albeit, only slightly given the very small size of the coefficient) by declining labour inputs while industries with high imports, experienced an increase in relative capital usage.

Measuring the role of trade on wage differentials

We now move to examining the influence that trade (in the form of imports) and trade policy (in the form of tariffs) has on wage differentials. We define wage differentials as the difference in wages in occupation *p*, industry *k* between countries *i* and *j*. For example, the difference in the wages paid to weavers in the textile industry in the United States and China. We regress on wage differentials the amount of imports of textiles from China to the United States and the tariff rate applied in the United States on Chinese textile imports.[25] We report our findings in Table 2.A1.10.

Table 2.A1.10 reports results using several specifications.[26] First we examine the link between imports and tariffs only on wage differentials. The sign on the coefficient of imports is negative and significant, implying that the bigger the imports the smaller is the wage differential. When we break these findings down further by skill, we find the impact of imports stronger on unskilled workers than skilled. The sign on tariffs is also significant but it is positive, indicating that large tariffs are associated with large wage differentials. Taken with the

22. Indeed, given that non-OECD economies make up a relatively small share of the remaining sample, it stands to reason that this positive result is strong.

23. No good quantitative estimates of NTMs are available for our sample. Given the limited sample size, we estimated these results using pooled OLS with dummies to control for fixed effects. The results were broadly consistent with those found in the original fixed effects model.

24. This is based on Table 2.2 reported in Dee *et al*. (2011) which presents *ad valorem* estimates of NTMs for US/EU trade.

25. See Data Annex for detailed definitions of these variables.

26. Additional variables examined included differentials in industry outputs, differentials in industry's share of GDP, differentials in number of employees and using dummies for both industry and year. Details of these outcomes are available upon request.

outcome reported above, one could infer that large imports have a significant and positive impact on domestic wages.

In column (2) we report the findings controlling for the level of capital intensity in the industry, using the capital/labour ratio (K/L). The findings for imports remain the same, however tariffs are now insignificant. The K/L is negative and significant, indicating that more capital intensive industries are associated with smaller wage differentials. This could be due to the fact that occupations that work with machinery may be more standardised with fewer differences between countries. This explanation is given weight by the fact that when we break these results down by skill, K/L is no longer significant for skilled workers yet is negative and significant for unskilled workers.

Column (3) shows the relationship if we control for the partner's share of total imports in this industry. The sign is significant and negative. The interpretation is that large trade partners are associated with smaller wage differentials. We also interact import shares with tariffs but the results (column 4) are not significant.

Our final model includes all variables as well as the interaction term [column (5)]. In this regression, imports are no longer significant and tariffs fall to the 10% level of significance. The impact of these variables is being captured by the import shares and the interaction of import share with tariffs. Here, the interpretation is that large importers with high tariffs are associated with larger wage differentials. However, the coefficient on the tariff variable was not robust to various specifications so its results should be viewed with caution.[27]

2.5. Conclusions

The graphical analysis in this paper provides an overview of developments relating trade, tariffs, and wages from 1988 until 2004. Correlation coefficients relate exports and imports with wages and tariffs for both OECD and non-OECD countries. The resulting evidence suggests wages fluctuate with trade flows, providing support for a SS view of trade. This view is also consistent with evidence of resource-driven model of production networks, i.e. taking advantage of different cost-saving opportunities offered to them in various countries. Moreover, examining certain country/industry pairs, we show that trade deficits are not necessarily associated with low wages and a trade surplus could be an outcome of higher productivity by the firms in that industry.

The regressions provide a more nuanced story. We find that imports have a positive impact on wages for the entire sample, yet a negative impact for the OECD economies alone. This negative impact repeats when the dependent variable is employment. However, imports do not significantly impact factor prices in import-intensive industries. These seemingly conflicting results could be due to the level of aggregation in the sample, the fact that we cover mostly manufacturing industries, and domestic particularities associated with specific countries in the way wages are set and the degree of flexibility in domestic labour markets in their response to import shocks. We provide evidence that the outcome associated with OECD economies could be due to other trade policies in the form of NTMs.

An analysis of wage differentials shows that the larger the trade is between countries, the smaller is the wage differentials. In sum, overall the evidence supports the contention that imports positively affect wages and we attribute this positive relationship to the productivity gains associated with these imports. These results, taken with the finding that large trade flows

27. Over certain time periods and for some industries, the tariff coefficient became negative and significant or not significant. Given that the sign of the coefficient varied, we must interpret this outcome with caution.

are related to small wage differentials implies that trade could lead to an upward wage conversion for skilled workers. That is, the inference is that imports may tend to bring wages up, rather than push wages down.

The implications for policy formulation are that the trade story is not simply a matter of protecting domestic workers from 'cheap' overseas imports. Imports do not, out of hand, cause wages to decline. On the contrary, we present evidence that trade barriers have a larger negative impact on wages. Policymakers concerned with the potentially detrimental impacts of further liberalisation on labour markets should be cautioned against focusing on negative outcomes. Taken as a whole, the evidence is that imports are good for wages. Potential negative outcomes on employment are best dealt with in the context of improving resource allocation rather than blocking imports.

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Annex 2.A1

Data

The data used in the above analysis are derived from a number of sources. The Occupational Wages around the World dataset by Richard Freeman and Remco Oostendorp was used to examine wages and occupations. Freeman and Oostendorp transformed the International Labour Organization's October Inquiry Survey into a consistent data file on pay for 161 occupations in over 150 countries from 1983 to 2003. The standardisation allowed for comparison across countries circumventing measurement problems such as differences in reporting units, quality of reporting sources, wage levels, and any other country specific issues. The wages are reported in domestic currency units and in US dollars. The figures employed were in US dollars and deflated using the deflators in the Penn World Tables to account for purchasing power parity issues.

The output, value-added, wage-bill were taken from the Trade, Production and Protection dataset as outlined in Nicita and Olarreaga (2006) and based primarily on World Bank data. It covers mainly manufacturing data at the 3-digit International Standard and Industrial Classification (ISIC) Rev 2 level. This dataset provides coverage for over 100 developed and developing economies from 1976 through 2004. Values for capital are obtained by subtracting the wage bill from value-added. Again, values are deflated using the Penn World Tables.

The import price series is taken CEPII BACI dataset (Gaulier, Martin, Méjean and Zignago 2008). This series contains a variety of import and export price series for over 250 countries from 1996 through 2004. Complete description of the data as well as derivation of the indices can be found at *www.cepii.fr/anglaisgraph/bdd/baci/non_restrict/price.asp*. We use the chained geometric Laspeyres index for the ISIC Rev2 series at the 3-digit level.

The TFP numbers are taken from EUKLEMS and described in detail in O'Mahony and Timmer (2009). This database estimated TFP values for 28, mostly European, economies for the period 1970-2005. This information was reported using the European NACE Revision 1 classification system. This data was supplemented with data from the Asian Productivity Organisation (APO) out of Keio University, Tokyo, Japan. This organisation publishes productivity estimates for a number of Asian Economies from 1970 through 2007. We were able to obtain TFP estimates for Korea, Indonesia, China, the Philippines and Thailand from this source. Unfortunately, detailed industry-level data was not available. Thus we applied economy-wide estimates to the industry level detail along with a dummy variable to control for this effect. The dummy was not significant in any of the regressions here.

Data on import and export flows are from the COMTRADE database and tariffs were taken from the TRAINS database. Both sources report values in ISIC Rev2 at the three digit level for a period from 1995 through 2007.

The factor shares are derived using data from the Global Trade Analysis Project (GTAP). This publicly available, completely documented (Dimaranan and McDougall (2002) and Badri and Walmsley (2008)) database provides input-output tables for between 45 and 85 countries (depending on the database version), 57 sectors and 5 factors of production for the years 1997, 2001 and 2004. Factors of production are: skilled labour, unskilled labour, capital, natural resources and land. We calculate our factor shares using skilled and unskilled labour and capital.

The derivation of skilled versus unskilled labour is econometrically estimated based on ILO statistics and generalised to GTAP economies based on income and education. Complete documentation of the methods used to split total labour payments into skilled and unskilled can be found in Liu, *et al.* (1998). We use the values for 1997 to complete the series for the years through 2000, and for 2001 for the years up until 2003.

The employment data comes from the Bureau of Labor Statistics International Labor Comparisons. The coverage of the employment data is limited to ten OECD countries: Australia, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, United Kingdom, and United States. Similarly, the disaggregation of the employment data is for larger sectors of the economy only. These sectors are: agriculture, industry, manufacturing, and services. To match the employment data to the wages and trade flows the latter had to be aggregated to four big categories. The employment data are available at *www.bls.gov/fls/flscomparelf/employment.htm* accessed on 29 June 2011.

We needed to then concord the different reporting standards from the various data source to one system – namely SICI Rev 2. We relied on published concordance schedules from the UN, as well as those available through the GTAP website. Finally, we also used Jon Haveman's website which provides concordances for a number of different data standards:

www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeConcordances.html.

Tables 2.A1.1 and 2.A1.2 list the countries and industries remaining while Table 2.A1.3 lists the occupations.

Table 2.A1.1. Country coverage[a]

Argentina	Morocco
Australia	Mozambique
Bangladesh	Netherlands
Belgium	New Zealand
Botswana	Peru
Brazil	Philippines
Canada	Poland
Chile	Portugal
China	Russian Federation
Colombia	Singapore
Denmark	Slovak Republic
Finland	Slovenia
France	South Africa
Germany	Spain
Greece	Sri Lanka
Hungary	Sweden
India	Switzerland
Indonesia	Taiwan, China
Ireland	Thailand
Israel	Turkey
Italy	Uganda
Japan	United Kingdom
Korea, Republic	United States
Luxembourg	Uruguay
Malawi	Venezuela
Malaysia	Viet Nam
Mexico	Zambia
	Zimbabwe

a. Country coverage varied for individual regressions depending on data availability.

Table 2.A1.2. Industry coverage[a]

ISIC	Description
111	Agricultural and livestock production
112	Agricultural services
113	Hunting, trapping and game
121	Forestry
122	Logging
130	Fishing
210	Coal mining
220	Crude petroleum and natural gas production
230	Metal ore mining
290	Other mining
311	Food manufacturing-1
312	Food manufacturing-2
313	Beverage industries
314	Tobacco manufactures
321	Manufacture of textiles
322	Manufacture of wearing apparel, except footwear
323	Manufacture of leather and products
324	Manufacturing of footwear, except vulcanized or moulded rubber or plastic footwear
331	Manufacture of wood and wood and cork
332	Manufacture of furniture and fixtures
341	Manufacture of paper and paper products
342	Printing, publishing and allied industries
351	Manufacture of industrial chemicals
352	Manufacture of other chemical products
353	Petroleum refineries
354	Manufacture of miscellaneous product
355	Manufacture of rubber products
356	Manufacture of plastics products not elsewhere
361	Manufacture of pottery, china and earthenware
362	Manufacture of glass and glass products
369	Manufacture of other non-metallic mineral products
371	Iron and steel basic industries
372	Non-ferrous metal basic industries
381	Manufacture of fabricated metal products
382	Manufacture of machinery except electrical
383	Manufacture of electrical machinery
384	Manufacture of transport equipment
385	Manufacture of professional and scientific
390	Other manufacturing industries
410	Electricity, gas and steam

a. Industry coverage varied for individual regressions depending on data availability.

Table 2.A1.3. Industry, occupation coverage

ISIC code	Industry name	Occupations included in industry
	Primary products	
21	Coal Mining	Coalmining engineer, Miner, Underground helper, loader
22	Crude petroleum and Natural Gas Production	Derrickman, Petroleum and natural gas engineer, Petroleum and natural gas extraction fe, Supervisor of general foreman
29	Other Mining and Quarrying	Miner, Quarryman,
111	Agricultural Production	Farm supervisor, Field crop farm worker, Plantation supervisor, Plantation worker
121	Forestry	Forest supervisor, Forestry worker,
122	Logging	Logger, Tree feller and bucker,
130	Fishing	Deep-sea fisherman, Inshore (coastal) maritime fisherman,
	Final consumer products	
311	Food Manufacturing	Baker (ovenman), Butcher, Dairy product processor, Grain miller, Packer
321	Manufacture of Textiles	Cloth weaver (machine), Labourer, Loom fixer, tuner, Thread and yarn spinner,
322	Manufacture of Wearing Apparel, except Footwear	Garment cutter, Sewing-machine operator,
323	Manufacture of Leather and Products of Leather	Leather goods maker, Tanner,
324	Manufacturing of Footwear	Clicker cutter (machine), Laster, Shoe sewer (machine),
331	Manufacture of Wood and Wood and Cork Products	Plywood press operator, Sawmill sawyer, Veneer cutter,
332	Manufacture of Furniture and Fixtures	Cabinetmaker, Furniture upholsterer, Wooden furniture finisher,
341	Manufacture of Paper and Paper Products	Paper-making-machine operator (wet end), Wood grinder,
342	Printing, Publishing and Allied Industries	Bookbinder (machine), Hand composito, Journalist, Labourer, Machine composito, Office clerk, Printing pressman, Stenographer-typist
	Intermediate Products	
351	Manufacture of Industrial Chemicals	Chemical engineer, Chemistry technician, Labourer, Mixing-and blending-machine operator, Supervisor or general foreman,
352	Manufacture of Other Chemical Products	Labourer, Mixing-and blending-machine operator, Packer,
353	Petroleum refineries	Controlman,
371	Iron and Steel Basic Industries	Blast furnaceman (ore smelting), Hot-roller (steel), Labourer, Metal melter, Occupational health nurse
381	Manufacture of Fabricated Metal Products	Metalworking machine setter, Welder,
382	Manufacture of Machinery (except electrical)	Bench moulder (metal), Labourer, Machinery fitter-assembler,
383	Manufacture of Electronic Equipment, Machinery and Supplies	Electronic equipment assembler, Electronics draughtsman, Electronics engineering technician, Electronics fitter,
384	Manufacture of Transport Equipment	Shipplater,
	Services	
410	Electricity, Gas and Steam	Electricpower lineman, Labourer, Office clerk, Power distribution and transmission engineer, Power-generating machinery operator

Table 2.A1.4. Correlation coefficients for OECD countries[a]

	Exports	Imports	Tariffs	Wages
Exports	1			
Imports	0.8242	1		
	(0.00)			
Tariffs	-0.3221	-0.5486	1	
	(0.0094)	(0.00)		
Wages	0.7093	0.7384	-0.6043	1
	(0.00)	(0.00)	(0.00)	

a. Significance levels in parenthesis

Source: Authors' calculations.

Table 2.A1.5. Correlation coefficients for non-OECD countries[a]

	Exports	Imports	Tariffs	Wages
Exports	1			
Imports	0.1060	1		
	(0.4282)			
Tariffs	-0.3977	-0.4126	1	
	(0.0017)	(0.0011)		
Wages	0.1733	0.0842	-0.4025	1
	(0.1743)	(0.5118)	(0.0014)	

a. Significance levels in parenthesis

Source: Authors' calculations.

Table 2.A1.6. Price, wage and employment equations[a]

Dependent variable	Total	OECD	High importer[c]	Total	OECD	High importer[c]			Total / OECD	High importer[c]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
TFP	-0.003*		-0.061		-0.273	0.148)*	0.172*	0.037	0.027	0.024
	(-1.89)		(-0.98)		(-0.42)	(1.81	(1.96)	-0.46	(1.96)	(1.57)
Output	-0.031	-0.035*	-0.090*	-0.083***	0.006	0.562***	0.525***	0.815***	0.081**	0.083**
	(-1.39)	(-1.92)	(-1.72)	(2.97)	-0.26	(3.73)	(2.92)	(15.25)	(5.10)	(5.44)
Imports	-0.082**	-0.106***	-0.149**	-0.176***	-0.114	0.073	0.068	0.181	-0.041*	-0.057**
	(-2.18)	-4.23	(-3.44)	(4.74)	(-1.52)	(-1.17)	(-1.06)	(-1.27)	(2.26)	(2.84)
Tariffs	0.068***	0.026***	0.045**	0.011	0.138***	-0.016	-0.026	0.044	0.041**	0.013**
	(-2.56)	(-3.28)	(-1.97)	(-1.25)	(6.51)	(-1.40)	(-1.52)	-0.87	(3.66)	(3.37)
K/L	-0.003	0.049***	-0.011	0.078***	0.02	-0.464***	-0.341***	-0.403***	0.009**	0.005
	(-0.17)	(3.65)	(-0.18)	(3.18)	-0.87	(13.40)	(4.16)	(15.32)	(3.03)	(1.54)
Con-stant	6.27***	6.65***	8.52***	8.44***	6.26**	2.03	2.61	3.19*	7.04	7.334
Obs	860	2731	734	2082	311	496	437	159	335	335
R-squared	0.12	0.06	0.2	0.09	0.28	0.73	0.68	0.94	0.27	0.25

a. Estimation is by fixed effect across country-industry groupings, robust t-statistics (in parentheses).

* p<0.10

** p<0.05

*** p<0.01. Values are reported in percent change.

b. All data are at the 3-digit ISIC sector. Prices are import price data using chained geometric Laspayre; Wages are the skill share of total wage bill. All variables are logged. .

c. High importer defined as those industries where the value of imports is 50% or more of total output.

Source: Authors' calculations.

Table 2.A1.7. First stage: determinants of effective prices[a]

Dependent variable	Total	OECD	High importer[b]
K/L	0.004	0.044	0.027
	(0.25)	(0.79)	(1.30)
Output	0.016	0.103	0.010
	(0.62)	(1.10)	(0.18)
Imports	0.005	-0.075	0.133
	(0.13)	(-1.18)	(1.11)
Tariffs	0.003	0.008	0.042
	(0.23)	(0.63)	(0.79)
Constant	8.95***	8.74***	7.20***
Observations	436	377	141
R-squared	0.01	0.02	0.04

a. Estimation is by fixed effect across country-industry groupings, robust t-statistics (in parentheses).

* p<0.10;

** p<0.05;

*** p<0.01. Effective prices are the log of import unit price plus the log of TFP. Values reported are percentage change.

b. High importer defined as those industries where the value of imports is 50% or more of total output.

Source: Authors' calculations.

Table 2.A1.8. Second stage: estimated factor price change[a]

Dependent variable	K/L	Output	Imports	Tariffs
Total				
Share of skilled labour	-0.039	0.110	0.032**	-0.041*
	(-1.21)	(1.38)	(1.99)	(-1.64)
Share of capital	-0.013***	0.014	0.007*	-0.013**
	(3.55)	(1.00)	(1.76)	(2.60)
Observations	436	436	436	436
R-squared	0.02	0.02	0.01	0.02
OECD				
Share of skilled labour	0.293	1.667**	-1.391***	-0.300**
	(1.47)	(3.45)	(3.24)	(2.45)
Share of capital	0.124	0.417**	-0.438***	-0.082*
	(1.62)	(2.41)	(2.91)	-1.93
Observations	377	377	377	377
R-squared	0.02	0.02	0.01	0.01
High Importer[b]				
Share of skilled labour	2.058***	0.123***	0.186	-2.428***
	(2.77)	(4.27)	(0.25)	(13.87)
Share of capital	0.755***	0.026**	-0.07	-0.708***
	(2.99)	(2.59)	(-0.29)	(10.61)
Observations	141	141	141	141
R-squared	0.19	0.01	0.04	0.11

a. Estimation is by fixed effect across country-industry groupings, robust t-statistics (in parentheses). * p<0.10; ** p<0.05; *** p<0.01. Values reported are percentage chance.

b. High importer defined as those industries where the value of imports is 50% or more of total output.

Source: Authors' calculations.

Table 2.A1.9. Second stage: estimations for OECD imports[a]

Skilled labour	Coefficient	Standard error	t-Statistic	P value	NTM rank[c]
Interaction industry[b]					
Footwear	-0.0389	0.011	-3.28	0.001	7
Printing, Paper	-0.0407	0.007	-5.61	0.000	10
Chemicals	-0.0478	0.009	-4.92	0.000	2 and 3
Non-metallic	-0.0397	0.007	-5.30	0.000	8
Metal products and machinery	-0.0356	0.008	-4.30	0.000	6
Capital					
Interaction industry[b]					
Food, Beverage, Tobacco	0.0165	0.004	3.82	0.000	9
Chemicals	-0.0123	0.004	-3.26	0.001	2 and 3
Plastics	0.0102	0.005	1.74	0.083	3
Metal products and machinery	-0.0072	0.004	-1.93	0.055	6
Professional and scientific measuring equipment	0.0067	0.004	1.76	0.079	5

a. Estimation is by OLS industry grouping dummies, robust t-statistics reported.

b. Results for selected significant industries shown. Complete results available upon request.

c. NTM rank based on table 2.2 of 25 industries reported in Dee *et al.* (2011). Two ranks reported for industry specifications that span two NTM categories.

Source: Authors' calculations.

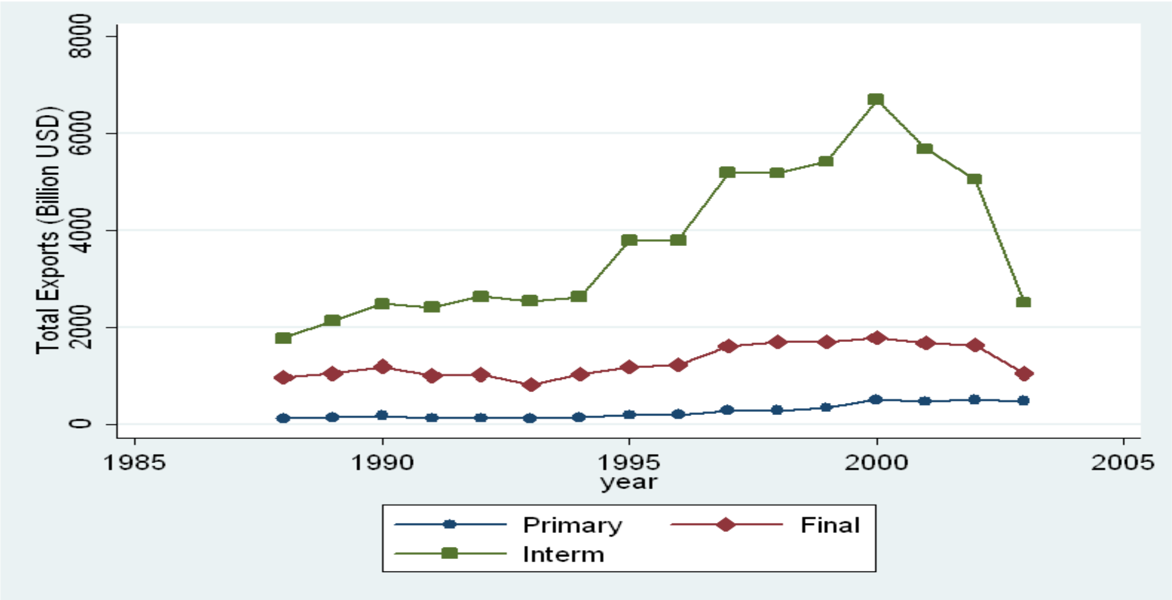
Table 2.A1.10. Estimated trade impact on wages differentials[a]

Dependent variable: DiffWage	(1)	(2)	(3)	(4)	(5)
Imports	-0.089***	-0.051***	-0.016***	-0.016***	0.009
	(-64.92)	(-24.21)	(2.96)	(-2.96)	(1.35)
Tariffs	0.033***	0.001	0.034***	0.034***	0.028*
	(6.66)	(0.22)	(4.73)	(2.91	(1.81)
K/L		-0.077***			-0.091***
		(-15.87)			(-11.08)
Importshare			-0.073***	-0.074***	-0.073***
			(-12.72)	(-12.32)	(-8.75)
Importshare*tariffs				-0.000	0.009***
				(-0.09)	(2.82)
Observations	23603	11393	10161	10161	4675
R-squared	0.47	0.51	0.47	0.47	0.52

a. Estimation is by OLS using country dummies, robust t-statistics (in parentheses), * p<0.10; ** p<0.05; *** p<0.01.

Source: Authors' calculations.

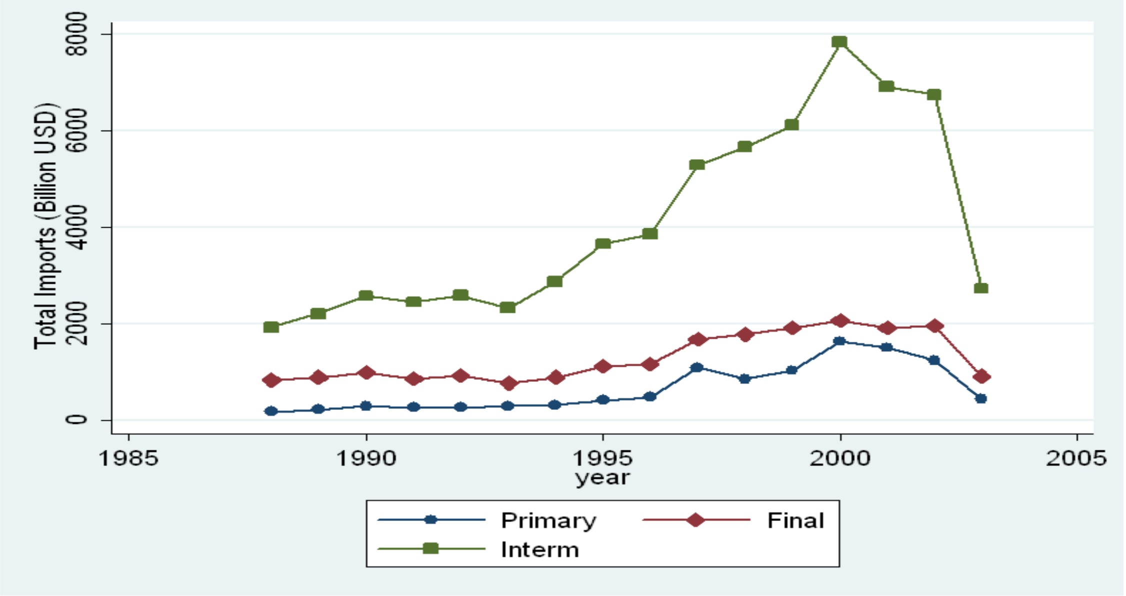
Figure 2.A1.1. Total exports by categories OECD countries (1988-2003)[a]



a. United States not included in 2003.

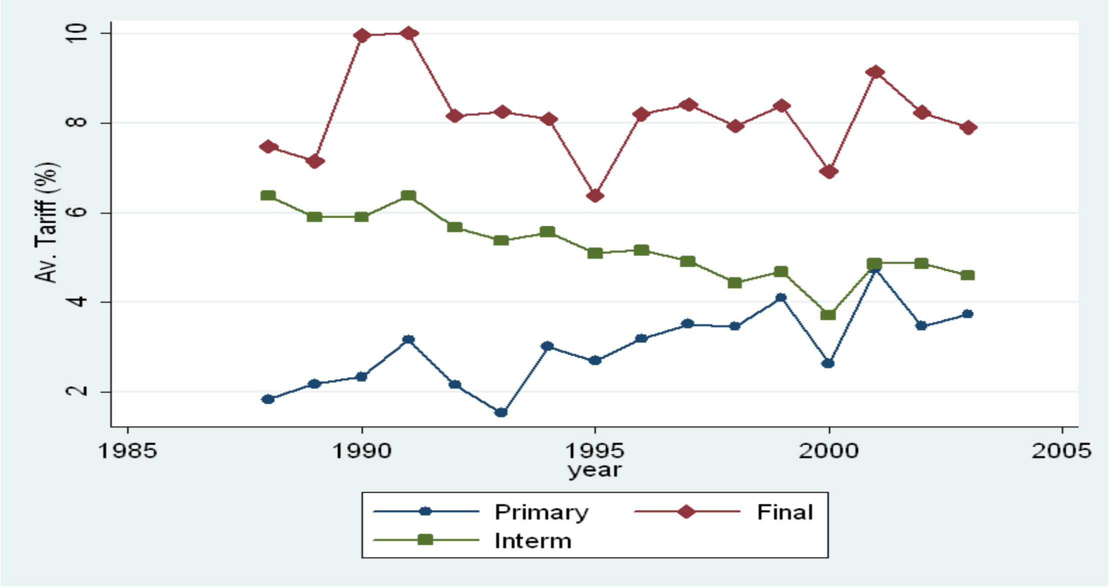
Source: Authors' calculations.

Figure 2.A1.2. Total imports by categories OECD countries (1988-2003)[a]



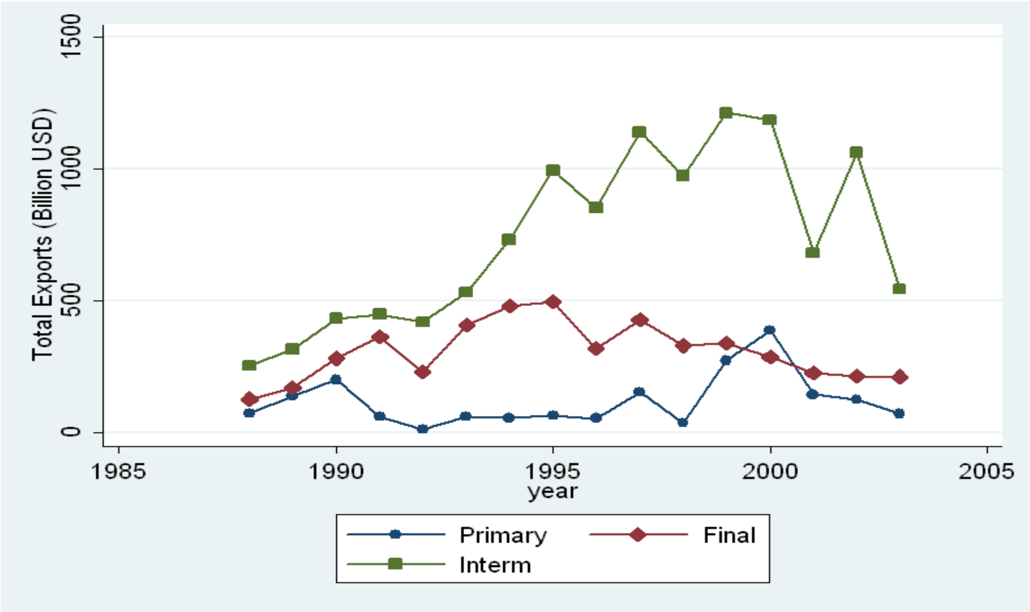
a. United States not included in 2003.
Source: Authors' calculations.

Figure 2.A1.3. Average tariffs by categories OECD countries (1988-2003)[a]



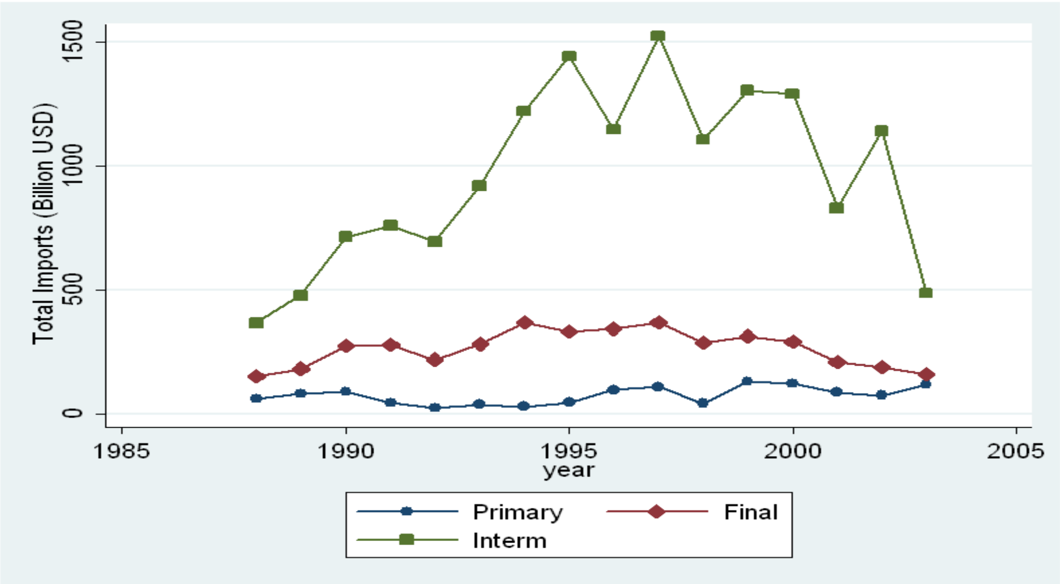
a. United States not included in 2003.
Source: Authors' calculations.

Figure 2.A1.4. Total exports by categories non-OECD countries (1988-2003)



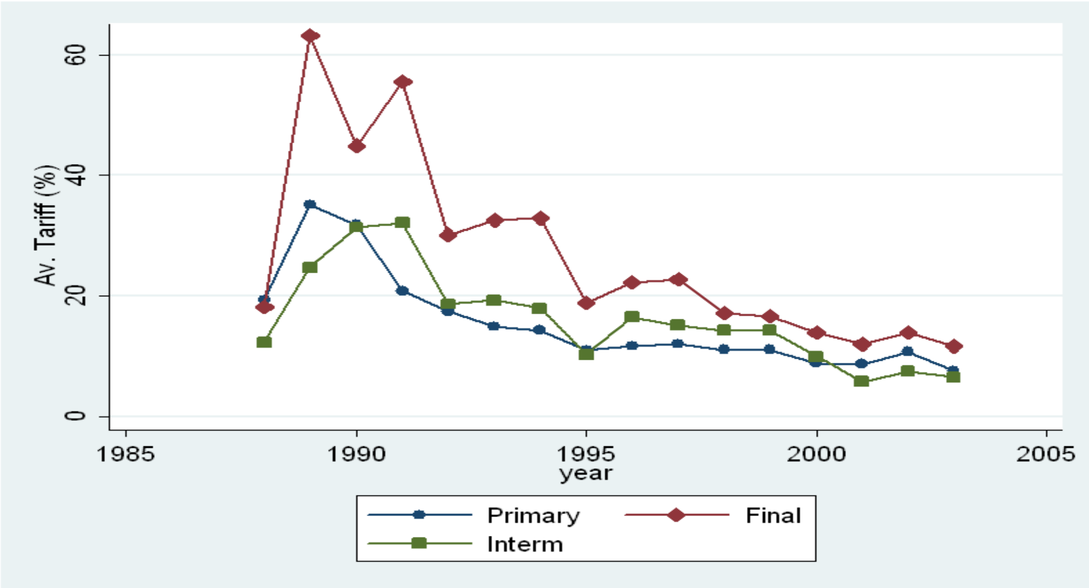
Source: Authors' calculations.

Figure 2.A1.5.Total imports by categories non-OECD countries (1988-2003)



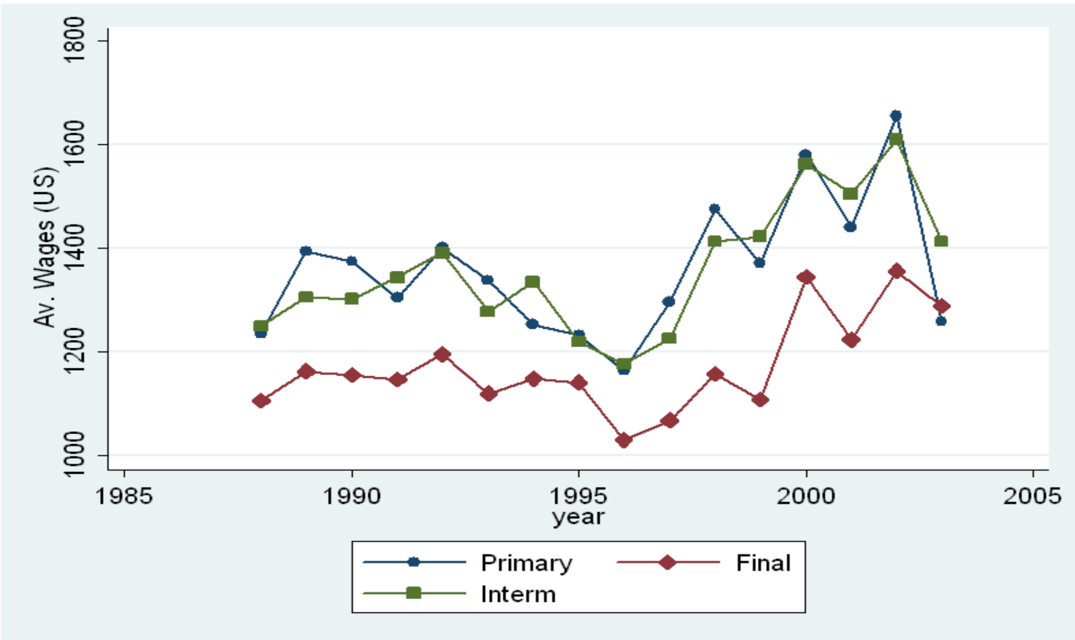
Source: Authors' calculations.

Figure 2.A1.6. Average tariffs by categories non-OECD countries (1988-2003)



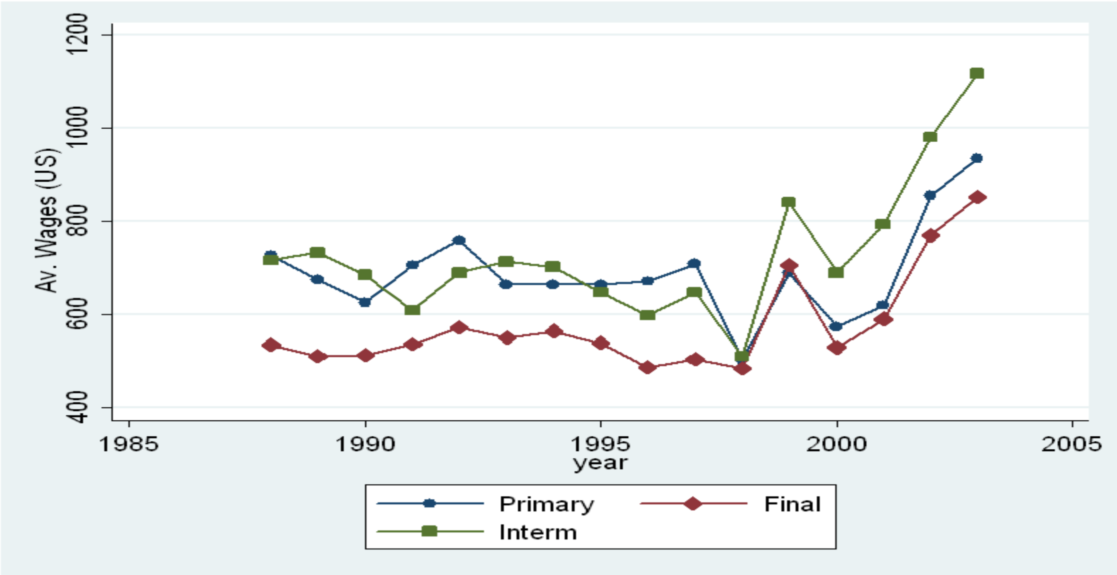
Source: Authors' calculations.

Figure 2.A1.7. Average wages by categories OECD countries (1988-2003)[a]



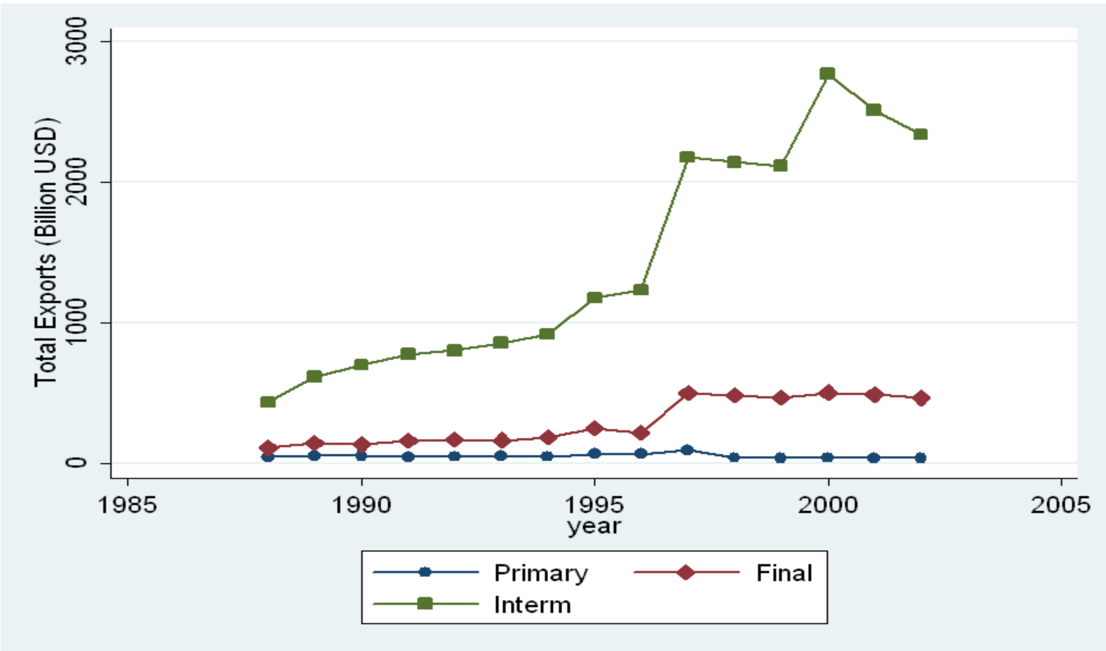
a. United States not included in 2003 due to lack of comparable wage data.
Source: Authors' calculations.

Figure 2.A1.8. Average wages by categories non-OECD countries (1988-2003)



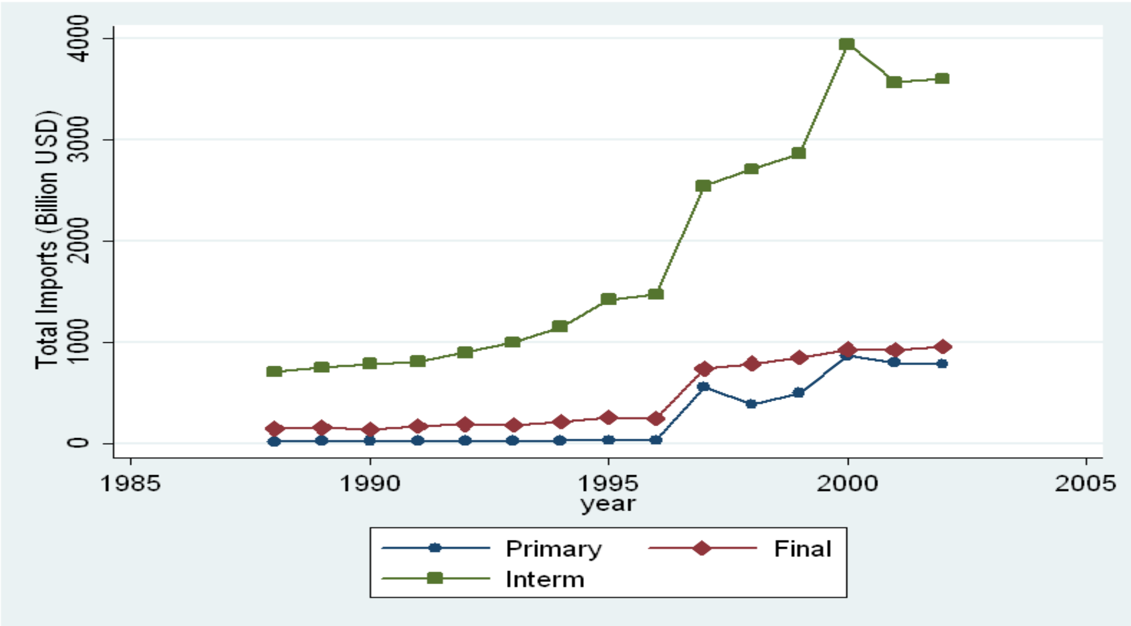
Source: Authors' calculations.

Figure 2.A1.9. United States' total exports by categories (1988-2002)



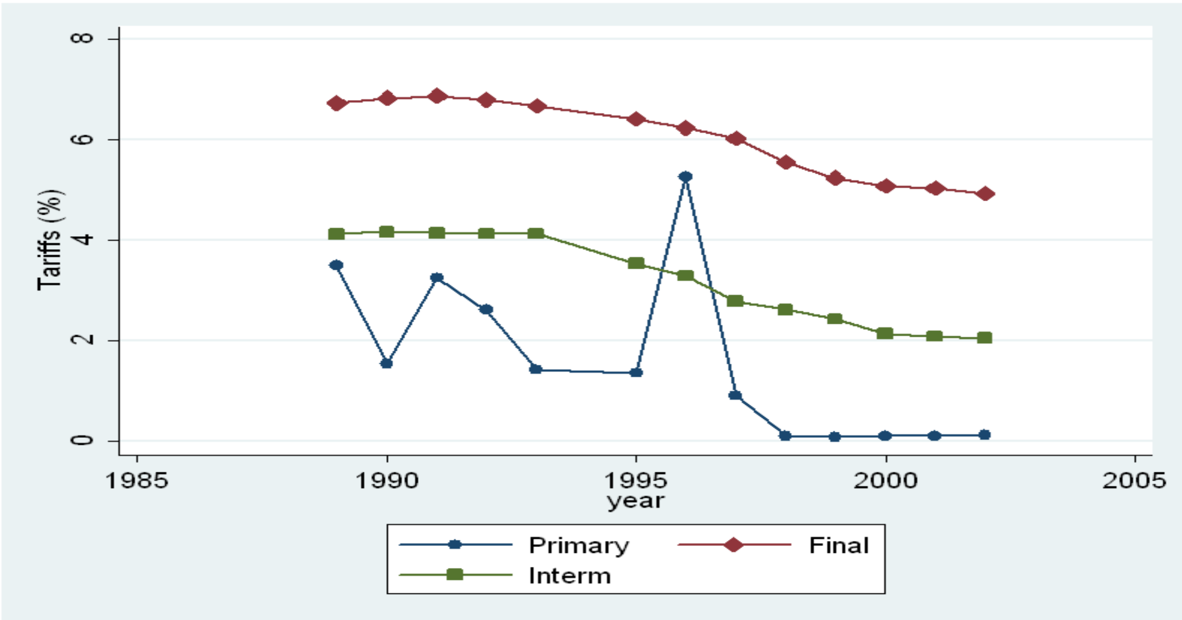
Source: Authors' calculations.

Figure 2.A1.10. United States' total imports by categories (1988-2002)



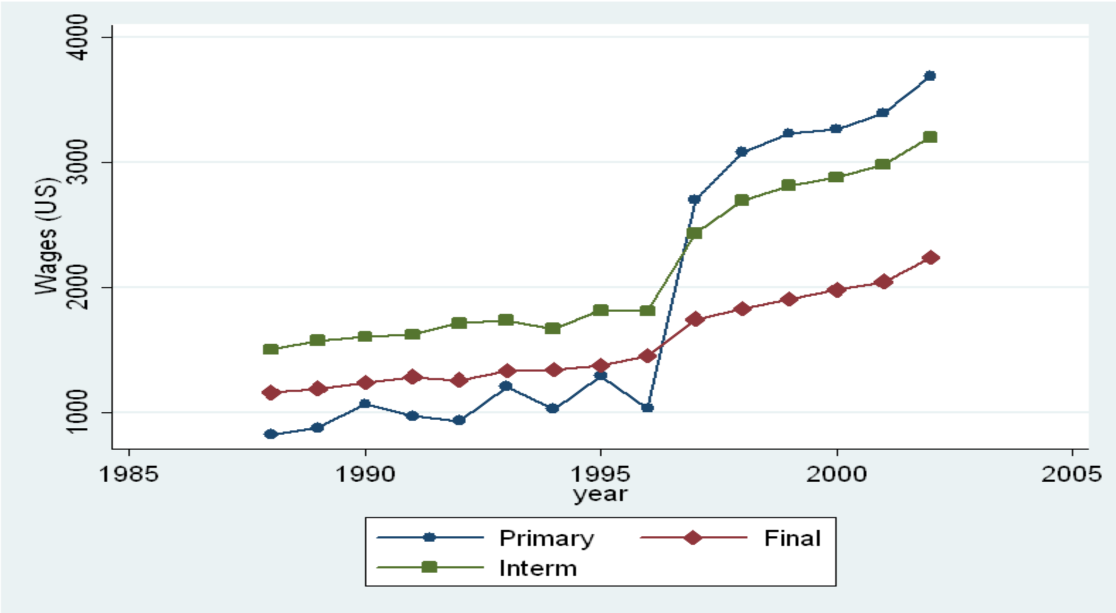
Source: Authors' calculations.

Figure 2.A1.11. United States' average tariffs (1988-2002)



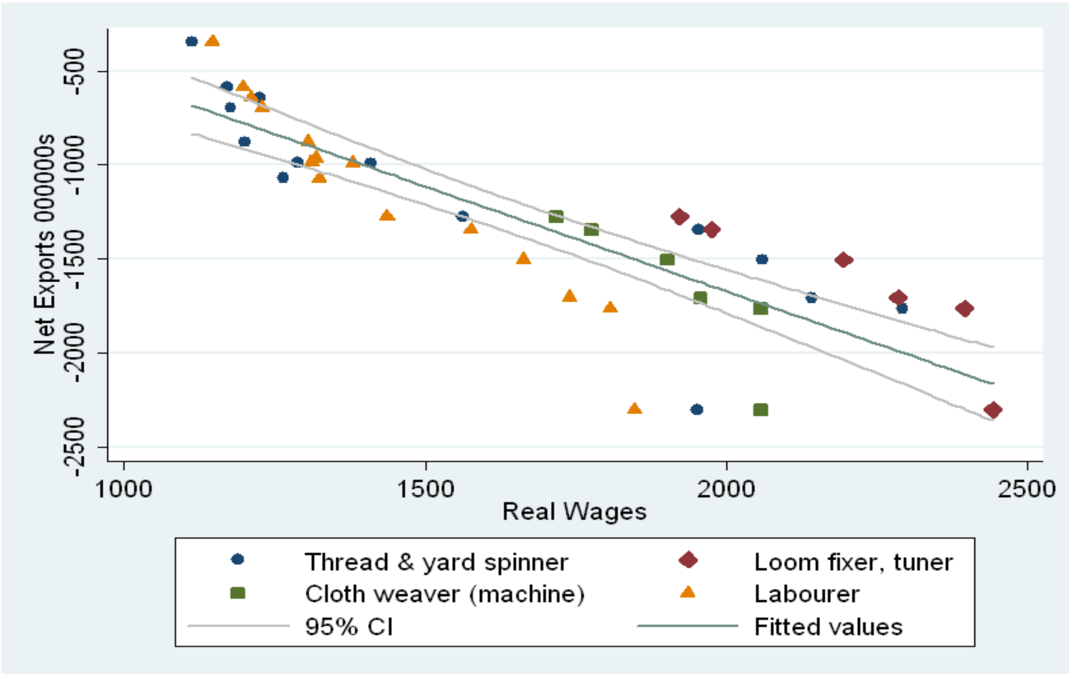
Source: Authors' calculations.

Figure 2.A1.12. United States' average wages (1988-2002)



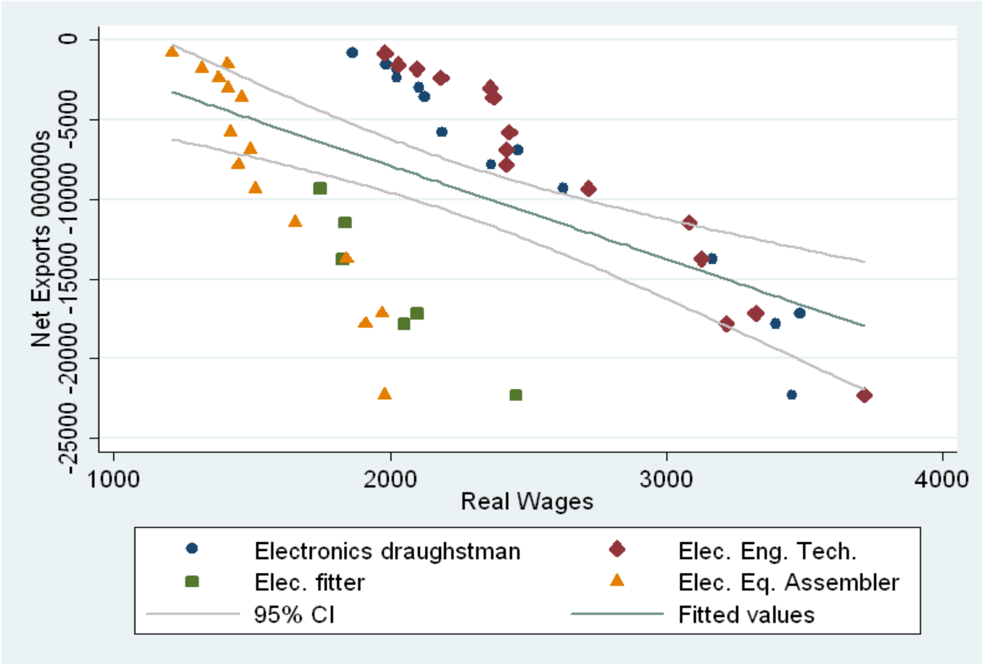
Source: Authors' calculations.

Figure 2.A1.13. US-China textile manufacturing: US net exports and real wages by occupation (1988-2002)[a]



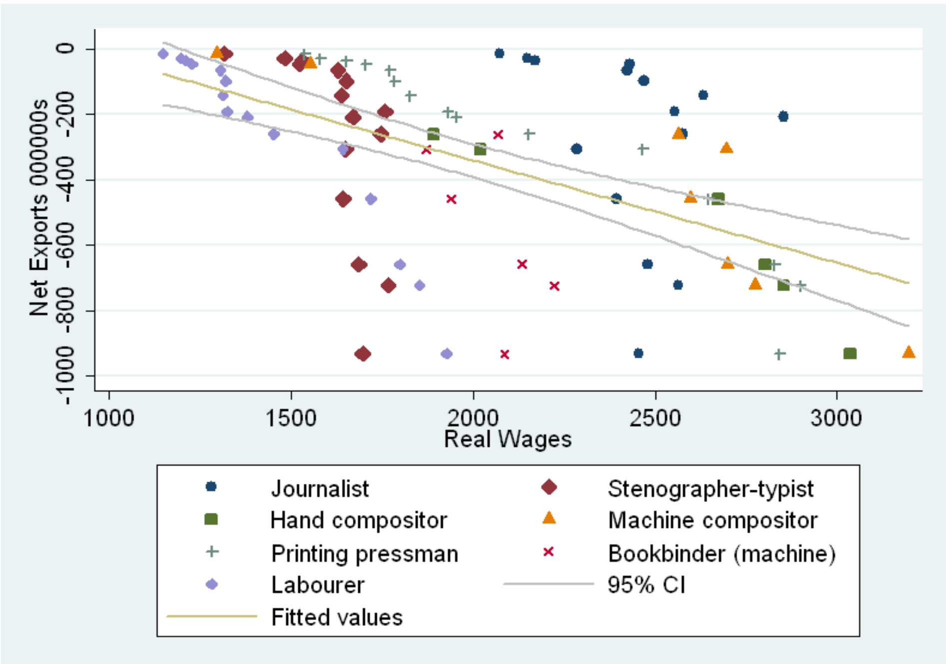
a. 95% CI represents a 95% Confidence Interval estimated around the fitted line.
Source: Authors' calculations.

Figure 2.A1.14. US-China manufacturing of electronic machinery: US net exports and real wages by occupation (1988-2002)[a]



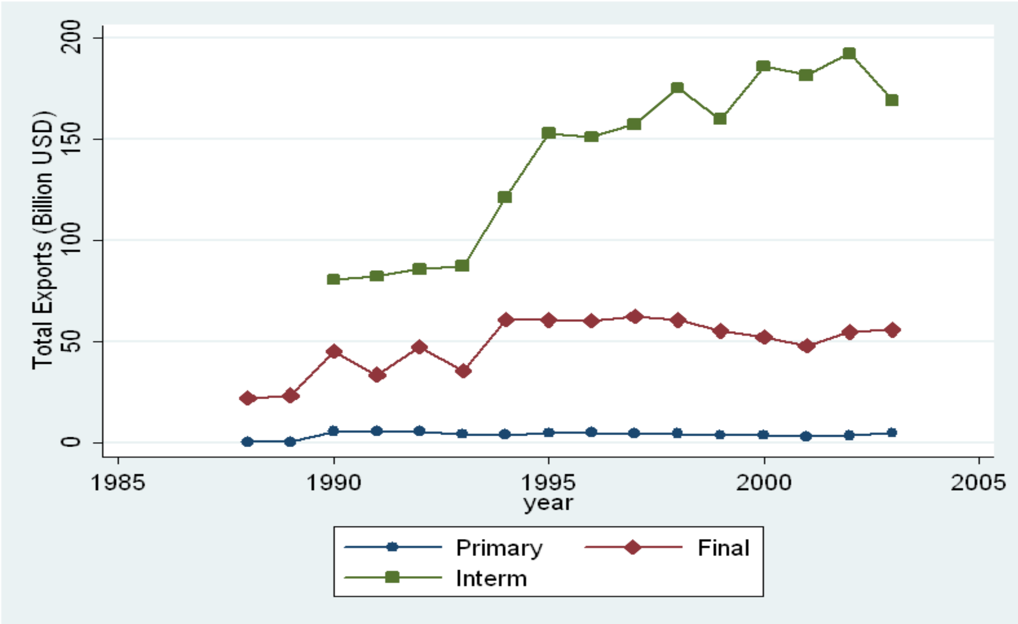
a. 95% CI represents a 95% Confidence Interval estimated around the fitted line.
Source: Authors' calculations.

Figure 2.A1.15. US-China printing and publishing: US net exports and real wages by occupation (1988-2002)[a]



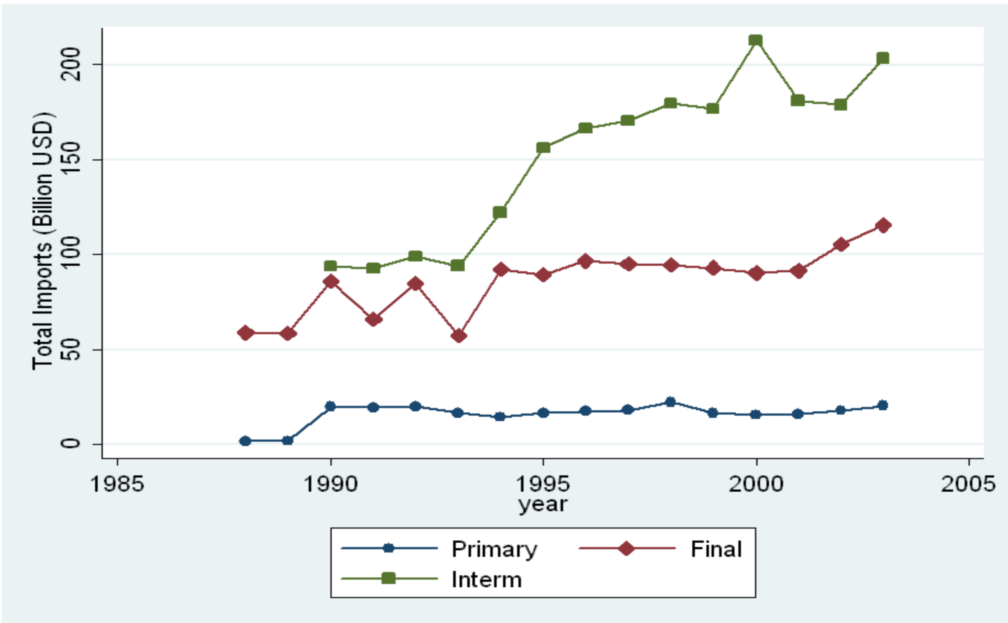
a. 95% CI represents a 95% Confidence Interval estimated around the fitted line.
Source: Authors' calculations.

Figure 2.A1.16. United Kingdom's total exports by categories (1988-2003)



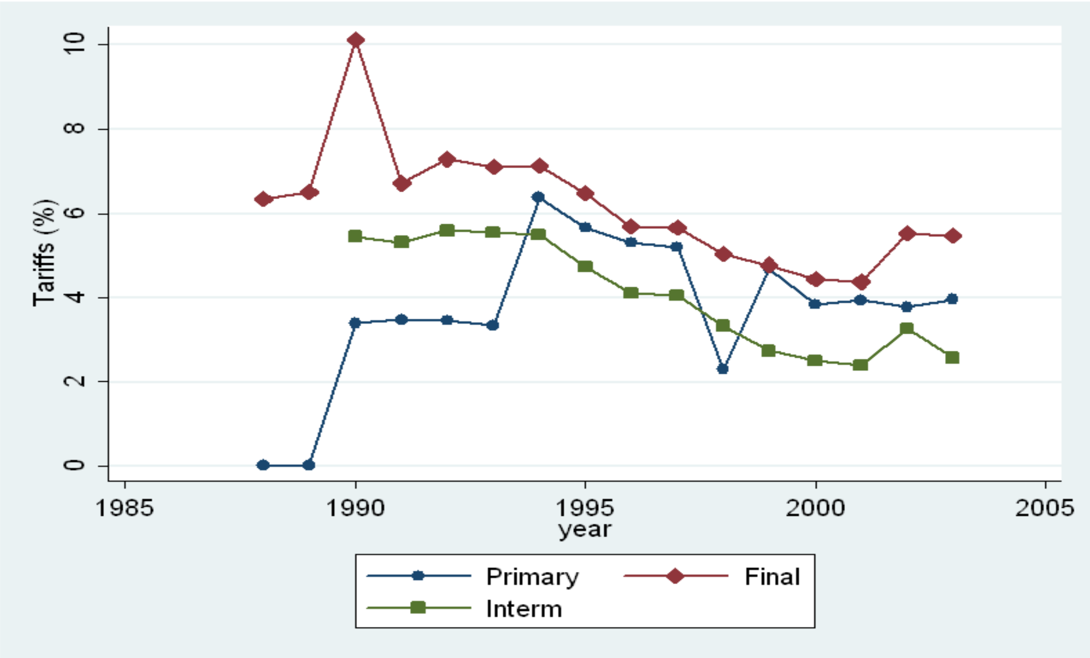
Source: Authors' calculations.

Figure 2.A1.17. United Kingdom's total imports by categories (1988-2003) Error! Bookmark not defined.



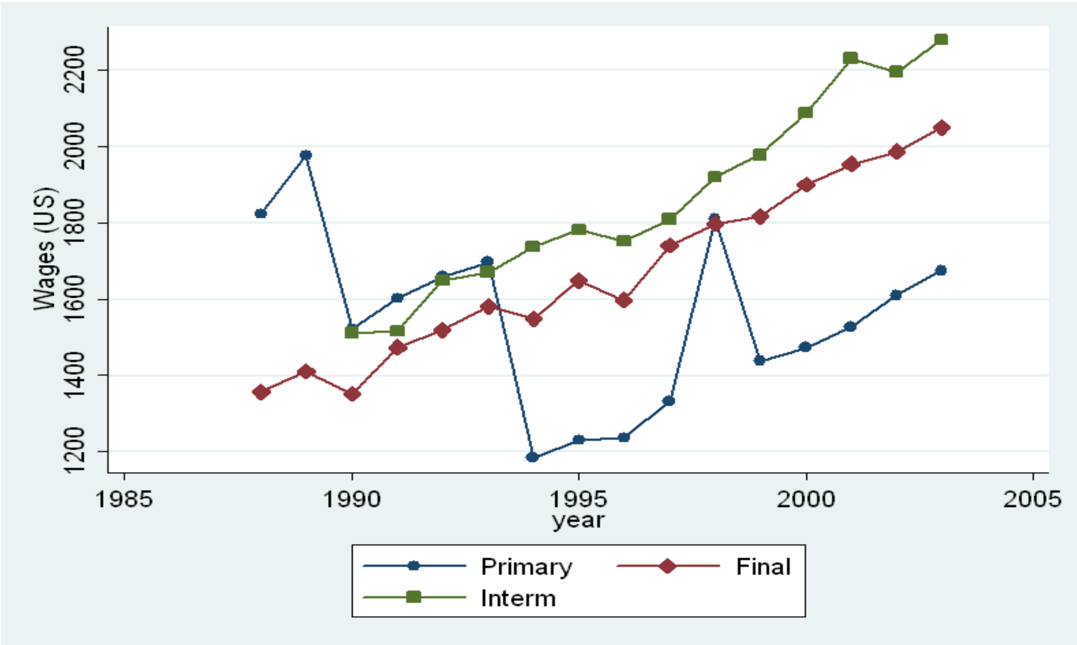
Source: Authors' calculations.

Figure 2.A1.18. United Kingdom's average tariffs (1988-2003)



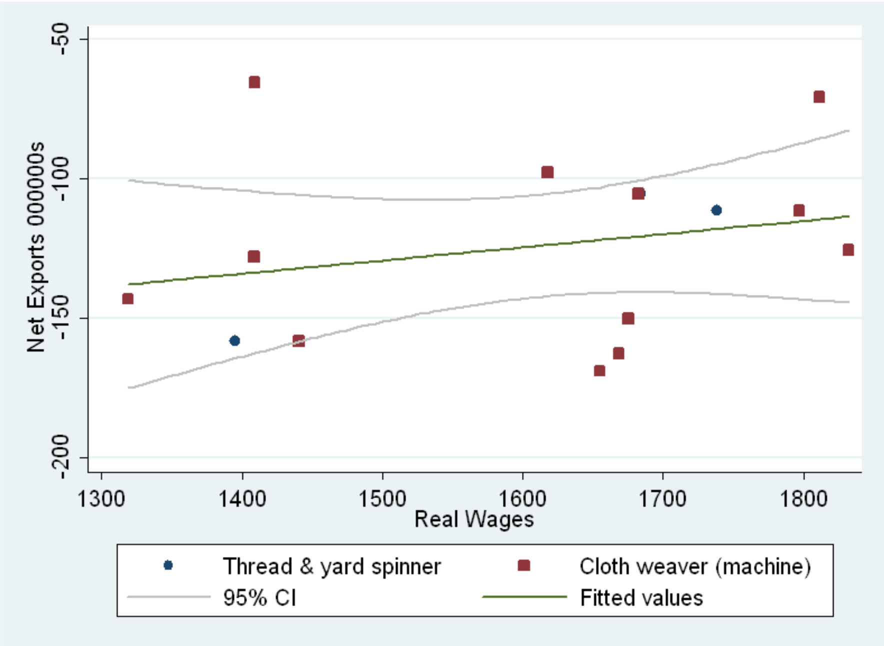
Source: Authors' calculations.

Figure 2.A1.19. United Kingdom's average wages (1988-2003)



Source: Authors' calculations.

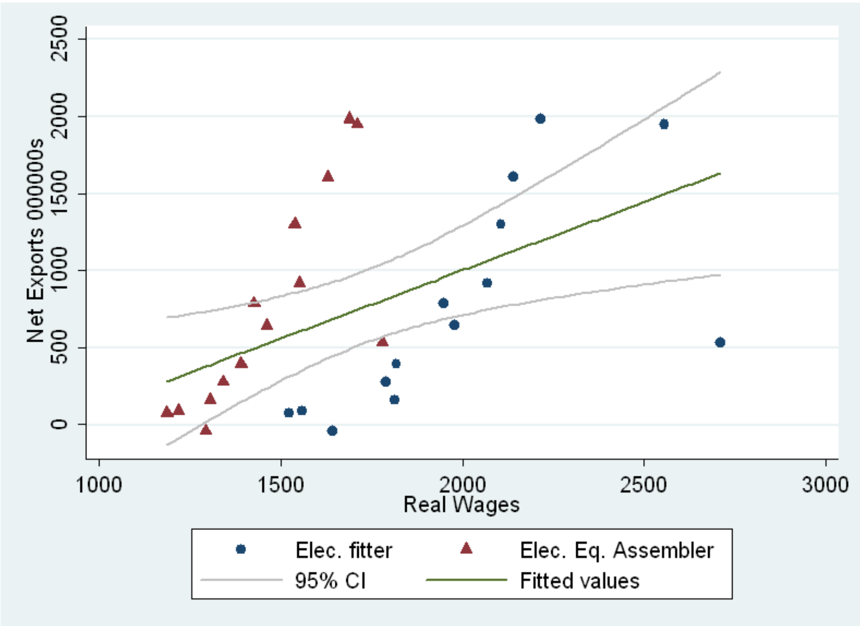
Figure 2.A1.20. United Kingdom-France textile manufacturing: UK net exports and real wages by occupation (1988-2003)[a]



a. 95% CI represents a 95% Confidence Interval estimated around the fitted line.

Source: Authors' calculations.

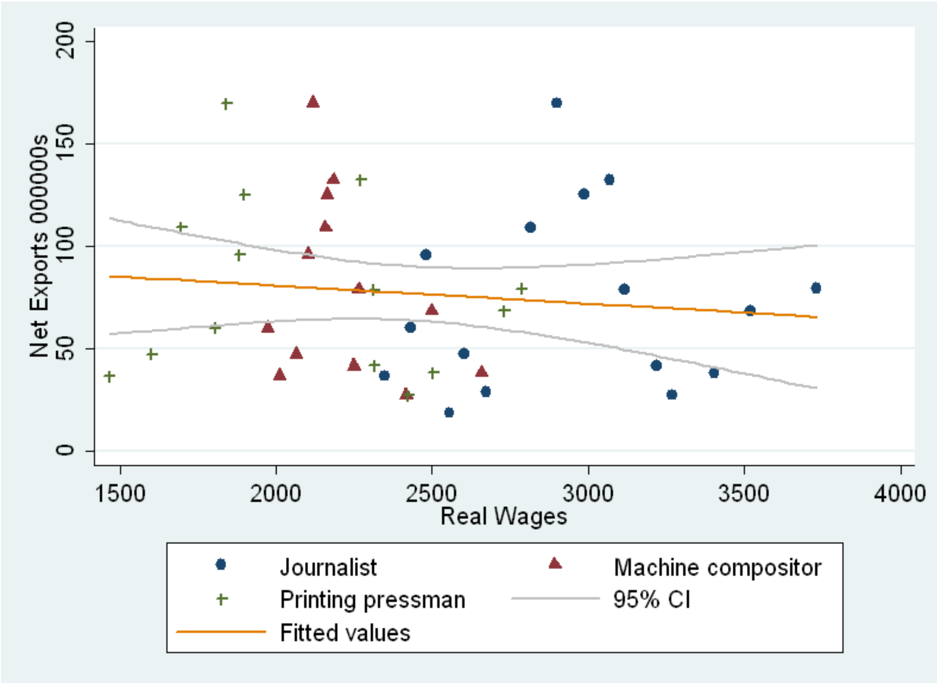
Figure 2.A1.21. United Kingdom-France manufacturing of electronic machinery: UK net exports and real wages by occupation (1988-2003)[a]



a. 95% CI represents a 95% Confidence Interval estimated around the fitted line.

Source: Authors' calculations.

Figure 2.A1.22. United Kingdom-France printing and publishing: UK net exports and real wages by occupation (1988-2003)[a]



a. 95% CI represents a 95% Confidence Interval estimated around the fitted line.

Source: Authors' calculations.