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（チリにおける経済自由化の実証研究）

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Empirical Analysis on Economic Liberalization in Chile

by

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Doctoral dissertation

Graduate School of Economics
Kobe University

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To the memory of
Prof. Shoji Nishijima

"Great ideas never die, and in many ways some of the key ideas spearheaded by Raúl Prebisch—one of the greatest Latin American economists who ever lived—are very much back in vogue. Prebisch thought that the economic structure really makes a difference: that what countries produce—whether they specialize in primary industries or in manufacturing—makes a real difference to their economic performance."

—Dani Rodrik

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Abstract

Chile is the first of Latin American and Caribbean countries (henceforth, LACs) to convert development strategy from inward-looking development strategy to outward-looking one. Following the military *coup d'état* that overthrew Allende's government in 1973, Chile introduced far-reaching economic liberalization including trade and financial liberalization, privatization, tax reforms, labor market deregulation, and macroeconomic stabilization. The economic liberalization has profoundly affected various aspects of socio-economic conditions of this country. In this regard, this thesis empirically analyzes the impacts of economic liberalization—especially trade liberalization—on the evolution of wage inequality and the transformation of industrial structure.

This thesis consists of five chapters. Although Chile has continued with economic liberalization during the past almost 40 years, it has followed a pragmatic approach learning from past mistakes—that is, the experience of Chile is not considered as a case of linear deepening of economic liberalization. From this view point, Chapter 1 overviews the experiences of economic liberalization in Chile, summarizes its achievements and pending issues, by surveying existing studies and making reference to author's own findings, and provides some policy lessons for other small LACs with rich natural resource endowment that liberalized their economies later in the 1980s and 1990s. This chapter suggests that the following two issues are of particular importance. First, the competitive and stable real exchange rate since the mid 1980s and reciprocal trade liberalization since the 1990s seem to play important roles in a broader context of sustainable economic development patterns propelled by export promotion in the early stage of the recovery. Second, the active prudential regulations and policies since the 1990s also have contributed to reduction of external vulnerability in the face of external shocks.

Chapter 2 analyzes the validity of using return to higher education (i.e., an education-based measure of skill premium) during Chile's economic liberalization period as a measure of wage inequality, when taking sample selection bias into consideration. The findings show that the return to higher education estimated by both ordinary least squares (OLS) and Heckman two-step procedures (Heckit), as well as other measures of wage inequality such as the Gini of wages, tend to move

precisely in the same direction up to the early 1990, especially in the aftermath of trade liberalization, in spite of persistent highly fluctuations in the unemployment rate during the mid-1970s and the 1980s. However, the return to higher education estimated by Heckit is substantially larger than that by OLS in more recent, post-2002 periods, although OLS and Heckit estimates of return to higher education still tend to move in a similar direction in this period. Therefore, we find that the use of the return to higher education as estimated by OLS, while limiting the sample to full-time salaried male workers, as a measure of wage inequality should not be overly problematic, although we need to be more cautious about the presence of selection bias in more recent periods.

Chapter 3 empirically analyzes whether trade liberalization has been associated with the evolution of wage inequality between skilled and unskilled workers (i.e., the log difference between skill premium for college equivalents and high-school equivalents) and identifies the channel through which it would affect wage inequality. For that purpose, Chapter 3 uses tariffs that are the most direct measure of trade liberalization, and covers only the post-1974 Chilean trade liberalization period. The findings show that tariff reductions contribute to increases in wage inequality by causing price reductions of unskilled labor-intensive goods that were protected with the highest tariffs prior to trade liberalization. In contrast, I find no evidence that skill-intensive technologies embodied in capital and intermediate goods caused skill-biased technological change (henceforth, SBTC). The findings can be explained by the de-industrialization after the abandonment of the import substitution of consumption goods that reduced the demand for imports of capital and intermediate goods. In addition, this chapter also shows that an increase in the relative supply of college equivalents does not contribute to wage equalization, while an increase in the minimum wages contributes to wage equalization during the period of the democratic governments.

Although Chile has applied a flat tariff since 1979, the import-weighted average applied tariffs (henceforth, applied tariffs) levied in each industrial sector have diverged from the MFN tariffs especially since the 2000s, owing to a wider preferential margin resulting from the proliferation of preferential trade agreements (henceforth, PTAs). Therefore, relative price changes caused by PTAs may have produced distributional impacts through industry wage premiums, unlike the sector-neutral impacts of uniform tariff reduction. Moreover, we need to cover not only manufacturing sectors but also natural resource-related sectors in the case of Chile, because Chile has succeeded in expanding non-traditional natural resource-based exports (e.g., fish, fruit, and forestry products), and thus, Chile has been the most successful LAC in terms of export-led growth.

For this purpose, Chapter 4 analyzes the impact of PTAs on wage inequality through a channel in which applied tariffs would affect industry wage premiums during 2000–2006, using nationally and regionally representative household surveys. The findings show that the skill premiums for high-skilled workers there to have decreased, especially after 2000; this circumstance

is unlike that seen in most other LACs or Chile's initial reform period. The results of econometric analyses show as follows. First, the industries which experienced larger tariff reductions were those with initially higher shares of low-skilled workers and lower industry wage premiums. Second, there is a statistically significant negative relationship between applied tariffs and industry wage premiums. However, the significance of applied tariffs on industry wage premiums disappear, after controlling for unobservable time-invariant industry characteristics; there is no general relationship between applied tariffs and industry wage premiums in all industries during 2000–2006. Thus, I find no statistically significant relationship between applied tariffs and industry wage premiums. The findings suggest that, unlike a theoretical assumption that tariff reduction-induced productivity improvements lead to increases in industry wage premiums, industries with initially higher productivity tend to have lower applied tariffs and higher wage premiums in such a short time-period. Therefore, I cannot conclude that bi- or plurilateral trade liberalization during this period has contributed to wage equalization through a channel in which applied tariffs affect industry wage premiums.

Chile has succeeded in creating new kinds of export products, which were hardly exported before the economic liberalization, and in diversifying the export basket among natural resource-based products since the mid-1980s, as mentioned in Chapter 4. Therefore, Chapter 5 analyzes whether non-traditional natural resource-based export sectors produced different domestic inter-industrial linkage effects compared with the traditional mining export sector, because the nature of the countries' export sectors would show the production patterns of the economies in question. For this purpose, Chapter 5 reconstructs three input-output tables from 1986, 1996, and 2003, in order to perform inter-temporal comparisons of linkage effects. The findings show that the backward linkage effects of non-traditional natural resource-based export sectors increased, with the trend being especially evident in the wood and wood products, and the fish products sectors. However, the backward linkage effects of the copper sector did not increase and continued to be stably low. Moreover, this chapter finds that the ratio of domestic intermediate inputs, like prepared animal feeds, substantially increased in the fish products sector. These findings corroborate the fact that salmon aquaculture has developed backward linkages with domestic suppliers. On the other hand, this chapter also finds the persistent weakness of backward linkage effects of the entire economy and manufacturing sectors, especially the heavy manufacturing sectors, contradicting the general assumption of the transformation of industrial structure when accompanied by economic development. Therefore, the findings indicate the limitations of Chile's current export-led development strategy

1

Achievements and Problems of Economic Liberalization in Chile

1-1. Introduction

Chile is the first of Latin American and Caribbean countries (henceforth, LACs) to convert development strategy from inward-looking to outward-looking one, i.e., far-reaching economic liberalization including trade and financial liberalization, privatization, tax reforms, labor market deregulation, and macroeconomic stability.[1] Although Chile has continued with economic liberalization during the past almost 40 years, it has followed a pragmatic approach learning from past mistakes—that is, the experience of Chile is not considered as a case of linear deepening of economic liberalization. From this view point, this chapter reviews the literature on the experiences of economic liberalization in Chile, summarizes its achievements and pending issues, by surveying existing studies and making reference to author's own findings, and provides some policy lessons for other small LACs with rich natural resource endowment that liberalized their economies later in the 1980s and 1990s.

1-2. Overview of economic liberalization and its achievements

Chile often has been praised as the most successful country of economic liberalization among LACs and the experience of Chile has been considered as a case of linear deepening of economic liberalization. However, Ffrench-Davis (2005; 2008; 2010a) argue that the conviction that Chile has a uniform economic reform-regime is misleading and there are at least three sub-periods of economic liberalization. From this view point, this section discusses some important features of

[1] This thesis assumes that the term "economic liberalization" is interchangeably "(neo-liberal) reforms". The main feature of economic policies based on neo-liberalism is its emphasis on macroeconomic stability, liberalization of goods, services and capital market, and reduction in roles of government and public sector (Nishijima, 1995). This thesis mainly focuses on the second issue, especially liberalization of goods and services—that is, external reforms.

economic liberalization in comparison with pure neo-liberal reforms, and summarizes its main results and achievements across different periods (see Table 1-1).

1-2-1. Pure neo-liberalism

The first subperiod of economic liberalization (1973-81) started amid political and economic turmoil inherited in "socialist-populist Chilean experience" (Larraín and Meller, 1991) under the Allende's government. Therefore, the initial conditions of Chile preceding the reforms were an extreme case of price distortion and government intervention observable among LACs.[2] Thus, Chile implemented the reforms very rapidly because the existing situation was considered unacceptable (Stallings and Peres, 2000). One of the most serious problems in this period was high inflation exceeding more than 500% (October/ October) in the immediate aftermath of the military *coup d'état* in 1973.[3] The military government implemented across-the-board reduction of government expenditure including the eliminating of social subsidies, far-reaching privatization of government owned firms, and tax reforms,[4] in order to curb the inflation. As a result of those reforms, the annualized inflation rate came down to a 2-digit level, i.e., 91.9% in 1977 and the fiscal deficit/ GDP ratio decreased from 24.6% in 1973 to 2.6% in 1975. However, this "shock" stabilization program which started in April of 1975 led a large reduction in the level of economic activity; GDP declined by 13.4% in 1975 and the unemployment rate increased to 18.7% in December of that year.

The military government also carried out important external reforms during this period; tariffs levied in industrial sectors, which varied widely from 0% to 750% and their average stood at 94% at the end of Allende's administration, were progressively reduced and their dispersions decreased; a flat 10% tariff was applied to most goods by 1979, and countless non-tariff barriers were almost completely eliminated by the same year. Various kinds of liberalization related measures were also introduced; the multiple exchange rates were replaced by a uniform exchange rate, price controls including interest rates were removed, and restrictions on foreign investment were eliminated in 1974[5] and an important step towards capital liberalization was also taken in 1979.[6]

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[2] Chile had the lowest reform index averaged 0.316 preceding the economic reforms among main nine LACs. The reform index was created by Morley *et al.* (1999), which take values between zero and one, with one being the most reformed or free from distortion or government intervention (Stallings and Peres, 2000).

[3] The data source of macro-economic figures is Banco Central de Chile (2002) and the bank's web page (http://www.bcentral.cl/) and IFS (International Financial Statistics) 2009 CD-ROM, unless otherwise mentioned.

[4] Tax reforms were carried out in 1975. They aimed at increasing tax revenues and reducing the distortions generated by the old tax system—e.g., replacing a cascade type sales tax with a 20% flat rate value- added tax and unification of the corporate and non-corporate income taxes into a flat business tax (Edwards and Cox Edwards, 1987).

[5] In this regard, Chile withdrew from the Andean Pact in 1976, which adopted a common external tariff and regulated foreign capital.

However, the military government mishandled macroeconomic policies during this period (Nishijima, 1995). The authorities incorporated the exchange rate policy into the anti-inflationary policy in 1978;[7] they pre-announced the rate of devaluation and set a clear inflation rate, based on the assumption that the domestic inflation rate was linked to depreciation of nominal exchange rates popularly known as *tablita*. In July of 1979, the depreciation rate was equal to zero, that is, a fixed exchange rate regime was adopted.[8] As a result of this exchange rate regime, the real exchange rate was substantially overvalued because the domestic inflation rate was not actually equal to the world inflation rate, and as a result, current account deficit rapidly expanded. On the other hand, the current account deficit was financed by accumulation of foreign debt by private banks without proper prudential regulations,[9] under the circumstance of liberalized capital account and sizable differentials between domestic and foreign interest rates. Moreover, the external borrowing financed real estate sector investment, thereby creating a bubble economy. In that sense, economic growth between 1976 and 1981 was not "productive" development which linked to vigorous growth of real productive sectors, but "financieristic" development, although GDP grew 6.8% per year after the "shock" stabilization program introduced in 1975.[10] The accumulation of external imbalances and external debts were not sustainable amid historically high interest rates in developed countries in 1981 to 1982. As a result, the abandonment of fixed exchange rate regime in May of 1982 caused massive capital flights and a debt crisis, which again led Chile into severe recession; GDP declined by 13.4% and 3.5% in 1982 and 1983, respectively, and the unemployment rate of the Greater Santiago area increased to 23.2% in June of 1982.

The military government also applied the neo-liberal reforms to various areas of society in the name of "the seven modernization".[11] First, the new labor law was established in 1979. The prominent features of this law were the allowance of collective bargaining at the firm level, relaxation of the prohibition on workers dismissals, and restricted strikes. Second, new pension funds were administrated by private companies, i.e., *Administradoras de Fondos de Pensiones* (AFP).[12] Third, education reforms were carried out in 1980 to 1981. The major components of such

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[6] The elimination of restriction on bank's maximum ratio of foreign liabilities to equity greatly contributed to this step (Edwards and Cox Edwards, 1987).

[7] The stabilization program started in April 1975 did not consider using the exchange rate as an anti-inflation tool (Edwards and Cox Edwards, 1987).

[8] The nominal exchange rate was pegged at 39 Chilean pesos per US dollar.

[9] Almost all commercial banks had been privatized since 1975.

[10] Regarding the differences between "productive" and "financieristic" development, see Ffrench-Davis (2010b).

[11] The remaining four areas are the agricultural sector reform, health services reform, justice system reform, and administrative and regionalization reform. For more details, see Edwards and Cox Edwards (1987).

[12] Later, AFP contributed to deepening financial markets and an increase in private saving (Nishijima, 1995).

reforms were the decentralization of the school system and introduction of a voucher financing scheme in primary and secondary schools, and the deregulation of establishment standards, diversification of institutions, and introduction of a new financing system in higher education.[13]

In summary, the transition period introduced a series of stabilization programs and economic reforms which laid foundations for the forthcoming following period. However, the across-the-board opening and liberalization efforts did not take into consideration the importance of policy sequencing, especially capital account liberalization, leading to the financial crises and heavily undermined stabilization programs (Nishijima, 1995). Therefore, one of the important experiences from this subperiod was that the capital account opening should wait until a significant progress is achieved in stabilization and relative price adjustment, and adequate regulations on financial markets are in place (Corbo and Fischer, 1994).

1-2-2. Pragmatic neo-liberalism with a regressive bias

The second subperiod of economic liberalization (1982-89) was characterized by deviating from pure neo-liberalism and moving toward more pragmatic reforms to overcome and recover from the aforementioned deep crises (Ffrench-Davis, 2010a). The prominent pragmatic policies during this period are as follows. First, the military government intervened in private banks which were in danger of going bankrupt, assumed foreign debt of private banks and local debtors in 1983, and later, strengthened prudential regulation and supervision. Second, the uniform tariff rate was temporally increased from 10% to 35% during 1982–1984 and the nominal exchange rate continued to be devaluated, in order to reduce current account deficit. Third, the government introduced a novel exchange rate system, characterized by a crawling band exchange rate system in 1983. The main purpose of this policy was to maintain international competitiveness of Chilean exports by preventing real appreciation. By adopting this system, the authorities could not use exchange-rate pegs as nominal anchors for anti-inflationary policies. In fact, inflation rates of the 1980s remained at a 2-digit level. However, the authorities gave priority to the growth of productive sectors based on the export promotion, learning from the failures in the first subperiod of economic liberalization mentioned earlier, such as the collapse of the bubble economy and the debt crisis deriving from the accumulation of current account deficit under the fixed exchange regime from 1979 to 1982 (Hosono, 2002). Fourth, the government introduced several export promotion policies—especially, selective incentives to promote non-traditional exports, moving away from the across-the-board import

[13] Chile had only 8 traditional universities up to 1980. Due to the deregulation and diversification of the higher education system, private institutions were permitted to establish not only private universities but also non-university higher education institutions, namely, *Centro de Formación Técnica* (CFT) and *Instituto Profesional* (IP), with minimum establishment criteria and requirements.

liberalization policies of the first subperiod of economic liberalization. Among those selective export incentives, the simplified tariff drawback system (*Reintegro Simplificado*), introduced in 1985 for reimbursement of tariffs paid on imported inputs used for non-traditional exports, stands out.[14]

As a result of the introduction of pragmatic policies, the real exchange rate depreciated 52% during 1984–1990[15] and the current account deficit/ GDP ratio substantially decreased from 14.5% in 1981 to 3.6% in 1987. Accordingly, macroeconomic performance significantly improved after 1984. The fiscal deficit/ GDP ratio decreased from 4.3% in 1984 to about balance in 1989. The GDP growth averaged 6.6% per year from 1984 to 1989. Export performance was also impressive during this period. Exports expanded 7.8% per year from 1982 to 1989. The export basket became more diversified; the share of non-copper traditional exports such as fresh fruits and forestry products increased from an average of 17.2% in 1970-73 to 35.6% in 1982–89, while non-traditional exports, which included manufacturing goods with higher valued-added and new resource-based product, such as wine and salmon increased from an average of 8.3% to 17.5%,. During the same period the share of copper decreased from an average of 74.5% to 47.0% (Ffrench-Davis, 2010a).

A second round of economic liberalization began in 1985, as the economy started to recover. The banks that were intervened by the governments to prevent from bankruptcy were sold to the private sector again. Most of the basic industries that remained publicly-owned during the first subperiod of economic liberalization such as national nitrate, airline, telephone, and electric power companies were also progressively privatized. The uniform tariff was gradually reduced again, first from 35% to 30% in March of 1985, then to 20% in June of 1985, and to 15% in 1988. A foreign debt conversion program into Chilean assets (debt-equity swaps) was also set up in 1985. The ratio of external debt to GDP decreased from 113% in 1987 to 40% in 1994. The combination of the competitive exchange rate, low and flat tariffs, and the specific incentives such as drawbacks led to expansion of non-traditional exports (Labán and Larraín, 1995). In addition to the introduction to debt-equity swaps, export expansion in the early stage of the recovery was the key determinant of overcoming the debt crisis (Nishijima, 1995).

However, pragmatic policies in this subperiod were still heavily biased toward higher-income group, while a tough position was maintained towards lower-income group (Ffrench-Davis, 2005; 2010a). For example, full wage indexation (1976–81) was abolished in order to sustain the real depreciation, in line with the military government's repressive labor policy. Therefore, the expansion of non-traditional exports described earlier relied primarily on low wages. In fact, the real minimum wage index (1989=100) averaged 90.9 in 1984–89, which was even below

[14] Concerning the selective export incentives, see for more details Ffrench-Davis (2010a).
[15] The index of real effective exchange rate increased from 74.0 in 1984 to 112.7 in 1990 (1989=100).

the average of 103.6 in 1974–81, despite the sustainable economic growth during this period. In that sense, the pragmatic policies during this period was regressive.

1-2-3. Reforms to the neo-liberal reforms

The third stage of the economic liberalization began in 1990, accompanied by a transition to democracy. The experiences of democratic transitions in other LACs suggested that new democratic governments tended to fall into populist policies in the face of urgent and immediate pressures to improve the socioeconomic conditions of low income groups hit worst during the prolonged adjustment process (Nishijima, 1995). However, the center-left coalition government in Chile, known as Concertación, succeeded in avoiding a traditional cycle of populist policies, frequently evidenced in other LACs. The Chilean authorities continued with free-market, open economic policies and were committed to macroeconomic stability, based especially on fiscal discipline. In this regard, the equity-enhancing "Reforms to the neo-liberal reforms"—e.g., active social policies, and tax and labor reforms (to the reforms), were carried out in line with a "change-with-continuity" policy framework (Ffrench-Davis, 2010a). Thus, the increase in social spending in health, housing, pension and education for the poor was financed by tax reforms, without running a fiscal deficit. The central pillar of the 1990 tax reform was an increase in corporate-tax rate from 10% to 15%.[16] The labor reform to the 1979 labor reform was also carried out based on the tripartite negotiations between the government, the labor (*Central Unitaria de Trabajadores*), and the business (*Confederación de la Producción y del Comercio*). The prominent features of the 1990 tax reform were the allowance of collective bargaining at the industry level, the prohibition of the right of employers to dismiss workers with no specific explanation for such dismissal, and the elimination of the maximum 60 day limit for strikes.[17] The critics often expressed that the labor reform would push up real wages beyond productivity, and thus raise unemployment (Labán and Larraín, 1995). However, the unemployment rate was quite low and stable during the 1990s; the average unemployment rate of the Greater Santiago area of each June from 1990 to 1998 was 7.1%, while the index of real average minimum wage continued to improve from 106.8 in 1990 to162.5 in 1998 (1989=100).

One outstanding feature of the macroeconomic policy reform during the 1990s was an introduction of prudential regulations on capital inflows—namely, a non-interest-bearing reserve requirement on foreign loans and liquid inflows (*el encaje*)—in June of 1991. Chile was faced with

[16] The tax reform also included progressive personal income tax levy, in a way that increased the number of individuals in high marginal tax baskets, controls on tax evasion, and an increase in value-added tax from 16% to 18% (Boylan, 1996). The corporate tax was raised from 15% to16.5% in 2003 and 16.5% to17% in 2004.

[17] Labor reform was once again carried out in 2001.

massive capital inflows again from the end of the 1980s. The changes in global markets, the increasing international approval of Chilean economic policies, the high interest rates to control inflation remained at the 2-digit level until 1994, and the aforementioned smooth democratic transition stimulated capital inflows to Chile (Agosin and Ffrench-Davis, 1996). Learning from the mistakes of the first subperiod of the economic liberalization that resulted in the huge current account deficit financed by short-term and speculative capital inflows, the authorities attempted to shift the composition of capital inflows to long-term ones such as FDI and to allocate those funds in more productive investment (Ffrench-Davis, 2010a). At the same time, massive capital inflows continued to put pressure on the real exchange rate. With the view that a competitive and stable exchange rate is crucial for export expansion and diversification, the authorities introduced two important changes in 1992. First, the dollar peg of the official rate was replaced by a peg to a basket of currencies (*Canasta Referencial de Monedas*, CRM) with weights of 50 % for the dollar, 30 % for the deutsche mark, and 20 % for the yen. Second, the authorities widened the band from $\pm$5% to 10%. They were intended to make interest rate arbitrage between the dollar and the peso less profitable and prevent speculative capital inflows (Hosono, 2002). Therefore, the authorities maintained consistency of macroeconomic policies by adopting intermediate exchange rate regimes, such as crawling pegs or basket pegs, in conjunction with macro prudential policies, which include regulation on capital inflows.

The set of those policies was successful in reducing short-term and volatile capital inflows and while increasing long-term and more stable inflows, such as FDI, and also keeping the current account deficit within sustainable levels: the ratio of current account deficits to GDP was 2.3% during 1990–1995 (Ffrench-Davis, 2010a). In contrast, disincentives to short-term capital flows could not prevent the real appreciation: the real effective exchange rate was appreciated at a rate of 30.1% during 1990–1998.[18] However, the real appreciation in Chile was more moderate than countries that actively welcomed all forms of foreign capital, such as Argentina and Mexico (Agosin and Ffrench-Davis, 1996). In fact, Chile has been immune from severe financial crises since 1990, while other major LACs, such as Mexico and Argentina with a fixed exchange rate regime as an anti-inflation tool and liberalized capital inflows, fell in currency crises.[19]

The subsequent democratic government also introduced several important external reforms during this period. They continued with free-market open economic policies, as described in the foregone parts of this sub-section. For example, the flat tariff rate was progressively reduced from

[18] The index of real effective exchange rate decreased from 112.7 in 1990 to 78.0 in 1998 (1989=100).

[19] However, the authorities reduced the reserve requirement to 0% in September 1998, and adopted a floating exchange rate regime in September 1999 after being affected by the contagion of the Asian financial crisis.

15% to 11% in 1992 to 10% in 1999, 9% in 2000, 8% in 2001, 7% in 2002, and 6% in 2004. Nonetheless, the most important feature of trade policy after the 1990s was the policy shift from unilateral, across-the-board liberalization under the military government toward a strategy that also included bi- or plurilateral preferential trade agreements (henceforth, PTAs) with a strong focus on reciprocal trade liberalization (Ffrench-Davis 2010a). As a result of enforcements of PTAs, the export destinations became significantly diversified. The European Union's share declined from 36.8% in 1983–1989 to 24.3% in 2004–2008 and the United States' share also decreased from 20.8% to 13.8%, while the Asian countries—especially China emerged as major trading partners; China increased from 1.7% to 12.1% and the sum of Asian 12 countries (including China and Japan) increased 19.4% to 34.2% (Ffrench-Davis 2010a).

One outstanding feature of the macroeconomic policy reform after the 2000s was an introduction of new countercyclical fiscal policies to the Copper Stabilization Fund *(Fondo de Estabilización del Cobre*, henceforth FEC) in 2001. FEC itself was established in 1985 to mitigate the impacts of volatility in international copper prices (Romaguera and Contreras, 1995), but the novelty of this new fiscal policy was to establish structural rules in order to isolate the both public revenues and expenditures from not only copper prices but also business fluctuations—that is, to define the role of FEC as maintaining an annual structural surplus target equivalent to 1% of GDP (Ffrench-Davis, 2010a; Ocampo, 2011).[20] By late 2008, the Economic and Social Stabilization Fund (*Fondo de Estabilización Económica y Social*, FEES), which was established as the merger of FEC and the Copper Compensation Fund (*Fondo de Compensación del cobre*, FCC) in march of 2007, and the Pension Reserve Fund (*Fondo de Reserva de Pensiones*, FRP) had accumulated the equivalent of 18% of GDP. However, the socially profitable allocation for the structural surplus of 1% needs to finance social investments and productive development more (Ffrench-Davis, 2010a). The reforms to the neo-liberal reforms have not been completed; the counter-cyclical policies are also in ongoing process.

1-3. Problems

Chile is today the most open economy with macroeconomic stability among LACs. However, there are still substantial problems to overcome. In this section, I discuss two relevant issues among those problems by making reference to author's own findings.

[20] The structural surplus target was reduced to 0.5% of GDP in 2008 and to 0% in 2009 with being affected by the contagion of the global financial crisis.

Table 1-1. Economic liberalization and its results and achievements across different periods

Period	Regime	Extetrnal reforms	Other reforms	Some results or achievements
1973-81	Pure neo-liberalism	1974 (79)- liberalization of FDI and capital flows	1974- reduction in government expenditure	
		unilateral import liberalization	1974- wide-ranging privatization	
		1979- flat tariff 10%	1975 tax reform	1979-81fisical surplus
			1979 labor reform (suppresion of labor unions, queeze on real wages)	to reduce inflation
			1979-82 fixed exchange rate real appreciation	bubble economy
			1980 pension system reform (AFP), education reform	1982-83 debt crisis
1982-89	Pragmatic neo-liberalism	1982-84 tentative tariff increases (35% in 1984)	1983 intervention in private banks, prudential regulation	
		1985- selective incentives to non-traditional exports	1983-92 crowling band competitive real exchage rate	to overcome the debt crisis
			1985- debt-equity swaps	diversification of export basket
		1985-further uniform tariff reduction (15% in 1988)	1985-massive privatization again	1985- sustainable economic growth
1990-	Reforms to the neo-liberal reforms	1991-98 regulations on capital inflows (encaje), excluding FDI	1990- reforms to the 1975 tax reform	without running a fiscal deficit
		1992-further uniform tariff reduction (6% in 2003)	1990- reforms to the 1979 labor reform (increase in real wages)	to prevent finaicial crises
		reciprocal trade liberalization	1990- active social policies	
		the early 1990s- bi- or plurilateral PTAs	1992-99 currency reference basket (CRM)	diversification of export destination
			1999- floating exchange rate regime	
			2001- new countercyclical fiscal policies (Copper Stabilization Fund)	

Source: compiled by Author's literature review

1-3-1. Inequality

Chapter 2 and 3 show that whichever indices of inequality we use—e.g., Gini of wage, variance of the log hourly wage, and skill premium between the skilled and unskilled workers when taking sample selection bias into consideration, there is little doubt that the evolution of wage inequality in Chile after economic liberalization has not been favorable (see Figure 1-1). The findings show that wage inequality increased significantly since the mid-1970s, reached its peak in 1987 amidst the "pragmatic neo-liberalism with a regressive bias" period, then decreased substantially up to the first half of the 1990s, when "reforms to the neoliberal reforms" were carried out. Later on, wage inequality once again increased in the mid- or late 1990s, and still has not reached the levels of wage

equality observed at the beginning of economic liberalization (see Figure 1-1).[21] On the other hand, poverty was reduced substantially from 38.6 % of the total population in 1990 to 13.7 % in 2006.[22] Therefore, what is at issue here is whether the evolution of inequality is associated with economic reforms, especially trade liberalization.[23]

Some previous studies—e.g., Beyer *et al.* (1999) and Gallego (2012), tried to answer how trade liberalization has affected wage inequality between skilled and unskilled workers in Chile, using exactly the same employment survey over the same period while employing a similar methodology. However, the findings are quite different. The former study finds that trade liberalization, measured as the volume of trade over GDP (the ratio of exports plus imports to GDP), and the price reductions of unskilled labor-intensive goods widen the wage premium gap between skilled and unskilled workers during 1960–1996. In contrast, Gallego (2012) finds that the wage premium in the United States, which is a proxy for skill-biased technological change in developed countries, increased the relative demand for skilled workers in Chile, while he finds no statistical significance of the volume of trade over GDP and the prices of unskilled labor-intensive goods during 1960–2000. However, I am skeptical for the both findings, because both Beyer *et al.* (1999) and Gallego (2012) cover not only the post-1974 trade liberalization period but also the pre-1973 import substitution industrialization (henceforth, ISI) period. Moreover, they use trade volumes as measures of trade liberalization, instead of tariffs that are the most direct measures of trade liberalization.

In this regard, Chapter 3 using tariffs and covering only the post-1974 trade liberalization period shows that tariff reductions contributed to widen wage inequality between skilled (college equivalents) and unskilled (high-school equivalents) workers during 1974–2007. These findings supports that the across-the-board unilateral trade liberalization—especially from 1974 to 1979 during the first subperiod of economic liberalization—certainly had adverse effects on wage distribution by causing price reductions of unskilled labor-intensive goods that were protected by highest tariffs prior to trade liberalization, as in the cases of textiles, footwear and apparel in the Grater Santiago area.

However, we expect that the impacts of trade liberalization that have been sustained for some periods of time could be different from those of the initial reform period, which incurred huge

[21] According to the author's calculations based on data from *Encuesta de Ocupación y desocupación en el Gran Santiago*, Gini of wage increased from 0.429 in 1973 to 0.562 in 1987 and then decreased to 0.443 in 2007. The sample used comprises the individuals of working age (14–65 years) who report positive income and a positive number of work hours. Moreover, this sample includes only salaried workers who work on a full-time basis (i.e., more than 30 hours per week).

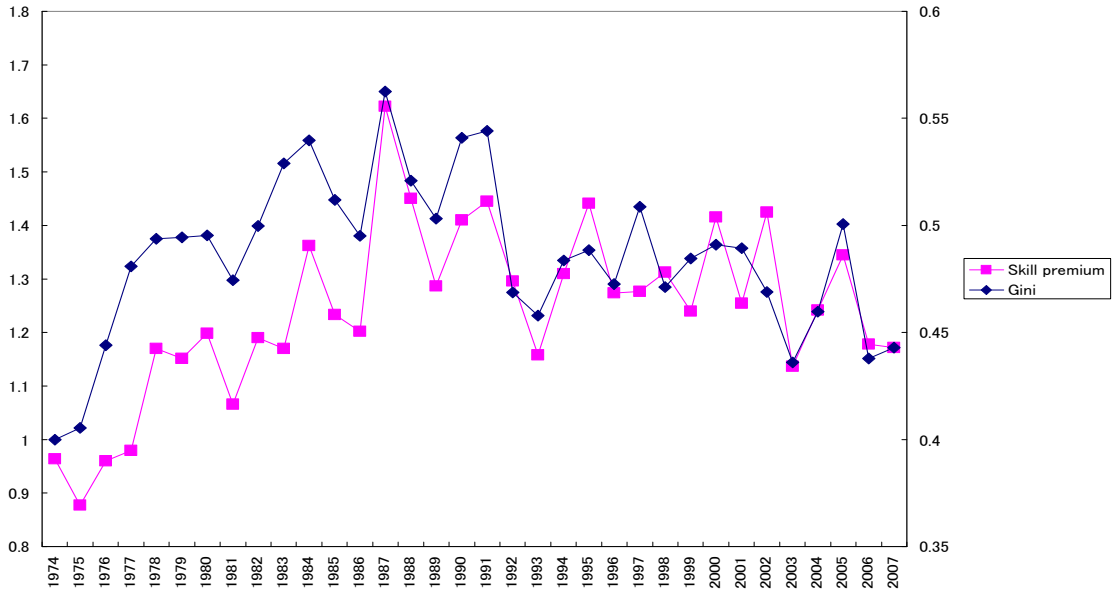
[22] The calculations based on *Encuesta de Caracterización Socioeconómica Nacional* (CASEN), which is a comprehensive nationally representative household survey.

[23] This is because trade liberalization is the most direct determinant of changes in relative prices.

transition and adjustment costs. From this view point, Chapter 4 analyzes the impact of trade liberalization on wage inequality through a transmission channel through which applied tariffs —owing to a wider preferential margin resulting from the proliferation of preferential trade agreements (henceforth, PTAs)—would affect industry wage premiums during the 2000–2006. The findings show that the impacts of applied tariffs on industry wage premiums disappear, after controlling for unobservable time-invariant industry characteristics during 2000–2006. Thus, I find no statistically significant relationship between applied tariffs and industry wage premiums Therefore, bi- or plurilateral trade liberalization during this period has not contributed to wage equalization through a channel in which applied tariffs affect industry wage premiums. In contrast, Chapter 3 shows that increases in the minimum wages contributed to reducing wage inequality during the period of the third subperiod of economic liberalization. Therefore, the findings show that trade liberalization was not determinants of wage inequality, while other variables—e.g., minimum wages did matter since the 1990s.

What is also relevant from the viewpoint of comparisons between the trade liberalization in a context of across-the-board, indiscriminate and unilateral opening, and bi- or plurilateral liberalization under reciprocal PTAs is that the former had adverse effects on wage inequality, but the latter did not. However, the absolute level of wage inequality is still high and we cannot still conclude that trade liberalization contributes to wage equalization. “Growth with Equity” still has not been achieved in Chile.

Figure 1-1. Changes in the Gini of wages and skill premiums between skilled and unskilled workers: full- time salaried male workers in Greater Santiago, 1974–2007



Source: Author's calculations based on data from *Encuesta de Ocupación y desocupación en el Gran Santiago*.

1-3-2 Industrial structure

The expected gains from unilateral trade liberalization includes modernizing production structure and disseminating new technologies through aligning domestic prices and grater foreign investment in the export sectors (Rosales, 2004). However, Chile's industrial structure has been strongly dependent on natural resource-based products and not yet been industrialized, unlike in the case of East Asian NICs (Schruman, 1996). In fact, the production structure is characterized by the weak intermediate linkages of the manufacturing sector (Albala-Bertrand, 2001), and the incomplete intermediate production linkages between large enterprises and small-medium enterprises (Infante and Sunkel, 2009). Therefore, the present development strategy, even though it is a very successful case among the LACs, has proved clearly inadequate to change the countries' production pattern.

Some existing studies argue that the traditional negative assumptions on natural resources—e.g., a long-term worsening of the terms of trade, a high price volatility, very limited back- and forward- linkage effects, and low scope for high value added for their export—are not necessarily applicable to Chilean exports.[24] In fact, Chapter 5 shows that non-traditional natural resource-based export sectors in Chile, such as fish, fruit, and forestry products, produced relatively high domestic inter-industrial linkage effects, compared with the traditional mining export sector. However, it is important to note here that Chile is not immune from a tendency that countries whose industrial structure is dependent on exports of primary products tend to lower their labor productivity. McMillan and Rodrik (2011) decompose the labor productivity growth into the weighted sum of productivity growth within individual sectors, i.e., within components of productivity growth, and the economy-wide productivity effects of labor re-allocation across different sectors, i.e., structural change term.[25] The author's calculations on this decomposition show that the within component of productivity growth during 1990–2005, in the third subpediod of economic liberalization (at averaged 3.8 % per year) is larger than that of during 1950–1975, in the era of ISI (at averaged 1.9 % per year). In contrast, the structural change term declined from 0.15 % during 1950–1975 to -0.90 % during 1990–2005 (see Figure 1-2). This suggests that intensified competition brought about trade liberalization forced tradable sector to reduce labor costs, while displaced workers were absorbed in

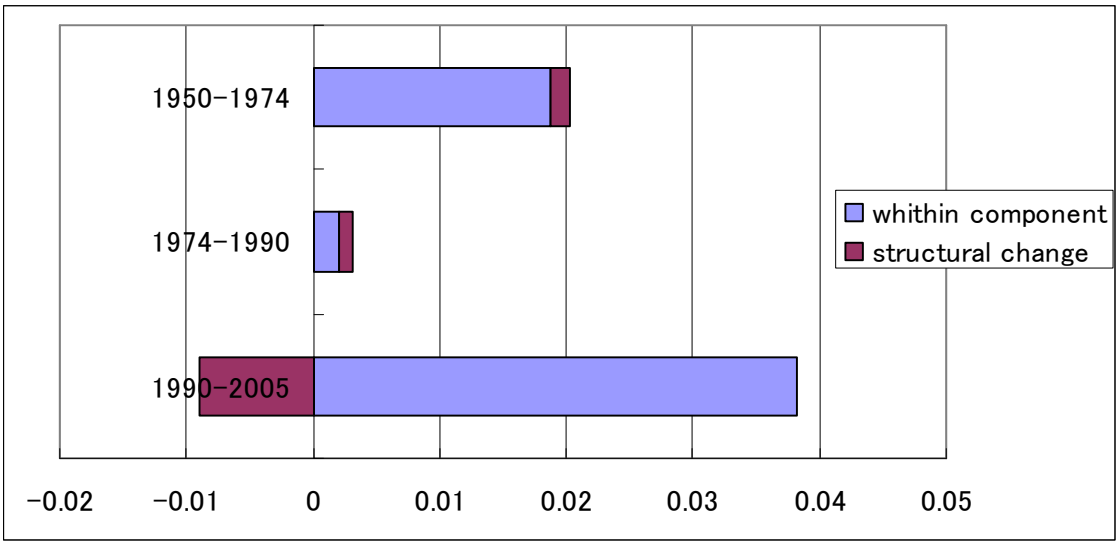
[24] For more details, see Díaz and Ramos (1998).

[25] The labor productivity is disaggregated into 9 industrial sectors. The classification is as follows: (1) agriculture, hunting, forestry and fishing, (2) mining and quarrying, (3) manufacturing, (4) public utilities (electricity, gas, and water), (5) construction, (6) wholesale and retail trade, hotels and restaurants, (7) transport, storage and communications, (8) finance, insurance, real estate and business services, and (9) community, social, personal and governments services.

even lower-productivity and low-wage service sectors, caused by a shrinking manufacturing sectors and limited capacity to absorb employment in the natural resource sectors. This can be interpreted as the experience of a country with a weak manufacturing sector and comparative advantage in natural resources in the aftermath of a rapid and far-reaching trade liberalization, that is, "premature de-industrialization" (McMillan and Rodrik, 2011).

Although Chile promoted export diversification among natural resources, there are few incentives to promote more sophisticated or high-tech manufacturing exports. Moreover, the authorities today have few measures for promoting non-resource based exports—e.g., the simplified tariff drawback for non-traditional exports was partly eliminated by the end of 2005, in accordance with World Trade Organization (WTO) commitments. The production pattern will not easily be transformed and the aforementioned growth-reducing structural change will likely persist. These pending issues highlight the limitations of Chile's current export-led development strategy.

Figure 1-2. Productivity decomposition across different periods, 1950–2005 (annual growth rates)



Source: Author's calculations based on data from Groningen Growth and Development Centre (GGDC) 10-sector database[26]

1-4. Policy lessons

Economic liberalization in Chile may provide some important policy lessons for other small LACs with rich natural resource endowment liberalized their economies later in the 1980s and 1990s. First,

[26] http:// www.ggdc.net/ (accessed on May 28, 2011)

gains from economic liberalization take a long time to materialize—especially, in distributional aspects. Some other LACs could not endure huge transition and adjustment costs of economic liberalization and thus, might revert to populist policies. In contrast, Chile has followed a pragmatic policy approach learning from the past mistakes of the across-the-board liberalization in the first subperiod, and sustained the credibility of economic policies. Second, the competitive and stable real exchange rate since the mid 1980s and reciprocal trade liberalization since the 1990s seem to play important roles in a broader context of sustainable economic development patterns propelled by export promotion in the early stage of the recovery. Third, the active prudential regulations and policies since the 1990s also have contributed to reduction of external vulnerability in the face of external shocks. In fact, Chile experienced better macro-economic performance and more significant reduction of wage inequality during the 1990s than those of other LACs or Chile's first subperiod of economic liberalization, which placed much emphasis on anti-inflation policies and across-the-board capital account and import liberalization.

At the same time, the experiences of economic liberalization in Chile also show that inequality and industrial structure are not easily reversible. Although wage inequality declined in the first half of the 1990, it still has not reached the levels at the beginning of economic liberalization. Moreover, the industrial structure heavily dependent on the exports of natural resources has not yet been industrialized. Therefore, the Chilean experiences show that the policy makers in small countries with rich natural resource endowment that liberalized their economies later in the 1980s and 1990s need to take into considerations the unavoidable costs of premature de-industrialization inherent in economic liberalization.

2

Wage Inequality and Return to Education in Chile

2-1. Introduction

Chile is the first of Latin American and Caribbean countries (henceforth, LACs) to convert from import substitution industrialization (henceforth ISI) to far-reaching trade liberalization, following the military *coup d'état* that overthrew Allende's government in 1973. Thus, among LACs, Chile has the longest history of external reforms. Moreover, the external reform-experiences in Chile are not uniform, but have at least three sub-periods (Ffrench-Davis, 2005; 2010a). Chile represents unique example not only because of the long history of economic liberalization but also because the country had reacted to global economic change by applying pragmatic modifications to the original pure neo-liberal reforms, as discussed in greater detail in Chapter 1, which might have had relevant distributional impacts. Therefore, the analysis of changes in wage inequality in Chile has been very interesting for other LACs that liberalized their trade regimes later in the 1980s and 1990s and had implemented the first stage of external reforms (i.e., import liberalization) or where the second or third stage of external reforms (i.e., export promotion or reciprocal trade liberalization) have just begun; through such analysis, we can see whether different periods of external reforms produced different trends of inequality in Chile.

In this regard, this chapter engages in a detailed analysis of changes in wage inequality in Chile after the post-1974 trade liberalization period, by using the narrowest measure of inequality—namely, skill premium, or returns to skill—as a measure of wage inequality. Goldberg and Pavcnik (2007) point out that this narrowest measure of inequality has been used widely in the literature on globalization and inequality, because the increase in inequality documented in many developing countries has been associated with an increase in skill premiums. Moreover, they mention that in several countries, changes in skill premiums seem to chronologically coincide with

trade reforms. In that sense, skill premiums constitute a very suitable measure of inequality if we focus on an analysis on wage-inequality change following trade liberalization. In addition to the advantages this measure beers as an indicator, when information on an individual's education attainment is available, we can easily use return to higher education as a measure of skill premium (Goldberg and Pavcnik, 2007).

However, we need to be cautious when using return to higher education as a measure of wage inequality; this is because, as a considerable volume of labor economics literature points out, estimates of return to education are biased in the presence of violations of OLS assumptions, such as measurement error, endogeneity, and sample selection bias. In the case of Chile, endogeneity problems caused by omitted and unobservable individual-level characteristics, Contreras *et al.* (1999) show that the extent of overestimation of the rate of an additional year of education is approximately only 1%, by using the education attainments of parents as a proxy of unobservable individual characteristics. On the other hand, most previous studies that analyze return to education in Chile—such as Montenegro (1998), Mideplan (2000) and Contreras (2002)—limit the sample to full-time salaried male workers. Thus, they yield biased estimates as long as the decision to be a full-time labor force participant does not affect the determinants of wage.

If we review the process by which external reforms occurred in Chile, it chronologically coincides with the many other reforms, as discussed in greater detail in Chapter 1. Those reforms incurred huge adjustment costs, such as persistently high unemployment, squeeze on real minimum wages, especially in the first and second subperiods of the external reforms.[1] As discussed in greater detail in section 2-3-2, the smaller the probability of labor-force participation—that is, the higher the unemployment rate is, the larger sample selection bias will become. Moreover, the unemployment rate fluctuated greatly during the period under analysis; it sometimes jumped after an economic crisis (e.g., between 1974 and 1976; after the shock stabilization program, between 1981 and 1982; after the debt crisis, between 1998 and 1999; and after the contagion of the Asian financial crisis [see Figure 2-1]). Therefore, we must assume that the impact of sample selection bias cannot be ignored during 1974–2007 in Chile, especially in the period during which the unemployment rate fluctuated greatly.

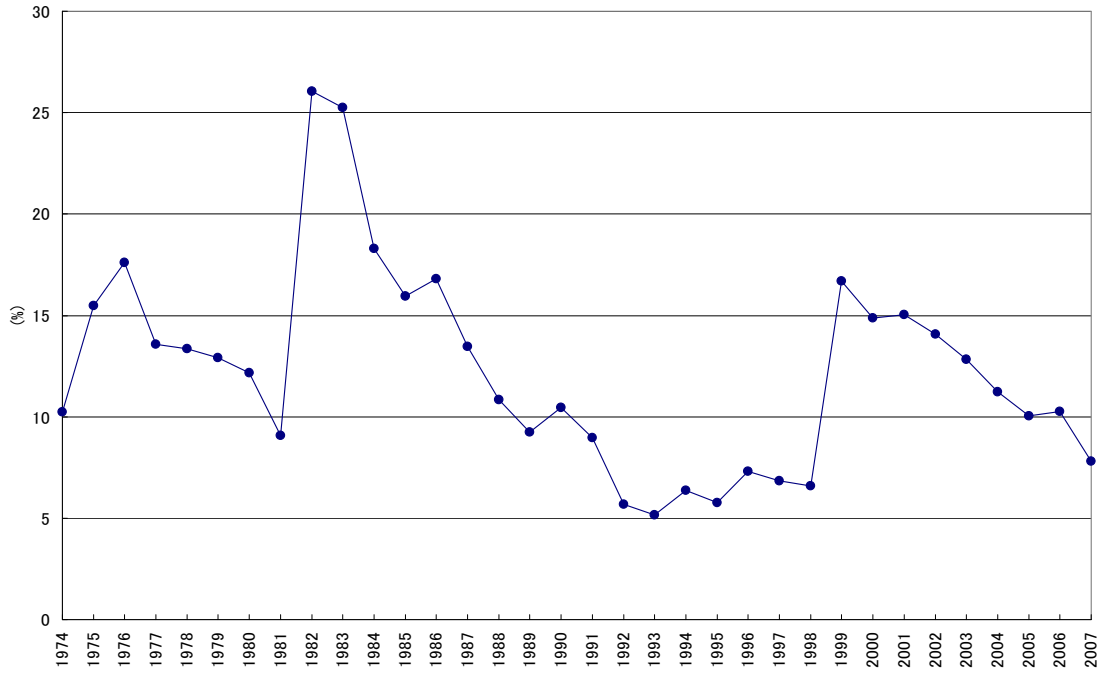
Therefore, the objective of this chapter is to analyze the validity of return to higher education as a measure of wage inequality, when taking sample selection bias into consideration and by using data from the trade liberalization period in Chile. If we find that the changes in the return to higher education as estimated by OLS, while limiting the sample to full-time male workers, the

[1] The real indices of minimum wage in 1989 (1989=100) were squeezed to levels lower than those in 1970 (108.9), but they have drastically increased since 1990 becoming 220.3 in 2007 (Ffrench-Davis, 2010a: 181).

return to higher education as estimated by Heckman selection bias correction procedures—as well as other measures of wage inequality, such as the Gini of wages—tend to move in the same direction, we can confirm the validity of the return to higher education as a measure of wage inequality in the presence of sample selection bias.

This chapter is organized as follows. Section 2-1 describes the data used herein and presents descriptive statistics concerning the changes in wage inequality, education attainment and the industrial sector's share in the total employment. Section 2-3 details the specifications of wage equation, as well as the estimation method for Heckman selection bias correction procedures. Section 2-4 presents the findings of econometric analysis, while Section 2-5 provides concluding remarks.

Figure 2-1. Changes in the unemployment rate of males in Greater Santiago, 1974–2007 (%)



Source: Author's calculations based on data from *Encuesta de Ocupación y desocupación en el Gran Santiago*.

2-2. Data and Descriptive Statistics

This chapter uses data from the Employment and Unemployment Survey for Greater Santiago (*Encuesta de Ocupación y desocupación en el Gran Santiago)*, conducted by the University of Chile. This survey, conducted in June every year, covers the Greater Santiago area, which comprises

roughly 40% of Chile's total population, and is conducted in June every year. Each survey covers a fixed 3600 households[2] and approximately 10,000 and 14,000 individuals during 1974–2007. The data are repeated cross-section, and the sample is fully representative of the Greater Santiago area.

First, changes in two frequently used wage inequality indicators—that is, the Gini of wages and the variance of the log hourly wages of full-time salaried male workers— are presented in Figure 2-2. I define "wages" as income from paid employment; thus, wages do not include income from self-employment, assets, pensions, or other sources. The sample used in this chapter comprises the individuals of working age (14–65 years) who report positive income and a positive number of work hours. Like previous studies, the sample includes only salaried workers—that is, white-collar workers (*empleados*), blue-collar workers (*obreros*), and domestic servants who work on a full-time basis (i.e., more than 30 hours per week).[3] Therefore, self-employed—that is, employers and independent workers—are not included. Unpaid family workers and military personnel are also excluded from the sample because their wages are not likely to be determined by market forces. The samples whose variables are not answered or missing in at least one survey question are also eliminated in advance.[4] Females are also eliminated from the sample, because it is natural to assume that labor market of females are segmented from that of males.[5]

The data trends can be summarized as follows, with the two aforementioned indicators showing very similar trends. Both increased significantly in the aftermath of trade liberalization—that is, the import liberalization period—and reached its peak in 1987, amidst the "pragmatic neo-liberalism with a regressive bias" period. On the other hand, they substantially decreased during the early 1990s, when "reforms to the neoliberal reforms" were carried out, although, they temporarily increased in the mid or late-1990s and mid-2000s.[6] However, they still have not reached the levels of wage inequality seen at the beginning of trade liberalization. Therefore, the findings show that different periods of external reforms certainly produced different trends vis-à-vis wage inequality in Chile. Moreover, changes in the aforementioned wage-based measures of inequality indicate trends very similar those of income-based measures of inequality (cf. Larrañaga, 2001); the Gini of incomes increased significantly since the mid-1970s, reached its peak

[2] Although the number of households fluctuated during 1957–1979, the number has stayed fixed since 1980.

[3] Almost all domestic servants are female; thus, they are *de facto* excluded when limiting the sample to male workers.

[4] I also exclude the samples whose pre-1997 education attainments are "special schools." Although some "special schools" seem to be secondary schools—especially in the 1990s— they constitute an ambiguous and inconsistent category during the entire analysis period.

[5] However, I find that the return to an additional year of education has not been statistically different between males and females in the recent years.

[6] The worsening of wage inequality between 1996 and 1999 can be attributable to the contagion of external negative shocks derived from the Asian financial crisis (Ffrench-Davis, 2010a).

in 1987, then decreased substantially in the early 1990s. Therefore, the findings show that limiting the components of income to wages and the sample to full-time salaried male workers would not lead to bias in measurements of inequality, although the absolute levels of the Gini coefficients in themselves are stably undermeasured during the full period under analysis.

Figure 2-2. Changes in the Gini of wages and the variance of the log hourly wages: full-time salaried male workers in Greater Santiago, 1974–2007

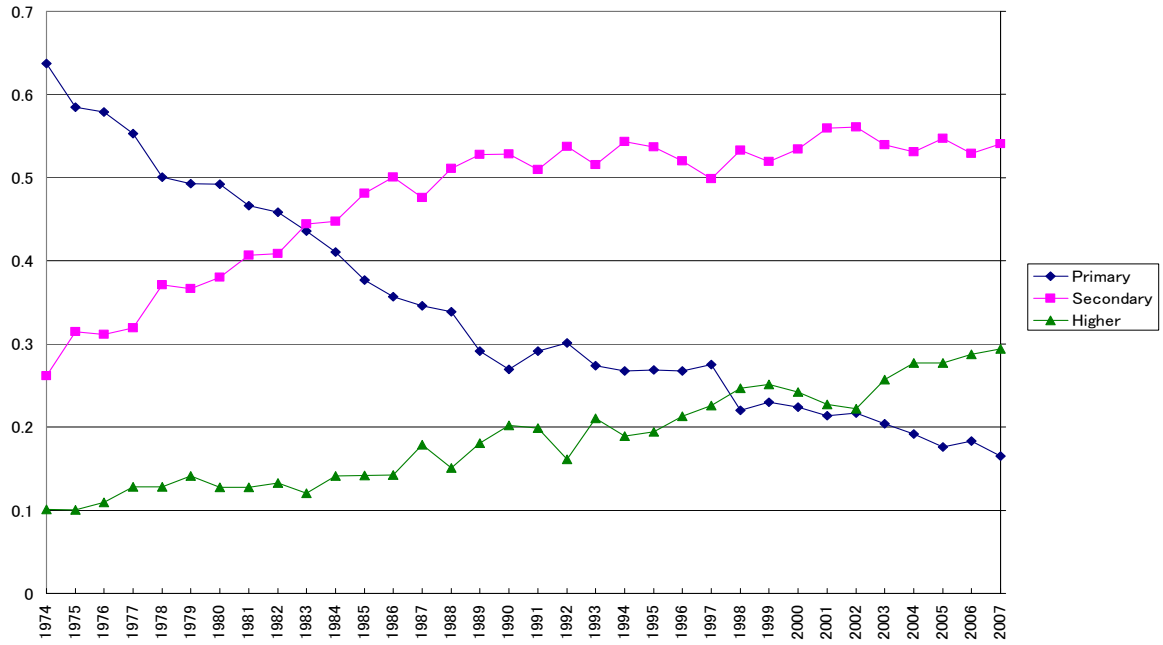
Source: Author's calculations based on data from *Encuesta de Ocupación y desocupación en el Gran Santiago*.

Second, changes in education attainments within the aforementioned samples are presented in Figure 2-3. The figure shows stable improvements in education attainment during 1974–2007. The share of workers who had completed only up to primary school education decreased from 63.8% in 1974 to 16.6% in 2007, while the share of workers who had attended up to secondary and higher education was an increasing trend.[7] However, changes in secondary and higher school education showed another characteristic: the share of workers who had attended up to secondary school education substantially increased until the mid-1980s and after that time, the share remained relatively stable (about 50%); meanwhile, the share of workers who had attended up to higher

[7] The secondary and higher education categories include both dropouts and graduates. Higher education not only includes university education but also *Centro de Formación Técnica* (CFT)- or *Instituto Profesional* (IP)-based education, which was established by the 1980 higher education reforms in Chile.

education increased mainly after the mid-1980s.

Figure 2-3. Changes in education attainment: full- time salaried male workers in Greater Santiago, 1974–2007



Source: Author's calculations based on data from *Encuesta de Ocupación y desocupación en el Gran Santiago*.

Finally, the descriptive statistics of full-time salaried male workers in the selected years are presented in Table 2-1. We can again confirm stable improvements in education attainments with the number of years of schooling increasing from 7.68 in 1974 to 12.00 in 2007. Changes in the industrial sector's share of total employment are also presented, to show the transformation of employment structure after trade liberalization. The original classification typology features 9 sectors, i.e., agriculture, mining, manufacturing, construction, commerce, financial services, personal services, community services, and transportation. I also break out the manufacturing sector into natural resource-based manufacturing (henceforth, NRBM) and the non-resource-based manufacturing sector.[8] An especially striking finding in this table is that the employment share of the manufacturing sector—especially that of non-resource-based manufacturing—substantially decreased: 38.0% of full- time salaried male workers were employed in the manufacturing sector at the beginning of trade liberalization, but the ratio persistently decreased, in a trend that became more

[8] I classify the manufacture of foods, beverages, and tobacco; the manufacture of wood and wood products; and the manufacture of paper and paper products as part of NRBM sector.

evident after the 1990s; less than 20% (i.e., 17.3%) of workers were employed by the manufacturing sector in 2007. Even the employment share of the NRBM sector had been stable or slightly decreased in the Greater Santiago area. On the other hand, the employment share of service sectors—such as commerce and financial service sectors—was persistently increasing. Those situations reflect the de-industrialization of Chile, following trade liberalization.[9]

Table 2-1. Descriptive statistics of full-time salaried male workers in Greater Santiago, 1974–2007

	1974	1982	1987	1993	1997	2003	2007
Variable Average							
Age	34.32	34.72	34.85	36.48	36.60	37.72	37.86
	(12.14)	(11.45)	(11.52)	(11.82)	(11.48)	(11.53)	(12.20)
Years Schooling	7.68	9.28	10.31	10.94	11.07	11.56	12.00
	(4.13)	(4.11)	(4.05)	(3.95)	(4.00)	(3.60)	(3.42)
Years of Experience	20.64	19.44	18.54	19.55	19.53	20.16	19.86
	(13.03)	(12.62)	(12.64)	(12.88)	(12.55)	(12.58)	(13.21)
Public Sector	0.230	0.125	0.138	0.079	0.070	0.068	0.065
	(0.421)	(0.331)	(0.345)	(0.269)	(0.255)	(0.252)	(0.247)
Industrial Sector's Share of Total Employment							
Agriculture	0.021	0.012	0.012	0.011	0.008	0.013	0.009
	(0.144)	(0.109)	(0.108)	(0.104)	(0.090)	(0.113)	(0.095)
Mining	0.011	0.006	0.012	0.004	0.006	0.007	0.009
	(0.102)	(0.075)	(0.110)	(0.063)	(0.079)	(0.086)	(0.092)
Manufacturing	0.380	0.292	0.295	0.324	0.268	0.236	0.173
	(0.485)	(0.455)	(0.456)	(0.468)	(0.443)	(0.425)	(0.379)
NRBM	0.121	0.114	0.121	0.118	0.098	0.102	0.075
	(0.326)	(0.318)	(0.327)	(0.323)	(0.298)	(0.302)	(0.263)
Non-resource based manufacturing	0.259	0.178	0.174	0.206	0.170	0.134	0.098
	(0.438)	(0.382)	(0.379)	(0.405)	(0.376)	(0.341)	(0.298)
Construction	0.160	0.185	0.129	0.152	0.183	0.137	0.176
	(0.367)	(0.389)	(0.336)	(0.359)	(0.387)	(0.344)	(0.381)
Commerce	0.099	0.166	0.157	0.145	0.154	0.174	0.195
	(0.299)	(0.373)	(0.364)	(0.352)	(0.361)	(0.379)	(0.397)
Financial services	0.071	0.100	0.111	0.104	0.120	0.147	0.139
	(0.258)	(0.301)	(0.314)	(0.305)	(0.325)	(0.354)	(0.346)
Personal services	0.063	0.049	0.062	0.046	0.046	0.047	0.051
	(0.243)	(0.217)	(0.241)	(0.209)	(0.209)	(0.211)	(0.221)
Community services	0.088	0.090	0.112	0.104	0.111	0.105	0.111
	(0.284)	(0.287)	(0.315)	(0.305)	(0.314)	(0.307)	(0.315)
Transport	0.107	0.098	0.110	0.111	0.105	0.134	0.136
	(0.309)	(0.298)	(0.313)	(0.314)	(0.306)	(0.341)	(0.343)
Number of Obs.	1793	1923	1788	1742	1598	2005	1986

Note: Numbers in parentheses are standard deviations.

Source: Author's calculations based on data from *Encuesta de Ocupación y desocupación en el Gran Santiago*.

2-3. Estimation Method

2-3-1. Specifications of Wage Equation

We usually estimate return to education based on the Mincerian wage equation, as follows:

[9] Chile has succeeded in expanding of non-traditional natural resource-based export sectors since the mid-1980s, while the ISI sectors have been pretty much destroyed. However, this employment survey covers only the Greater Santiago area—an urban area that is a part of a metropolitan region; thus, only about 1% of all the workers surveyed there were employed in the agriculture, forestry, or fishing sectors, as shown Table 1. Therefore, this employment survey does not represent the employment structure of the whole of Chile, especially with respect to natural resource related ones.

(2-1) $$\ln w_i = cons + \beta_1 school_i + \beta_2 \exp_i + \beta_3 \exp_i^2 + X_i'\beta + e_i,$$

where *w* is hourly wage, *school* is completed years of schooling, *exp* is years of potential experience in the labor market (age – school – 6), and vector *X* is the observable worker characteristics. β_1 shows the change in wage given a one-unit increase in the number of education years; thus, it can be interpreted as the rate of return to an additional year of education. However, under this specification, the rate of return to an additional year of education is constant across all education attainments. Therefore, I use a spline function, which allows the return to educations to differ among education attainments. This specification is similar to that seen in Contreras *et al.* (1999).

(2-2)

$$\ln w_i = cons + \beta_1 school_i + \beta_2 \exp_i + \beta_3 \exp_i^2 + \beta_4 * d8 * (school - 8) + \beta_5 * d12 * (school - 12) + X_i'\beta + e_i$$

where the dummy variable *d8* is equal to 1 if an individual has more than 8 completed years of schooling, otherwise; equal to 0. The dummy variable *d12* is equal to 1 if an individual has more than 12 completed years of schooling, otherwise; equal to 0.[10] In the current study, vector *X* contains a head of the household dummy, which takes a value of 1 for workers with a position, and 0 otherwise; public sector dummy, which takes a value of 1 for workers employed in the public sector, and 0 otherwise; and 9 industry indicators, which are detailed in the previous section.[11] In this specification, β_1, $\beta_1 + \beta_4$, and $\beta_1 + \beta_4 + \beta_5$ show the return to primary, secondary, and higher education, respectively. Previous studies, such as those of Mideplan (2000) and Contreras (2002), estimate equation (2-2) by OLS.

2-3-2. The Estimation Method for the Heckman Model

As mentioned in the introduction, the estimates will be biased as long as full-time labor force participation does not affect the determinants of wage. In this regard, the Heckman selection

[10] Chile's school system had an 8-4 structure after 1965 and a 6-6 structure before that year. This employment survey converts the years of schooling from the older system into those of the current system. For example, an individual who received up to the second year of schooling in the older system of secondary school is treated as having 8 years of schooling.

[11] The industry indicators are classified as follows: agriculture, mining, NRBM, nonresource-based manufacturing, construction, commerce, financial services, personal services, community services, and transportation. Construction is chosen as a base category because it holds a relatively large employment share among non-trade sectors; its share is stable for the whole of the analysis period, as seen in Table 2-1.

correction procedure might be useful. To simplify the notation, I rewrite as x the set of containing all the independent variables of the wage equation (2-2). z is also a set of independent variables of participation equation, and it determines whether or not an individual *i* is a full-time wage worker.

(2-3)
$$\ln w_i^* = x_i'\beta_0 + e_i$$

$$w_i = w_i^* \quad \text{if} \quad z_i'\gamma_0 + u_i > 0 \Leftrightarrow d_i = 1$$
$$=0 \qquad \text{if} \quad z_i'\gamma_0 + u_i \le 0 \Leftrightarrow d_i = 0,$$

where w_i^* shows individual *i*'s latent offered wage including unobserved samples. d_i is a dummy variable that takes a value of 1 or 0 when individual *i* is a full-time salaried worker or not, respectively. Thus, individual *i*'s wage becomes observable—that is, he decides to be in the sample of workers ($d_i = 1$) only when his offered wage exceeds his reservation wage ($z_i'\gamma_0 + u_i > 0$). We assume that e_i and u_i have a bivariate normal distribution with zero means, a known covariance matrix and correlation coefficient ρ :[12]

(2-4)
$$\begin{pmatrix} e_i \\ u_i \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_e^2 & \rho\sigma_e\sigma_u \\ \rho\sigma_u\sigma_e & \sigma_u^2 \end{pmatrix}\right) .$$

Therefore, nonsalaried workers (including part-time workers and unpaid workers)—that is, those outside the sample of the wage equation—consist of those not at all employed. Thus, working-age (14–65 years) unemployed male, male part-time workers, and male unpaid workers are now included in the sample for the participation equation. However, self-employed workers—i.e., employers and independent workers—remain eliminated from the participation equation,[13] because it is very difficult to find a variable that determines whether an individual is a salaried worker or self-employed. In this regard, it is very feasible to argue that an individual will make the sequential decision to work or not work (including part-time work and unpaid work), and given the decision to

[12] We normally assume $\rho > 0$, because a greater likelihood of labor force participation will associated with higher wages (Milanovic, 2006). We can relax strong assumptions vis-à-vis the distribution of error terms by applying a semiparametric estimation technique. See, for example, Schafgans (2000).

[13] The samples whose variables used in the wage equation and participation equation (2-3) are not answered or missing in at least one survey question are also eliminated in advance.

work whether as a salaried or self-employed workers (Schafgans, 2000). Alternatively, we can assume that the decision of the individual is to be a salaried worker, self-employed, or not to be employed at all. However, from the view point of this chapter's objective of pinpointing a precise estimate of return to education—that is, estimating the relationship between education and wage—it does not seem appropriate to include the self-employed in the same manner as salaried workers. First, the "wages" of self-employed individuals are in question, as they need to be separated precisely from asset income (Montenegro, 1998). Moreover, the "wages" of self-employed are determined by virtue of many other factors in addition to the education they have received (Mideplan, 2000).[14] Therefore, I eliminate self-employment individuals in advance from the participation equation in the sample selection correction model.

For identification, at least one variable needs to be included in z that also does not enter x (Schafgans, 2000; Wooldridge, 2003).[15] As Schafgans (2000) and Milanovic (2006) point out, an individual with large non-employment income tends to reduce his or her labor force participation because he or she will be less likely to work for wages, given the higher opportunity cost of being employed.[16] Like those previous studies, I too use the sum of non-employment income—sum of income from assets, pensions, and income from other sources in each household—as the aforementioned identifying variable.[17] In addition to non-employment income, I add the number of children under the age of 14 years in each household to the identifying variable, because a man heading a household with a large number of children is more likely to be working full-time in order to earn more money.

I estimate equation (2-3) by the Heckman two- step procedure (henceforth, Heckit). We can obtain the conditional expectation of hourly wages of individuals within the sample, as follow:

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[14] What is relevant from this issue, Repetto (2005) points out, is that Chile is not a purely meritocratic country; the existing evidence shows that not only education but also socioeconomic origin plays an important role as determinants of wages. This situation is more likely to applly to self-employed workers, especially rich employers.

[15] If all variables of z are equal to those of x, $\hat{\lambda}_i$ can highly correlated with the variables of x_i; thus, such multicollinearity can lead to very high standard errors among estimates of $\hat{\beta}_0$ (Wooldridge, 2003).

[16] However, Milanovic (2006) does recognize the endogeneity of non-employment income, because high current non-employment income might have resulted from previous labor force participation and high wages.

[17] For example, in this employment survey, house-rent income and estimated rent from the value of royalties (*regalía*) is a component of income from assets. However, I do not include imputed rent as income from assets, because the imputed rent of each household highly correlates with the wages of its members; thus it is apparently an endogenous variable with regard to wages.

(2-5) $$E(\ln w_i \mid x_i, z_i, d_i = 1) = x_i'\beta_0 + \rho\frac{\sigma_u}{\sigma_e}\lambda(\frac{z_i'\gamma_0}{\sigma_u}),$$

where $\lambda(\frac{z_i'\gamma_0}{\sigma_u}) = \frac{\phi(\frac{z_i'\gamma_0}{\sigma_u})}{\Phi(\frac{z_i'\gamma_0}{\sigma_u})}$ —that is, an inverse Mills ratio.

It is clear that we will obtain biased estimates of β_0 if we perform OLS while using only the samples whose wages are observable—that is, those with in the sample for the wage equation. Equation (2-5) also shows that the larger the correlation is between the error terms of the wage equation and those of the participation equation—or the smaller the probability of full-time labor force participation is—the larger the sample selection bias becomes, because we assume ρ is positive and the inverse Mills ratio $\lambda(\cdot)$ is a monotonic decreasing function of the probability that an observation is selected.

We can obtain a reduced form to estimate from equation (2-5) as follows:

(2-6) $$\ln w_i \mid x_i, z_i, d_i = 1 = x_i'\beta_0 + \rho\frac{\sigma_u}{\sigma_e}\lambda(\frac{z_i'\gamma_0}{\sigma_u}) + v_i.$$

We can assume $E(v_i \mid x_i, z_i, d_i = 1) = 0$. Thus, we can obtain the unbiased estimates of β_0 from equation (2-6). Therefore, the Heckit estimation method is as follows. First, we estimate $\frac{\hat{\gamma}_0}{\sigma_u}$ through the probit of d_i on z_i, using the entire sample, and compute $\hat{\lambda}_i$. Second, using sample for the wage equation, we regress w_i on x_i and $\hat{\lambda}_i$; then, we can obtain the estimates of β_0 and $\rho\frac{\sigma_u}{\sigma_e}$. In the Heckit procedures, estimates of β_0 are unbiased.

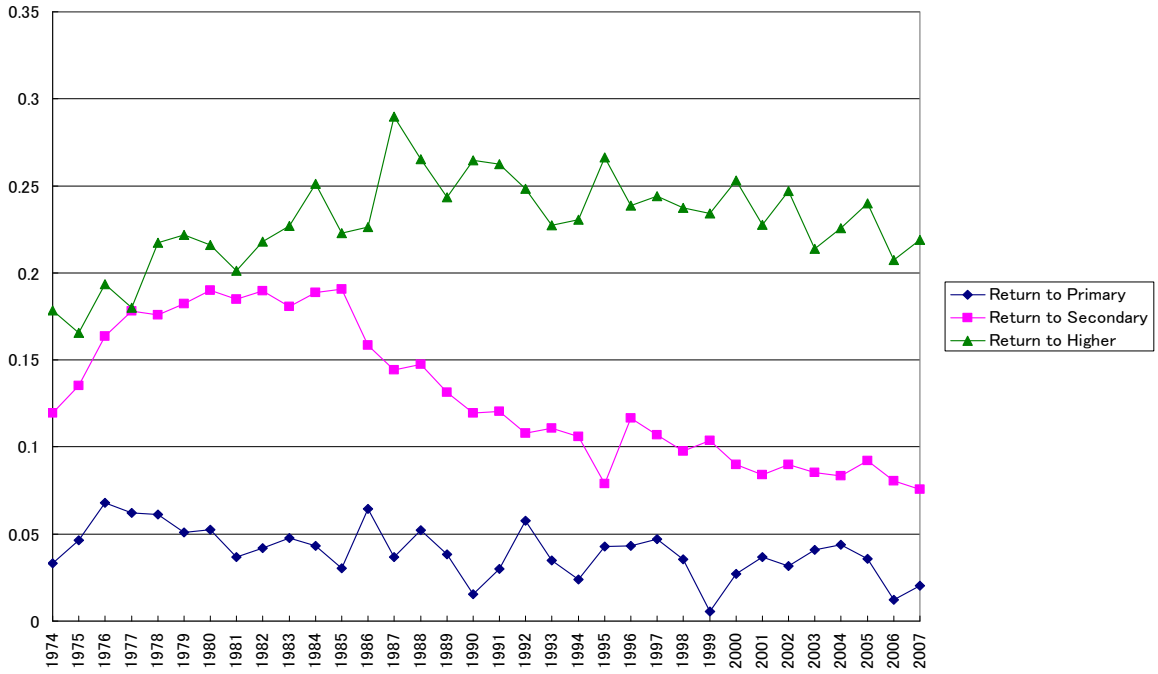
Equation (2-6) shows also that the sample selection bias can be considered omitted variable bias. If we perform OLS using only the samples whose wages are observable—that is, if we drop the inverse Mills ratio term $\lambda(\frac{z_i'\gamma_0}{\sigma_u})$ from equation (2-6) —the term is included in the error term. If we assume $\rho > 0$ and number of years of schooling positively correlates with the

probability of full-time labor force participation ($\frac{z_i'\gamma_0}{\sigma_u}$), the number of years of schooling negatively correlates with the omitted variable $\lambda(\frac{z_i'\gamma_0}{\sigma_u})$, because $\lambda(\cdot)$ is a monotonic decreasing function. Therefore, the omission of the inverse Mills ratio term causes an underestimation of the return to education. This is a highly relevant issue, because "actual" skill premiums as measured by return to education are larger than the frequently used results that limit the sample to full-time salaried male workers.

2-4. Estimation Results

First, we can see in Figure 2-4 changes in return to education in terms of various attainments, among full-time salaried male workers during 1974–2007. The return to higher and secondary education apparently increased after the post-1974 trade liberalization period. However, the return to secondary education has persistently decreased since the mid-1980s and is now less than 10%; indeed, it is noteworthy that it decreased from 19.5% in 1985 to 7.5% in 2007. Thus, the decreasing trend of the return to secondary education in Chile, which was founded by each of in Contreras *et al* (1999) and Contreras (2002), has persisted since 1997. On the other hand, the return to higher education continued to increase following trade liberalization, reaching its peak in 1987, but slightly decreased thereafter; thus, changes in the return to higher education and the Gini of wages have seemed to move in the same direction, as will be discussed in greater detail in section 2-4-3. Overall, the return to primary education fluctuated by about 5%.

Figure 2-4. Changes in return to education by various attainments: full-time salaried male workers in Greater Santiago, 1974–2007



Source: Author's calculations based on data from *Encuesta de Ocupación y desocupación en el Gran Santiago*.

Second, I compare the two measurements of return to education: that estimated by OLS using only full-time male salaried workers and that by Heckit using the full male sample including the unemployed, part-time workers and unpaid workers. The estimation results of Heckit are presented in Table A-1. Among the coefficients of the identifying variables, non-employment income is negative and statistically significant in most years, while the coefficients of the number of children under the age of 14 years in each household are not statistically significant in most years. The signs lack of consistency: they are positive is some years, but negative in others. Thus, we consider that the latter is not an appropriate identifying variable. Therefore, the low significance of those identifying variables in some years create high standard errors among the variables of the wage equation as estimated by Heckit, compared to that estimated by OLS. The coefficients of the inverse Mills ratio $\hat{\lambda}_i$ are positive in most years, except 1975 and 1982; they do have the expected signs, but they are not statistically significant at the 10% level, especially in the 1990s. Moreover, the coefficients of the years of schooling are positive and statistically significant in all the analyzing years; thus, more-educated individuals are actually more likely to be part of the full-time labor force.

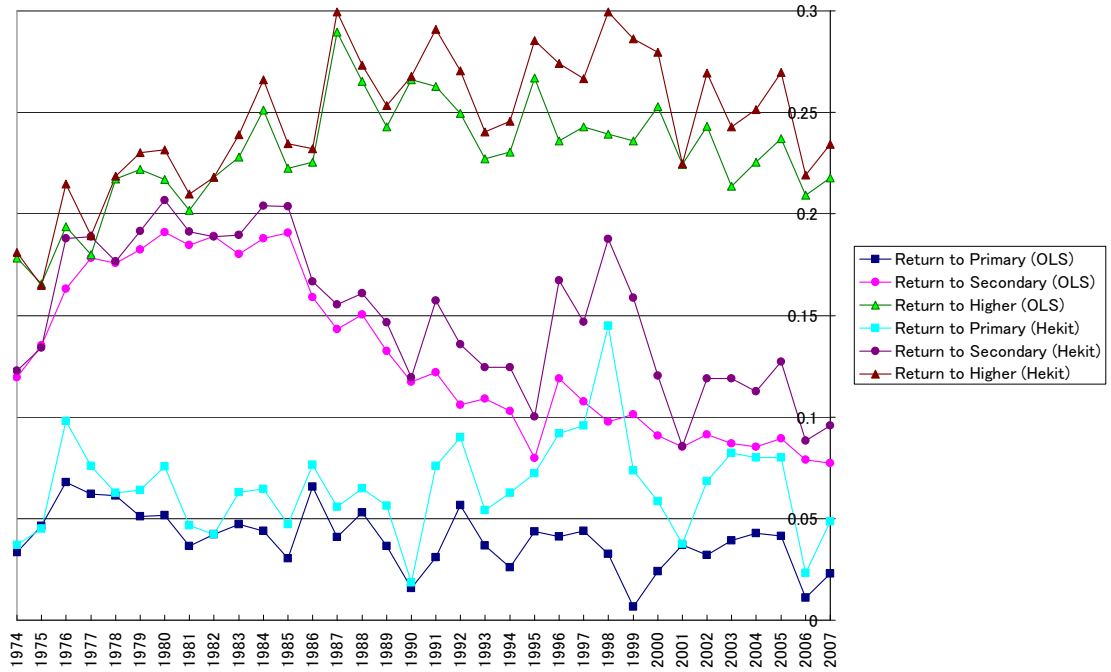
Therefore, those two findings—that the coefficients of the inverse Mills ratio are positive and that the coefficients of the years of schooling in the participation equation are positive—and the feature that the inverse Mills ratio is a monotonic decreasing function, lead to a larger return to education when estimated by Heckit than when estimated by OLS, except in 1975 and 1982.

Changes in the return to education in terms of various education attainments during 1974–2007, as estimated by both OLS and Heckit are presented in Figure 2-5. One of the most striking findings there is that differences between OLS and Heckit estimates are as small as 2% and are very stable until 1990, in spite of persistently high fluctuations in the unemployment rate during the 1970s and the 1980s; in comparison, differences are substantially large and greatly fluctuate in the mid-1990s, in spite of there being during the 1990s very low and stable unemployment rates (see Figure 2-1)[18]. However, the coefficients of years of schooling in most study years and the coefficients of the inverse Mills ratio in the 1990s are not statistically significant. Therefore, we must reject the assertion that there were sample selection biases during the aforementioned periods; thus, this issue can be ignored. On the other hand, the differences between OLS and Heckit estimates after 2002 are not practically small; there, the coefficients of years of schooling and of the inverse Mills ratio are statistically significant: when considering selection bias, the return to higher education increased, at most, by 3.2% in 2005. The large differences between OLS and Hekit estimates after 2002 can be attributed to relatively large coefficients of the inverse Mills ratio—that is, there was higher correlation between the error terms of the wage equation and the participation equation during that period (see Table A-1) and a relatively high unemployment rate after 1999 (see Figure 2-1).

In summary, OLS and Heckit estimates of the return to higher education tend to move precisely in the same direction up to 1990, and the differences between them in the mid-1990s are ignorable. However, the differences between OLS and Heckit estimates after 2002 are robust and not ignorable.

[18] The ratios of the censored portions of the sample to the entire samples are larger than unemployment ratios, because not only unemployed but also part-time and unpaid workers are included in the sample for the participation equation, as explained in Section 2-3-2. However, they moved in precisely the same direction during 1974–2007.

Figure 2-5. Changes in return to education, by various attainments estimated by both OLS and Heckit in Greater Santiago, 1974–2007



Source: Author's calculations based on data from *Encuesta de Ocupación y desocupación en el Gran Santiago*.

Third, I compare changes in the Gini of wages and the return to higher education, as estimated by OLS and Heckit. Changes in the Gini of wages and the return to higher education as estimated by OLS, in both of which we have limited the samples to full-time salaried male workers during 1974–2007, are presented in Figure 2-6, while changes in the Gini of wages among full-time salaried male workers and the return to higher education estimated by Heckit are presented in Figure 2-7. The findings show that changes in the Gini of wages and the return to higher education estimated by both OLS and Heckit move precisely in the same direction up to the early 1990s, especially in the aftermath of trade liberalization. However, changes in the return to higher education as estimated by both OLS and Heckit tend to deviate from those of Gini of wages since the mid-1990s; especially, the decreasing trend of the Gini of wages after the 1990s is not evident in the Heckit estimates. However, the Heckit estimates in the 1990s lack statistical robustness, as mentioned, and we can see again that changes in Gini of wages and the return to higher education as estimated by Heckit tend to move in a similar direction after 2003, when the Heckit estimates are statistically significant. Therefore, it should not be overly problematic to use return to higher

education as a measure of wage inequality during the 1974–2007 period, although the decreasing trend of the Gini of wages after the 1990s is not as evident in the case of the return to higher education, in absolute terms.

Figure 2-6. Changes in the Gini of wages and return to higher education estimated by OLS: full-time salaried male workers in Greater Santiago, 1974–2007

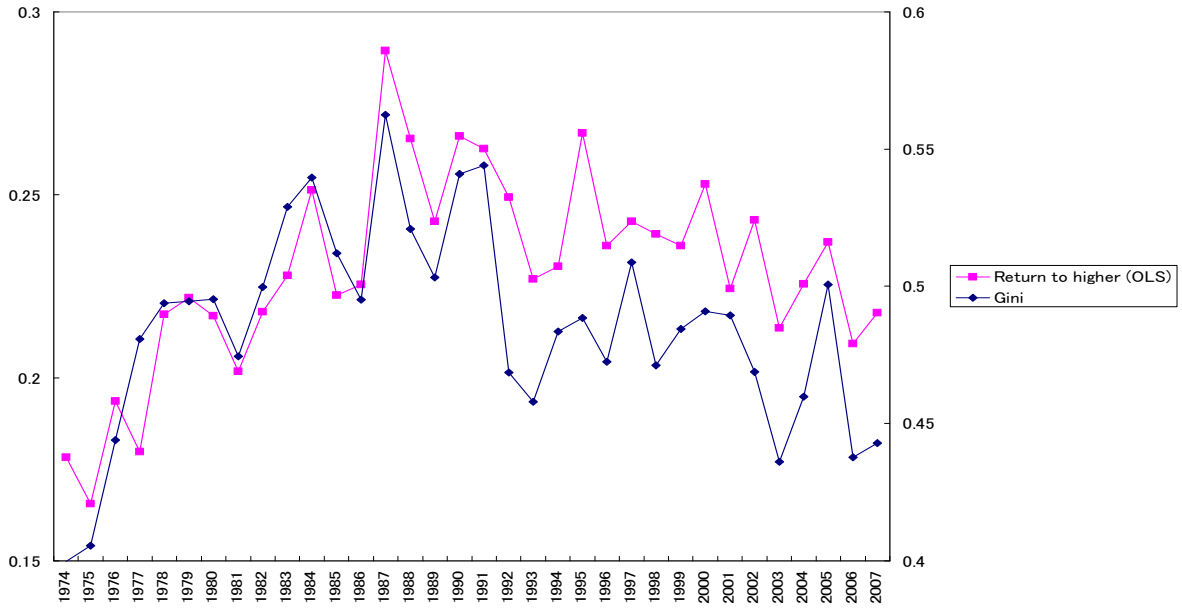
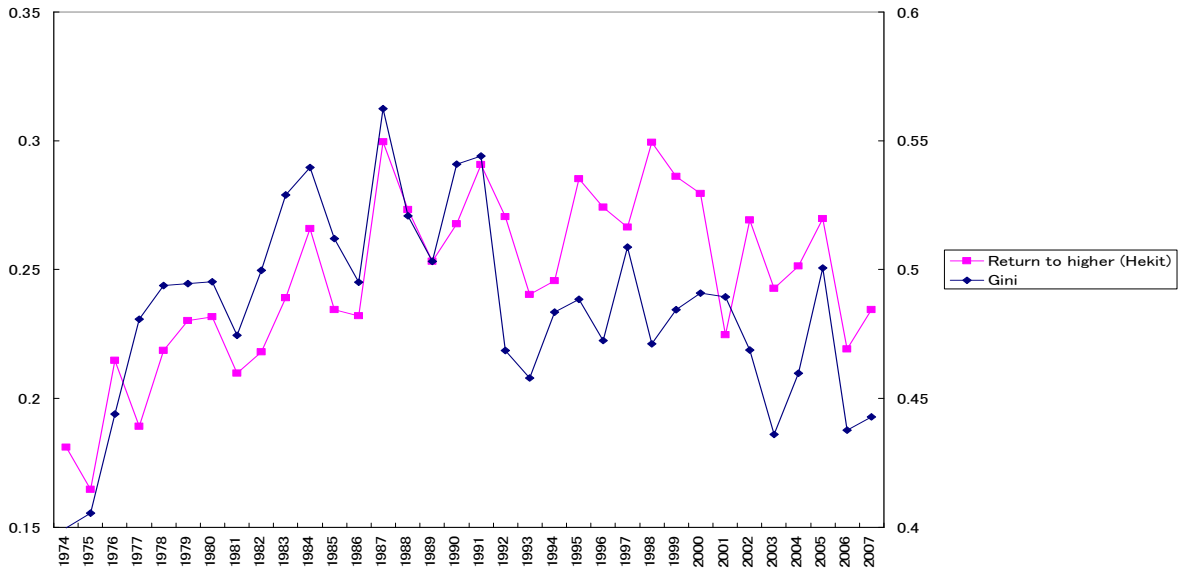


Figure 2-7. Changes in the Gini of wages (full-time salaried male workers) and the return to higher education estimated by Heckit in Greater Santiago, 1974–2007



Source: Author's calculations based on data from *Encuesta de Ocupación y desocupación en el Gran Santiago*.

2-5. Conclusion

This chapter analyzed the validity of the return to higher education, an education-based measure of skill premium, as a measure of wage inequality, while taking into consideration sample selection bias; it uses data drawn from Chile during its trade liberalization period. The main findings are as follows. First, the return to higher education as estimated by OLS limiting the sample to full-time salaried male workers, and Heckit estimates tended to move precisely in the same direction up to 1990, especially in the aftermath of the trade liberalization, in spite of persistently and highly fluctuating unemployment rates during the 1970s and the 1980s. However, the return to higher education as estimated by Heckit was actually larger than those by OLS—at most 3%—as theoretically expected, in more recent periods after 2002. Second, changes in the return to higher education, as estimated by both OLS and Heckit, as well as other measures of wage inequality such as the Gini of wages, also tended to move in the same direction up to the early 1990s—that is, they increased significantly in the aftermath of the trade liberalization period, but substantially decreased during the early 1990s when trade liberalization had been sustained for some time and "reforms to the neoliberal reforms" were carried out. Thus, we confirmed—by using the return to higher education as a measure—that different periods of external reforms certainly produced different trends in wage inequality in Chile.

Therefore, I assert that the use of return to higher education as estimated by OLS—where the sample is limited to full-time salaried male workers—as a measure of wage inequality should not be problematic among data up to the early 1990s, especially in the aftermath of trade liberalization, although we need to be more cautious about the existence of selection bias in post-2002 data.

Further research needs to be done in this area. First, the number of children under than age of 14 years does not seem to be an appropriate identifying variable when analyzing male sample selection bias. Therefore, we involve a severe identification problem when the other identifying variable is not statistically significant in the participation equation. If I were to obtain an appropriate identifying variable that determines male labor force participation other than non-employment income, I could more precisely estimate the return to higher education, while taking into consideration sample selection bias. Second, this chapter cannot analyze why the return to higher education as estimated by Heckit has, since the 1990s, deviated from those estimated by OLS. The relatively large differences between OLS and Heckit estimates after 2002 can be attributed to the higher correlation between the error terms of the wage equation and those of the participation equation; this is because the differences in the periods are larger than in 1983, when the

unemployment rate was the highest.[19] Therefore, the higher correlation between error terms of the wage equation and those of participation equation in recent years may reflect some kinds of changes within the Chilean labor market. One possible explanation is that the spread of higher education in a developing country is often associated with a general trend wherein an individual is more likely to participate in labor market, after controlling for the individual's education attainment. However, no such empirical analyses were undertaken in this chapter; this area will be an interesting subject for future research.

[19] The difference between estimated by OLS and Hekit is only 1.1% in 1983, although unemployment rate was as high as 25.2% and the coefficient of the inverse Mills ratio is statistically significant.

3

Trade Liberalization and Skill Premium in Chile

3-1. Introduction

Does trade liberalization increase wage inequality between skilled and unskilled workers? If so, through which channel would trade liberalization affect wage inequality? In spite of traditional theorem inherent in the Heckscher–Ohlin–Samuelson (henceforth, HOS) theory, many empirical studies have shown that trade liberalization has increased wage inequality in Latin American and Caribbean countries (henceforth, LACs) during the last three decades. In this regard, Goldberg and Pavcnik (2007) provide two important explanations based on an abundant body of empirical research. The first line of explanation for these findings focuses on the inconsistency with the assumptions of the HOS theory. Previous research notes that contrary to expectations, the unskilled labor-intensive sectors were in fact the ones most protected, prior to trade liberalization, and that they experienced the largest tariff reductions during the trade liberalization period. Therefore, a rise in wage inequality is exactly what Stolper–Samuelson would predict. In contrast, the second line of explanation focuses on within-industry changes. According to past works, one of the main determinants of increases in wage inequality is the increase in demand for more skilled workers within all industries; that is, a skill-biased technological change (henceforth, SBTC). This increase is attributable to "defensive innovation" (Wood, 1995), which indicates that intensified competition from abroad induces firms to take advantage of the existing new technologies that were unavailable prior to trade liberalization. SBTCs also arise from the incorporation of new technologies embodied in cheaper imported capital goods, such as machines and office equipment, or intermediate goods that are complementary to skilled workers.

With regard to the evolution of wage inequality between skilled and unskilled workers in Chile, the first of the LACs to introduce far-reaching trade liberalization, there seems to be little room for argument; that is, there is, in general, a common agreement that wage inequality increased

significantly since the mid-1970s, reached its peak in 1987, then decreased substantially up to the first half of the 1990s, once again increased in the mid- or late 1990s, and decreased afterward over the past decade (that is, during 1998–2007).[1] However, the impacts of trade liberalization on the evolution of wage inequality still remain controversial. Beyer *et al.* (1999) and Gallego (2012), in a more recent study, try to answer the aforementioned questions using exactly the same employment survey over the same period while employing a similar methodology. However, the findings are quite different. The former chapter finds that trade liberalization, measured as the volume of trade over GDP (the ratio of exports plus imports to GDP), and the price reductions of unskilled labor-intensive goods widen the wage premium gap between skilled and unskilled workers during 1960–1996. Therefore, they conclude that the evolution of wage premiums during this period can be understood within the context of the aforementioned inconsistencies in the assumptions of the HOS theory. In contrast, Gallego (2012) finds that the wage premium in the United States, which is assumed to be a proxy for SBTC in developed countries, increased the relative demand for skilled workers in Chile, while he finds no statistical significance of the volume of trade over GDP and the prices of unskilled labor-intensive goods during 1960–2000. Therefore, he concludes that SBTC caused by technology transfers from developed countries through imported capital is the crucial determinant of the evolution of relative demand for skilled workers.

Furthermore, the impacts of an increase in the supply of skilled workers on wage inequality are also controversial among previous studies. Theoretically, an increase in the supply of skilled workers should push the wages of skilled workers down relative to that of unskilled workers, thereby contributing to wage equalization. Beyer *et al.* (1999) find that an increase in the proportion of the labor force comprising university graduates reduces wage inequality. However, Robbins (1994a) finds that an increase in the relative supply of university graduates does not explain the observed wage inequality during 1975–1992. Gindling and Robbins (2001) also find that education-price effects, that is, wage premiums for more educated workers, dominate the effects of an increase in the supply of education during 1974–1990.

In addition to considering the changes in labor supply, we must take into account other possible explanations, such as labor market conditions, when analyzing the evolution of wage inequality between skilled and unskilled workers (Gindling and Robbins, 2001). Among the labor market conditions, minimum wages, unemployment, and union bargaining should be considered the relevant factors for the Chilean case.[2] However, the findings of previous studies are also ambiguous. Gindling and Robbins (2001) find a negative relationship between minimum wages and wage

[1] See, for example, Friedman *et al.* (2011), which provides the latest evidence in this matter.
[2] For more details on the role of labor market conditions, see Bussolo *et al.* (2002) and Reinecke and Valenzuela (2011). The minimum wage law was established in the immediate aftermath of the military *coup d'état*, in October, 1973.

premiums: an increase in the minimum wages contributes to wage equalization, but the correlations are not statistically significant at 10%. Gallego (2012) too finds a negative relationship between minimum wages and the relative demand for skilled workers but these correlations are not statistically significant at 10%. Gindling and Robbins (2001) find a positive relationship between unemployment and wage premiums: a decrease in unemployment contributes to wage equalization; however, the correlations are not statistically significant at 10%. Thus, these previous studies find that the evolution of wage inequality cannot be explained by changes in labor market conditions, although they do recognize the potential role that they play. In contrast, Reinecke and Valenzuela (2011) argue that the weaknesses of unionization and collective bargaining are the key determinants of the limited improvement found in wage inequality after 1990.

I assume that there are at least two important reasons for the aforementioned unsettle debate on the distributional effects of trade liberalization. First, the two studies mentioned above, Beyer *et al.* (1999) and Gallego (2012), cover not only the post-1974 trade liberalization period but also the pre-1973 import substitution industrialization period. The problem with including this period is that Chile had experienced political and economic turmoil during this period, especially from 1970 to 1973; that is, Chile passed through the "socialist-populist Chilean experience" (Larraín and Meller, 1991) era. While various previous studies show that wage inequality was at its lowest level during this period, the determinants of wage equalization comprise the temporal results of distributional policies typically inherent in "economic populism" (Dornbusch and Edwards, 1991); thus, wage equalization should be interpreted as in a separate mechanism from the trade liberalization perspective. This problem is also applicable in the case of labor market condition variables. For example, a decrease in wage inequality chronologically coincides with temporary increases in real minimum wages; this is one of the typical "economic populism" policies. Thus, the aforementioned negative relationship between minimum wages and wage premiums could disappear if we exclude this period from my study. Therefore, we should only cover the post-1974 period when analyzing the impact of trade liberalization on wage inequality; this chapter extends the analysis to 2007.

Further, I argue that all the trade-related variables used by Beyer *et al.* (1999) and Gallego (2012) are not necessarily appropriate measures of trade liberalization. First, the volume of trade over GDP has crucial flaws as a measure of trade liberalization, as pointed out by Rodriguez and Rodrik (2001). In particular, when one considers the specific Chilean context, trade volumes have crucial flaws as a measure of trade liberalization. This is because exports from Chile still depend heavily on a limited number of commodities, including copper; thus, trade volumes can be approximately determined from the price of copper and the real exchange rate, neither of which is

related to trade liberalization by itself.[3] Second, changes in the prices of unskilled labor-intensive goods occur not only because of trade liberalization, that is, tariff reductions or elimination of non-tariff barriers, but also because of other factors, such as decreases in domestic demand. Therefore, we cannot deny the fact that the prices of unskilled labor-intensive goods are endogenous variables with respect to wage inequality. Third, the channel through which wage premiums in the United States would contribute to SBTC in Chile is very ambiguous, although wage premiums in the United States are certainly exogenous variables with respect to wage inequality in Chile. In this regard, Gallego (2012) argues that the imported capital from developed countries plays a crucial role in technological transfer. However, he does not show any direct evidence linking technological transfers and imported capital. Therefore, I am rather skeptical of the findings of the two studies and therefore, argue that we should use tariffs, which are the most direct measures of trade liberalization (Rodriguez and Rodrik, 2001). Moreover, tariffs have been not only appropriate proxies for trade liberalization but also exogenously determined with respect to wage inequality in the case of Chile, because Chile applied flat tariffs to most goods since 1979.[4]

Therefore, the objective of this chapter is to empirically analyze whether trade liberalization increases wage inequality between skilled and unskilled workers and identify the channel through which it would affect wage inequality by using tariffs that are the most direct measure of trade liberalization, and covering only the post-1974 Chilean trade liberalization period. In addition, this chapter tries to identify the impacts of the labor supply of skilled workers and labor market conditions on wage inequality, which vary in previous studies. With regard to the analytical methodology, this chapter does not use an *ad-hoc* linear regression analysis, as did Beyer *et al.* (1999), but takes advantage of the methodology developed by the relevant labor economics literature, as will be discussed in greater detail in the following section.

This chapter is organized as follows. Section 3-2 describes a stylized theoretical model to analyze wage inequality between skilled and unskilled workers and explains how to apply the model to the Chilean context. Section 3-3 describes the data and method of estimation. Section 3-4 provides the findings of econometric analysis. The conclusions are summarized in Section 3-5.

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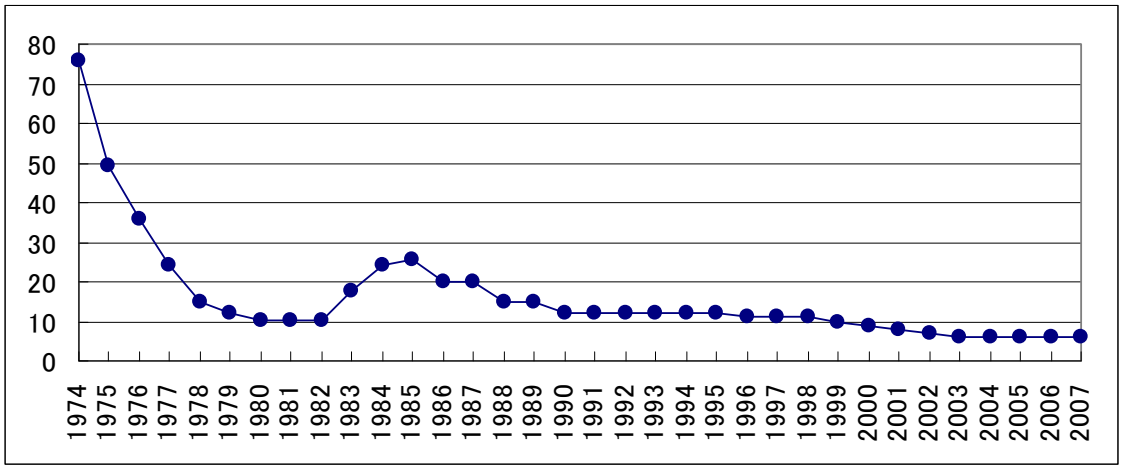
[3] In fact, during 1974–1996, the correlation coefficient between the volume of trade over GDP and the real effective exchange rate was very high: 0.89. The data on the ratio of exports plus imports to GDP are from the International Financial Statistics (IFS) 2009 CD-ROM. The data on the real effective exchange rate are from the calculations developed by the author on the basis of Ffrench-Davis, Leiva and Madrid (1992: 44) during 1974–1976, Banco Central de Chile (2002: 345-349) during 1977–1985, and the bank' s web page (http://www.bcentral.cl/) during 1986–2007.

[4] Although the tariffs levied in each industrial sector varied widely, from 0% to 750%, and the average tariff was 94% at the end of Allende's administration, the military government not only completely eliminated NTBs but also applied a uniform 10% tariff on most goods by 1979. The center-left coalition government, which took office in 1990, implemented further uniform tariff reductions (see Figure 3-1).

Figure 3-1. Evolution of average nominal tariff rates, 1974–2007 (%)



Source: Ffrench-Davis, Leiva and Madrid (1992), Ffrench-Davis (2002), and World Integrated Trade Solution (WITS).

3-2. Model

In this section, I describe a stylized theoretical model to analyze wage inequality between skilled and unskilled workers and explain how to apply this model to the Chilean context. This model was presented by Katz and Murphy (1992) and then developed by Card and Lemieux (2001) and many other previous studies. This model assumes that wage inequality between skilled and unskilled workers is attributable to the evolution of the relative supply and relative demand for skilled workers. While Card and Lemieux (2001) developed a model incorporating imperfect substitutability between not only different skill groups but also different age groups, this chapter uses the simplest model presented by Katz and Murphy (1992),[5] because this chapter uses not wages in themselves but "pure" skill premiums estimated by controlling for observable workers' characteristics, as will be discussed in greater detail in the next section.

Therefore, I assume the following CES production function for aggregate demand *Y* with two production factors, skilled workers and unskilled workers:

$$Y_t = [(a_t Ls_t)^{\frac{\sigma-1}{\sigma}} + (b_t Lu_t)^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}}, \quad \text{(3-1)}$$

where Ls_t and Lu_t are the total quantities of skilled and unskilled workers used in production during period *t*; a_t and b_t are the factor-augmenting technological parameters in period *t*, meaning

[5] I also owe my specification to Acemoglu and Autor (2011), a recent labor economics textbook.

that technological changes cause an increase in the productivity of skilled and unskilled workers; and $\sigma \in [0,\infty)$ is the time-invariant elasticity of substitution between skilled and unskilled workers.

If we assume that the wage rate of unskilled workers is equal to the marginal product of unskilled workers and that the wage rate of skilled workers is equal to the marginal product of skilled workers, we obtain the following wage inequality function as the natural log of the ratio of the wage rate of skilled workers to that of unskilled workers:

$$\ln(\frac{Ws_t}{Wu_t}) = (\frac{\sigma - 1}{\sigma})\ln(\frac{a_t}{b_t}) - \frac{1}{\sigma}\ln(\frac{Ls_t}{Lu_t}), \tag{3-2}$$

where Ws_t and Wu_t stand for the wage rate of skilled and unskilled workers, respectively, in period *t*. This equation decomposes the evolution of wage inequality between skilled and unskilled workers into the first term, which represents the relative demand for skilled workers, $\ln(\frac{a_t}{b_t})$, and the second term, which represents the relative supply of skilled workers, $\ln(\frac{Ls_t}{Lu_t})$. What is relevant from the theoretical assumption regarding the impacts of an increase in the supply of skilled workers on wage inequality can be given as follows:

$$\frac{\partial \ln(\frac{Ws_t}{Wu_t})}{\partial \ln(\frac{Ls_t}{Lu_t})} = -\frac{1}{\sigma} < 0. \tag{3-3}$$

Therefore, this model shows that an increase in the relative supply of skilled workers reduces the wage inequality between skilled and unskilled workers.

Since we assume that σ is a time-invariant production parameter, technological change is skill neutral as long as the productivity of skilled and that of unskilled workers increase at the same rate. However, this model usually assumes the existence of SBTC, that is, $\frac{a_t}{b_t} > 1$. Since a_t and b_t are not directly observable parameters, the literature assumes that there is a log linear increase in the relative demand for skilled workers over time coming from technology; that is, the evolution of the relative demand for skilled workers can be captured by a linear time trend (Acemoglu and Autor, 2011). Therefore, we make the following assumption on the first term, which represents the relative demand for skilled workers:

(3-4) $$\ln(\frac{a_t}{b_t}) = \gamma_0 + \gamma_1 t \,,$$

where *t* is a linear time trend. If we substitute equation (3-4) into equation (3-2), we obtain

(3-5) $$\ln(\frac{Ws_t}{Wu_t}) = (\frac{\sigma - 1}{\sigma})\gamma_0 + (\frac{\sigma - 1}{\sigma})\gamma_1 t - \frac{1}{\sigma}\ln(\frac{Ls_t}{Lu_t}) \,.$$

Apparently, this model assumes that SBTC takes place at a constant rate. However, there is no special reason for SBTC to always take place at a constant rate; therefore, we do not have to necessarily abide by the aforementioned assumption. In fact, Autor *et al.* (2008) allow the term representing the relative demand for skilled workers to have more flexible specifications; they include not only a linear time trend but also a quadric time trend and a cubic time trend. Moreover, it is natural to assume that SBTC takes place in Chile at a varying rate, because trade liberalization in Chile is very rapid and comprehensive as compared to in other developing countries, including the LACs. Therefore, I assume that a linear time trend can capture a SBTC that is not necessarily related to trade liberalization as mentioned in the usual labor economics literature; thus, I include trade-related variables that can capture the SBTC inherent in trade liberalization instead of a quadric or a cubic time trend. Under this assumption, the term representing the relative demand for skilled workers can be described as follows:

(3-6) $$\ln(\frac{a_t}{b_t}) = \gamma_0 + \gamma_1 t + \gamma_2 trade_t \,,$$

where *trade* stands for the trade-related variables in period *t*. I include the average nominal tariff rates of each year as the measure of trade liberalization, as discussed in the introduction. I also separately include the ratio of imports of consumption goods, capital goods, and intermediate goods to each year's GDP to identify the channel through which trade liberalization would affect SBTC. This is because SBTC is attributable to both import competition in final goods and the incorporation of new technologies embodied in capital or intermediate goods, as discussed in the introduction; thus, I need to identify which channel is relevant to the case of Chile. Therefore, this is the estimation strategy in which I apply this model to the Chilean context. If we again introduce equation (3-6) into equation (3-2), we obtain

(3-7) $$\ln(\frac{Ws_t}{Wu_t}) = (\frac{\sigma-1}{\sigma})\gamma_0 + (\frac{\sigma-1}{\sigma})\gamma_1 t + (\frac{\sigma-1}{\sigma})\gamma_2 trade_t - \frac{1}{\sigma}\ln(\frac{Ls_t}{Lu_t}) .$$

In addition, I add possible control variables that could have different effects on skilled and unskilled workers. First, I need to control for labor market conditions, such as minimum wages and unemployment, as discussed in the introduction. Theoretically, if the wages of unskilled workers are affected by the minimum wages while the wages of skilled workers are not, an increase in minimum wages can be expected to increase the wages of unskilled workers; thus, it contributes to a reduction in wage inequality (Gindling and Robbins, 2001). Concerning unemployment, if unemployment requires some additional qualification, an increase in unemployment would be expected to lead to an increase in the wages of skilled workers, thus contributing to an increase in wage inequality (Larrañaga, 2001). Second, I consider the export impacts predicted by the HOS theory: if the non-traditional natural resource-based exports, e.g., fish, fruit, and forestry products, expanding after trade liberalization comprises unskilled labor-intensive goods, these changes would favor unskilled labor, thus contributing to a reduction in wage inequality.[6] In my empirical analyses, I estimate equations (3-5) and (3-7) without and with control variables, as will be discussed in greater detail in the next section.

3-3. Data and estimation method

In this section, I describe the data used in this chapter and the method of estimation. In the estimation of equations (3-5) and (3-7) mentioned above, the evolution of wage inequality between skilled and unskilled workers, $\ln(\frac{Ws_t}{Wu_t})$, and that of the relative supply of skilled workers, $\ln(\frac{Ls_t}{Lu_t})$, are observable variables. Therefore, the most relevant issue in the estimation method is how to calculate the aforementioned two variables.

The data used for calculating the variables come from the Employment and Unemployment Survey for Greater Santiago (*Encuesta de Ocupación y desocupación en el Gran Santiago*), conducted by the University of Chile. This survey covers the Greater Santiago area, which includes roughly 40% of total Chilean population, and is conducted in June every year. Each

[6] For example, Scott (1996) and Schurman (2002) point out that those non-traditional natural resource-based export sectors, especially the fruit sector, were successful in creating relatively unskilled labor-intensive jobs as compared to copper, which is a traditional export sector in Chile.

survey covers fixed 3600 households,[7] and approximately 10000 and 14000 individuals during 1974–2007. The data are repeated cross-section, and the sample is fully representative of the Greater Santiago area.

I define "wages" as the remuneration from one's principal occupation; thus, wages does not include the income from self-employment, assets, pensions, or other sources. The samples used in this chapter comprise the working age (14–65 years) population who report positive income and positive work hours. The sample includes only salaried workers—that is, white-collar ("empleados") and blue-collar ("obreros") workers—who work on a full-time basis (more than 30 hours a week). Therefore, self-employed workers—that is, employers and independent workers—are not included. Domestic servants, unpaid family workers, and military personnel are also excluded from the sample because their wages are not likely to be determined by market forces. The samples whose variables are not answered in at least one survey question are also eliminated in advance.

To calculate the evolution of wage inequality between skilled and unskilled workers and the relative supply of skilled workers, I define skilled workers as college equivalents and unskilled workers as high-school equivalents, because there is a notable wage gap between people who completed university education and those who completed only high school in Chile (Ffrench-Davis, 2010a). Therefore, the evolution of wage inequality between skilled and unskilled workers and that of relative supply of skilled workers are calculated as the skill premiums between college equivalents and high-school equivalents (*wp*) and that of the relative supply of college equivalents (*relative supply*). Then, I apply the methodology of Autor *et al.* (2008) to my study to calculate the evolution of wage inequality college equivalents and high-school equivalents. The methodology is as follows. First, I construct six education categories (workers with up to primary school education, high-school dropouts, high-school graduates, vocational high-school dropouts and graduates, some college,[8] and university graduates) up to 1997, five education categories (workers with up to primary school education, high-school dropout, high-school graduate, some college, and university graduates) after 1998[9], and four potential experience categories[10] (0–9, 10–19, 20–29, and 30+ years), and then construct 24 or 20 education × experience groups. Second, I estimate the skill premiums for high-school graduates and university graduates from the following wage equation, limiting the sample to males:[11]

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[7] Although the number of households fluctuated during 1957–1979, the number has stayed fixed since 1980.

[8] "Some college" comprises workers who had not completed *Centro de Formación Técnica* (CFT)- or *Instituto Profesional* (IP)-based education (which are non-university post-high-school education programs), CFT- or IP-based education graduates, or university dropouts.

[9] The classification of education categories has changed since the 1998 survey.

[10] The years of potential labor experience is calculated by (age – years of schooling – 6).

[11] Following Card and Lemiuex (2001), I consider only males when calculating the evolution of

(3-8) $$\ln(W_i) = cons + educateg_i'\alpha + \beta_1 \exp_i + \beta_2 \exp_i^{\,2} + X_i'\delta ,$$

where *i* indexes an individual; *W* stands for hourly wages obtained by dividing monthly wages by four weeks of working hours and are then deflated by the national consumer price index (December 1998 = 1); vector *educateg* represents the aforementioned education categories; *exp* is years of potential experience;[12] and vector *X* contains a head of household dummy that is 1 for workers with a head position, a public sector dummy that is 1 for workers employed in the public sector, and 8 industry indicators.[13] Third, using the results of the aforementioned regression, I calculate the predicted log wages for high-school graduates and university graduates evaluated at the relevant experience level (5, 15, 25, or 35 years, depending on the aforementioned experience groups) and at the base categories with regard to all variables in vector *X*. Finally, I calculate the difference between the predicted log wage for the group of university graduates, $\ln(\hat{W}s_t)$, and high-school graduates, $\ln(\hat{W}u_t)$, using the average share of total monthly hours worked by education × experience groups in each year as weights.

To calculate the evolution of the relative supply of college equivalents, I apply the methodology followed by Card and Lemiux (2001). The model assumes that there are only two kinds of production factors, skilled workers and unskilled workers. Therefore, we need to classify all male and female workers into two groups—that is, college equivalents and high-school equivalents. In this regard, I calculate the quantities of high-school equivalents, Lu_t, in period *t* as follows:

(3-9) $$Lu_t \equiv L_t^{PS}\left(\frac{\overline{w}_t^{PS}}{\overline{w}_t^{HSG}}\right) + L_t^{HSD}\left(\frac{\overline{w}_t^{HSD}}{\overline{w}_t^{HSG}}\right) + L_t^{HSG} + L_t^{SC}\left(\frac{\left(\frac{\overline{w}_t^{UG}}{\overline{w}_t^{SC}} - 1\right)}{\left(\frac{\overline{w}_t^{SC}}{\overline{w}_t^{HSG}} - 1\right) + \left(\frac{\overline{w}_t^{UG}}{\overline{w}_t^{SC}} - 1\right)}\right),$$

---

wage inequality between college equivalents and high-school equivalents to avoid potential sample selection biases, but I consider both males and females when calculating the evolution of the relative supply of college equivalents.

[12] Although Autor *et al.* (2008) include the interactions of the quadric and Gallego (2012) includes the interactions of cubic for experience with education categories, I do not include the interaction terms with education categories because I cannot reject the jointly conducted *F* test for the insignificance of the interaction terms at the 10% level for most of the analysis period.

[13] The industry indicators are classified as follows: agriculture, mining, construction, manufacturing, commerce, financial services, personal services, community services, and transportation. The manufacturing sector is chosen as the base category because it holds the largest employment share among all the industrial sectors.

where L_t^{PS}, L_t^{HSD}, L_t^{HSG}, and L_t^{SC} are the total monthly working hours of workers who have completed up to primary school education, are high-school dropouts, are high-school graduates, and have attended some college, respectively; $\overline{w}_t^{PS}$, $\overline{w}_t^{HSD}$, $\overline{w}_t^{HSG}$, $\overline{w}_t^{SC}$ and $\overline{w}_t^{UG}$ are the average wages of each year for workers who have completed up to primary school education, are high-school dropouts, are high-school graduates, have attended some college, and are university graduates, respectively. Therefore, I assume perfect substitution between the less educated workers up to high-school graduates, and precisely weigh their working hours according to the ratio of their actual hourly average wages to those of high-school graduates. I distribute the working hours of the workers with some college education, which are "split" between college equivalents and high-school equivalents on the basis of their relative wages, as shown in equation (3-9). The quantities of college equivalents, Ls_t, in period *t* are calculated in exactly the same way:

$$Lu_t \equiv L_t^{UG} + L_t^{SC}\left(\frac{\left(\frac{\overline{w}_{jt}^{SC}}{\overline{w}_t^{HSG}} - 1\right)}{\left(\frac{\overline{w}_t^{SC}}{\overline{w}_t^{HSG}} - 1\right) + \left(\frac{\overline{w}_t^{UG}}{\overline{w}_t^{SC}} - 1\right)}\right). \tag{3-10}$$

Although Gallego (2012) also weighs the working hours of workers according to their education level, he applies fixed weights to all years: for example, the working hours of high-school dropouts are half of those of high-school graduates. However, the relative wages substantially fluctuated during his analysis period, rendering his assumption unrealistic and his calculations of the relative supply of skilled workers biased.

Regarding the trade-related variables, the data of average nominal tariff rates (*Tariff*) are from Ffrench-Davis, Leiva and Madrid (1992) for 1974–1989, and Ffrench-Davis (2002) and World Integrated Trade Solution (WITS) for 1990–2007 (shown in percentage terms). I do not consider preferential tariffs given the enforcement of numerous preferential free trade agreements that Chile has actively pursued since the 1990s. The data of the imports of consumption goods (*Consumption M/GDP*), capital goods (*Capital M/GDP*), and intermediate goods (*Intermediate M/GDP*) are from Banco Central de Chile (2002) for 1974–1999 and its web page for 2000–2007 (shown in percentage terms). As for the control variables stated earlier, I use the unemployment rate of males (*Unemployment*) from my own calculations based on data from the aforementioned employment survey (shown in percentage terms), real minimum wages (*Real minwage*) from Banco Central de

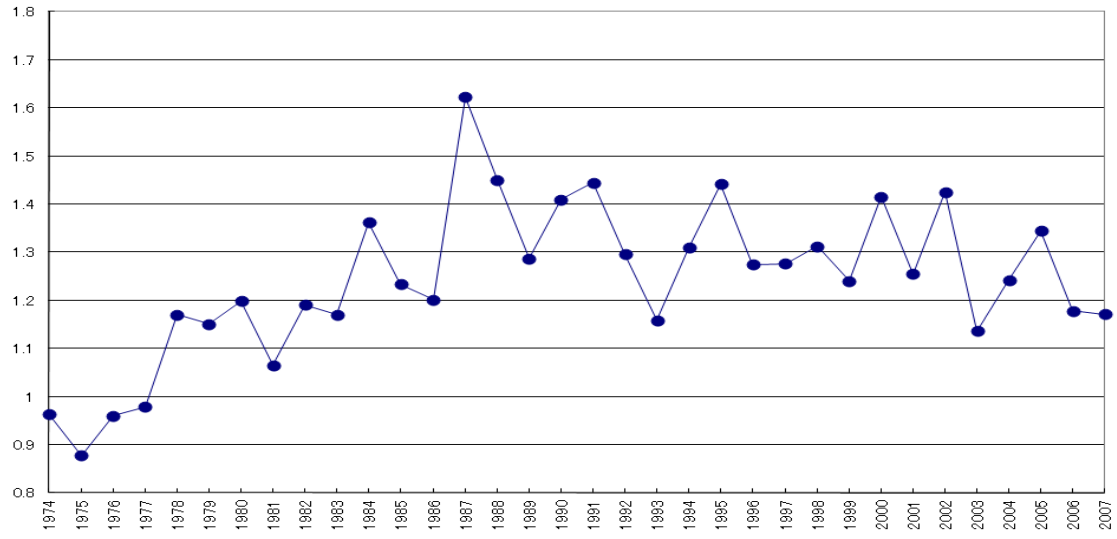
Chile (2002), and the web page of *Biblioteca del Congreso Nacional de Chile*[14] deflated by the national consumer price index (December 1998 = 100). As a proxy for non-traditional natural resource-based exports (*Non-copper EX /GDP*), I use the ratio of non-copper exports to GDP from Banco Central de Chile (2002) for 1974–1999 and its web page for 2000–2007 (shown in percentage terms).

I perform the Augmented Dickey–Fuller (ADF) tests to check the unit root hypothesis for all dependent and independent variables mentioned in this section. If the null hypotheses of unit roots are not rejected at the 1% significance level, I also perform the Engel–Granger cointegration tests.

3-4. Estimation results

Figure 3-2 shows the evolution of skill premiums between college equivalents and high-school equivalents, and figure 3-2 shows the evolution of the relative supply of college equivalents during 1974–2007. The evolution of skill premiums basically coincides with that seen in the previous studies: it increased significantly since the mid-1970s, reaching its peak in 1987; it then decreased substantially up to the first half of the 1990s, and once again increased in the mid-1990s; after that, it slightly decreased, although fluctuating year by year. This is as discussed in the introduction. The evolution of the relative supply of college equivalents basically shows an increasing trend, although this too fluctuated year by year.

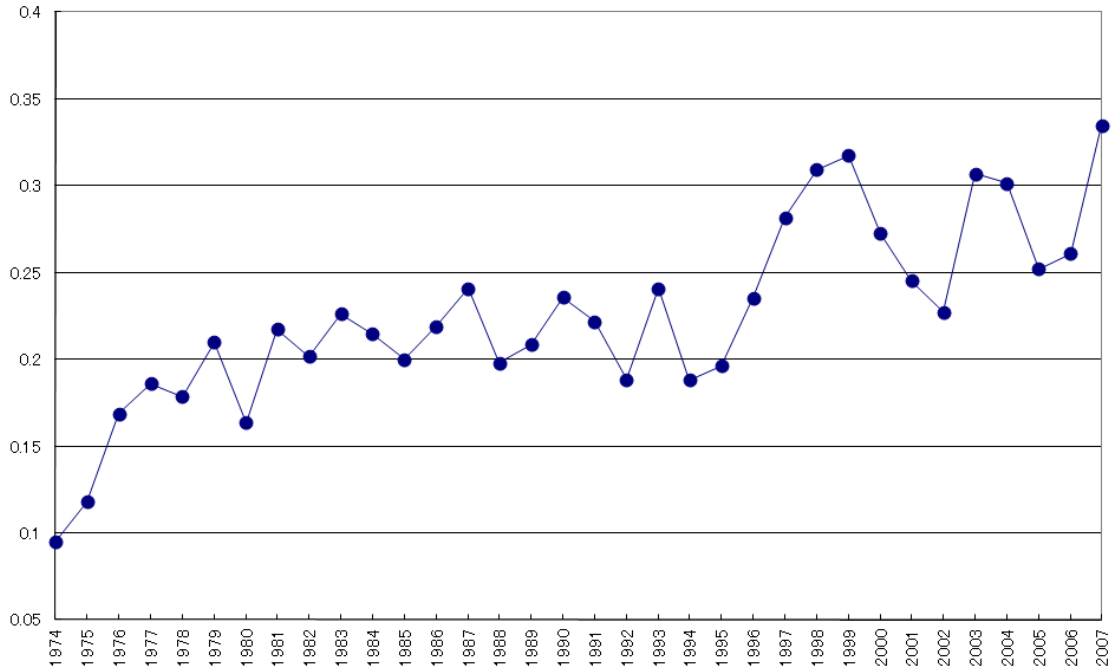
Figure 3-2. Evolution of skill premiums between college equivalents and high-school equivalents in Greater Santiago, 1974–2007



[14] http://www.bcn.cl/ (accessed on December 8, 2011)

Source: Author's calculations based on the data from *Encuesta de Ocupación y desocupación en el Gran Santiago*.

Figure 3-3. Evolution of the relative supply of college equivalents in Greater Santiago, 1974–2007



Source: Author's calculations based on the data from *Encuesta de Ocupación y desocupación en el Gran Santiago*.

The results of the unit roots tests are presented in tables 3-1 and 3-2. Tables 3-1 and 3-2 report the ADF tests without and with time trend, respectively. I begin without any lag and proceed to re-estimate the equation with additional lags until serial correlation is removed.[15] The results show that the null hypotheses of unit roots are not rejected at the 1% significance level in either without or with time trend in all the variables. Therefore, I perform the Engel–Granger cointegration tests in the estimation. I use the significance level of 1% in the following parts of this chapter unless otherwise mentioned, because the sample size is as small as 34.

[15] I consider the serial correlation as removed if the null hypothesis that there is no serial correlation cannot be rejected at the 10% significance level.

Table 3-1. Results of the ADF tests without time trend

variable	Test statistics	Number of lags	Number of obs	DW	Breusch–Godfrey LM test	Prob > F
wp	−3.141	3	30	1.939	0.105	0.748
Relative supply	−2.433	0	33	2.019	0.597	0.446
Real minwage	−0.816	1	32	1.785	1.574	0.220
Unemployment	−2.443	0	33	1.793	0.376	0.545
Tariff	−2.464	1	32	2.055	0.178	0.676
Consumption M/GDP	−2.055	0	33	1.833	0.088	0.769
Capital M/GDP	−2.042	0	33	1.860	0.194	0.663
Intermediate M/GDP	−1.028	1	32	1.896	0.000	0.991
Non-copper EX/GDP	−1.233	2	31	1.924	0.056	0.814

Table 3-2. Results of the ADF tests with time trend

variable	Test statistics	Number of lags	Number of obs	DW	Breusch–Godfrey LM test	Prob > F
wp	−3.372	0	33	2.156	2.507	0.124
Relative supply	−4.183	0	33	1.872	0.000	0.994
Real minwage	−1.894	1	32	1.834	0.690	0.414
Unemployment	−2.834	0	33	1.789	0.743	0.396
Tariff	−3.127	1	32	2.184	1.399	0.247
Consumption M/GDP	−2.523	0	33	1.757	0.580	0.453
Capital M/GDP	−2.096	0	33	1.834	0.268	0.609
Intermediate M/GDP	−4.226	0	33	1.688	0.646	0.428
Non-copper EX/GDP	−1.753	2	31	1.936	0.069	0.795

Table 3-3 reports the results of estimation equations (3-5) and (3-7). The coefficients on the relative supply of college equivalents are not statistically significant at all. Moreover, they show positive in some models—that is, they do not show theoretically the "correct" signs. Therefore, I cannot reject the perfect substitution between college equivalents and high-school equivalents; I find that an increase in the relative supply of skilled workers does not contribute to wage equalization during 1974–2007. The findings are quite different from both Gallego (2012), who rejects the perfect substitution between college equivalents and high-school equivalents during 1960–2000,[16] and Beyer *et al.* (1999), who finds that an increase in the proportion of labor force with university graduates reduces wage inequality during 1960–1996, but agree with Robbins (1994a).

Regarding trade-related variables, the coefficients on tariffs are negatively significant in models with control variables (reported in column [4]), indicating that tariff reductions contribute to increases in wage inequality between skilled and unskilled workers. The coefficients on the ratio of the imports of consumption goods and capital goods to GDP are positive but not statistically significant (reported in columns [5] and [6]). The coefficients on the ratio of the imports of

[16] Gallego (2012) estimates the values of substitution between college equivalents and high-school equivalents from 1.40 to 1.70; that is, the coefficients on relative supply of college equivalents are estimated from –0.714 to –0.588. For more details, see footnote 14 of Gallego (2012).

intermediate goods to GDP are negatively significant at 5% level (reported in column [7]). However, the significance of the ratio of the imports of intermediate goods to GDP disappears after controlling for tariffs, while the significance of tariffs is found to persist (reported in column [8]). Therefore, the results show that tariff reductions in themselves affect wage inequality, while the observed negative relationship between the ratio of the imports of intermediate goods to GDP and wage inequality is spurious; that is, tariffs correlate with both wage inequality and the ratio of the imports of intermediate goods to GDP. In fact, a regression of the ratio of the imports of intermediate goods to GDP on tariffs yields a positive and statistically significant coefficient of 0.074 (with a *T*-statistic of 4.46) during 1974–1989.[17]

The null hypotheses of no cointegration are also rejected, as shown in columns [4] and [8]; thus, the relationship between wage inequality and tariffs is not spurious. Moreover, the impacts of tariffs on wage inequality are practically large; a coefficient of –0.0090 shows that a 50% tariff reduction would lead to a 0.45-point increase in the log wage difference between college equivalents and high-school equivalents; thus, 67% of the total change of skill premiums from 1974 to 1987 can be explained by tariff reductions.

A logical examination of these findings would directly show what Beyer *et al.* (1999) imply by using the prices of unskilled labor-intensive goods; the unskilled labor-intensive sectors that were protected with the highest tariffs prior to trade liberalization experienced the largest tariff reductions. In fact, Hachette (2000) shows that the two unskilled labor-intensive sectors, textiles and footwear and apparel, which were protected with the highest effective tariffs among 23 industrial sectors in 1975, experienced the largest tariff reductions from 1975 to 1979.[18] Therefore, tariff reductions contribute to increases in wage inequality through the Stolper–Samuelson effects.

A possible explanation for the insignificance of the ratio of the imports of intermediate goods and capital goods to GDP is the effect of "imports-de-substitution" (Ffrench-Davis, 2008; 2010a) after trade liberalization in Chile. Ffrench-Davis (2008; 2010a) points out that the abandonment of the import substitution of final consumption goods reduced the imports of intermediate goods and capital goods, such as machinery and equipment, while it increased the imports of consumption goods (particularly non-food goods), leading to bankruptcy in the remaining import substitution sectors, such as the automotive industry. Therefore, the findings show that SBTC is not attributable to the incorporation of new technologies embodied in capital and intermediate goods in the case of Chile. Therefore, the findings are quite different from both Gallego (2012) and Gindling and Robbins (2001), who conclude that skill-intensive technologies embodied in imported

[17] I cover only the 1974–1989 period in this analysis because there have been few variances of average nominal tariff rates since 1990.

[18] The effective tariffs of the textiles sector decreased from 138% to 16% and those of the footwear and apparel sector decreased from 164% to 14% from 1975 to 1979.

capital goods caused SBTC in Chile. Moreover, the findings are unique to Chile in that they are in contrast with other LACs like Mexico, which experienced a growing importance of trade in intermediate goods; thus, the new technologies embodied in imported capital and intermediate goods are the main causes for SBTC in those countries.[19] The findings can be also interpreted as the experience of a country with a weak manufacturing sector and comparative advantage in natural resources after rapid and far-reaching trade liberalization, that is, "premature de-industrialization" (McMillan and Rodrik, 2011).

Another interesting finding is the impact of minimum wages. The coefficients on minimum wages are negatively significant in cointegrated models (reported in columns [2], [4], and [8]). The finding shows that a decrease in minimum wages certainly contributes to increases in wage inequality between skilled and unskilled workers, even if I exclude the "socialist-populist Chilean experience" era from the analysis period; thus, it is quite different from the ambiguous results of the previous studies. This is a reasonable finding, because the minimum wages were sufficiently low under the military government; it is just the same as the per capita poverty line income of an urban area in Chile.[20] Thus, the finding coincides with the theoretical assumption that if the wages of unskilled workers are affected by minimum wages while the wages of skilled workers are not, an increase in minimum wages would be expected to decrease wage inequality. Therefore, I conclude that the weak performance of labor markets under the military government is also an important determinant of increasing in wage inequality, while the improvement in labor market performances, especially an increase in the minimum wages, contributed to wage equalization during the period of the democratic governments. On the other hand, the coefficients on unemployment are not statistically significant, although they are negative, except for column [7]; that is, they are the expected signs.

The coefficients on the ratio of non-copper exports to GDP are positive except for in columns [4], which is unexpected. However, one possible explanation for the positive sign is that this employment survey covers only the Greater Santiago area—an urban area that includes part of a metropolitan region; that is, only about 1% of all the workers surveyed there were employed in the agriculture, forestry, or fishing sectors, excluding for the natural resource-based manufacturing sectors. Therefore, it is not appropriate to empirically analyze the impacts of natural resource-based exports on wage inequality using this employment survey.

[19] See, for example, Crag and Epelbaum (1996) and Harrison and Hanson (1999).
[20] For example, the monthly minimum wage was only 10120 pesos, while the per capita poverty line of monthly income in urban areas was 10158 pesos in 1987 (Banco Central de Chile, 2002).

Table 3-3. Regression results of estimation equations (3-5) and (3-7)

	equation (5)		equation (7)					
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Relative supply	0.1221	0.1479	−0.0702	−0.1889	0.0825	0.1463	0.0142	−0.1652
	(0.1708)	(0.1707)	(0.1871)	(0.1466)	(0.1370)	(0.1406)	(0.1453)	(0.1316)
Trend	0.0049	0.0183 ***	0.0045	0.0237 ***	0.0143	0.0090	0.0097	0.0202 ***
	(0.0043)	(0.0056)	(0.0048)	(0.0085)	(0.0117)	(0.0072)	(0.0084)	(0.0027)
Real minwage		−0.0035 ***		−0.0045 ***	−0.0036	−0.0025	−0.0019	−0.0046 ***
		(0.0012)		(0.0009)	(0.0020)	(0.0012)	(0.0012)	(0.0007)
Unemployment		0.0025		0.0057	0.0038	0.0019	−0.0006	0.0061
		(0.0031)		(0.0028)	(0.0055)	(0.0076)	(0.0036)	(0.0029)
Tariff			−0.0048	−0.0081 ***				−0.0090 ***
			(0.0026)	(0.0021)				(0.0021)
Consumption M/GDP					0.0275			
					(0.0426)			
Capital M/GDP						0.0064		
						(0.0323)		
Intermediate M/GDP							−0.0253	0.0121
							(0.0111)	(0.0074)
Non−copper EX/GDP				−0.0041	0.0142	0.0175	0.0244	
				(0.0142)	(0.0140)	(0.0105)	(0.0140)	
Constant	1.3413 ***	1.5894 ***	1.1345 ***	1.2684 ***	1.2813 ***	1.3692 ***	1.3568 ***	1.1792 ***
	(0.3138)	(0.3412)	(0.3334)	(0.2446)	(0.2638)	(0.4208)	(0.2826)	(0.2602)
Number of obs	34	34	34	34	34	34	34	34
R−squared	0.2287	0.4583	0.2897	0.6058	0.4846	0.4794	0.5181	0.6115
ADF−Test	−3.647	−5.102 ***	−3.693	−6.947 ***	−5.409 ***	−5.288 ***	−5.977 ***	−6.861 ***

*** indicates significance at the 1% levels.

Note: Numbers in parenthesis are Newey–West HAC standard errors.

3-5. Conclusions

This chapter empirically analyzed whether trade liberalization increases wage inequality between skilled and unskilled workers and identifies the channel through which it would affect wage inequality in Chile. The findings show that tariff reductions contributed to increases in wage inequality by causing price reductions of unskilled labor-intensive goods protected with the highest tariffs prior to trade liberalization. In contrast, I found no evidence that skill-intensive technologies embodied in capital goods and intermediate goods caused SBTC. In addition, this chapter shows that an increase in the relative supply of college equivalents did not contribute to wage equalization. In contrast, the minimum wages did matter—that is, a decrease in minimum wages contributed to increases in wage inequality during the period of the military government, while an increase in the minimum wages contributed to wage equalization during the period of the democratic governments. Therefore, this chapter found that under the military government, unskilled workers faced two major issues. First, the price reductions of unskilled labor-intensive goods after trade liberalization decreased their relative wages. Second, they were also affected by a squeeze on the real minimum wage due to the government's repressive labor policy. In this regard, this chapter shows quite different findings from previous studies by using tariffs, which are the most direct measures of trade liberalization, and by covering only the post-1974 trade liberalization period in Chile.

Further research needs to be done in this area. First, I have not mentioned the reason why the increase in the relative supply of college equivalents does not contribute to wage equalization.

The most possible explanation is that the relative supply of college equivalents in this chapter has flaws in that it could be an endogenous variable with respect to wage inequality, because this chapter uses actual wages as weights for calculating the relative supply of college equivalents; thus, wage inequality also simultaneously affects the relative supply of college equivalents. Another possible explanation is the quality of education. If private universities established after 1980 are not compatible with traditional universities, my calculation of the relative supply of college equivalents could be biased, although both Gindling and Robbins (2001) and Gallego (2012) argue using cohort effects analyses that the difference in the quality of education between the new private universities and the traditional universities does not influence the skill premiums for college equivalents. Second, if I were to obtain more detailed data on the components of consumption, capital, and intermediate goods, I could identify more precisely the channel through which trade liberalization affects wage equality in Chile. For example, if I were to classify consumption goods into non-food and food goods and capital goods into machinery and equipment and other goods, I could obtain the precise impact of trade liberalization on SBTCs. However, no such empirical analyses regarding these issues were undertaken in this chapter; this area will be an interesting subject for future research.

4

Trade Policy and Wage Inequality in Chile since the 1990s

4-1. Introduction

A number of previous studies have attempted to econometrically analyze the impacts of trade liberalization on wage distribution in Latin American and Caribbean countries (henceforth LACs). Many of the findings of those studies, whether based on country-specific or cross-country evidence, suggest that trade liberalization has adverse effects on wage distribution, except in a few cases.[1]

In order to explain the findings, which seem to contradict the traditional theorem inherent in Heckscher–Olin–Samuelson theory, Goldberg and Pavcnik (2007) provide comprehensive discussion based on an abundant body of empirical research. In summarizing the main points of discussion, two main explanations are provided. The first line of explanation for those findings focuses on between-industry relative price changes. Those studies note that, contrary to expectations, unskilled labor-intensive sectors had been in fact protected the most, prior to trade liberalization, and that they experienced the largest tariff reductions during trade liberalization. Therefore, the decline of unskilled worker wage and widening the gap between skilled and unskilled is exactly what Stolper-Samuelson would predict. On the other hand, the second line of explanation focuses on within-industry changes. According to those studies, one of the main factors contributing to the rise in wage inequality is an increase in demand for more skilled workers within industries, that is, skill-biased technological change (henceforth SBTC). This increase was caused by an increase in cheaper imports of capital goods that are complementary to skilled workers and defensive innovation caused by intensified competition from abroad after trade liberalization.

However, I am rather skeptical of the findings of the studies cited by Goldberg and Pavcnik (2007) and Giordano and Florez (2009), in two respects. First, they mainly cover the initial reform period, that is, the conversion from import substitution industrialization (henceforth ISI) to liberalized trade. Therefore, previous studies cannot isolate the impacts of trade liberalization from

[1] Concerning the specific-country evidence of Latin American countries, Giordano and Florez (2009: 99-103) summarize the methods and results of each study.

those derived from other reforms (e.g., stabilization programs, macroeconomic adjustments, wide-ranging privatization, financial sector reforms, tax reforms, labor market reforms), because they had chronologically coincided with trade liberalization in the initial reform period.

Second, those studies cover only urban areas or manufacturing sectors. This means that natural resource-related sectors—over which LACs have a comparative advantage—are excluded from their analyses.[2] For example, Attanasio *et al.* (2004) analyze the case of Colombia from 1984 to 1998, Hanson and Harrison (1999) analyze the case of Mexico from 1984 to 1990, and Feliciano (2001) also analyzes the case of Mexico from 1986 to 1990; each of these studies shows that unskilled labor-intensive sectors, which are likely to hold a comparative advantage, were protected the most prior to trade liberalization. However, as mentioned, those studies analyze only manufacturing sectors; therefore, if natural resource-related sectors were included, the protection pattern prior to the trade liberalization could change. It is the commonly accepted view that under the ISI regime, in addition to the tariff structure that had positively protected most manufacturing sectors at the expense of natural resource-related sectors (Perry and Olarreaga 2006), various anti-agricultural and pro-urban biased policies, for example, over-valuated exchange rates and high export taxes on agricultural exports, were implemented (Spoor, 2000). Moreover, taking into consideration the fact that natural resource-related sectors bore a very large export share after trade liberalization, it is not appropriate to exclude natural resource-related sectors when analyzing the impacts of trade liberalization on wage inequality.

From this viewpoint, the experiences of Chile since the 1990s collectively provide a very interesting case. First, during 1990–2006, Chile—the first of the LACs to introduce a free-market strategy—had already implemented main economic reforms and its economic situation was relatively stable, unlike those of other LACs. Especially, Chile continued with trade liberalization via the enforcement of preferential trade agreements (henceforth PTAs) in this period, which will be discussed in greater detail in the Section 4-3. Second, Chile has succeeded in expanding non-traditional natural resource-based exports (e.g., fish, fruit, and forestry products), and so Chile has been the most successful LAC in terms of export-led growth.

Concerning the analytical methodology, we explore a variety of possible approaches to identify the impacts of trade liberalization on wage inequality. This chapter takes the following approach: it uses tariffs as measures of trade liberalization and analyzes the impacts of trade liberalization on wage inequality, through a channel in which tariffs would affect industry wage premiums; this channel will be discussed in greater detail in the next section. Industry wage

[2] One possible reason why many studies drop rural areas from their analysis is there are few household surveys that cover rural areas. Moreover, it is very difficult to measure the wage income of workers employed in agricultural sectors.

premiums are defined as the part of worker wages that cannot be explained by observable workers' characteristics, but can be attributed to workers' industry affiliations (Goldberg and Pavcnik, 2007); they can also be interpreted as the relative wage of each industry after controlling for observable workers' characteristics.

Therefore, the objective of this chapter is to analyze empirically whether trade liberalization in Chile has produced different distributional impacts at a time when various sectors of its economy, including natural resource-related ones, during a period in which the country had implemented important economic reforms and has continued with its sustained open economy strategy, while focusing on industry wage premiums. For this purpose, this chapter takes advantage of data obtained through a series of comprehensive nationally representative household surveys, *Encuesta de Caracterización Socioeconómica Nacional* (henceforth CASEN); it also makes use of applied tariff rates, which are actually applied to imports as a part of PTA enforcement.

This chapter is organized as follows. Section 4-2 reviews previous studies and discusses the methodology used to analyze the relationship between tariffs and industry wage premiums. Section 4-3 overviews the main feature of trade policy during the period in question. Section 4-4 describes the data and estimates skill premiums as measures of wage inequality, as well as industry wage premiums, in the first-stage estimation. Section 4-5 econometrically analyzes the relationship between tariffs and industry wage premiums in the second-stage estimation. The conclusions are summarized in Section 4-6.

4-2. Literature review

Although very few studies focus on the relationship among trade policy variables such as tariffs and industry wage premiums (Pavcnik *et al.* 2004) with respect to LACs, three studies, each of which analyzes the impact of trade liberalization on increases in wage inequality through a channel in which tariffs affect industry wage premiums, are cited in Goldberg and Pavcnik (2007). Feliciano (2001) analyzes the case of Mexico from 1986 to 1990, and finds that although there is no statistically significant relationship between tariffs and industry wage premiums, there is a statistically significant positive relationship between import licenses and industry wage premiums; she also finds that import-license coverage decreased the most in industries with the highest share of low-skilled workers. Thus, she asserts, trade liberalization could contribute to increases in wage inequality. Attanasio *et al.* (2004) analyze the case of Colombia from 1984 to 1998, and they find a statistically significant positive relationship between tariff reductions and declines in industry wage premiums; they also find that industries that experienced the largest tariff reductions were also those with the initially highest shares of unskilled workers and lowest wages. Thus, they too assert that

trade liberalization could contribute to increases in wage inequality. Finally, Pavcnik *et al.* (2004) analyze the case of Brazil from 1987 to 1998, and they find that there is no statistically significant relationship between tariffs and industry wage premiums; thus, they say, there is no evidence that trade liberalization contributes to increases in wage inequality. Although these studies concentrate their analyses on initial reform periods and analyze only manufacturing sectors, as mentioned in the introduction, I do believe the methodologies of those studies are relevant to this chapter. The reasons are as follows.

First, tariffs have an advantage as trade liberalization measures. Goldberg and Pavcnik (2007) discuss the assessment of trade liberalization, wherein they show that many studies indirectly measure trade liberalization through more readily available data on trade volumes (e.g., exports and imports amounts). However, according to Rodriguez and Rodrik (2001), trade volumes are not necessarily consequences of trade policies: they can also be determined by many other factors unrelated to trade policy, such as reductions in transport costs and increases in world demand. Thus, they argue that tariffs and nontariff barriers (henceforth NTBs) are the most direct measures of trade liberalization. Moreover, trade volumes would be endogenous variables with respect to wages (Goldberg and Pavcnik, 2007). In the case of Chile, NTBs were virtually eliminated, due not only to the drastic trade liberalization introduced by the military government, but also because of the enforcement of PTAs under the center-left coalition government, as will be discussed in greater detail in the next section. As a result, tariffs can be considered the best direct measures of trade liberalization in the case of Chile.

Second, the methodologies provided by the aforementioned three studies allows us to show, quite clearly, the impacts of tariffs on wage inequality; different industries employ different proportions of skilled and unskilled workers, and the extent of tariff reductions will differ by industry. Thus, under the assumption that there is a lack of labor mobility, changes in industry wage premiums would translate into changes in the relative incomes of skilled and unskilled workers (Pavcnik *et al.* 2004; Perry and Olarreaga, 2006). In cases where tariff reductions contribute to increases in wage inequality, the procedures provided by the aforementioned three studies are as follows. In the first stage, each of these studies estimates industry wage premiums from standard Mincerian wage equations for each year, using household survey data; they show that industry wage premiums tend to be lower in industries that employ higher shares of unskilled workers. In addition, industries that experience larger tariff reductions are those with initially higher shares of unskilled workers and lower industry wage premiums. In the second-stage estimation, these studies pool the estimated industry wage premiums over time and show there is a statistically significant positive relationship between tariff reductions and declines in industry wage premiums. Therefore, the wages in industries that have proportionately larger shares of unskilled workers declined, relative to the

average wages; thus, they assert, tariff reductions contribute to an increase in wage inequality.

Furthermore, the existence of industry wage premiums presupposes that labor mobility across industries is imperfect because of labor market rigidity, especially in the short and medium term. Although labor market restrictions that can obstruct labor mobility across industries are common in LACs, industry wage premiums are especially relevant to this study, as it analyzes not only the manufacturing sector but also natural resource-related sectors, as mentioned. It is likely that workers employed in natural resource-related sectors are complementary with land, an immobile factor, but that those workers are less mobile across industries. Therefore, it is feasible to focus on the channel by which tariffs affect industry wage premiums.

Third, the aforementioned three studies concentrate their analyses on relatively short and medium periods of time, and within specific countries. Goldberg and Pavcnik (2007) argue that such analyses are likely to be more credible than analyses over longer periods of time, because over long periods of time, higher-income households tend to become more affluent faster than anyone else. Thus, in studies over shorter periods, these households' incomes would be truncated and wage inequality would tend to be underestimated.

Although the experiences of Chile provide a very interesting case—in that Chile was the first country to introduce trade liberalization and is the most successful case of export-led growth strategy among the LACs—as mentioned above, very few studies deal with the topic of trade liberalization in Chile. In fact, Florez (2009) mentions only Beyer *et al.* (1999) and Pavcnik (2002) as related studies in the specific case of Chile. Beyer *et al.* (1999) find that trade liberalization, measured as the volume of trade over GDP (henceforth OPEN), widened the gap of wage premiums between skilled and unskilled labor during 1960–1996. They argue that SBTC in natural resource-based export sectors following trade liberalization are the main explanations for the results.[3] However, I am skeptical of the empirical findings of that study and their explanations. First, as mentioned, trade volumes are not necessarily appropriate measures of trade liberalization. Especially, when one considers the specific Chilean context, OPEN has crucial flaws as a measure of trade liberalization. This is because the exports of Chile still heavily depend on a limited number of commodities, including copper, and thus trade volumes can be almost determined by copper price and the real exchange rate, neither of which are related to trade policy in itself. In fact, during 1974–1996, the correlation coefficient between trade volumes and the real effective exchange rate was very high: 0.87.[4] Therefore, their indicator OPEN is only a proxy variable for exchange rate.

[3] They define "natural resources" as both mining and other nontraditional ones, for example, fruit and pulpwood.

[4] Data vis-à-vis the share of trade volume of GDP comes from the IFS (International Financial Statistics) 2009 CD-ROM. Data on the real effective exchange rate are from the calculations developed by the author on the basis of Ffrench-Davis, Leiva and Madrid (1992: 44) during

Second, as has also been pointed out, the results in such long period are less reliable. I find that truncated distribution, mentioned above, is certainly applicable to the household surveys. By 1972, there were no missing samples owing to truncation, but the ratio has been drastically increasing. By 1999, 13.9% of the total sample is missing for some reasons, including truncation of high-income households[5]; thus, as has been pointed out by Heskia (1979), the degree to which wages are underestimated varies with income groups and time. Therefore, as these circumstances are also applicable to other household surveys, wage data cannot be precisely compared across such long periods of time; thus, their estimated evolution of skill premiums would be biased.[6] Third, setting SBTC aside, I shall argue that the aforementioned explanations for the results are seriously flawed. Although those studies argue that the relative demand for skilled labor in natural resource-based export sectors, including copper, would increase wage inequality, the survey covers only the Greater Santiago area—an urban area that comprises part of a metropolitan region. As one might expect, only about 1% of all workers surveyed there were employed in the agriculture, forestry, or fishing sector, and less than 1% of all workers were employed in the mining sector during this period[7]. Therefore, it is impossible to identify directly the impacts of natural resource-based exports on wage inequality, so long as these surveys are used as source material—although we can concede the possibility that increasing those exports affects the employment of natural resource-based manufacturing in the Greater Santiago area and labor mobility between the Greater Santiago and rural areas. To empirically analyze the impacts of natural resource-based exports on wage inequality, we need to use as source material nationally representative household surveys that cover both urban and rural areas.

Pavcnik (2002) analyzes plant-level data from 1979 to 1986 and defines the measures of import-competing industries as 0–1 dummies that take the value of 1 if the ratio of imports to total domestic output of the industry to which the plants belong exceeds 15%. The finding of this study is that there are significant within-plant productivity improvements in import-competing industries, after controlling for other measures of exposure to trade such as import-to-output ratios, tariffs, and exchange rates. The findings are explained thus: that domestic plants need to improve their efficiency and "trim the fat" in order to survive, because trade lowers domestic prices. Therefore, this explanation details precisely the factors that would give rise to SBTC. Although I consider their main results in themselves robust, from the viewpoint of the impacts of trade liberalization on wage

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1974–1976, Banco Central de Chile (2002: 345-349) during 1977–1985, and the bank's web page (http://www.bcentral.cl/) during 1986–2007.

[5] The ratio of missing samples is calculated by the author on the basis of the results of the *Encuesta de Ocupación y desocupación en el Gran Santiago* and its questionnaire.

[6] Chapter 2 and 3 of this thesis also cannot be immune from the critiques.

[7] These are calculated by the author on the basis of the results of the *Encuesta de Ocupación y desocupación en el Gran Santiago* and its questionnaire.

inequality, I shall argue the following three points. First, this study also uses trade volume as a measure of trade liberalization. Second, although a statistically negative relationship has been found between tariffs and plant productivity, Chile applied a flat tariff of 10.1% to almost all industries after 1979 and maintained constant tariff rates during the 1979–1982 period.[8] Therefore, although this study also addresses this problem, it is still difficult to determine exactly what it is that tariffs capture, from each year indicator. Third, and in what is most relevant from the viewpoint of the impacts of trade liberalization on wage inequality, the question left unanswered in this study is what happened to the workers displaced from closed-down plants. McMillan and Rodrik (2011) argue the prospect that displaced workers would be absorbed in even lower-productivity and lower-wage activities, such as service and informal sectors. Taking into consideration Chile's premature deindustrialization and drastic increase in wage inequality after trade liberalization, it is natural to assume that such situations have really been to blame in Chile since the mid-1970s. Therefore, we need to analyze the impacts of plant or industry-level productivity improvements on the economy-wide wage inequality.

Before closing the literature review, I wish to mention other laborers who are not mentioned in Florez (2009). Robbins (1994b) analyzes the same household surveys used by Beyer *et al.* (1999), from 1957 to 1992, and finds that demand changes between industries are weak and that demand changes within industries favoring skilled workers, that is, SBTC after trade liberalization, can be attributed to an increase in wage inequality. I shall argue that such a simple before–after analysis cannot be immune from identification problems, because in the period under examination, trade liberalization chronologically coincided with many other economic reforms. For example, severe expenditure cuts associated with stabilization programs would also cause defensive innovation, which is one of the main drivers inherent in SBTC. Meller and Tokman (1996) analyze manufacturing sectors from 1968 to 1993 and find the ratio of skilled to unskilled workers—which is assumed to be a proxy variable for technology, that is, demand for skilled workers within industries—widened the gap between the relative wages of skilled and unskilled workers; thus, SBTC increased wage inequality. However, unlike other studies, they find the share to have a smaller effect on the relative wage since post-1975 trade liberalization. However, I shall argue their model contains a possible misspecification, and thus, their findings lack robustness—although they do recognize this problem, in part. We can theoretically assume that the ratio of skilled to unskilled workers, in itself, is determined by supply and demand, and thus it is an endogenous variable with respect to its relative wage. Although to assert that the share in each industry could act as a proxy variable for the demand for skilled workers within industries, they assume the supply of skilled to

[8] The data come from Ffrench-Davis, Leiva, and Madrid (1992: 44)

unskilled workers to be constant, but this assumption is hardly realistic in Chile during the period under examination.

In summary, all the aforementioned previous studies analyzing Chile mainly cover the initial reform period, cover only urban areas or manufacturing sectors, and explain the increase in wage inequality solely in terms of SBTC. Moreover, with the exception of Pavcnik (2002), none of the studies are fully immune from what Goldberg and Pavcnik (2007) consider methodological flaws; for example, they use trade volumes as measures of trade liberalization and analyze long periods of time. Therefore, this chapter applies the methodology of Feliciano (2001), Attanasio *et al.* (2004), and Pavcnik *et al.* (2004), which use tariffs as measures of trade liberalization, analyze the impacts of trade liberalization on wage inequality through a channel in which tariffs would affect industry wage premiums, and concentrate their analyses on relatively short and medium time-periods; it applies this methodology to the case of Chile in the 1992–2006 period. However, there is one possible difficulty with employing tariffs in the methodology of the aforementioned three studies, especially in the case of Chile: nominal tariffs levied in each industrial sector vary little, because Chile has applied flat tariffs to almost all industries since 1979. I attempt to mitigate this problem by using import-weighted average applied tariffs, as discussed in greater detail in the next section.

4-3. Trade policy in Chile, 1992–2006: from "unilateral" to "reciprocal" trade liberalization

Chile started drastic economic reforms in 1975, following the military *coup d'état* that overthrew Allende's government in 1973. Pinochet's government replaced the formerly inward-looking development strategy with an outward-looking one. At the end of Allende's administration, tariffs levied in each industrial sector varied widely, from 0% to 750%; the average tariff was 94%. The trade policy introduced by Pinochet's government bore the following characteristics. NTBs such as import quotas and permits were almost completely eliminated, and tariffs were progressively reduced and their dispersions decreased, so that by 1979 a flat tariff was applied to most goods (Macario, 2000). The average tariff between 1979 and 1982 was 10.1% (Ffrench-Davis, Leiva and Madrid, 1992). Although tariffs were raised owing to the economic crisis between 1983 and 1985, tariff levels were again progressively reduced as the economy recovered post-1986.[9]

The economic policy of the center-left coalition government that took office in 1990 maintained the basic trade-policy principles of the former government, for example, an export-led

[9] The average tariff from 1983 to 1985 was 22.7%; from 1986 to 1989, it was 17.6%. Data are obtained from Ffrench-Davis (2002: 168)

growth strategy, openness to trade, further uniform tariff reduction, and intersectoral neutrality.[10] Therefore, Chile consolidated within the World Trade Organization a maximum tariff rate of 25%, bringing it down from 35% (Macario, 2000); meanwhile, the tariff rate of the most-favored nation (MFN) was progressively reduced from 11% in 1992 to 10% in 1999, 9% in 2000, 8% in 2001, 7% in 2002, and 6% in 2004.[11]

The most important feature of Chile's trade policy after the 1990s was in the transformation from unilateral, across-the-board liberalization toward a strategy that also included bi- or plurilateral PTAs subject to reciprocal trade liberalization (Ffrench-Davis, 2010a). Since the early 1990s, Chile has actively pursued PTA negotiations; most of the PTAs signed during that period fall into a category known as Economic Complementation Agreements (ECAs) under the framework of *Asociación Latinoamericana de Integración* (ALADI), which focus on the elimination of tariffs and NTBs for goods (Kuwayama, 2003). By 2006, Chile had executed ECAs with Mexico (1992), Venezuela (1993), Bolivia (1993), Colombia (1994), Ecuador (1995), and Peru (1998).[12] Moreover, since the mid-1990s, Chile has pursued a more comprehensive PTA style—that is, NAFTA-style agreements or Free Trade Agreements (FTAs), which not only have faster and more universal tariff phase-out programs, but also include those areas not addressed by ECAs, such as investment, trade in services, competition policy, government procurement, and intellectual property rights (Kuwayama, 2003). By 2006, Chile had executed FTAs of this type with MERCOSUR (1996), Canada (1997), Mexico (1999), Costa Rica (2002), El Salvador (2002), the European Union (2003), the United States of America (2004), the Republic of Korea (2004), the European Free Trade Association (2004), and China (2006); the Trans-Pacific Strategic Economic Partnership Agreement among Chile, New Zealand, Singapore, and Brunei Darussalam (2006) also falls into this category.[13]

As a result of these agreements, the share of import values from countries with which Chile has PTAs has drastically increased. As shown in Table 4-1, the share increased from 2% in 1992 to 85% in 2006. Furthermore, the import-weighted average applied tariffs (henceforth, applied tariffs) levied in each industrial sector diverged from the MFN tariffs,[14] owing to a wider

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[10] Concerning trade policy since 1990, see for more details Ffrench-Davis (2008; 2010a).
[11] Data are obtained from World Integrated Trade Solution (WITS).
[12] See, for more details: the web page of the Organization of American State's Foreign Trade Information System (SICE): http://www.sice.oas.org/agreements_e.asp (accessed on October 7, 2009) and Kuwayama (2003: 178-179).
[13] See, for more details: the web page of the Organization of American State's Foreign Trade Information System (SICE): http://www.sice.oas.org/agreements_e.asp (accessed on October 7, 2009) and Kuwayama (2003: 178-179).
[14] If Chile imports a good *i* from China, with which Chile has no kind of PTA, and the United States of America (USA), with which Chile does have an FTA, the import-weighted average applied tariff of good *i* is calculated as follows:

preferential margin resulting from the proliferation of PTAs and the many exceptions allowed by tariff phase-out programs.[15] This chapter attempts to use tariffs as measures of trade liberalization by employing applied tariffs. Additionally, what is relevant from the viewpoint of the impacts of trade liberalization on wage inequality is that applied tariffs not only lead to reductions in import tariffs but also prevent trade partners from arbitrarily increasing tariffs on Chilean exports; thus, applied tariffs ensure strong access conditions and stability for Chilean exports, both of which are afforded by the PTAs' principle of reciprocity.[16]

However, it is very difficult to calculate applied tariffs, given the many kinds of exceptions allowed by tariff phase-out programs, especially with respect to agricultural products (e.g., beef, sugar, wheat, wheat flour),[17] although some attempts have certainly been made to calculate them. Although Becerra (2006) provides a thorough calculation, it covers only the 2000–2005 period. Dúran (2008) covers the 1990–2007 period, but only calculates a proxy for applied tariffs *(proxy arancel efectivo*), and thus assumes them to be equal to 0 on all products after any kind of PTA came into effect. Therefore, Dúran's (2008) assumption may be too strong and unrealistic, if they are to be used in actual empirical analyses. World Integrated Trade Solution (henceforth WITS) also provides a thorough calculation and defines the applied tariff as the minimum tariff granted by a reporter country to a partner for the product in question; it is equal to the MFN tariff, unless a preferential tariff exists in the database. However, the data apparently do not reflect the realities of applied tariffs. For example, all applied tariffs levied in each industrial sector in 2000 were at the homogenous rate of 9%, that is, they were identical to MFN tariff rates, although many PTAs had already come into effect in that year.

In summary, data from Becerra (2006) can be considered the only data available for empirical analyses. In fact, Ffrench-Davis (2008), one of the most widely accepted studies on the Chilean economy, uses data from Becerra (2006) vis-à-vis applied tariffs.[18] However, in addition to covering a limited time-period, the classifications in Becerra's data do not necessarily coincide with the general industrial classification of economic activities, for example, the international standard industrial classification (ISIC). Some sectors are classified according to the 2-digit ISIC level

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$$\tau^i = \tau^i_{MFN} \times \frac{M^i_{China}}{M^i} + \tau^i_{FTAUSA} \times \frac{M^i_{USA}}{M^i},$$

where M^i is the total import value of good *i* from a country.

[15] This is also pointed out by Macario (2000).

[16] For more details, see Sáez and Valdés (1999).

[17] For example, in the agreements between Chile and MERCOSUR, Chile includes some traditional agricultural products as the most restricted categories: they receive duty-free treatment after 15 and 18 years, respectively (Agosin 1999: 255-256). For a list of the exceptions due to tariff phase-out programs in 2004, see Schuschny *et al.* (2007).

[18] See Ffrench-Davis (2008: 255).

(Rev.2), others are classified according to the 3-digit ISIC level (Rev.2), and still others are classified according to an aggregated 2 or 3-digit ISIC level (Rev.2), that is, aggregation of some 2 or 3-digit level sectors into one sector (see Table 4-2). Therefore, I reconstruct household surveys, as explained in greater detail in the next section, according to Becerra's (2006) own classification, and I apply this classification to the tradable sectors addressed in this chapter.

Table 4-2 shows the average applied tariffs according to this classification between Q2 2000 and Q4 2005, inclusive.[19] This table shows some noticeable trends. First, in the initial 2000 time period, applied tariffs were the highest in the agricultural (ISIC 11) and agricultural-based manufacturing (ISIC 311/312) sectors, both of which had many exceptions allowed by tariff phase-out programs. Second, applied tariffs levied in each industrial sector including the agricultural and agricultural-based manufacturing sectors drastically decreased after 2000. After that time, many important FTAs with quicker tariff phase-out programs came into effect, and most of the ECAs had already been in effect for 10 years. Therefore, the applied tariffs in 2006 nearly equal 0% in most of the industrial sectors.

Table 4-1. Share of import values from countries with which Chile has PTAs, 1992–2006 (%)

Year	1992	1994	1996	1998	2000	2003	2006
PTAs share (%)	1.93	4.99	27.28	30.70	34.58	62.97	84.50

Source: Author's calculations, based on data from WITS, the web page of the Organization of American State's Foreign Trade Information System (SICE)[20] and Kuwayama (2003: 178-179)

[19] There is a reason as to why I use data from Q2 2000 as initial tariff rates, to perform a Durbin–Wu–Hausman test for the endogeneity of applied tariffs; this is discussed in detail in section 4-5.

[20] http://www.sice.oas.org/agreements_e.asp (accessed on October 7, 2009)

Table 4-2. Applied tariffs, 2000–2005 (%)

ISIC (Rev.2)	Industry	Q2 2000	Q2 2003	Q4 2005	
11	Agriculture and hunting	13.91	2.29	1.03	
12	Forestry and logging	4.63	1.98	0.7	
13	Fishing	9.01	5.4	2.34	
21/22	Coal mining/Crude petroleum and natural gas production	4.88	1.37	2.47	
23/29	Metal ore mining/Other mining	3.98	1.2	0.13	
311/312	Food manufacture	13.1	3.5	2.61	
313/314	Beverage industries/Tobacco manufacture	6.12	3.68	1.94	
321/322	Manufacture of textiles/Manufacture of wearing apparel, except footwear	7.71	4.6	4.33	
323/324	Manufacture of leather and products of leather/Manufacture of footwear	7.79	4.33	5.09	
331	Manufacture of wood and wood and cork products	7.22	1.53	0.96	
332	Manufacture of furniture and fixtures	7.01	3.94	3.78	
341	Manufacture of paper and paper products	5.58	1.22	0.39	
342	Printing, publishing and allied industries	2.53	1.51	1.14	
351	Manufacture of industrial chemicals	5.8	2.89	1.38	
352	Manufacture of other chemical products	6.9	3.21	2.01	
353/354/355/356	Petroleum refineries/Manufacture of miscellaneous products of petroleum/Manufacture of rubber products/Manufacture of plastic products	7.51	3.54	1.57	
36	Manufacture of nonmetallic mineral products, except products of petroleum and coal	6.67	3.08	2.23	
37	Basic metal industries	4.81	2.21	1.04	
381/383/385	Manufacture of fabricated metal products/Manufacture of electrical machinery apparatus/Manufacture of professional and scientific and measuring controlling equipment	7.39	3.36	2.57	
382	Manufacture of machinery except electrical	5.97	2.26	1.08	
384	Manufacture of transport equipment	6.83	2.89	1.4	
39	Other manufacture industries	8.15	4.94	4.79	
MFN		9	6	6	

MFN: Most-favored nation

Source: Becerra (2006: 21-26)[21]

[21] The sector names were originally written in Spanish, and the ISIC codes are explicitly written up to the 2-digit level. I use the name of each sector to match Becerra's (2006) own classification to the general ISIC code, which is as detailed as possible, for example, up to the 3-digit level. I refer to the web page of the United Nations Statistics Division (UNSD): http://unstats.un.org/unsd/cr/registry/ (accessed on October 2, 2009) for Spanish-to-English translations.

4-4. Wage premiums in Chile, 1992–2006 (first-stage estimation)

4-4-1. Data used

I use data from seven comprehensive household surveys: CASEN, from the years 1992, 1994, 1996, 1998, 2000, 2003, and 2006.[22] Each is a nationally and regionally representative household survey carried out by *Ministerio de Planificacion y Cooperación* (MIDEPLAN).[23] The objectives of the survey are to generate a reliable portrait of socioeconomic conditions across the country and to monitor the incidence and effectiveness of the government's social programs (Valdés 1999); it is carried out in November of each year. Therefore, the survey provides detailed information on demographic characteristics, education, health, housing, employment, and various sources of income, including income transfers and government subsidies. The data is a repeated cross-section, and the sample size of each year is substantially large: each survey covers between 130,000 and 270,000 individuals, from between 33,000 and 74,000 households. As such, the data are available in two forms: individual and household levels; for the purpose of this chapter, I use the former. The survey is unique, in that the employment data are reported at the 3-digit ISIC level (Rev.2) from 1992 to 1996, while data are provided at the 4-digit level from 1998 to 2006.[24]

I define "wages" as the sum of wage income and bonuses from principal occupation.[25] Therefore, they do not include income from other occupations, self-employment, asset income, income transfers, or subsidies. The samples used in this chapter are defined as comprising the population of working age (aged 14–65 years) who report positive income and positive work hours. The sample includes only salaried workers; thus, self-employed workers—that is, employers and independent workers—are not included.[26] Military personnel and unpaid family workers are also excluded from the sample, because their wages are not likely to be determined by market forces. The samples whose variables had not been answered at least one survey question are also eliminated.

For the 1992–1994 period, I construct hourly wages by dividing monthly wages by four

[22] Although the year 1990 is also available, the classification of economic activity in this year is different from that of the others, and it is not consistent with any international classification. Therefore, we do not use data from this year.

[23] Each survey is carried out by MIDEPLAN through the Department of Economics of the University of Chile. Once each survey is complete, the data are entrusted to ECLAC, which is in a position to evaluate the consistency of the information and generate a series of new variables that are compatible with other LACs (Valdés 1999).

[24] In the 1990s, household surveys in LACs were far less internationally standardized than today. For this reason, the lack of an international framework vis-à-vis the concepts and classifications used in surveys is rather common.

[25] Although I want to eliminate bonuses from wages, in CASEN 2006, we cannot distinguish wage income from bonuses.

[26] We cannot know the working hours of self-employed workers in 2006, because in this year the questions were asked only of salaried workers.

weeks of working hours, owing to the unavailability of monthly working-hour figures during this period. Wages are deflated by the national consumer price index (December 2008 = 1).

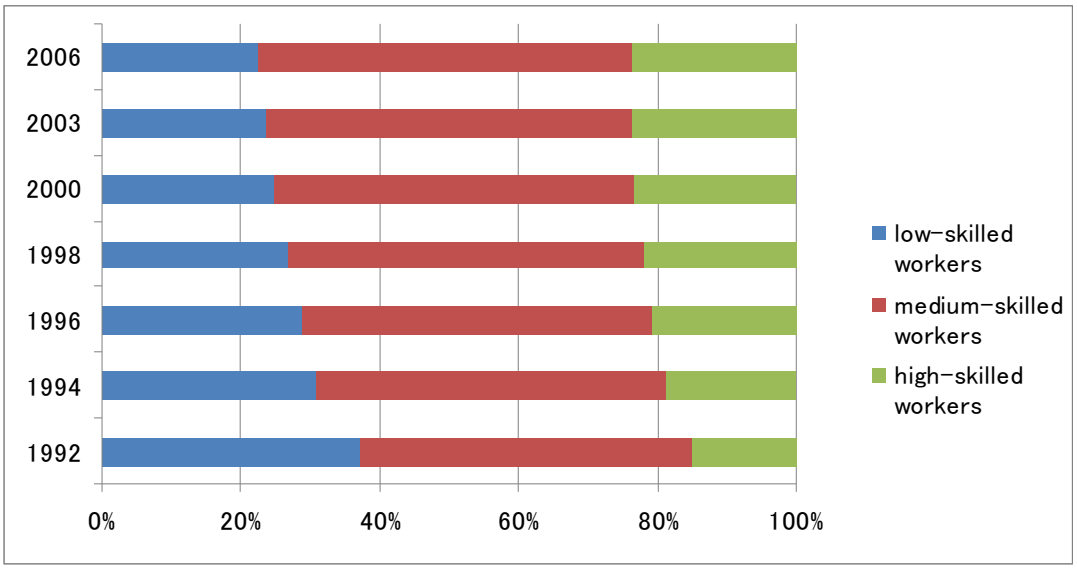
4-4-2. Skill premiums

In this section, I estimate the narrowest measure of inequality—skill premiums.[27] This chapter defines the skill premiums as the returns to different levels of school attainment, after controlling for various observable individual characteristics. To estimate skill premiums, we define three educational categories: (1) low-skilled workers, who comprise workers who had completed up to elementary school education, (2) medium-skilled workers, who comprise workers who had not completed *Centro de Formación Técnica* (CFT) or *Instituto Profesional* (IP)-based education, as well as secondary school graduates or those workers who had not completed secondary school education, and (3) high-skilled workers, who comprise university graduates or those workers who had not completed a university education, and CFT or IP-based education graduates. The high-skill premiums are estimated as the returns to high-skilled workers relative to those for low-skilled workers, while medium-skill premiums are estimated as the returns to medium-skilled workers relative to those for low-skilled workers. These premiums are estimated in each year of the 1992–2006 period by using the following Mincerian wage equation (4-1).

Fig. 4-1 shows the evolution in the level of education attainment during 1992–2006. What is evident from these descriptive statistics is that the share of low-skilled workers decreased from 37.0% in 1992 to 24.8% in 2000, while the share of high-skilled workers increased from 15.1% to 23.2% and that of medium-skilled workers remained relatively stable (about 50%). However, after 2000, the share of low-skilled workers slightly decreased—from 24.8% to 22.3% in 2006—while the share of medium skilled workers slightly increased from 51.9% to 54.0% in 2006 and that of high-skilled workers remained stable (23%).

[27] The validity of the most frequently used inequality indices such as the Gini coefficient or coefficient of variation, especially over longer periods of time, has been questioned recently, because coverage of income sources and taxes tends to vary, and higher-income households tend to be truncated. Therefore, to avoid these problems, many studies have focused on the narrowest measure of inequality, that is, skill premiums (Goldberg and Pavcnik, 2007). However, even skill premiums are not immune to the aforementioned second problem, because very high wages can be also truncated. However, I use skill premiums as the measure of inequality. This is because the increase in inequality documented in many developing countries has been associated with an increase in skill premiums (Goldberg and Pavcnik, 2007). Moreover, very few samples are truncated in the case of CASEN.

Figure 4-1. Evolution of education attainment, 1992–2006



Note: The calculated values are weighted using sample weights.

Source: Author's calculations, based on data from CASEN

The wage-equation specification to be estimated is as follows:

(4-1)

$$\ln W_{ij} = cons + \beta_1 mskilled_{ij} + \beta_2 hskilled_{ij} + \beta_3 \exp_{ij} + \beta_4 \exp_{ij}^2 + X'_{ij}\beta + I_{ij} * wp_j + e_{ij},$$

where *i* and *j* indexes individual and industry, respectively; *w* is hourly wage; *mskilled* is a dummy variable with a value of 1 for individuals who fall into the medium-skilled workers-category; *hskilled* is a dummy variable with a value of 1 for individuals who fall into the high-skilled workers category; and *exp* is potential labor experience (age – years of schooling – 6). The vector *X* contains demography dummies, a part-time dummy that has a value of 1 for workers working fewer than 40 h/week, an informal dummy that has a value of 1 for workers working without any kind of contract, 3 workplace characteristics dummies,[28] 8 occupational dummies,[29] and 25 region

[28] This classification is based on Infante and Sunkel (2009). They consider establishments with fewer than nine people to be in low-productivity sectors. Establishments with one to five people are chosen as the base category.

[29] Unskilled workers are chosen as the base category. Unskilled workers (originally *trabajadores no calificados*) is another category different from low-skilled workers, who are categorized according to level of education attainment.

dummies.[30] A set of industry indicators (*I*) reflect worker *i*'s industry affiliation (see Table 4-3).[31]

The results from equation (4-1) are reported in Table 4-3. The most striking finding from this wage equation is a decreasing trend in the skill premiums for high-skilled workers, while skill premiums for medium-skilled workers remained stable.[32] While the high-skilled workers earned 87.4% more than their low-skilled counterparts in 1992, that difference declined to 58.5% in 2006[33]; thus, wage inequality—that is, wage gaps between high-skilled and low-skilled workers, after controlling for various observable individual characteristics—decreased during this period in Chile (see Figure 4-2). There is striking for following reason: most findings observed in LACs, including those of Attanasio *et al.* (2004), and the initial reform period in Chile, including Beyer *et al.* (1999), show that the skill premiums for high-skilled workers, that is, a return to tertiary education, is in increasing trend. Therefore, concerning the skill premiums for high-skilled workers (henceforth, skill premiums), the findings totally contradict those of most studies.

To confirm that the aforementioned trend of skill premiums certainly coincides with that of the frequently used inequality indices, the evolution of the variance of the natural logarithm of hourly wage and the difference between the 90th and 10th percentiles of the natural logarithm of the hourly wage are also shown in Table 4-4. Attanasio *et al.* (2004) also use those indices to measure inequality. The trend of skill premiums is nearly identical to that of those indices; wage inequality once increased in the mid- or late 1990s (i.e., from 1996 to 1998 or from 1994 to 1996), and after 1998 wage inequality decreased; it also slightly decreased during 1992–2006. Moreover, I confirm that the aforementioned trend coincides with that of official statistics published by authorities, because the estimation of skill premiums is limited to salaried workers; that is, independent workers whose wages would be more unequal are excluded from this estimation. Thus, this suggests that skill premiums would be underestimated. Table 4-4 also shows the ratio of the highest-income 20% of households to the lowest-income 20% of households (Q5/Q1) as calculated by ECLAC (2008b), also

[30] Chile has 13 regions, each of which is classified into urban and rural areas. The urban area of the Metropolitan Region (Santiago) is chosen as the base category, because it absorbs the largest percentage of the population.

[31] The industry indicators are classified according to Becerra (2006) in tradable sectors and according to the 2-digit ISIC level (Rev.2) in nontradable sectors. Construction (ISIC code 500) is chosen as the base category, because it holds the largest employment share among all nontradable sectors.

[32] A possible concern with this estimation is that the level of education attainment correlates with unobservable variables, such as individual specific ability. Although this problem persists, it is unlikely that the impacts of unobservable variables on the level of education attainment substantially changed during 1992–2006.

[33] As Halvorsen and Palmquist (1980) point out, the coefficient of dummy variable (C) in semi-logarithmic regressions like in equation (4-1) needs to be interpreted carefully. Not C but exp(C) – 1 shows the effect of this dummy being equal to 1 on a dependent variable. Therefore, the percentage effect is given as 100(exp(C) – 1)).

using CASEN. This calculation also shows Q5/Q1 increased in the mid- or late 1990s (from 1994 to 1998),[34] decreased after 1998, and slightly decreased from 1994 to 2006 (see Table 4-4). Moreover, some studies also mention this decreasing trend in wage inequality, especially after 2000: Ffrench-Davis (2008; 2010a) points out that this trend was accentuated during 2000–2006.

In summary, the estimated trend basically coincides with that seen in official statistics. Therefore, the decreasing trend of skill premiums found by this chapter, that is, wage equalization between skilled and unskilled workers, during the period can be confirmed as robust.

[34] Some studies also point out an increasing trend of wage inequality from 1996 to 1998. See, for example, Raczynski and Serrano (2005: 266), Ffrench-Davis (2008: 304-305; 2010a: 190-191). According to Ffrench-Davis (2010a), the worsening wage inequality is attributable to the recession, which happened after 1998 and was influenced by the Asian crisis.

Table 4-3. First-stage estimations: results of wage equation, 1992–2006

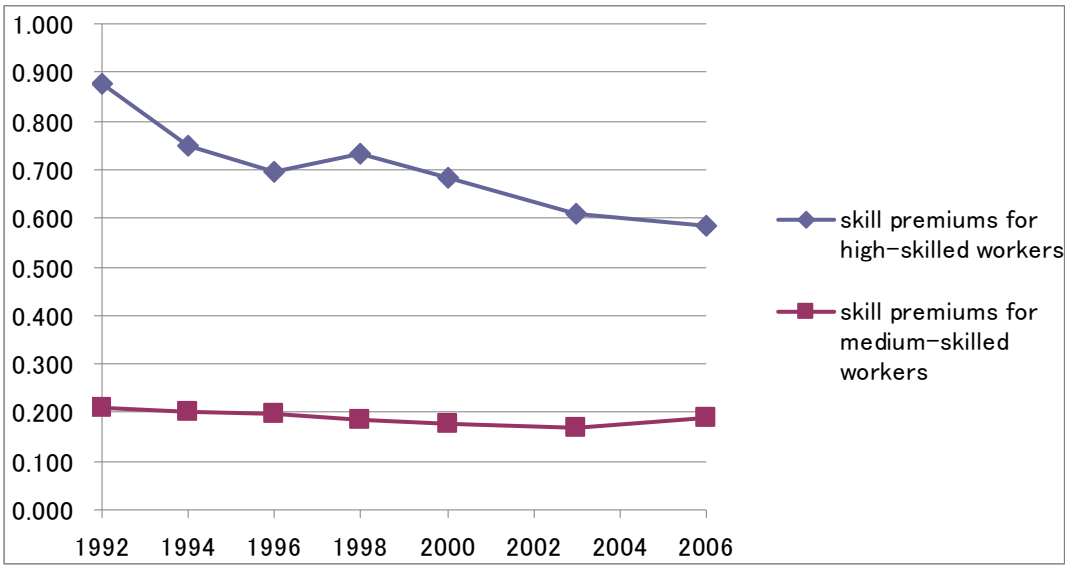
	1992	1994	1996	1998	2000	2003	2006
cons	5.8859 ***	6.1022 ***	6.2132 ***	6.3000 ***	6.2589 ***	6.3246 ***	6.4286 ***
	(0.0203)	(0.0193)	(0.0234)	(0.0171)	(0.0160)	(0.0159)	(0.0153)
mskilled	0.1892 ***	0.1823 ***	0.1808 ***	0.1691 ***	0.1641 ***	0.1569 ***	0.1743 ***
	(0.0084)	(0.0079)	(0.0087)	(0.0068)	(0.0061)	(0.0060)	(0.0059)
hskilled	0.6283 ***	0.5601 ***	0.5276 ***	0.5501 ***	0.5202 ***	0.4755 ***	0.4609 ***
	(0.0150)	(0.0140)	(0.0167)	(0.0118)	(0.0107)	(0.0106)	(0.0102)
exp	0.0157 ***	0.0149 ***	0.0140 ***	0.0123 ***	0.0136 ***	0.0130 ***	0.0126 ***
	(0.0008)	(0.0008)	(0.0010)	(0.0007)	(0.0007)	(0.0006)	(0.0006)
exp2	-0.0002 ***	-0.0002 ***	-0.0002 ***	-0.0002 ***	-0.0002 ***	-0.0002 ***	-0.0002 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Male	0.1213 ***	0.1431 ***	0.1273 ***	0.1253 ***	0.1218 ***	0.1140 ***	0.1282 ***
	(0.0092)	(0.0086)	(0.0102)	(0.0072)	(0.0065)	(0.0062)	(0.0058)
Head of the household	0.0697 ***	0.0774 ***	0.0892 ***	0.0817 ***	0.0796 ***	0.0758 ***	0.1006 ***
	(0.0084)	(0.0077)	(0.0093)	(0.0066)	(0.0058)	(0.0055)	(0.0053)
Married	0.0702 ***	0.0852 ***	0.0787 ***	0.0806 ***	0.0732 ***	0.0807 ***	0.0789 ***
	(0.0074)	(0.0067)	(0.0081)	(0.0057)	(0.0051)	(0.0050)	(0.0049)
Part	0.2984 ***	0.4559 ***	0.5152 ***	0.4469 ***	0.4115 ***	0.3441 ***	0.3047 ***
	(0.0123)	(0.0110)	(0.0112)	(0.0077)	(0.0069)	(0.0064)	(0.0065)
Informal	-0.1256 ***	-0.1984 ***	-0.2320 ***	-0.2038 ***	-0.2415 ***	-0.2407 ***	-0.2620 ***
	(0.0088)	(0.0078)	(0.0095)	(0.0067)	(0.0059)	(0.0060)	(0.0060)
Work place characteristics dummies							
Establishment with 200 or more people	0.3309 ***	0.3034 ***	0.2849 ***	0.2442 ***	0.2252 ***	0.2113 ***	0.2414 ***
	(0.0120)	(0.0112)	(0.0149)	(0.0088)	(0.0080)	(0.0077)	(0.0076)
Establishment with 10-199 people	0.1663 ***	0.1600 ***	0.1501 ***	0.1154 ***	0.1265 ***	0.1288 ***	0.1479 ***
	(0.0089)	(0.0084)	(0.0101)	(0.0074)	(0.0066)	(0.0068)	(0.0068)
Establishment with 6-9 people	0.0790 ***	0.0891 ***	0.0834 ***	0.0698 ***	0.0760 ***	0.0832 ***	0.0841 ***
	(0.0119)	(0.0115)	(0.0120)	(0.0104)	(0.0089)	(0.0093)	(0.0095)
Occupational dummmies							
Managers (public offices and private enterprices)	1.1296 ***	1.0598 ***	1.1810 ***	1.0192 ***	1.0132 ***	1.4542 ***	1.1893 ***
	(0.0294)	(0.0303)	(0.0356)	(0.0254)	(0.0236)	(0.0294)	(0.0288)
Professionals	0.8288 ***	0.8390 ***	0.9105 ***	0.8533 ***	0.8831 ***	0.9619 ***	0.8795 ***
	(0.0189)	(0.0177)	(0.0215)	(0.0155)	(0.0139)	(0.0139)	(0.0139)
Technical workers	0.6373 ***	0.5496 ***	0.6145 ***	0.5301 ***	0.5373 ***	0.5233 ***	0.4405 ***
	(0.0172)	(0.0152)	(0.0181)	(0.0132)	(0.0121)	(0.0119)	(0.0119)
Office workers	0.3999 ***	0.3808 ***	0.3948 ***	0.3097 ***	0.3249 ***	0.3003 ***	0.2348 ***
	(0.0148)	(0.0135)	(0.0164)	(0.0114)	(0.0104)	(0.0103)	(0.0101)
Sales	0.2034 ***	0.2193 ***	0.2025 ***	0.1336 ***	0.1575 ***	0.1399 ***	0.1316 ***
	(0.0137)	(0.0128)	(0.0152)	(0.0107)	(0.0097)	(0.0098)	(0.0093)
Agricultural skilled workers	0.0760 ***	0.1140 ***	0.0681 ***	0.0988 ***	0.0693 ***	0.0667 ***	0.0898 ***
	(0.0144)	(0.0145)	(0.0181)	(0.0127)	(0.0087)	(0.0093)	(0.0090)
Craft-workers	0.1756 ***	0.1978 ***	0.1638 ***	0.1601 ***	0.1501 ***	0.1321 ***	0.1529 ***
	(0.0117)	(0.0110)	(0.0138)	(0.0101)	(0.0092)	(0.0089)	(0.0087)
Factory-workers	0.1527 ***	0.1792 ***	0.1962 ***	0.1410 ***	0.1493 ***	0.1565 ***	0.1763 ***
	(0.0135)	(0.0118)	(0.0148)	(0.0108)	(0.0094)	(0.0094)	(0.0088)
Regional dummies							
Region I urban	-0.0441 **	-0.1153 ***	-0.1627 ***	-0.0974 ***	-0.1132 ***	-0.1180 ***	-0.0829 ***
	(0.0211)	(0.0229)	(0.0285)	(0.0225)	(0.0195)	(0.0189)	(0.0206)
Region I rural	-0.1518 ***	-0.1204 ***	-0.1866 ***	-0.1276 ***	-0.1471 ***	-0.2438 ***	-0.2075 ***
	(0.0388)	(0.0425)	(0.0516)	(0.0229)	(0.0228)	(0.0227)	(0.0274)
Region II urban	-0.0399 **	-0.1409 ***	0.0276	0.0032	0.0312 *	-0.0134	0.0567 ***
	(0.0174)	(0.0159)	(0.0244)	(0.0199)	(0.0173)	(0.0171)	(0.0158)
Region II rural	-0.0292	-0.2058 ***	-0.2073 ***	-0.0065	-0.1021 ***	0.0081	-0.0197
	(0.0359)	(0.0387)	(0.0358)	(0.0311)	(0.0262)	(0.0301)	(0.0255)
Region III urban	-0.0582 ***	-0.2584 ***	-0.2123 ***	-0.1347 ***	-0.1192 ***	-0.0836 ***	0.0033
	(0.0185)	(0.0187)	(0.0275)	(0.0173)	(0.0169)	(0.0169)	(0.0167)
Region III rural	-0.1722 ***	-0.2925 ***	-0.2532 ***	-0.1825 ***	-0.1254 ***	-0.0686 ***	0.0063
	(0.0331)	(0.0347)	(0.0362)	(0.0250)	(0.0230)	(0.0250)	(0.0227)
Region IV urban	-0.2332 ***	-0.2875 ***	-0.2959 ***	-0.2143 ***	-0.1788 ***	-0.1893 ***	-0.1502 ***
	(0.0234)	(0.0172)	(0.0214)	(0.0153)	(0.0162)	(0.0150)	(0.0151)
Region IV rural	-0.2539 ***	-0.3403 ***	-0.3984 ***	-0.2326 ***	-0.2082 ***	-0.2199 ***	-0.1463 ***
	(0.0300)	(0.0188)	(0.0308)	(0.0164)	(0.0176)	(0.0163)	(0.0165)
Region V urban	-0.1529 ***	-0.1438 ***	-0.1838 ***	-0.1404 ***	-0.1259 ***	-0.1151 ***	-0.1005 ***
	(0.0148)	(0.0110)	(0.0137)	(0.0090)	(0.0096)	(0.0090)	(0.0086)
Region V rural	-0.0983 ***	-0.1794 ***	-0.1897 ***	-0.2038 ***	-0.1376 ***	-0.1180 ***	-0.0959 ***
	(0.0250)	(0.0174)	(0.0254)	(0.0147)	(0.0158)	(0.0146)	(0.0141)
Region VI urban	-0.1484 ***	-0.1668 ***	-0.2315 ***	-0.1969 ***	-0.1308 ***	-0.1334 ***	-0.1070 ***
	(0.0187)	(0.0211)	(0.0162)	(0.0128)	(0.0118)	(0.0120)	(0.0103)
Region VI rural	-0.1614 ***	-0.2077 ***	-0.2097 ***	-0.2042 ***	-0.1355 ***	-0.1106 ***	-0.1306 ***
	(0.0214)	(0.0257)	(0.0220)	(0.0162)	(0.0126)	(0.0154)	(0.0109)
Region VII urban	-0.1988 ***	-0.3115 ***	-0.3565 ***	-0.2178 ***	-0.1930 ***	-0.2026 ***	-0.2004 ***
	(0.0183)	(0.0145)	(0.0175)	(0.0137)	(0.0119)	(0.0114)	(0.0119)
Region VIII rural	-0.2386 ***	-0.3192 ***	-0.3613 ***	-0.2785 ***	-0.2170 ***	-0.2072 ***	-0.1743 ***
	(0.0230)	(0.0143)	(0.0233)	(0.0189)	(0.0114)	(0.0116)	(0.0114)
Region VIII urban	-0.2965 ***	-0.3776 ***	-0.3466 ***	-0.2525 ***	-0.2261 ***	-0.2136 ***	-0.2055 ***
	(0.0116)	(0.0112)	(0.0139)	(0.0101)	(0.0089)	(0.0088)	(0.0087)
Region VIII rural	-0.3187 ***	-0.4449 ***	-0.5072 ***	-0.2853 ***	-0.3411 ***	-0.3414 ***	-0.3238 ***
	(0.0134)	(0.0136)	(0.0262)	(0.0191)	(0.0116)	(0.0121)	(0.0119)
Region IX urban	-0.2316 ***	-0.1914 ***	-0.4129 ***	-0.2855 ***	-0.2625 ***	-0.2643 ***	-0.2164 ***
	(0.0199)	(0.0223)	(0.0167)	(0.0139)	(0.0118)	(0.0114)	(0.0117)
Region IX rural	-0.2640 ***	-0.2429 ***	-0.4489 ***	-0.3002 ***	-0.2627 ***	-0.2890 ***	-0.2415 ***
	(0.0285)	(0.0326)	(0.0259)	(0.0198)	(0.0148)	(0.0149)	(0.0151)
Region X urban	-0.2024 ***	-0.2237 ***	-0.2800 ***	-0.2546 ***	-0.2076 ***	-0.1782 ***	-0.1316 ***
	(0.0187)	(0.0181)	(0.0192)	(0.0161)	(0.0126)	(0.0106)	(0.0106)
Region X rural	-0.2187 ***	-0.2749 ***	-0.3948 ***	-0.2946 ***	-0.1938 ***	-0.1892 ***	-0.1118 ***
	(0.0231)	(0.0262)	(0.0330)	(0.0293)	(0.0134)	(0.0124)	(0.0115)
Region XI urban	-0.0624 **	-0.1191 ***	-0.1101 ***	-0.1271 ***	-0.0670 ***	-0.0083	0.0996 ***
	(0.0311)	(0.0282)	(0.0302)	(0.0240)	(0.0257)	(0.0245)	(0.0239)
Region XI rural	-0.1844 ***	-0.1875 ***	-0.1993 ***	-0.1616 ***	-0.0923 ***	-0.0635 *	0.0343
	(0.0448)	(0.0396)	(0.0423)	(0.0321)	(0.0347)	(0.0357)	(0.0332)
Region XII urban	0.0778 ***	0.0602 **	0.0286	0.0051	0.0697 ***	0.0410	0.0655 ***
	(0.0252)	(0.0300)	(0.0316)	(0.0267)	(0.0251)	(0.0262)	(0.0247)
Region XII rural	0.0285	-0.0060	-0.0237	-0.1234 ***	-0.0200	0.0106	0.0921 ***
	(0.0365)	(0.0313)	(0.0456)	(0.0364)	(0.0357)	(0.0387)	(0.0304)
Metropolitan rural	-0.0603 ***	-0.1578 ***	-0.0889 ***	-0.0702 ***	-0.0517 ***	-0.0028	-0.0356 **
	(0.0160)	(0.0168)	(0.0272)	(0.0130)	(0.0125)	(0.0128)	(0.0139)
Industry indicators	yes	yes	yes	yes	yes	yes	yes
Numbers of obs	31,461	35,003	28,217	40,850	48,882	51,739	58,458
R-squared	0.5014	0.5219	0.4975	0.5059	0.5163	0.5187	0.4497
R-squared without industry indicators	0.4811	0.5051	0.4801	0.4929	0.5043	0.5040	0.4381
Variation attributed to industry indicators	0.0405	0.0322	0.0350	0.0257	0.0232	0.0283	0.0258

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Note: Numbers in parentheses are standard errors.

Source: Author's calculations, based on data from CASEN

Figure 4-2. Evolution of skill premiums, 1992–2006



Source: Author's calculations, based on data from CASEN

Table 4-4. Evolution of wage inequality, 1992–2006

Year	Variance log wage	90-10 Percentile	Skill premiums	Q5/Q1
1992	0.6218	1.8738	0.8745	no data
1994	0.6508	1.9363	0.7508	17.9
1996	0.7606	2.0202	0.6948	18.6
1998	0.6399	1.9459	0.7334	19.7
2000	0.6553	1.9302	0.6824	19.5
2003	0.6102	1.8608	0.6089	18.4
2006	0.5921	1.7641	0.5855	15.7

Note: Calculated values are weighted using sample weights.

Source: Indices except for Q5/Q1 are from author's calculations, based on data from CASEN. Q5/Q1 indices are sourced from ECLAC (2008b): Table 12

4-4-3. Industry wage premiums

As mentioned above, industry wage premiums are captured by the coefficient on the industry indicators of equation (4-1), *wp*, which shows the part of worker wages that cannot be explained by observable workers' characteristics but can be attributed to workers' industry affiliation. However, this chapter does not estimate industry wage premiums as deviations from a particular base category; instead, industry wage premiums are expressed as deviations from employment-share-weighted average wage premiums, and their exact standard errors are calculated by using Haisken-Denew and

Schmidt's (1997) restricted least squares procedures.[35] The advantages and necessities inherent in the calculation are summarized as follows. First, this normalized industry wage premium can be interpreted as the proportional difference in wages for a worker in a given industry, relative to an average worker in all industries with the same observable characteristics (Attanasio *et al.* 2004), that is, a worker, who is employed in an industry whose normalized industry wage premium is larger than zero, earns more than the average wage, given the same observable characteristics. Second, the estimated standard errors of industry wage premiums differ widely from industry to industry; thus, it is natural in the second-stage estimation that we should put more weight on industries with smaller standard errors in industry wage premiums, and vice versa. Therefore, we need to calculate exact standard errors to perform weighted least squares in the second-stage estimation.[36]

Table 4-5 reports industry wage premiums from 1992 to 2006. We note some important features within the results. First, most of the industry wage premiums are statistically significant at the 10% level, and they vary widely across industries in each year; thus, the assumption that labor mobility across industries is imperfect because of labor rigidities is likely realistic during this period in Chile. For example, if we calculate the average of the estimated industry wage premiums from 2000 to 2006,[37] which is analyzed in the second-stage estimation discussed in the next section, then the metal ore mining/other mining sector (ISIC 23/29) has the highest industry wage premium (0.327), while the agriculture and hunting sector (ISIC 11) has the lowest industry wage premium (–0.084). In other words, a worker who maintains the same observable characteristics and who switches from the agriculture and hunting sector to the metal ore mining/other mining sector would experience a 50.8% increase in hourly wage.[38] As a general trend, the mining sector, which includes Chilean traditional export goods, shows a high industry wage premium, while the agricultural and light manufacturing sectors such as textiles, apparel, and food manufacture show low industry wage premiums (see Table 4-5).

Second, the time-series and cross-sectional structure of industry wage premiums did not change substantially during 1992–2006 in Chile, although applied tariffs substantially decreased after 2000. The year-to-year correlations among the industry wage premiums of tradable sectors are substantially high, with all correlation coefficients exceeding 0.62 and statistical significance occurring at the 1% level (see Table 4-6). Therefore, the time-series structure of industry wage premiums is stable. These findings coincide with those of Pavcnik *et al.* (2004), who analyze the

[35] Details of how to calculate these are shown in the appendix to chapter 4.
[36] If we estimate industry wage premiums as deviations from a particular base category, we cannot calculate the standard error of the omitted base category, and the standard errors depend upon the industry we choose as the base category.
[37] I limit this calculation to tradable sectors whose industry wage premiums are statistically significant in all three periods examined.
[38] The value is calculated by exp (0.327 – (– 0.084)) – 1.

case of Brazil from 1987 to 1998, but they contradict those of Attanasio *et al.* (2004), who analyze the case of Colombia from 1984 to 1998.[39] The standard deviations of the industry wage premium differentials of the tradable sectors within the same year, as reported at the bottom of Table 4-5, fluctuated from 0.089 to 0.124; thus, they show little change. Therefore, the cross-sectional structure of the industry wage premiums is also relatively stable. This evidence suggests that trade liberalization is not likely to be associated with changes in industry wage premiums, which are analyzed in greater detail in the next section.

Finally, I find that industry wage premiums tend to be lower in industries that employ higher shares of low-skilled workers. Therefore, changes in industry wage premiums would also translate into changes in the relative incomes of high-skilled and low-skilled workers in the case of Chile. The correlation coefficients of the industry wage premiums with the shares of low-skilled workers in tradable sectors are certainly negative, ranging from -0.556 in 2000 to -0.236 in 1992. If I pool industry wage premiums over time and regress them on the share of low-skilled workers, it yields a negative and statistically significant coefficient of -0.2630 (with a *T*-statistic of -5.02). Therefore, industry wage premiums tend to be lower in industries that employ higher shares of low-skilled workers,[40] such as the agriculture and hunting sector (ISIC 11), the forestry and logging sector (ISIC 12), the fishing sector (ISIC 13), and the wood-products manufacturing sector (ISIC 331) (see Table 4-7). On the other hand, the mining sector, which has the highest average industry wage premium between 2000 and 2006, drastically decreased its share of low-skilled workers. Therefore, there is considerable heterogeneity across a variety of natural resource-related sectors with respect to the employment share of low-skilled workers.[41]

[39] In the case of Attanasio *et al.* (2004), year-to-year correlations in industry wage premiums are as low as 0.14.

[40] However, this tendency is not as evident as Brazil from 1987 to 1998 (Pavcnik *et al.* 2004).

[41] In some studies, for example, Leamer *et al.* (1999), the argument is that natural resource-related sectors, especially tropical crops and raw materials, are complementary to capital; thus, natural resource abundance increases inequality of LACs. However, Perry and Olarreaga (2006) show that net mining exports tend to correlate positively with the capital–unskilled labor ratio in LACs, while net food exports correlate negatively with that ratio. Therefore, while taking into consideration that Chilean agricultural products derive from temperate rather than tropical crops, the finding that the agricultural sector employs a higher share of low-skilled workers is not surprising.

Table 4-5. First-stage estimations: Industry wage premiums, 1992–2006

ISIC (Rev.2)	Industry	1992	1994	1996	1998	2000	2003	2006
11	Agriculture and hunting	-0.041 ***	-0.060 ***	-0.116 ***	-0.075 ***	-0.076 ***	-0.103 ***	-0.073 ***
		(0.010)	(0.009)	(0.012)	(0.008)	(0.007)	(0.007)	(0.006)
12	Forestry and logging	0.124 ***	0.046 **	0.016	-0.003	-0.014	-0.033 **	-0.023 *
		(0.017)	(0.018)	(0.026)	(0.020)	(0.013)	(0.013)	(0.013)
13	Fishing	0.120 ***	0.050 **	0.144 ***	0.050 **	0.064 ***	0.134 ***	0.113 ***
		(0.025)	(0.024)	(0.032)	(0.026)	(0.018)	(0.018)	(0.018)
21/22	Coal mining/Crude petroleum and natural gas production	0.145 ***	0.102 **	0.091	0.096	0.134 **	-0.019	0.292 ***
		(0.041)	(0.051)	(0.065)	(0.072)	(0.063)	(0.097)	(0.085)
23/29	Metal ore mining/Other mining	0.375 ***	0.340 ***	0.372 ***	0.254 ***	0.342 ***	0.351 ***	0.287 ***
		(0.018)	(0.017)	(0.023)	(0.017)	(0.016)	(0.016)	(0.014)
311/312	Food manufacture	-0.034 **	-0.021	-0.059 ***	-0.051 ***	-0.050 ***	-0.072 ***	-0.050 ***
		(0.017)	(0.015)	(0.018)	(0.013)	(0.012)	(0.012)	(0.011)
313/314	Beverage industries/Tobacco manufacture	0.019	-0.002	0.079 *	0.043	-0.031	-0.035	0.013
		(0.041)	(0.036)	(0.046)	(0.034)	(0.024)	(0.027)	(0.026)
321/322	Manufacture of textiles/Manufacture of wearing apparel, except footwear	0.011	-0.026	-0.071 **	-0.001	-0.055 **	-0.058 **	-0.107 ***
		(0.021)	(0.023)	(0.028)	(0.023)	(0.022)	(0.025)	(0.026)
323/324	Manufacture of leather and products of leather/Manufacture of footwear	-0.015	-0.099 **	0.001	-0.041	-0.054	-0.057	-0.157 ***
		(0.036)	(0.040)	(0.051)	(0.038)	(0.040)	(0.049)	(0.058)
331	Manufacture of wood and wood and cork products	0.064 **	-0.020	0.068 **	-0.020	-0.046 **	-0.023	-0.022
		(0.027)	(0.023)	(0.030)	(0.026)	(0.020)	(0.019)	(0.019)
332	Manufacture of furniture and fixtures	-0.022	0.029	-0.008	-0.021	-0.019	-0.006	0.007
		(0.040)	(0.030)	(0.043)	(0.031)	(0.032)	(0.030)	(0.032)
341	Manufacture of paper and paper products	0.188 ***	0.276 ***	0.222 ***	0.193 ***	0.148 ***	0.137 ***	0.131 ***
		(0.041)	(0.035)	(0.052)	(0.039)	(0.036)	(0.033)	(0.029)
342	Printing, publishing and allied industries	0.112 ***	0.105 ***	0.109 **	0.013	0.038	0.066 **	0.052
		(0.042)	(0.039)	(0.045)	(0.034)	(0.037)	(0.031)	(0.034)
351	Manufacture of industrial chemicals	0.196 ***	0.096	-0.096	0.117 *	0.131 **	0.045	0.142 **
		(0.061)	(0.074)	(0.102)	(0.060)	(0.067)	(0.059)	(0.064)
352	Manufacture of other chemical products	0.113 ***	0.151 ***	0.261 ***	0.137 ***	0.221 ***	0.210 ***	0.115 ***
		(0.041)	(0.042)	(0.046)	(0.036)	(0.033)	(0.035)	(0.038)
353/354/355/356	Petroleum refineries/Manufacture of miscellaneous products of petroleum/Manufacture of rubber products/Manufacture of plastic products	0.072 *	0.043	0.060	0.004	0.008	-0.033	-0.047 *
		(0.043)	(0.047)	(0.050)	(0.033)	(0.036)	(0.034)	(0.025)
36	Manufacture of nonmetallic mineral products, except products of petroleum and coal	0.128 ***	0.111 ***	0.013	0.116 ***	0.027	0.038	0.055
		(0.035)	(0.036)	(0.046)	(0.035)	(0.032)	(0.033)	(0.035)
37	Basic metal industries	0.164 ***	0.137 ***	0.118 **	0.115 ***	0.191 ***	0.206 ***	0.201 ***
		(0.056)	(0.049)	(0.059)	(0.039)	(0.044)	(0.050)	(0.032)
381/383/385	Manufacture of fabricated metal products/Manufacture of electrical machinery apparatus/Manufacture of professional and scientific and measuring controlling equipment	0.089 ***	0.106 ***	0.064 **	0.092 ***	0.092 ***	0.109 ***	0.118 ***
		(0.025)	(0.023)	(0.029)	(0.021)	(0.022)	(0.019)	(0.023)
382	Manufacture of machinery except electrical	0.171 ***	0.020	0.237 ***	0.160 **	0.197 ***	0.213 ***	0.135 ***
		(0.062)	(0.064)	(0.081)	(0.067)	(0.050)	(0.041)	(0.031)
384	Manufacture of transport equipment	0.251 ***	0.142 *	0.175 **	0.133 **	0.083	-0.053	0.033
		(0.058)	(0.076)	(0.088)	(0.067)	(0.053)	(0.050)	(0.058)
39	Other manufacture industries	-0.176 ***	0.150 **	0.055	-0.055	0.154 *	-0.129	0.013
		(0.067)	(0.064)	(0.133)	(0.124)	(0.087)	(0.089)	(0.093)
41	Electricity, gas and steam	0.288 ***	0.221 ***	0.339 ***	0.187 ***	0.148 ***	0.215 ***	0.087 ***
		(0.045)	(0.033)	(0.048)	(0.029)	(0.031)	(0.034)	(0.031)
42	Water works and supply	0.066	0.079	0.120 *	0.032	0.089 **	0.032	0.027
		(0.059)	(0.048)	(0.063)	(0.045)	(0.036)	(0.038)	(0.036)
50	Construction	0.095 ***	0.104 ***	0.081 ***	0.076 ***	0.039 ***	0.045 ***	0.053 ***
		(0.012)	(0.011)	(0.012)	(0.009)	(0.009)	(0.009)	(0.008)
61	Wholesale trade	0.079 ***	0.067 **	0.054 **	0.016	0.048 ***	-0.027	0.013
		(0.024)	(0.026)	(0.027)	(0.017)	(0.017)	(0.018)	(0.023)
62	Retail trade	-0.059 ***	-0.055 ***	-0.069 ***	-0.057 ***	-0.054 ***	-0.086 ***	-0.055 ***
		(0.013)	(0.011)	(0.013)	(0.009)	(0.009)	(0.008)	(0.008)
63	Restaurants and hotels	-0.119 ***	-0.100 ***	-0.141 ***	-0.135 ***	-0.107 ***	-0.067 ***	-0.034 ***
		(0.022)	(0.018)	(0.023)	(0.016)	(0.014)	(0.013)	(0.012)
71	Transport and storage	0.079 ***	0.016	0.001	-0.022 *	-0.043 ***	-0.030 ***	0.000
		(0.014)	(0.013)	(0.016)	(0.012)	(0.011)	(0.010)	(0.010)
72	Communication	0.130 ***	0.117 ***	0.099 ***	0.144 ***	0.036	-0.013	0.013
		(0.034)	(0.032)	(0.038)	(0.025)	(0.023)	(0.025)	(0.024)
81	Financial institutions	0.441 ***	0.345 ***	0.372 ***	0.306 ***	0.242 ***	0.339 ***	0.290 ***
		(0.030)	(0.028)	(0.030)	(0.023)	(0.023)	(0.025)	(0.024)
82	Insurance	0.215 ***	0.207 ***	0.172 ***	0.199 ***	0.165 ***	0.292 ***	0.108 ***
		(0.041)	(0.035)	(0.040)	(0.037)	(0.033)	(0.035)	(0.040)
83	Real estate and business services	0.088 ***	0.080 ***	0.116 ***	0.068 ***	0.055 ***	0.060 ***	0.071 ***
		(0.023)	(0.020)	(0.022)	(0.015)	(0.013)	(0.013)	(0.011)
91	Public administration and defence	-0.054 ***	0.037 **	0.111 ***	0.026 *	0.003	0.034 ***	0.011
		(0.020)	(0.017)	(0.022)	(0.014)	(0.011)	(0.012)	(0.012)
92	Sanitary and similar services	-0.050	-0.057	-0.161 ***	-0.092 ***	-0.034	-0.065 ***	-0.052 **
		(0.044)	(0.041)	(0.044)	(0.031)	(0.026)	(0.023)	(0.024)
93	Social and related community services	-0.179 ***	-0.172 ***	-0.134 ***	-0.114 ***	-0.079 ***	-0.057 ***	-0.087 ***
		(0.011)	(0.010)	(0.012)	(0.008)	(0.007)	(0.007)	(0.007)
94	Recreational and cultural services	-0.006	-0.027	-0.068 *	-0.037	-0.012	0.022	-0.018
		(0.033)	(0.030)	(0.036)	(0.026)	(0.025)	(0.022)	(0.022)
95	Personal and household services	-0.098 ***	-0.018 *	-0.009	0.033 ***	0.032 ***	0.057 ***	0.035 ***
		(0.011)	(0.010)	(0.013)	(0.009)	(0.009)	(0.009)	(0.009)
96	International and other extra-territorial bodies	0.459 ***	0.352 **	0.370 *	0.506 ***	0.844 ***	0.512 ***	0.377 ***
		(0.158)	(0.155)	(0.198)	(0.142)	(0.157)	(0.177)	(0.138)
standard deviation (only tradable sectors)		0.117	0.104	0.122	0.089	0.112	0.124	0.117
standard deviation (all sectors)		0.147	0.122	0.143	0.125	0.163	0.143	0.117

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Note: Numbers in parentheses are standard errors. Industry wage premiums and their standard errors are calculated using Haisken-Denew and Schmidt's (1997) procedure.

Source: Author's calculations, based on data from CASEN

Table 4-6. Year-to-year correlation matrix of industry wage premiums, 1992–2006

	1992	1994	1996	1998	2000	2003	2006
1992	1.0000	0.6399	0.6397	0.8753	0.6233	0.7255	0.6875
1994	0.6399	1.0000	0.7142	0.7758	0.8360	0.6421	0.7442
1996	0.6397	0.7142	1.0000	0.7610	0.7780	0.7732	0.6288
1998	0.8753	0.7758	0.7610	1.0000	0.8127	0.8164	0.7881
2000	0.6233	0.8360	0.7780	0.8127	1.0000	0.7917	0.8441
2003	0.7255	0.6421	0.7732	0.8164	0.7917	1.0000	0.7302
2006	0.6875	0.7442	0.6288	0.7881	0.8441	0.7302	1.0000

Source: Author's calculations, based on data from CASEN

Table 4-7. Evolution of the share of low-skilled workers in each industry employment, 1992–2006

ISIC (Rev.2)	Industry	1992	1994	1996	1998	2000	2003	2006
11	Agriculture and hunting	0.7609	0.7365	0.7310	0.7178	0.6888	0.6346	0.5822
12	Forestry and logging	0.6200	0.6399	0.5602	0.5409	0.5938	0.5460	0.5219
13	Fishing	0.4155	0.4166	0.4390	0.3128	0.4326	0.4360	0.4035
21/22	Coal mining/Crude petroleum and natural gas production	0.4577	0.2544	0.2625	0.1776	0.2169	0.2308	0.1382
23/29	Metal ore mining/Other mining	0.3186	0.2312	0.2036	0.1988	0.1357	0.1383	0.1704
311/312	Food manufacture	0.3484	0.3213	0.3090	0.2387	0.2631	0.2322	0.2042
313/314	Beverage industries/Tobacco manufacture	0.3522	0.2747	0.2789	0.2227	0.2854	0.2344	0.1706
321/322	Manufacture of textiles/Manufacture of wearing apparel, except footwear	0.3532	0.3052	0.1710	0.1791	0.1944	0.1807	0.1959
323/324	Manufacture of leather and products of leather/Manufacture of footwear	0.3826	0.3818	0.3272	0.2029	0.1901	0.2130	0.1947
331	Manufacture of wood and wood and cork products	0.5169	0.5424	0.4489	0.4867	0.3896	0.4510	0.3594
332	Manufacture of furniture and fixtures	0.3775	0.3308	0.4374	0.2860	0.2333	0.2360	0.2473
341	Manufacture of paper and paper products	0.2222	0.2956	0.2458	0.1298	0.1278	0.1038	0.1656
342	Printing, publishing and allied industries	0.1654	0.1580	0.1627	0.1109	0.1111	0.0851	0.0824
351	Manufacture of industrial chemicals	0.1946	0.1784	0.1534	0.1711	0.2062	0.1878	0.1164
352	Manufacture of other chemical products	0.1461	0.0959	0.1396	0.0968	0.0718	0.1399	0.1339
353/354/355/356	Petroleum refineries/Manufacture of miscellaneous products of petroleum/Manufacture of rubber products/Manufacture of plastic products	0.2683	0.2489	0.2671	0.1885	0.1757	0.1824	0.2309
36	Manufacture of nonmetallic mineral products, except products of petroleum and coal	0.4401	0.2794	0.3251	0.3180	0.2602	0.4017	0.3276
37	Basic metal industries	0.3811	0.2306	0.1160	0.1222	0.1727	0.1162	0.1502
381/383/385	Manufacture of fabricated metal products/Manufacture of electrical machinery apparatus/Manufacture of professional and scientific and measuring controlling equipment	0.2094	0.2328	0.1835	0.1998	0.1691	0.1816	0.1698
382	Manufacture of machinery except electrical	0.1180	0.0652	0.0988	0.0530	0.1260	0.0501	0.0811
384	Manufacture of transport equipment	0.1940	0.1406	0.0841	0.0845	0.1141	0.1644	0.1710
39	Other manufacture industries	0.2081	0.1635	0.0443	0.0911	0.0550	0.2068	0.1316
41	Electricity, gas and steam	0.1961	0.1485	0.0562	0.1923	0.0945	0.0837	0.0943
42	Water works and supply	0.2721	0.2794	0.1375	0.1646	0.1717	0.2288	0.1776
50	Construction	0.4929	0.4548	0.4373	0.3614	0.3675	0.3389	0.3183
61	Wholesale trade	0.2104	0.1600	0.2030	0.1748	0.2259	0.1404	0.1065
62	Retail trade	0.2074	0.1624	0.1350	0.1383	0.1191	0.1069	0.0818
63	Restaurants and hotels	0.3732	0.3049	0.2421	0.2510	0.2160	0.2084	0.1884
71	Transport and storage	0.3152	0.2471	0.2583	0.2255	0.2189	0.2001	0.1873
72	Communication	0.1557	0.0776	0.0300	0.0868	0.0274	0.0258	0.0261
81	Financial institutions	0.0257	0.0126	0.0071	0.0091	0.0085	0.0092	0.0103
82	Insurance	0.0251	0.0088	0.0087	0.0033	0.0208	0.0150	0.0112
83	Real estate and business services	0.1014	0.0638	0.0695	0.0966	0.0725	0.0551	0.0884
91	Public administration and defence	0.1894	0.1149	0.1115	0.0922	0.1577	0.1130	0.0987
92	Sanitary and similar services	0.4731	0.4513	0.4557	0.3452	0.4345	0.3357	0.4596
93	Social and related community services	0.1173	0.0877	0.0662	0.0775	0.0628	0.0575	0.0504
94	Recreational and cultural services	0.2335	0.1888	0.2769	0.1687	0.1248	0.0838	0.0974
95	Personal and household services	0.5669	0.5404	0.4768	0.4854	0.4243	0.4314	0.4171
96	International and other extra-territorial bodies	0.1711	0.0582	0.0329	0.0460	0.0000	0.0000	0.0266
all sectors		0.3704	0.3087	0.2887	0.2694	0.2482	0.2363	0.2234

Note: The calculated values are weighted using sample weights.

Source: Author's calculations, based on data from CASEN

4-5. Impacts of trade policy on wage inequality (second-stage estimation)

4-5-1. Industry wage premiums and tariffs

In this section, I econometrically analyze the relationship between trade liberalization and wage equalization as shown in the previous sections, through a channel in which tariffs would affect industry wage premiums. However, the limited data availability vis-à-vis applied tariffs makes it impossible to analyze the full period after 1992; therefore, I limit the analysis to the 2000–2006 period and use applied tariffs data from Q2 2000 for 2000, that from Q2 2003 for 2003, and that from Q4 2005 for 2006.

Studies that show trade liberalization would contribute to increases in wage inequality, through a channel in which tariffs would affect industry wage premiums, assume the following logic chain: (i) In the first stage, these studies estimate industry wage premiums from the standard Mincerian wage equation and show that industry wage premiums tend to be lower in industries that employ higher shares of low-skilled workers; (ii) Industries that experienced larger tariff reductions were those with initially higher shares of low-skilled workers and lower industry wage premiums; (iii) In the second-stage estimation, these studies show there is a statistically significant positive relationship between tariff reductions and declines in industry wage premiums; and (iv) Therefore, wages in industries with initially lower wages and higher shares of low-skilled workers declined relative to economy-wide average wages; thus, tariff reductions contribute to an increase in wage inequality. The current chapter has already shown (i); however, unlike most existing studies, in the current chapter, wage inequality tends to decrease. Therefore, to show that trade liberalization would contribute to wage equalization through a channel in which tariffs would affect industry wage premiums, we assume the following procedures as analogous to (ii) and (iii). If industries that experienced larger tariff reductions were those with initially higher industry wage premiums, that is, a regression of tariff reductions on initial wage premiums yields a positive coefficient, the positive coefficient of industry wage premiums on tariffs is the "correct" sign in the second-stage estimation. On the other hand, if industries that experienced larger tariff reductions were those with initially lower industry wage premiums, that is, a regression of tariff reductions on initial wage premiums yields a negative coefficient, the negative coefficient of industry wage premiums on tariffs is the "correct" sign in the second-stage estimation. Therefore, we need to show the protection pattern prior to the tariff reductions, *before* performing the second-stage estimation.

In this context, I review a possible theoretical assumption vis-à-vis the association between tariffs and industry wage premiums. First of all, the most natural point of departure for thinking about the effects of tariffs on industry wage premiums is the specific factors model (Attanasio *et al.* 2004). This model is short-term by nature, as it considers factors of production immobile across

industries (Attanasio *et al.* 2004; Pavcnik *et al.* 2004).[42] According to the simple prediction made via the specific factor model, sectors that experienced relatively large tariff reductions, that is, larger declines in their prices, will see a decline in the returns to specific factors, relative to those of the economy-wide average. Therefore, this model predicts a positive association between tariffs and industry wage premiums. Second, Feliciano (2001) and Pavcnik *et al.* (2004) each point out that trade polices including tariffs and NTBs would generate industry rents. Therefore, the tariff reductions would decrease industry rents, because trade liberalization likely lowers the profit margins of domestic firms that were previously sheltered from foreign competition (Pavcnik *et al.* 2004); they also predict a positive association between tariffs and industry wage premiums.

On the other hand, a negative association between tariffs and industry wage premiums can also be assumed. Empirical studies find strong evidence that decreases in tariffs are associated with productivity improvements, as mentioned in the comments to Pavcnik (2002) in Section 4-2. As tariffs declined, firms had to become more productive to remain competitive. If the productivity enhancements had been partially passed onto workers through higher industry wages, wages would increase in the industries with the largest tariff reductions (Pavcnik *et al.* 2004). Therefore, the aforementioned channel assumes a negative association between tariffs and industry wage premiums.

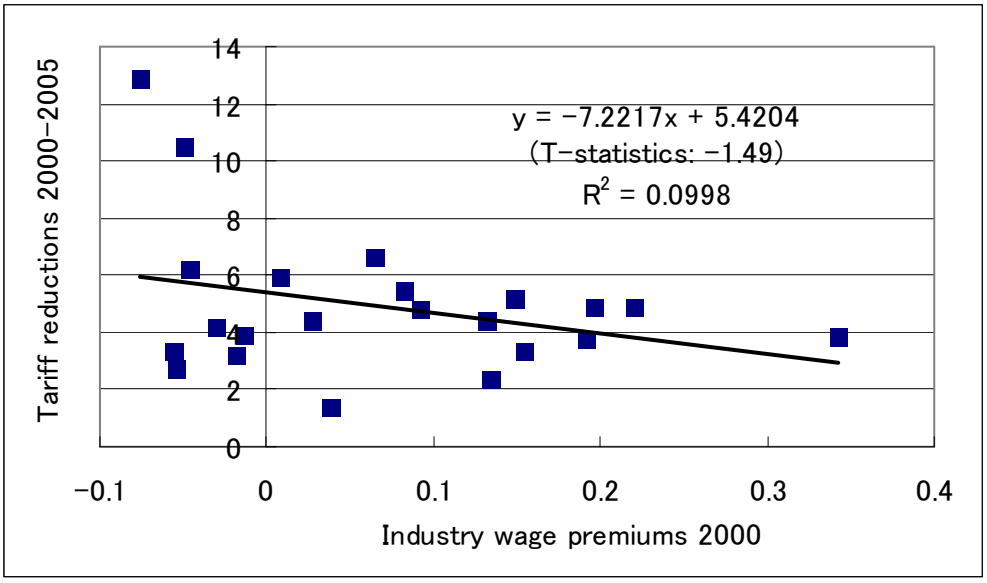
Figure 4-3 plots the tariff reductions between 2000 and 2005 against the industry wage premiums in the first year of my sample, 2000. A regression of the tariff reductions between 2000 and 2005 on the industry wage premiums of 2000 yields a coefficient of -7.22, but it is not statistically significant at 10% (*p*-value: 0.152). However, if we follow the aforementioned procedure precisely, a negative coefficient of industry wage premiums on tariffs is the "correct" sign.

Moreover, what is relevant in terms of the objective of this chapter is the protection pattern prior to the trade liberalization of natural resource-related sectors. Although I point out that if natural resource-related sectors had been included, the protection pattern prior to the trade liberalization could have been changed, the current chapter's findings show that the agriculture and hunting sector (ISIC 11) was precisely the sector that initially had the highest applied tariffs. This was owing to the existence of many kinds of exceptions allowed by tariff phase-out programs, as discussed in Section 4-3, and thus, that industry experienced the largest tariff reductions (see again Table 4-2). Moreover, this sector employed the highest share of low-skilled workers and thus had the lowest industry wage premiums (see again Table 4-7). Therefore, if various sectors of its economy, including natural resource-related ones, are included, it becomes clear that the protection pattern prior to the trade

[42] However, the explanation seems to be a bit strange, because those studies do not mention what they assume to be a mobile factor, unlike the case of industry-specific skill premiums, where they consider high-skilled workers an immobile factor and low-skilled workers a mobile factor.

liberalization had not changed, that is, industries that experienced larger tariff reductions were those with initially lower industry wage premiums, during 2000–2006 in Chile. This has also been shown to be the case with Colombia from 1984 to 1998 (Attanasio *et al.* 2004), although there, this tendency among tradable sectors was not entirely evident.

Figure 4-3. Tariff reductions and initial (2000) industry wage premiums



Source: Author's calculations, based on data from CASEN and Becerra (2006)

The model of the second-stage estimation is as follows:

$$wp_{jt} = cons + T'_{jt}\alpha_T + Y'_t\alpha_D + u_{jt}, \tag{4-2}$$

where *j* and *t* indexes industry and time, respectively, and *wp* is industry wage premiums. The vector *T* contains industry characteristic-related variables, which include applied tariffs and also other controls, such as share of professionals and technical workers in each industry employment, lagged exports, and lagged imports.[43] The vector *Y* consists of a set of year indicators.

I include lagged imports and exports to control the trade-oriented characteristics of each industry, that is, whether the industry is export-oriented or import-competing. Although the share of exports and imports of the total output of each industry should be used for this purpose, I cannot

[43] Values are expressed as US$100,000, at current prices. Because trade flows are arguably endogenous, I include the first lags of exports and imports measures, rather than their current values (Attanasio *et al.* 2004).

obtain the total output of each industry classified according to at least the 2-digit ISIC level. Therefore, I use the absolute values of lagged exports and lagged imports, according to the specification of Attanasio *et al.* (2004). I assume that the common changes across all industries, such as macroeconomic shocks, are absorbed by year indicators; I also assume that unobserved time-invariant industry characteristics are absorbed by industry fixed effects (industry indicators) or removed by first differences.

However, my specification is different from those of Pavcnik *et al.* (2004) and Attanasio *et al.* (2004), in that it includes the share of professionals and technical workers employed in each industry (henceforth *PTshare*). The reasons for this difference are as follows. Unlike previous studies, we use import-weighted average applied tariffs instead of MFN tariffs, as discussed in the Section 4-3; this could possibly cause endogeneity problems. The problem stems from the fact that applied tariffs are weighted by import origins, because each industry can change its import origins according to which have lower tariffs as a result of PTAs, and because the import origins of a industry can correlate with skill intensity in that sector. Furthermore, the skill intensity in each industry can also correlate with its industry wage premium, because we can assume an industry with more demand for skilled workers tends to offer higher wages. Therefore, applied tariffs can be an endogenous variable. The simple solution for this problem is to control for skill intensity in each industry; however, if we use the ratio of skilled to unskilled workers in each industry as the skill-intensity value, the ratio is also an endogenous variable, as discussed in the critical comments to Meller and Tokman (1996) in Section 4-2. Therefore, I use *PTshare.* Although the problem that it is still an endogenous outcome variable rather than exogenous technological shocks persists (Goldberg and Pavcnik, 2007), it is a more appropriate variable for skill intensity.

An additional concern vis-à-vis the endogeneity of applied tariffs can derive from political context, because it is likely that tariff phase-out programs are influenced by some kind of political power, such as industry lobbying. If such kinds of industry lobbying constitute time-varying industry characteristics and they also correlate with industry wage premiums, the results will be biased. To perform a regression-based Hausman test for endogeneity[44], I use presample applied tariffs (Q1 2000) interacted with the MFN tariffs in each year as the instrumental variable.[45] The MFN tariffs in each year are flat in the case of Chile, as discussed in the Section 4-3, and thus they are exogenously determined with respect to industry wage premiums. Moreover, both applied tariffs and MFN tariffs

[44] The regression-based Hausman test, which is convenient to calculate, turns out to be asymptotically equivalent to the original form of Hausman test (Wooldridge, 2002).

[45] Pavcnik *et al.* (2004) and Attanasio *et al.* (2004) each use presample tariffs interacted with exchange rate, as the instrumental variable. However, this is not an appropriate instrumental variable in our case of Chile, because in the 2000–2005 period, applied tariffs show a decreasing trend but the exchange rate shows no such trend. Therefore, presample applied tariffs interacted with exchange rate do not correlate with applied tariffs.

show a decreasing trend during 2000–2005 (see Table 4-2), and thus presample applied tariffs interacted with the MFN tariff in each year highly correlate with applied tariffs.[46] Therefore, they may be good instrumental variables for applied tariffs.

In estimating equation (4-2), I perform not only panel data analysis but also weighted least squares (WLS), because the dependent variable is estimated. When performing WLS, I use the inverse of the exact standard errors of industry wage premiums, calculated by using in the first stage Haisken-Denew and Schmidt's (1997) restricted least squares procedures as the weights. This procedure puts more weight on industries with smaller standard errors in industry wage premiums.[47] I perform a model specification test, that is, the Hausman test, Breusch-Pagan test, and F test in the case of panel data analysis, while I perform an F test for the significance of industry indicators in the case of WLS.

Table 4-8 reports the results of estimating equation (4-2). The results of the panel data analysis are presented in columns 1–8, while the results of WLS are presented in columns 9–14. The coefficients on applied tariffs are negatively significant in the pooling models [columns 3 and 7] and in the WLS models without industry indicators [columns 10 and 13]. However, those models are rejected as a result of the specification tests. The coefficients on applied tariffs are still negative; thus they show the "correct" sign but they are not statistically significant in the fixed-effects models [columns 1 and 5]; in the WLS models with industry indicators [columns 9 and 12], which are adopted as a result of the specification tests; or in the first-differences models [columns 4, 8, 11, and 14]. The results show that that there is no general relationship between applied tariffs and industry wage premiums in all industries. Therefore, the observed negative relationship between applied tariffs and industry wage premiums is spurious; that is, unobservable time-invariant industry characteristics correlate with both industry wage premiums and applied tariffs. The findings suggest that, unlike the aforementioned theoretical assumption, the industries with higher productivity tend to have lower applied tariffs and higher wage premiums, rather than that the tariff reductions themselves lead to productivity improvements in such a short time-period.

Concerning other variables, the *PTshare* coefficients are positively significant in all models; these are the expected signs. This suggests that the industries with more demand for skilled workers tend to offer higher wages. The coefficients on lagged exports and lagged imports are not statistically significant, except for the pooling model [columns 7], and the inclusion of these additional controls hardly changes the coefficients on applied tariffs. The results of regression-based Hausman tests for endogeneity show that we cannot reject the exogeneity of applied tariffs; the

[46] A regression of applied tariffs on presample applied tariffs interacted with the MFN tariffs yields a positive and statistically significant coefficient of 0.120 (with a *T*-statistic of 10.39).
[47] In the case of WLS, I assume there to be no serial correlations in the error term of equation (4-2).

p-value is 0.480 and 0.367 in the fixed-effects model and the WLS model with industry indicators, respectively.[48] The results are not surprising, because the policy-making process has been very technocratic since Chile's military *coup d'état*, and this situation persists under the center-left coalition government; thus, there seems to be little room for industry lobbying in Chile.[49]

Overall, I found no statistically significant relationship between applied tariffs and industry wage premiums, after controlling for unobservable time-invariant industry characteristics.[50] The findings are robust, because my estimations take into account the potential endogeneity of applied tariffs, and I perform WLS while putting more weight on industries with smaller exact standard errors of industry wage premiums. Moreover, I perform a regression-based Hausman test for the endogeneity of applied tariffs that would be caused by an omitted time-varying industry characteristic, such as industry lobbying.

[48] In both cases, *PTshare*, lagged exports, and lagged imports are included as exogenous variables.
[49] Concerning the technocratization of policy-making in Chile, see, for example, Silva (1991).
[50] Another possible method involves combining the regressors in equations (4-1) and (4-2) and estimating the relationship between applied tariffs and wages directly in one stage, that is, in what Galiani and Porto (2006) call a "stronger identification strategy." However, this method cannot control for individual fixed effects, because this individual-level data are not panel but repeated cross-section. Moreover, we must drop all observations who are employed in non-tradable sectors in each year, and dropping these observations may cause sample-selection bias. Although I implement this one-stage estimation, the coefficient on the log of applied tariffs is as small as 0.0048 and not at all statistically significant (*p*-value: 0.404). Therefore, the results also show there to be no statistically significant relationship between applied tariffs and wages.

Table 4-8. Second-stage estimation: applied tariffs and industry wage premiums, 2000-2006

	1	2	3	4	5	6	7	8
applied tariff	-0.0008	-0.0047	-0.0190 ***	-0.0014	-0.0012	-0.0061	-0.0141 ***	-0.0017
	(0.0042)	(0.0041)	(0.0060)	(0.0030)	(0.0042)	(0.0043)	(0.0053)	(0.0027)
PTshare	0.4715 ***	0.5186 ***	0.6490 ***	0.5478 ***	0.4571 ***	0.5248 ***	0.6230 ***	0.5291 ***
	(0.0738)	(0.0729)	(0.1090)	(0.0865)	(0.0755)	(0.0769)	(0.0945)	(0.0682)
lagged exports					-0.000001	0.000008	0.000021 ***	-0.000001
					(0.000005)	(0.000005)	(0.000005)	(0.000005)
lagged imports					0.000014	0.000019	0.000024 ***	0.000021
					(0.000012)	(0.000010)	(0.000009)	(0.000023)
Year indicators	yes	yes	yes	yes	yes	yes	yes	yes
Robust	no	no	no	yes	no	no	no	yes
Model	Fixed	Random	Pooling	First-differences	Fixed	Random	Pooling	First-differences
Number of obs	66	66	66	44	66	66	66	44
Number of groups	22	22	22		22	22	22	
R-squared			0.4852	0.5814			0.6374	0.6024
within	0.5361	0.5276			0.5522	0.5059		
between	0.4346	0.4793			0.4252	0.6596		
overall	0.4098	0.4475			0.4182	0.5897		
	Hausman test: 13.93***				Hausman test: 44.54***			
	Breusch-Pagan test: 30.27***				Breusch-Pagan test: 14.79***			
	F test: 12.05***				F test: 7.86***			
Model specification	Fixed				Fixed			

	9	10	11	12	13	14
applied tariff	-0.0007	-0.0125 **	-0.0007	-0.0007	-0.0114 **	-0.0007
	(0.0021)	(0.0050)	(0.0021)	(0.0022)	(0.0044)	(0.0022)
PTshare	0.4485 ***	0.8625 ***	0.4485 ***	0.4408 ***	0.8235 ***	0.4409 ***
	(0.0818)	(0.1260)	(0.0818)	(0.0855)	(0.1115)	(0.0855)
lagged exports				-0.000002	0.000022 ***	-0.000002
				(0.000004)	(0.000005)	(0.000004)
lagged imports				-0.000002	0.000016	-0.000002
				(0.000011)	(0.000011)	(0.000011)
Year indicators	yes	yes	yes	yes	yes	yes
Industry indicators	yes	no	no	yes	no	no
First-differences	no	no	yes	no	no	yes
Weight	yes	yes	yes	yes	yes	yes
Number of obs	66	66	44	66	66	44
Adj R-squared	0.9676	0.5281	0.4135	0.9678	0.6596	0.4172
	F test: 25.85***			F test: 17.33***		
Model specification	Industry indicators: yes			Industry indicators: yes		

*** and ** indicate significance at the 1% and 5% levels, respectively.

Note: Numbers in parentheses are standard errors.

Source: Author's calculations, based on data from CASEN and Becerra (2006)

4-5-2. Industry-specific skill premiums and tariffs

Although the aforementioned findings show there to be no statistically significant relationship between applied tariffs and industry wage premiums after controlling for unobservable time-invariant industry characteristics, trade liberalization could still contribute to wage equalization through a channel in which applied tariffs affect industry-specific skill premiums. Industry-specific skill premiums are defined as the incremental wage premiums that high-skilled workers earn in an industry, in addition to the base industry wage premiums (Pavcnik *et al.* 2004). Therefore, in the first stage, I estimate the following wage equation:

$$\ln W_{ij} = cons + \beta_1 mskilled_{ij} + \beta_2 hskilled_{ij} + \beta_3 \exp_{ij} + \beta_4 \exp_{ij}^2 + X'_{ij}\beta + I_{ij} * wp_j + I_{ij} * hskilled_{ij} * swp_j + \varepsilon_{ij} \quad (4\text{-}3)$$

This model differs from equation (4-1), in that I add interaction terms between industry indicators and high-skilled dummies; thus, the coefficient of interaction terms, *swp*, captures the industry-specific skill premium.

As in the case of industry wage premiums, industry-specific skill premiums are also expressed as deviations from the employment-share-weighted average skill premium, and their exact standard errors are calculated by using Haisken-Denew and Schmidt's (1997) restricted least squares procedures. This normalized industry-specific skill premium can be interpreted as the proportional difference in wages through the channel of industry-specific skill premiums for a high-skilled worker in a given industry, relative to average high-skilled workers who have the same observable characteristics, across all industries (Pavcnik *et al.* 2004). That is to say: a worker who is employed in an industry whose normalized industry-specific skill wage premium is larger than zero earns more than the average wage of a high-skilled worker, given the same observable characteristics.

The theoretical assumption that trade liberalization contributes to wage equalization through a channel in which applied tariffs affect industry-specific skill premiums goes as follows. We assume high-skilled workers are less mobile across industries than low- or medium-skilled workers, that is, high-skilled workers are immobile (specific) factors and low-skilled workers are mobile factors, in the short to medium term.[51] Under this assumption, wage equalization is exactly what the specific factor model (or Ricardo–Viner model) would predict: high-skilled workers, that is, immobile factors employed in industries that experience more tariff reductions, will see a greater decline in their wages than those employed in industries that experience fewer tariff reductions, and the effects of mobile factors, that is, low- or medium-skilled workers, are ambiguous. Therefore, whatever protection patterns exist prior to tariff reductions, those reductions would decrease industry-specific skill premiums, and would thus contribute to economy-wide wage equalization, as long as we can assume that high-skilled workers are less mobile than low- or medium-skilled workers. Thus, the positive coefficient of industry wage premiums on tariffs is the expected sign in the second-stage estimation.

Table 4-9 reports industry-specific skill premiums from 1992 to 2006, wherein we see some important features. First, more than half of all industry-specific skill premiums are statistically significant at the 10% level, and they vary widely across industries in each year; thus, one can

[51] Needless to say, we can also assume that low- or medium-skilled workers are less mobile across industries than high-skilled workers. It is also a natural assumption that high-skilled workers can easily move across industries, because highly educated workers accumulate general, transferable skills. However, if we take into consideration the reality of Chile, the assumption that low-skilled workers are mobile seems to be plausible. Raczynski and Serrano (2005) point out that an important current characteristic of the poor in Chile is that they are employed in various kinds of temporary and precarious economic activities, including those in the agriculture, manufacture, construction, and service sectors.

plausibly assume that high-skilled workers were more or less immobile across industries during this period in Chile. For example, if we calculate the average of the estimated industry-specific skill premiums from 2000 to 2006,[52] we see that, for example, in the forestry and logging sector (ISIC 12), the highest industry wage premium was 0.258, while in the coal mining/crude petroleum and natural gas production sector (ISIC 21/22), the lowest industry wage premium was -0.210; therefore, a high-skilled worker with the same observable characteristics who switched from the coal mining/crude petroleum and natural gas production sector to the forestry and logging sector would experience a 59.7% increase in hourly wage.[53] As a general trend, the forestry and forestry-processing industries such as paper and paper products, which in Chile are newly growing export sectors, show high industry-specific skill-premiums (see Table 4-9).

Second, unlike industry wage premiums, the structure of industry-specific skill premiums is not stable. The year-to-year correlation coefficients of the industry-specific skill premiums of tradable sectors are low: a maximum of 0.612 (between 1992 and 1994) and a minimum of 0.099 (between 2000 and 2003). Moreover, the standard deviations of industry-specific skill premium differentials among tradable sectors within the same year, as reported at the bottom of Table 4-9, fluctuated from 0.154 to 0.333; thus, they show substantial change, and the standard deviations in themselves are relatively larger than those of industry wage premiums.

[52] I limit this calculation to tradable sectors whose industry wage premiums are statistically significant in more than two periods, at the least.
[53] The value is calculated by exp (0.258 – (-0.210)) – 1.

Table 4-9. First-stage estimations: Industry-specific skill premiums, 1992–2006

ISIC (Rev.2)	Industry	1992	1994	1996	1998	2000	2003	2006
11	Agriculture and hunting	0.167 ***	0.179 ***	0.172 **	0.065	0.133 ***	0.162 ***	0.068 **
		(0.057)	(0.050)	(0.071)	(0.045)	(0.036)	(0.036)	(0.030)
12	Forestry and logging	0.101	0.328 ***	0.469 ***	0.254 ***	0.331 ***	0.093	0.351 ***
		(0.095)	(0.081)	(0.107)	(0.078)	(0.064)	(0.060)	(0.082)
13	Fishing	0.097	0.176 **	0.311 **	-0.028	0.165 **	0.006	0.156 **
		(0.084)	(0.088)	(0.125)	(0.065)	(0.072)	(0.068)	(0.068)
21/22	Coal mining/Crude petroleum and natural gas production	0.319 *	0.158	0.278	0.224	0.301 *	-1.099 **	0.168
		(0.163)	(0.153)	(0.303)	(0.240)	(0.171)	(0.510)	(0.206)
23/29	Metal ore mining/Other mining	0.146 ***	0.166 ***	0.128 **	0.232 ***	0.091 **	0.141 ***	0.094
		(0.044)	(0.043)	(0.061)	(0.043)	(0.042)	(0.040)	(0.036)
311/312	Food manufacture	0.223 ***	0.178 ***	0.332 ***	0.028	0.167 ***	0.156 ***	-0.002
		(0.065)	(0.063)	(0.060)	(0.049)	(0.044)	(0.049)	(0.041)
313/314	Beverage industries/Tobacco manufacture	-0.050	0.091	0.292 **	0.289 **	-0.042	0.147 *	0.147 **
		(0.127)	(0.118)	(0.135)	(0.122)	(0.082)	(0.081)	(0.075)
321/322	Manufacture of textiles/Manufacture of wearing apparel, except footwear	0.270 ***	0.265 ***	0.164 *	0.173 *	0.408 ***	-0.006	0.038
		(0.088)	(0.096)	(0.090)	(0.089)	(0.079)	(0.098)	(0.097)
323/324	Manufacture of leather and products of leather/Manufacture of footwear	0.758 ***	0.447	0.250	0.116	-0.190	-0.763 ***	0.588 *
		(0.176)	(0.312)	(0.346)	(0.137)	(0.162)	(0.196)	(0.303)
331	Manufacture of wood and wood and cork products	-0.213 *	-0.002	0.176	0.196 *	0.194 **	0.200 **	0.220 **
		(0.128)	(0.108)	(0.122)	(0.106)	(0.092)	(0.079)	(0.093)
332	Manufacture of furniture and fixtures	0.294	0.259 *	0.559 *	-0.190	-0.244 *	-0.496 ***	0.187
		(0.210)	(0.139)	(0.299)	(0.132)	(0.147)	(0.122)	(0.117)
341	Manufacture of paper and paper products	0.493 ***	0.143	-0.192	0.328 ***	0.254 **	0.168 **	0.223 ***
		(0.111)	(0.091)	(0.146)	(0.089)	(0.103)	(0.085)	(0.072)
342	Printing, publishing and allied industries	0.126	-0.151	0.020	0.216 ***	0.009	-0.037	-0.143 *
		(0.088)	(0.129)	(0.113)	(0.083)	(0.083)	(0.071)	(0.077)
351	Manufacture of industrial chemicals	0.322 **	0.256	0.004	0.061	0.360 **	-0.123	0.170
		(0.138)	(0.158)	(0.222)	(0.161)	(0.162)	(0.149)	(0.151)
352	Manufacture of other chemical products	0.178	0.106	0.301 ***	0.176 **	0.193 ***	0.228 ***	0.221 **
		(0.117)	(0.107)	(0.105)	(0.077)	(0.071)	(0.072)	(0.087)
353/354/355/356	Petroleum refineries/Manufacture of miscellaneous products of petroleum/Manufacture of rubber products/Manufacture of plastic products	0.049	0.269 *	0.518 ***	0.379 ***	0.032	0.194 **	0.018
		(0.163)	(0.147)	(0.161)	(0.108)	(0.100)	(0.093)	(0.087)
36	Manufacture of nonmetallic mineral products, except products of petroleum and coal	0.391 **	0.327 **	0.267 *	0.150	0.230 **	0.048	0.359 ***
		(0.185)	(0.139)	(0.144)	(0.102)	(0.103)	(0.110)	(0.116)
37	Basic metal industries	0.208	0.123	-0.081	-0.158	0.104	-0.065	0.089
		(0.174)	(0.124)	(0.136)	(0.109)	(0.129)	(0.115)	(0.085)
381/383/385	Manufacture of fabricated metal products/Manufacture of electrical machinery apparatus/Manufacture of professional and scientific and measuring controlling equipment	0.049	0.122 *	0.083	0.065	0.040	0.044	-0.152 **
		(0.076)	(0.069)	(0.086)	(0.067)	(0.064)	(0.058)	(0.064)
382	Manufacture of machinery except electrical	-0.053	-0.053	-0.399 **	0.006	0.229 *	0.067	-0.002
		(0.160)	(0.201)	(0.199)	(0.165)	(0.119)	(0.092)	(0.085)
384	Manufacture of transport equipment	0.206	0.021	-0.062	0.077	-0.163	0.175	0.052
		(0.164)	(0.218)	(0.243)	(0.185)	(0.166)	(0.130)	(0.156)
39	Other manufacture industries	-0.106	-0.558 ***	0.159	0.402	0.788 ***	-0.095	0.536
		(0.218)	(0.213)	(0.370)	(0.292)	(0.240)	(0.267)	(0.524)
41	Electricity, gas and steam	0.090	0.305 ***	0.228 **	0.253 ***	0.131 *	0.300 ***	-0.074
		(0.103)	(0.075)	(0.111)	(0.077)	(0.079)	(0.083)	(0.074)
42	Water works and supply	0.103	0.390 ***	0.233	0.088	0.126	0.190 *	0.194 *
		(0.169)	(0.143)	(0.152)	(0.127)	(0.110)	(0.110)	(0.106)
50	Construction	0.299 ***	0.227 ***	0.322 ***	0.125 ***	0.135 ***	0.122 ***	0.177 ***
		(0.045)	(0.043)	(0.047)	(0.034)	(0.032)	(0.029)	(0.028)
61	Wholesale trade	0.077	0.311 ***	0.094	0.246 ***	0.205 ***	0.131 ***	0.233 ***
		(0.061)	(0.065)	(0.069)	(0.046)	(0.053)	(0.044)	(0.053)
62	Retail trade	0.082 **	0.085 **	0.028	0.069 ***	0.038	0.055 **	0.023
		(0.037)	(0.033)	(0.036)	(0.027)	(0.024)	(0.023)	(0.021)
63	Restaurants and hotels	-0.137	-0.041	-0.015	-0.080	-0.201 ***	0.045	0.074 **
		(0.091)	(0.096)	(0.079)	(0.051)	(0.050)	(0.042)	(0.037)
71	Transport and storage	0.069	0.166 ***	0.045	0.154 ***	0.114 ***	0.107 ***	0.151 ***
		(0.050)	(0.050)	(0.052)	(0.039)	(0.037)	(0.032)	(0.031)
72	Communication	0.104 **	0.262 ***	0.206 **	0.151 ***	-0.021	0.236 ***	0.177 ***
		(0.087)	(0.072)	(0.080)	(0.055)	(0.052)	(0.052)	(0.049)
81	Financial institutions	0.051	-0.085	-0.003	0.077 *	-0.064	0.113 **	0.064
		(0.061)	(0.056)	(0.056)	(0.045)	(0.045)	(0.048)	(0.046)
82	Insurance	-0.109	-0.003	0.035	-0.348 ***	-0.146 **	-0.032	-0.108
		(0.082)	(0.070)	(0.077)	(0.073)	(0.067)	(0.068)	(0.079)
83	Real estate and business services	0.153 ***	0.115 ***	0.164 ***	0.063 **	0.049 *	0.001	0.038
		(0.049)	(0.039)	(0.046)	(0.031)	(0.028)	(0.027)	(0.024)
91	Public administration and defence	-0.057	0.041	-0.039	-0.030	-0.001	0.058 **	0.081 ***
		(0.044)	(0.035)	(0.045)	(0.029)	(0.026)	(0.024)	(0.024)
92	Sanitary and similar services	0.921 ***	0.170	0.227	0.145	0.080	0.049	0.065
		(0.107)	(0.207)	(0.184)	(0.140)	(0.140)	(0.107)	(0.097)
93	Social and related community services	-0.164 ***	-0.162 ***	-0.179 ***	-0.130 ***	-0.100 ***	-0.118 ***	-0.135 ***
		(0.014)	(0.013)	(0.016)	(0.012)	(0.011)	(0.010)	(0.011)
94	Recreational and cultural services	0.217 **	0.002	0.006	0.060	-0.026	-0.014	-0.023
		(0.085)	(0.073)	(0.080)	(0.064)	(0.066)	(0.051)	(0.050)
95	Personal and household services	-0.083	0.007	0.003	-0.131 ***	-0.169 ***	-0.118 ***	0.071 *
		(0.066)	(0.059)	(0.068)	(0.047)	(0.045)	(0.039)	(0.042)
96	International and other extra-territorial bodies	0.833 ***	0.016	0.481	-0.081	0.483	0.525	0.137
		(0.319)	(0.328)	(0.418)	(0.291)	(0.341)	(0.406)	(0.278)
standard deviation (only tradable sectors)		0.211	0.205	0.229	0.154	0.224	0.333	0.106
standard deviation (all sectors)		0.252	0.182	0.201	0.160	0.207	0.276	0.160

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Note: Numbers in parentheses are standard errors. Industry-specific skill premiums and their standard errors are calculated using Haisken-Denew and Schmidt's (1997) procedure.

Source: Author's calculations, based on data from CASEN

As is the case with industry wage premiums, the estimated industry-specific skill premiums, *swp*, are pooled over time and regressed on industry characteristic-related variables, including applied tariffs. The specification and estimation method are the same as those of industry wage premiums.

Table 4-10 reports the results: the results of panel data analysis are presented in columns 1–8, while those of WLS are presented in columns 9–14. The coefficients on applied tariffs are not statistically significant in all models. They still have the "correct" (i.e., positive) signs in the pooling model [columns 3 and 7], WLS models without industry indicators [columns 13], which are adopted as a result of the specification tests.[54] However, they have the "wrong" (i.e., negative) signs in the first-differences models [columns 4, 8, 11, and 14]. Therefore, I find no statistically significant relationship between applied tariffs and industry-specific skill premiums.

Concerning other variables, the *PTshare* coefficients are positively significant, which are the expected signs, except for the WLS model with lagged exports and lagged imports. This suggests that industries with more demand for high-skilled workers tend to pay them relatively higher wages. The coefficients on the lagged imports and lagged exports, except for the pooling model [column 7], are not statistically significant. The results of regression-based Hausman tests for endogeneity again show that we cannot reject the exogeneity of applied tariffs; the *p*-value is 0.218 and 0.179 in the pooling model and the WLS model without industry indicators, respectively.[55] Therefore, the findings are also robust when one takes into account the potential endogeneity of applied tariffs.

In summary, I find no statistically significant evidence that trade liberalization in Chile during the examined time-period contributed to wage equalization through a channel in which applied tariffs affect industry-specific skill premiums.

[54] Unlike in the case of industry wage premiums, the significance of industry fixed effects (industry indicators) is very low.

[55] In both cases, *PTshare*, lagged exports, and lagged imports are included as exogenous variables.

Table 4-10. Second-stage estimation: applied tariffs and industry-specific skill premiums, 2000-2006

	1	2	3	4	5	6	7	8
applied tariff	0.0079	0.0190	0.0191	−0.0064	0.0091	0.0175	0.0175	−0.0062
	(0.0251)	(0.0178)	(0.0175)	(0.0229)	(0.0255)	(0.0179)	(0.0177)	(0.0231)
PTshare	1.3645 ***	0.7476 **	0.6796 **	2.1995 ***	1.4101 ***	0.8412 ***	0.7815 **	2.2345 ***
	(0.4425)	(0.3204)	(0.3159)	(0.5530)	(0.4548)	(0.3215)	(0.3169)	(0.5788)
lagged exports					−0.000013	−0.000005	−0.000005	−0.000007
					(0.000030)	(0.000016)	(0.000016)	(0.000023)
lagged imports					−0.000067	−0.000057 *	−0.000056 *	−0.000063
					(0.000074)	(0.000031)	(0.000030)	(0.000112)
Year indicators	yes	yes	yes	yes	yes	yes	yes	yes
Robust	no	no	no	yes	no	no	no	yes
Model	Fixed	Random	Pooling	First-differences	Fixed	Random	Pooling	First-differences
Number of obs	66	66	66	44	66	66	66	44
Number of groups	22	22	22		22	22	22	
R-squared			0.1827	0.4846			0.2294	0.4918
within	0.3277	0.2987			0.3456	0.3216		
between	0.0002	0.0020			0.0371	0.0707		
overall	0.1504	0.1822			0.2016	0.2291		
	Hausman test: 4.11				Hausman test: 3.45			
	Breusch and Pagan test: 0.30				Breusch and Pagan test: 0.12			
	F test: 1.35				F test: 1.19			
Model specification	Pooling				Pooling			

	9	10	11	12	13	14
applied tariff	−0.0031	−0.0001	−0.0031	−0.0012	0.0009	−0.0012
	(0.0142)	(0.0110)	(0.0142)	(0.0144)	(0.0111)	(0.0144)
PTshare	0.7722 *	0.1449	0.7722 *	0.7804	0.1994	0.7804
	(0.4533)	(0.2384)	(0.4533)	(0.4697)	(0.2411)	(0.4697)
lagged exports				−0.000001	−0.000006	−0.000001
				(0.000019)	(0.000010)	(0.000019)
lagged imports				−0.000069	−0.000035	−0.000069
				(0.000063)	(0.000024)	(0.000063)
Year indicators	yes	yes	yes	yes	yes	yes
Industry indicators	yes	no	no	yes	no	no
First-differences	no	no	yes	no	no	yes
Weight	yes	yes	yes	yes	yes	yes
Number of obs	66	66	44	66	66	44
Adj R-squared	0.4375	0.0503	0.0123	0.4547	0.0859	0.0426
	F test: 1.31			F test: 1.22		
Model specification	Industry indicators: no			Industry indicators: no		

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Note: Numbers in parentheses are standard errors.

Source: Author's calculations, based on data from CASEN and Becerra (2006)

4-6. Conclusions

This chapter empirically analyzed the impact of trade liberalization on wage inequality in Chile at a time when various sectors of its economy, including natural resource-related ones, during a period in which the country had implemented important economic reforms and has continued with its sustained open economy strategy.

As a result of the first-stage estimation, I found wage inequality measured by skill premiums for high-skilled workers showed a decreasing trend during 1992–2006; this trend is especially evident after 2000, and was quite the opposite of those of other LACs or that of Chile's initial reform period starting in the mid-1970s. Moreover, industry wage premiums varied widely across industries in each year. However, the findings of the second-stage estimation showed that there is no statistically significant relationship between applied tariffs and industry wage premiums, after controlling for unobservable time-invariant industry characteristics during 2000–2006.

Moreover, I found no statistically significant relationship between applied tariffs and industry-specific skill premiums. Therefore, I found no evidence that bi- or plurilateral trade liberalization during the period contributed to wage equalization through a channel in which applied tariffs affect industry wage premiums.

The contribution of this chapter to the literature that empirically analyzes trade and wage inequality is summarized as follows. First, this chapter is one of only a few to focus on tariffs—the most direct measures of trade policy—rather than indirect outcome variables such as trade volumes (Pavcnik *et al.* 2004). As discussed in the Section 4-2, tariffs have advantages as measures of trade liberalization, and thus findings of an analysis of the impact of trade liberalization on wage inequality using tariffs are more reliable. Moreover, this chapter is probably the first to analyze empirically the impacts of bi- or plurilateral trade liberalization on wage inequality while using applied tariffs, owing to the wider preferential margin resulting from the proliferation of PTAs since the 1990s in Chile.

Second, the results of econometric analyses show that the unobservable time-invariant industry characteristics correlate with both industry wage premiums and applied tariffs. Therefore, the findings suggest that, unlike the theoretical assumption that tariff reduction-induced productivity improvements lead to increases in industry wage premiums, industries with higher productivity tend to have lower applied tariffs and higher wage premiums in such a short time-period.

Third, once again, it is noticeable that none of the previous studies found statistically significant effects that trade opening or openness reduces wage inequality in LACs (Perry and Olarreaga, 2006). Therefore, the finding that trade liberalization does not necessarily contribute to an increase in wage inequality—at least since 2000 in Chile—is in itself very important, although this chapter cannot show that trade liberalization contributes to wage equalization through a channel in which applied tariffs affect industry premiums. Moreover, what is relevant from the viewpoint of comparisons between across-the-board, indiscriminate and unilateral opening since the mid-1970s, and bi- or plurilateral liberalization under reciprocal PTAs since the 1990s is that the former had adverse effects on wage distribution, but that the latter did not. These findings basically coincide with those of Galiani and Porto (2006), who analyze the case of Argentina from 1974 to 2001. They also compare the two liberalization episodes of the 1970s and 1990s and finds that tariff reductions increased wage inequality in both periods. However, those adverse effects were much less marked in the 1990s, when tariff reductions were mainly due to the enforcement of MERCOSUR. Those results suggest that tariff reductions due to reciprocal PTAs do not necessarily have adverse effects on wage distribution.

Much work remains to be done. I had to limit the second-stage estimation during 2000–2006, owing to data availability vis-à-vis applied tariffs. If I were to obtain reliable data

regarding applied tariffs between 1992 and 1998, I could perform the second-stage estimation for the whole of the 1992–2006 period. Moreover, other trade characteristic-related variables such as foreign direct investment (FDI) may be important determinants of industry wage premiums or industry-specific skill premiums. However, in addition to the total output of each industry, I have been unable to obtain the FDI of each industry classified according to at least up to the 2-digit ISIC level. If I were to perform the second-stage estimation including those variables, I may find another possible channel through which trade liberalization has affected wage equalization in Chile since the 1990s.

Further research needs to be conducted to determine the aforementioned unobservable time-invariant industry characteristics that correlate with both industry wage premiums and applied tariffs, and whether those characteristics relate to the effects of PTAs not captured by traditional trade theory. Sala-i-Martin (2009) argues that, among these benefits, perhaps the most important is the transmission and coordination of policies and institutions that lead to greater economic efficiency, greater productivity, and higher growth rates. Such factors, for example, quality of institution in each industry, may constitute part of the aforementioned unobservable time-invariant industry characteristics. However, no such empirical analyses were undertaken in this chapter; this area will be an interesting subject of future research.

5

Inter-Industrial Linkage Effects of Non-Traditional Natural Resource-Based Export Sectors in Chile

5-1. Introduction

Chile presents a very interesting study of economic development in Latin American and Caribbean countries (henceforth, LACs), in that it has recorded the most stable economic growth among the LACs since the mid-1980s in spite of having an economic structure that is strongly dependent on exports of primary products.[1] Since the 1980s, Chile's export strategy has been characterized not just by the expansion of primary products, such as copper in line with its comparative advantage, but also by the diversification of natural resources[2] contained in its export basket, in order to prevent the fluctuations in world prices of commodities from exposing the Chilean economy to external shocks (Meller, 1996). Thus, Chile has succeeded in creating new kinds of export products, such as fish, fruits, and forestry products, which were hardly exported before the economic liberalization.

This chapter defines the "non-traditional natural resource-based export sector," when a product sector satisfies the following two criteria. First, it defines a "non-traditional natural resource-based product" as a product derived from a natural resource, and one that is not ranked within the top ten exports in *Anuario estadístico de América Latina y el Caribe* (Statistical Yearbook for Latin America and the Caribbean) published by the Economic Commission for Latin America and the Caribbean (ECLAC) in 1975 (i.e., at the beginning of the economic liberalization), but is continuously ranked in the Yearbook during 2000–2003.[3] Second, it defines the "export sector" as a sector for which the ratio of export to total output exceeds 30% in the input-output tables published

[1] Chile's GDP growth averaged 5.8% per year from 1984 to 2007.
[2] This study defines "natural resources" according to the classification in ECLAC (2008a), namely, as including both commodities and natural resource-based manufacturing.
[3] The entries in the Year-book are classified according to the Standard International Trade Classification (SITC) Rev.1.

by the Central Bank of Chile.[4] However, this definition of "non-traditional natural resource-based export sector" does not strictly coincide with *exportaciones no tradicionales* defined by ProChile.[5]

We can confirm the aforementioned export diversification of natural resources and the increase in the importance of non-traditional natural resource-based products from descriptive statistics. The evolution of exports of the ten leading products from 1970 to 2003 is presented in Table 5-1. The share of copper (i.e., the sum of refined copper, ores and concentrates of copper, blister copper, and other unrefined copper) in total exports decreased from 78.8% in 1970 to 36.2% in 2003. On the other hand, the non-traditional natural resource-based products (i.e., fresh, chilled or frozen fish, fresh grapes, wine from fresh grapes, and sawn lumber) accounted for 17.5% of total exports in 2003. Moreover, the export share of the ten leading products showed a decreasing trend; that is, it decreased from 89.9% in 1970 to 60.0% in 2003, although the majority of the ten leading products continued to be natural resource-based. The same is also suggested by the Herfindahl–Hirschman Index (HHI) used to measure the export concentration; the value decreased from 0.41 in 1980 to 0.27 in 2002, one of the most prominent decreases in the LACs during this period (Agosin, 2009).[6] Therefore, while Chile continues to be strongly dependent on exports of natural resources, it has succeeded in diversifying its natural resource-based exports.

Chile's development process since the 1980s lays the ground for a very relevant debate about natural resources and economic development. ECLAC, which strongly influenced development strategies of LACs, especially from the 1950s to the debt crises in the early 1980s, argues that natural resource products are intrinsically different from manufacturing products; the dependence on exports on primary products harms their economic development. The main

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[4] This definition of the export sector is based on Meller and Tokman (1996). The product sectors of the input-output table of 1986, published by the Central Bank of Chile, are classified according to the International Standard Industrial Classification (ISIC) Rev.2. However, some sectors from 1986 were aggregated in the 1996 input-output table, as explained in greater detail in Section 5-3.

[5] ProChile is the Trade Commission of Chile and a part of the General Directorate of International Economic Affairs of Chile's Ministry of Foreign Affairs. ProChile (2004; 2005) defines *exportaciones no traditionales* as all products except for copper, fish meal, some fruits, cellulose, iron, nitrate, metallic silver, oxide and ferromolybdenum, minerals of gold, sawn and brushed lumber, and methanol. Thus, *exportaciones no traditionales* include blueberry, salmon, chicken, dairy products, and so on. ProChile (2005) also classify *no traditionales* and *fruta* (fruits). Therefore, the definitions used in this study do not differ considerably from those of ProChile, although sawn lumber is excluded in the latter.

[6] The HHI for country *j* is defined in the following manner: $HHI_j = \sum_i (\frac{x_{ij}}{x_j})^2$, where x_{ij} is the value of exports of good *i* by country *j* and x_j represents the total value of exports from country *j*. The simple average of HHI of the 17 prominent LACs decreased from 0.36 in 1980 to 0.25 in 2002. Moreover, Mexico experienced the largest decrease during this period, from 0.48 to 0.13 (Agosin, 2009).

assumptions of its argument are based on the falling long-term trend of prices of primary products in terms of manufacturing products. As indicated by the Prebisch–Singer thesis, this falling trend is mainly attributable to low income-elasticity of demand for primary products and asymmetric distribution of the fruits of technical progress (Prebisch, 1949; Singer, 1950).[7] The assumptions are also based on high price volatility, very limited back- and forward- linkage effects, and low scope for high value added for their export.[8] Regarding the linkage effects, which our study focuses on, the mining sector (nitrate prior to World War I and copper during 1930–1970) has been regarded as the "enclave," which has very limited back and forward linkage effects with the rest of the domestic economy (Meller, 1995).

However, in recent years, especially after 2000, not only Chile but other LACs also have succeeded in expanding natural resource exports; the emergence of non-traditional natural resource-based exports is evident in other LACs, such as winter vegetables from Guatemala and commercial grains from Paraguay (Carter *et al.* 1996). Those non-traditional natural resource-based products share common features in that they can be highly differentiated and processed. In this regard, recently, ECLAC has provided a positive assessment of development strategies based on natural resource-based exports. For example, Díaz and Ramos (1998) argue that the aforementioned negative assumptions on natural resource products can be rejected as myths, and they supported "Nordic" development strategies for Chile. Ramos (1998) also argues in favor of development based on production complexes or clusters of processed natural resource products. On the other hand, Rodrik (2005) finds that an indicator, which measures the quality of the country's export basket, is highly correlated with the per capita income of that country. Agosin (2009) also finds that export diversification was positively significant in explaining per capita GDP growth during 1980–2003, after controlling for other variables that affected per capita GDP growth. These recent findings still support ECLAC's traditional view that dependence on a limited number of primary product exports harms or delays economic development.

In this regard, it is very relevant that Chile, the most successful among the LACs in terms of export-led growth based on non-traditional natural resource-based products, has produced different outcomes compared to ECLAC's traditional assumptions on natural resource-based product exports. This chapter focuses on the linkage effects among the aforementioned assumptions, because the nature of the countries' export sectors would show the production patterns of the economies in question (ECLAC, 1990).[9] It is also because countries that have witnessed economic development

[7] They argued that the benefits of technical progress are passed on as rising of wages in manufacturing export countries and as lowering of prices in primary export countries.
[8] For more details, see Palma (1987).
[9] This study terms inter-industrial linkage effects alone as "linkage effects," although this term may refer to both inter-industrial and intra-industrial linkage effects.

based on natural resource-based exports, such as New Zealand, Australia, Norway, Finland, and Sweden, show a common pattern, namely, that exports act as an engine of growth by creating domestic linkages and generating new associated technologies (Machinea and Vera, 2006). Therefore, the objective of this chapter is to precisely analyze whether non-traditional natural resource-based export sectors in Chile, such as fish, fruits, and forestry products, have produced different domestic linkage effects, compared with the traditional mining export sector, by producing three input-output tables allowing inter-temporal comparisons.

This chapter is organized as follows. Section 5-2 critically reviews previous studies. Section 5-3 describes the methodology, that is, how to reconstruct input-output tables in order to perform inter-temporal comparisons and measure the linkage effects. Section 5-4 analyzes the empirical results. The conclusions are summarized in Section 5-5.

Table 5-1. The evolution of exports of 10 leading products, 1970–2003 (%)

1970			1975			2000			2003		
SITC	Name	Share of total exports (%)	SITC	Name	Share of total exports (%)	SITC	Name	Share of total exports (%)	SITC	Name	Share of total exports (%)
68212	Refined copper	53.5	68212	Refined copper	37.8	68212	Refined copper	25.6	68212	Refined copper	22.3
68211	Blister copper and other unrefined copper	23.0	68211	Blister copper and other unrefined copper	14.2	28311	Ores and Concentrates of copper	13.1	28311	Ores and Concentrates of copper	12.0
2813	Iron ore and concentrates	5.8	2813	Iron ore and concentrates	5.2	0311	Fish, fresh, chilled or frozen	6.5	0311	Fish, fresh, chilled or frozen	7.0
28311	Ores and concentrates of copper	2.3	68262	Copper powders and flakes	2.8	25172	Sulphate wood pulp, bleached, other than dissolving grades	5.2	25172	Sulphate wood pulp, bleached, other than dissolving grades	3.7
0814	Meat meal and fish meal for fodder	1.3	25172	Sulphate wood pulp, bleached, other than dissolving grades	2.5	11212	Wine of fresh grapes	3.2	0515	Grapes, fresh	3.5
2712	Natural sodium nitrate	1.1	68111	Silver, unwrought or partly worked, but not rolled	2.0	0515	Grapes, fresh	2.9	11212	Wine of fresh grapes	3.3
68942	Molybdenum	0.8	0612	Refined sugar and other products of refining beet and cane (not including syrups)	1.8	24321	Lumber, sawn lengthwise, etc., conifer	1.7	51221	Methyl alcohol	2.2
6411	Newsprint paper	0.8	68942	Molybdenum	1.6	51221	Methyl alcohol	1.6	24321	Lumber, sawn lengthwise, etc., conifer	2.1
25171	Sulphate wood pulp, unbleached	0.7	2712	natural sodium nitrate	1.6	97101	Gold, non-monetary, unwrought or semi-manufactured	1.6	382	Petoroleum products	2.0
25172	Sulphate wood pulp, bleached, other than dissolving grades	0.6	6411	Newsprint paper	1.5	68211	Blister copper and other unrefined copper	1.6	68211	Blister copper and other unrefined copper	1.9
Share of top ten exported products (%)		89.9			71.0			63.0			60.0

Source: CEPAL (1989:120–121), CEPAL (2005:151)

5-2. Literature Review

A few studies have analyzed the evolution of linkage effects for each product sector in Chile, by reconstructing input-output tables to perform inter-temporal comparisons. For example, Albala-Bertrand (1999) performs inter-temporal comparisons by aggregating the input-output tables from 1962, and from 1977 to 1986, into 25 sectors. He also classifies these 25 sectors into primary, light manufacturing, heavy manufacturing, construction, and services sectors. He finds that the

backward linkage effects for both light and heavy manufacturing decreased from 1977 to 1986, just when the Washington Consensus Model (a package of neoliberal reforms) was applied to Chile. However, these linkage effects increased from 1962 to 1977, in the era of import substitution industrialization. Moreover, the ratio of domestic inputs to total intermediations persistently decreased from 1962 to 1977, with this trend being particularly severe in the heavy industry from 1977 to 1986. Therefore, he concludes that Chile's development process since the mid-1970s, when neoliberal reforms were implemented, is in clear contrast with that of Taiwan and South Korea, where intermediate linkage effects increased systematically over time. Moreover, these intermediate linkage effects increased at a quicker rate in heavy manufacturing, although both Chile and Taiwan/South Korea stressed on export-led development. Therefore, the findings of Albala-Bertrand (1999) are striking, because linkage effects of the manufacturing sector weakened over time in Chile, in contrast to the general assumption that one of the main features of transformation of the industrial structure when accompanied by economic development is a rapid rise in the importance of manufacturing sector. An increase in linkages of manufacturing sectors is associated with their higher output growth, as typically seen in the development process of Taiwan and South Korea (Kubo *et al.*, 1986).[10]

However, Albala-Bertrand (1999) does not analyze the differences of linkage effects among natural resources, as he aggregated the primary sector into the non-mining sector and three mining sectors. Thus, non-traditional natural resource-based products, which increased importance in the export of Chile, as discussed in the Introduction, are excluded from the analyses. Moreover, an excessive aggregation of product sectors tends to wash out meaningful inter-sectoral linkage differentials (Jones, 1976). Therefore, we should use input-output tables with as detailed sector classifications as possible, when performing inter-temporal comparisons, as discussed in the next section. Albala-Bertrand (2006) extends the analysis from 1986 to 1996. However, besides aggregating the primary sector into the non-mining sector and three mining sectors, he also aggregates the input-output tables into 28 sectors, thus presenting findings that are very similar to those of his earlier work. Thus, the excessive aggregation of product sectors persists and non-traditional natural resource-based products are excluded from his analyses.

5-3. Methodology

In this section, I first describe how to reconstruct input-output tables in order to perform

[10] It does not mention any causality between linkages of manufacturing sectors and the sectors' total output. We may assume that the larger the linkage effects of manufacturing sectors, the higher their total output, and vice versa.

inter-temporal comparisons of linkage effects. The 1986, 1996, and 2003 input-output tables published by the Central Bank of Chile are classified into 75, 73, and 73 sectors, respectively, and thus, the classification of 1986 differs from that of 1996 and 2003. Therefore, if the sectors are to be aggregated in another period, I aggregate multiple sectors into one sector only, in order to reconstruct input-output tables with a sector classification that is as detailed as possible. A detailed analysis of the correspondence table of the Banco Central de Chile (2001) shows that the aggregation of two sectors in 1986 into one sector in 1996 was implemented for six sectors, while that of two sectors in 1996 into one sector in 1986 was implemented for four sectors.[11] As a result of the implementation of classification adjustments, the reconstructed input-output tables from 1986, and 1996 to 2003, have 69 sectors.

Moreover, the Central Bank of Chile does not collate product-by-product or industry-by-industry input-output tables, although it did collate the input coefficient matrix in the product-by-product form, and the Leontief inverse matrices in both product-by-product and industry-by-industry forms, for 1996 and 2003. Therefore, we need to convert product-by-industry input-output tables into product-by-product or industry-by-industry input-output tables, when implementing the aforementioned classification adjustments. This chapter produces product-by-product input-output tables in line with the industry-technology assumption that an industry uses the same technology to produce all its products. This is because there is a possibility that the elements of the produced input coefficient matrix take a negative value under the product-technology assumption. Thus, the industry-technology assumption allows for simpler mathematical operation (Bulmer-Thomas, 1982; Venegas, 1994). This chapter employs the methodology of Venegas (1994), which explains the conversion of a product-by-industry input-output table from 1986 into a product-by-product input-output table, and applies this methodology for the other two years also, i.e., 1996 and 2003. The product-by-industry tables exogenously give us *U*, the *V* matrix, the *e* vector, and the following balanced equations:

(5-1) $$\mathbf{q} = \mathbf{U}\mathbf{i} + \mathbf{e} \quad \text{and}$$

(5-2) $$\mathbf{g} = \mathbf{V}\mathbf{i},$$

where $\mathbf{U}$ is a 69 product × 69 industry absorption matrix, whose element *i*, *j* show that input *i* is absorbed by industry *j*, that is, it corresponds to the domestic flow matrix (Bulmer-Thomas, 1982); *e* is a 69 product × 1 column vector of net final demands (excluding imports); and $\mathbf{i}$ is a 69 × 1 unity column vector. Therefore, $\mathbf{q}$ is a 69 product × 1 column vector of domestic product output. $\mathbf{V}$ is

[11] The 69 sectors are calculated as 75 − 6 = 73 − 4 = 69. For more details, see Table A-2.

a 69 industry × 69 product make matrix, which shows the distribution of industrial output; the element *i, j* show that *i* industry produces *j* product. It is relevant to note here that one industry does not necessarily produce one product; it also produces a secondary product. For example, the metal industry produces not only metal goods, but also chemicals and other manufacturing products. In that sense, the $\mathbf{V}$ matrix is dominated by the elements on the diagonal, which represent the principal products, while the off-diagonal elements represent the secondary products (Bulmer–Thomas, 1982). Thus, $\mathbf{g}$ is a 69 industry × 1 column vector of domestic industry output.

The industry-technology assumption is given a formal expression in the matrix items as follows:

(5-3) $$\mathbf{B} = \mathbf{U}\hat{\mathbf{g}}^{-1} \quad \text{and}$$

(5-4) $$\mathbf{D} = \mathbf{V}\hat{\mathbf{q}}^{-1},$$

Where $\hat{\mathbf{g}}$ is a 69 industry × 69 industry diagonal matrix of domestic industry output $\mathbf{g}$. $\hat{\mathbf{q}}$ is a 69 product × 69 product diagonal matrix of domestic product output $\mathbf{q}$. We also term equation (5-4) as the market share hypothesis, which assumes that the product is supplied in fixed proportions by different contributing industries (Bulmer-Thomas, 1982). Therefore, the solution for unknown domestic input coefficient matrix $\mathbf{A^d}$ of the product-by-product input-output table is as follows. If we substitute equation (5-3) into equation (5-1), we obtain the following equation:

(5-5) $$\mathbf{q} = \mathbf{Bg} + \mathbf{e}.$$

Then, if we substitute the equations (5-2) and (5-4) into equation (5-5), we obtain the following equation:

(5-6) $$\mathbf{q} = \mathbf{BDq} + \mathbf{e}.$$

Therefore, we obtain equation (5-7).

(5-7) $$\mathbf{q} = (\mathbf{I} - \mathbf{BD})^{-1}\mathbf{e}.$$

Now, we obtain the domestic input coefficient matrix $\mathbf{A^d} = \mathbf{BD}$ and the domestic Leontief inverse matrix $(\mathbf{I} - \mathbf{A^d})^{-1} = (\mathbf{I} - \mathbf{BD})^{-1}$ of the reconstructed 69 product-by-product input-output table. In these procedures, I choose all matrices and vectors evaluated by basic prices, according to Venegas (1994), although those evaluated at purchasers' and producers' prices are also

presented in the original product-by-industry input-output tables. This is because the input coefficients evaluated at basic prices are purer; that is, they do not include any margins of distribution or indirect taxes (Venegas, 1994). The prices are deflated by the wholesale price index (June 1992 = 1).

Second, I explain how to measure the linkage effects. In line with Jones' (1976) observation, this chapter assumes that the column sums of the Leontief inverse matrix provide the appropriate measure of the backward linkage proposed by Hirschman (1958).[12] This chapter does not analyze forward linkages, because the main focus is the export sector, which is defined in the Introduction. Thus, it is meaningless to analyze the effects of the export sector, which induce attempts to utilize its output as inputs in some new domestic activities. Moreover, this chapter excludes imports from intermediate inputs, and uses the domestic input coefficient matrix produced previously in this section. This is very relevant for this chapter, because the lack of linkage effects, i.e., the "enclave" nature of underdeveloped countries, as mentioned in the Introduction, is characterized by the fact that inputs from other domestic sectors in advanced countries serve as imports to underdeveloped countries (Hirschman, 1958). Thus, this chapter calculates only the domestic intermediate inputs stimulated by an increase in one unit of net final demand for a particular sector. However, this chapter does not take into consideration heterogeneity within the same industries, i.e., the coexistence of small/medium and large firms, and the lack of linkages between them.[13]

Therefore, this chapter calculates the measure of backward linkage effects (henceforth, BL) of *j* sector as follows:

$$BL_j = \sum_i z_{ij}^d \ , \tag{5-8}$$

where z_{ij}^d denotes *i*,*j* elements of the domestic Leontief inverse matrix. BL_j represents the sum of direct and indirect domestic intermediate inputs stimulated by an increase in one unit of net final demand by a particular sector *j*. To compare the BL of each sector, this chapter normalizes the BL, by comparing the average stimulus created by sector *j* with the overall average. Thus, the normalized backward linkage effects (henceforth, NBL) are calculated as follows:

[12] Yotopoulos and Nugent (1973) assumed the column sums of the Leontief inverse matrix as the measure of the total linkage, and not backward linkage alone. Hirschman (1958) defined backward linkage effects as the economic activity that induces attempts to supply, through domestic production, the inputs needed in that activity.

[13] The lack of both inter- and intra-industrial linkages among small/medium and large firms continues to be a prominent issue in Chile today. For more details, see, for example, Infante and Sunkel (2009).

$$NBL_j = \frac{1/69\sum_i z_{ij}^d}{1/69^2\sum_i\sum_j z_{ij}^d}, \quad (5\text{-}9)$$

where the numerator represents the stimulus imparted to other sectors by an increase in one unit of net final demand by a particular sector *j*, while the denominator represents the average stimulus for the whole economy when all net final demands increase by one unit (Bulmer-Thomas, 1982). Therefore, in line with Albala-Bertrand (1999), for this chapter, if the NBL for a particular sector *j* is exceeds one, then this sector, on account of its above average BL, is said to have high BL. Conversely, if the NBL is smaller than one, then this sector, on account of its below average BL, is said to have low BL.

5-4. Analysis of Empirical Results

5-4-1. The evolution of backward linkage effects of non-traditional natural resource-based export sectors

First, I show the evolution of the 10 highest BL and NBL by product, and the simple average of BL and NBL classified into seven sectors, that is, non-mining primary products, mining products, natural resource-based manufacturing, light manufacturing, heavy manufacturing, construction, and services sectors,[14] for 1986, 1996, and 2003 (Table 5-2). This will reveal the characteristics of the production structure of the entire economy for the stated period. The results show that the meat and meat products sector has the highest BL and NBL. Light manufacturing products, except for natural resource-based products, and heavy manufacturing products, are not ranked within the 10 highest BL and NBL during this period. Moreover, the heavy manufacturing sector had very small BL and NBL, and notably, it recorded the smallest BL and NBL among the aforementioned seven sectors in 1996. On the other hand, the non-mining primary products sector shows increasing trends of BL and NBL; the BL increased from 1.550 in 1986 to 1.848 in 2003. An additional striking finding is that the average BL of all products did not increase at all; on the contrary, it decreased from 1.713 in 1986 to 1.645 in 1996.

Therefore, Chile's production structure is characterized by non-increasing BL for the entire economy, while the BL of the manufacturing sector and the non-mining primary products sector decreased and increased respectively during this period in spite of sustainable growth. Thus,

[14] Non-resource based light manufacturing products are included within the light manufacturing sector in this classification.

the transformation tendency of Chile's industrial structure, as noted by Albala-Bertrand (1999; 2006), has persisted after 1996, contradicting the general assumption of the transformation of industrial structure accompanied by economic development.

Table 5-2. The evolution of 10 highest BL and NBL by product, 1986–2003

Product	BL1986	NBL1986	Product	BL1996	NBL1996	Product	BL2003	NBL2003
Meat and meat products	2.470	1.442	Meat and meat products	2.277	1.384	Meat and meat products	2.584	1.497
Leather and leather products	2.452	1.431	Financial services	2.180	1.325	Sugar	2.227	1.290
Prepared animal feeds	2.444	1.427	Milk and milk products	2.156	1.311	Milk and milk products	2.219	1.285
Restaurant services	2.415	1.409	Prepared animal feeds	2.135	1.298	Restaurant services	2.188	1.267
Sugar	2.354	1.374	Coal	2.042	1.242	Wood and and wood products	2.160	1.251
Bakery products	2.326	1.358	Live animals and animal products	1.997	1.214	Live animals and animal products	2.111	1.223
Non-alcoholic beverages and beer	2.312	1.349	Prepared and preserved fish	1.980	1.204	Prepared animal feeds	2.092	1.212
Footwear	2.277	1.329	Restaurant services	1.967	1.196	Prepared and preserved fish	2.084	1.207
Prepared and preserved fruits and vegetables	2.116	1.235	Prepared and preserved fruits and vegetables	1.963	1.193	Bakery products	2.020	1.170
Milk and milk products	2.095	1.223	Bakery products	1.939	1.179	Financial services	2.013	1.166
Average	1.713	1.000	Average	1.645	1.000	Average	1.726	1.000
Non-mining primary products	1.550	0.905	Non-mining primary products	1.627	0.989	Non-mining primary products	1.848	1.071
Mining products	1.586	0.926	Mining products	1.696	1.042	Mining products	1.743	1.022
Natural resource-based manufacturing	2.080	1.214	Natural resource-based manufactueing	1.938	1.178	Natural resource-based manufactueing	2.028	1.174
Light manufacturing	1.996	1.165	Light manufacturing	1.622	0.986	Light manufacturing	1.740	1.008
Heavy manufacturing	1.635	0.954	Heavy manufacturing	1.534	0.933	Heavy manufacturing	1.612	0.934
Construction	1.774	1.035	Construction	1.645	1.000	Construction	1.716	0.994
Services	1.522	0.888	Services	1.526	0.928	Services	1.575	0.912

Source: Author's calculations based on data from Banco Central de Chile (1992; 2001; 2006)

Note: I refer to Banco Central de Chile (2001:215–216) for Spanish to English translations.

Second, Tables 5-3 to 5-5 provide the BL and NBL of export sectors, with an export ratio (i.e., the ratio of exports to the total output) exceeding 30%, in descending order of the export ratios. In 1986, 11 product sectors satisfied the aforementioned definition of the export sector, which included four non-traditional natural resource-based products,[15] that is, the prepared and preserved fruits and vegetables sector, the prepared and preserved fish sector (both of which had high BL), the wood and wood products sector, and the fruit products sector. The simple average of NBL among

[15] For the definition of non-traditional natural resource-based products, this study refers to *Anuario estadístico de América Latina y el Caribe* published by ECLAC, and the definition used by the input-output tables published by the Central Bank of Chile. Thus, non-traditional natural resource-based products are defined to include the following: fresh, chilled, or frozen fish products (SITC 0311) corresponding to fish products (ISIC 130) and fish product-based manufacturing, i.e., prepared and preserved fish (ISIC 3114); fresh grapes (SITC 0515) corresponds to fruit products (ISIC 111), and fruit product-based manufacturing, i.e., prepared and preserved fruits and vegetables (ISIC 3113); wine of fresh grapes (SITC11212) corresponds to distilled alcoholic beverages and wines (ISIC 3131); and sawn lumber products (SITC 24321) corresponds to wood and wood products (ISIC 331). Thus, this study defines these six product sectors as non-traditional natural resource-based products in the reconstructed 69 product-by-product input-output table.

those 4 non-traditional natural resource-based export sectors (1.036) was higher than that among the 3 mining export sectors (0.918), and that of all 11 export sectors (0.936).

In 1996, 12 products sectors satisfied the aforementioned definition of the export sector. These include five non-traditional natural resource-based products, that is, the prepared and preserved fish sector, the prepared and preserved fruits and vegetables sector, the distilled alcoholic beverages and wine sector, the wood and wood products sector (all of which had high BL), and the fruit products sector. The simple average of NBL among these five non-traditional natural resource-based export sectors (1.107) was higher than that of the three mining export sectors (0.995), that of one manufacturing sector (0.931), and that of all 12 export sectors (1.025).

Finally, in 2003, 15 products sectors satisfied the aforementioned definition of the export sector. This included six non-traditional natural resource-based products, that is, the wood and wood products sector, the prepared and preserved fish sector, the fish products sector, the prepared and preserved fruits and vegetables sector, the distilled alcoholic beverages and wine sector (all of which had high BL), and the fruit products sector. The simple average of NBL among these 6 non-traditional natural resource-based export sectors (1.111) was higher than that of the three mining export sectors (1.031), that of the three manufacturing sectors (0.951), and that of all 15 export sectors (1.019). Although the copper sector had the highest or second-highest export ratios from 1986 to 2003, the NBL of this sector were 0.962 in 1986, 0.980 in 1996, and 0.988 in 2003. Thus, it had stably low BL.

Therefore, the findings shows that, from 1986 to 2003, the number of the non-traditional natural resource-based export sectors with high BL and the average of NBL of the non-traditional natural resource-based export sectors both increased. Moreover, the non-traditional natural resource-based export sectors always had high BL. The average of NBL of non-traditional natural resource-based export sectors was always higher than the average of NBL of the mining export sectors and that of all export sectors. The NBL of the copper sector did not increase and it had stably low BL during this period. This increasing trend of NBL was especially evident in the wood and wood products, and fish products sectors. It is relevant to note here that, as per the features of non-traditional natural resource-based export sectors, the wood and wood products, and fish products sectors experienced a substantial increase in export ratios. The export ratio of the former increased from 33.0% in 1986 to 63.5% in 2003, while its NBL increased from 0.990 from 1.251 during this time. The export ratio of the fish products sector increased from only 3.0% in 1986 to 64.3% in 2003, while its NBL increased from 0.963 from 1.127.[16] This trend is also seen in the meat and meat products sector, which had the highest BL from 1986 to 2003 (as seen in Table 5-2). The export ratio

[16] Thus, the fish products sector in 1986 and 1996 is not classified as an export sector. In other words, it is not ranked in tables 5-3 and 5-4.

of the meat and meat products sector increased substantially from only 2.3% in 1986 to 16.0% in 2003; thus, it was still not classified as an export sector in 2003.

Table 5-3. Backward linkage effects of export sectors, 1986

Product	Export	Total output	Export ratio	BL	NBL	Rank of NBL
Copper	800,537	932,005	0.8589	1.648	0.962	38
Prepared and preserved fish	233,576	294,544	0.7930	1.921	1.121	14
Iron	42,138	55,996	0.7525	1.499	0.875	53
Other minerals	227,550	336,246	0.6767	1.573	0.918	45
Sea transport services	152,177	236,395	0.6437	1.340	0.782	62
Fruit products	142,880	254,826	0.5607	1.367	0.798	60
Air transport services	56,228	104,937	0.5358	1.522	0.888	50
Paper and paper products	116,382	245,413	0.4742	1.699	0.992	31
Prepared and preserved fruits and vegetables	23,524	67,741	0.3473	2.116	1.235	9
Forestry products	18,230	52,665	0.3462	1.252	0.731	67
Wood and and wood products	43,670	132,298	0.3301	1.697	0.990	32
Non-traditional natural resource-based products	443,650	749,410	0.5920	1.775	1.036	
Mining products	1,070,225	1,324,247	0.8082	1.573	0.918	
Total export sectors	1,856,892	2,713,067	0.6844	1.603	0.936	

Table 5-4. Backward linkage effects of export sectors, 1996

Product	Export	Total output	Export ratio	BL	NBL	Rank of NBL
Sea transport services	357,725	397,254	0.9005	1.428	0.868	60
Copper	1,828,083	2,223,383	0.8222	1.611	0.980	36
Prepared and preserved fish	460,806	575,608	0.8006	1.980	1.204	7
Iron	44,984	59,583	0.7550	1.672	1.017	27
Other minerals	324,394	488,759	0.6637	1.624	0.987	35
Prepared and preserved fruit and vegetable	165,836	294,138	0.5638	1.963	1.193	9
Air transport services	153,868	277,732	0.5540	1.431	0.870	59
Fruit products	207,722	458,465	0.4531	1.468	0.893	54
Paper and paper products	273,513	629,179	0.4347	1.820	1.107	16
Wood and and wood products	205,324	496,350	0.4137	1.772	1.077	20
Distilled alcoholic beverages and wine	90,095	218,810	0.4117	1.924	1.170	11
Other manufacturing products	13,083	37,110	0.3526	1.531	0.931	44
Non-traditional natural resource-based products	1,129,784	2,043,371	0.5529	1.821	1.107	
Mining products	2,197,461	2,771,726	0.7928	1.636	0.995	
Manufacturing products	13,083	37,110	0.3526	1.531	0.931	
Total export sectors	4,125,435	6,156,372	0.6701	1.685	1.025	

Table 5-5. Backward linkage effects of export sectors, 2003

Product	Export	Total output	Export ratio	BL	NBL	Rank of NBL
Sea transport services	504,785	566,623	0.8909	1.290	0.747	67
Copper	2,686,517	3,270,479	0.8214	1.705	0.988	35
Prepared and preserved fruit and vegetable	169,988	222,203	0.7650	1.927	1.116	18
Prepared and preserved fish	308,597	405,573	0.7609	2.084	1.207	8
Other minerals	367,579	551,069	0.6670	1.660	0.962	41
Fish products	420,030	653,003	0.6432	1.946	1.127	16
Wood and and wood products	418,096	657,985	0.6354	2.160	1.251	5
Distilled alcoholic beverages and wine	231,631	365,162	0.6343	1.900	1.101	20
Fruit products	331,285	533,313	0.6212	1.491	0.864	53
Air transport services	314,427	534,673	0.5881	1.475	0.854	57
Iron	35,456	64,425	0.5504	1.976	1.145	12
Paper and paper products	406,731	800,183	0.5083	1.851	1.072	23
Transport equipment	64,743	134,734	0.4805	1.491	0.863	54
Basic chemicals	240,633	552,713	0.4354	1.488	0.862	55
Basic metal products	178,760	514,140	0.3477	1.946	1.128	15
Non-traditional natural resource-based products	1,879,627	2,837,237	0.6625	1.918	1.111	
Mining products	3,089,553	3,885,973	0.7951	1.780	1.031	
Manufacturing products	484,136	1,201,587	0.4029	1.642	0.951	
Total export sectors	6,679,259	9,826,277	0.6797	1.759	1.019	

Source: Author's calculations based on data from Banco Central de Chile (1992; 2001; 2006)

Note: Export and total output values are expressed as 1,000,000 Chilean pesos, at prices deflated by the wholesale price index (June 1992 = 1). Rank of NBL shows the descending order of NBL. I show the sums of the exports and total output values of non-traditional natural resource-based products, mining products, manufacturing products, and total export sectors vis-à-vis the products sector. Their BL and NBL are simple averages vis-à-vis the products sector. I refer to Banco Central de Chile (2001:215–216) for Spanish to English translations.

5-4-2. The evolution of domestic intermediate inputs of non-traditional natural resource-based export sectors

This sub-section discusses the products sectors associated with the high NBL of non-traditional natural resource-based export sectors discovered in section 5-4-1. This is accomplished by analyzing their domestic intermediate inputs. In this regard, I focus on the evolution of domestic intermediate inputs of the four highest BL among the non-traditional natural resource-based export sectors in 2003, that is, the wood and wood products sector, the prepared and preserved fish sector, the fish products sector, and the prepared and preserved fruits and vegetables sector.

The evolution of the 10 highest domestic intermediate inputs and the sum of domestic input coefficients of the aforementioned four non-traditional natural resource-based export sectors from 1986 to 2003 are presented in tables 5-6 to 5-10. The results show that the sum of domestic input coefficients of the wood and wood products, and the fish products sectors, substantially increased from 44.7% in 1986 to 62.6% in 2003, and from 39.9% in 1986 to 50.8% in 2003, respectively. The increasing trend of the sum of domestic input coefficient in the wood and wood

products sector was associated with domestic intermediate inputs from forestry products, and wood and wood products, that is, inputs from its raw material and itself (see Table 5-6). On the other hand, the increasing trend of the sum of domestic input coefficient in the fish products sector was associated with the manufacturing sector, such as prepared animal feeds, plastic products, and basic chemicals. The increasing trend is especially evident in the prepared animal feeds sector; it increased from 0.22% in 1986 to 24.3% in 2003. Therefore, this particular increase is the main reason for the increase in the domestic intermediate inputs of the fish products sector. Moreover, as Agosin (1997) noted, these manufacturing sectors are considered as the backward linkage industries for salmon aquaculture, which recorded a rise in fishing exports during this particular period,[17] and included nutrients, packing materials, and fish medicine. Therefore, present chapter's findings quantitatively concur with those of Iizuka (2005), who showed that some inputs to Chilean salmon aquaculture, such as fish feed, are locally supplied, while other inputs, such as nets, chemicals, and packing materials, are partially locally supplied, based on the field surveys conducted in early 2004 in the 10th region of Chile.

Regarding the prepared and preserved fish sector, and the prepared and preserved fruits and vegetables sector, we find that the sum of domestic input coefficients did not show an increasing trend. However, we did find increasing trends of domestic intermediate inputs from business services in these sectors. The findings may be a reflection of how knowledge intensive these sectors have become.

Table 5-6. The evolution of the domestic inputs coefficient of the wood and wood products sector, 1986–2003

	1986		1996		2003	
Rank	Product	Domestic input coefficient	Product	Domestic input coefficient	Product	Domestic input coefficient
1	Forestry products	0.1026	Forestry products	0.1715	Forestry products	0.1573
2	Road freight transport services	0.0928	Road freight transport services	0.0893	Wood and and wood products	0.1540
3	Wood and and wood products	0.0421	Business services	0.0494	Road freight transport services	0.0983
4	Business services	0.0292	Wood and and wood products	0.0378	Business services	0.0557
5	Trade services	0.0183	Trade services	0.0313	Trade services	0.0348
6	Basic chemicals	0.0175	Electricity	0.0192	Basic chemicals	0.0321
7	Electricity	0.0169	Other road passenger transport services	0.0129	Electricity	0.0173
8	Refined petroleum products	0.0157	Other non-metallic mineral products	0.0119	Services related to transport	0.0154
9	Sea transport services	0.0115	Other community, social and personal services	0.0107	Other chemical products	0.0096
10	Agriculture products	0.0108	Real Estate services	0.0088	Financial services	0.0083
	sum of domestic input coefficient	0.4468		0.5080		0.6256

[17] The revenues from salmon aquaculture to total fishing exports increased from 28% in 1990 to 56% in 2000 (Perez-Aleman, 2005).

Table 5-7. The evolution of the domestic inputs coefficient of the prepared and preserved fish sector, 1986–2003

	1986		1996		2003	
Rank	Product	Domestic input coefficient	Product	Domestic input coefficient	Product	Domestic input coefficient
1	Fish products	0.3648	Fish products	0.3334	Fish products	0.3148
2	Metal products	0.0297	Prepared animal feeds	0.0412	Business services	0.0440
3	Prepared and preserved fish	0.0289	Trade services	0.0244	Trade services	0.0336
4	Business services	0.0140	Business services	0.0234	Prepared and preserved fish	0.0315
5	Electricity	0.0130	Refined petroleum products	0.0215	Transport- related services	0.0249
6	Coal	0.0093	Metal products	0.0165	Financial services	0.0215
7	Financial services	0.0089	Road freight transport services	0.0132	Prepared animal feeds	0.0210
8	Trade services	0.0089	Electricity	0.0095	Refined petroleum products	0.0186
9	Road freight transport services	0.0086	Other community, social and personal services	0.0070	Road freight transport services	0.0131
10	Other chemical products	0.0077	Real State services	0.0070	Electricity	0.0110
	sum of domestic input coefficient	0.5513		0.5702		0.5872

Table 5-8. The evolution of the domestic inputs coefficient of the fish products sector, 1986–2003

	1986		1996		2003	
Rank	Product	Domestic input coefficient	Product	Domestic input coefficient	Product	Domestic input coefficient
1	Fish products	0.1562	Prepared animal feeds	0.1217	Prepared animal feeds	0.2432
2	Refined petroleum products	0.0607	Fish and other fishing products	0.0776	Business services	0.0649
3	Trade services	0.0493	Refined petroleum products	0.0372	Trade services	0.0272
4	Air transport services	0.0162	Trade services	0.0366	Refined petroleum products	0.0210
5	Transport equipment	0.0130	Business services	0.0265	Fish and other fishing products	0.0205
6	Electric machinery and equipment	0.0103	Road freigth transport services	0.0160	Plastic products	0.0204
7	Business services	0.0096	Insurance services	0.0084	Other chemical products	0.0105
8	Plastic products	0.0091	Prepared and preserved fish	0.0082	Road freigth transport services	0.0085
9	Wood and and wood products	0.0077	Textiles	0.0073	Basic chemicals	0.0082
10	Road freight transport services	0.0067	Other chemical products	0.0072	Electric machinery and equipment	0.0077
	sum of domestic input coefficient	0.3989		0.4211		0.5083

Table 5-9. The evolution of the domestic inputs coefficient of the prepared and preserved fruits and vegetables sector, 1986–2003

	1986		1996		2003	
Rank	Product	Domestic input coefficient	Product	Domestic input coefficient	Product	Domestic input coefficient
1	Fruit products	0.1206	Fruit products	0.2023	Fruit products	0.1535
2	Agriculture products	0.1188	Agriculture products	0.0894	Agriculture products	0.0984
3	Trade services	0.0475	Business services	0.0400	Business services	0.0600
4	Metal products	0.0473	Trade services	0.0358	Trade services	0.0426
5	Sugar	0.0440	Metal products	0.0340	Prepared and preserved fruit and vegetable	0.0409
6	Basic metal products	0.0360	Basic metal products	0.0247	Road freigth transport services	0.0326
7	Business services	0.0212	Paper and paper products	0.0169	Paper and paper products	0.0177
8	Road freight transport services	0.0208	Road freigth transport services	0.0156	Plastic products	0.0168
9	Paper and paper products	0.0205	Transport- related services	0.0152	Refined petroleum products	0.0126
10	Animal and vegetable oil	0.0167	Other food products	0.0149	Transport- related services	0.0108
	sum of domestic input coefficient	0.6624		0.6084		0.5629

Source: Author's calculations based on data from Banco Central de Chile (1992; 2001; 2006)

Note: I refer to Banco Central de Chile (2001:215–216) for Spanish to English translations.

5-5. Conclusions

This chapter analyzed whether non-traditional natural resource-based export sectors in Chile, such as fish, fruits, and forestry products, have produced different domestic inter-industrial linkage effects, compared with the traditional mining export sector, by reconstructing input-output tables from 1986, 1996, and 2003. The main findings are as follows. First, the number of non-traditional natural resource-based export sectors with high BL, and the average of NBL of the non-traditional natural resource-based export sectors, both increased from 1986 to 2003. Moreover, the non-traditional natural resource-based export sectors always had high BL, while the average of NBL of the non-traditional natural resource-based export sectors was always higher than that of the mining export sectors and that of all export sectors. The NBL of the copper sector did not increase and it had stably low BL during this period. Second, this increasing trend of NBL was especially evident in the wood and wood products, and the fish products sectors, for which export ratios notably increased from 1986 to 2003. Moreover, among those non-traditional natural resource-based export sectors with high BL, the fish products sector substantially increased domestic intermediate inputs from the backward linkage industries.

Therefore, this chapter found that some non-traditional natural resource-based export

sectors, which have come about as a result of export diversification since the 1980s, certainly increased BL and had higher BL than the traditional copper export sector. Among these, the fish products sector, mainly constituted by the salmon aquaculture industry, succeeded in creating BL with domestic manufacturing suppliers. In this regard, one contribution of this chapter is that, in contrast to all other industrial sectors, salmon aquaculture has developed BL with domestic backward linkages at the industry level. This chapter made this finding based on reconstructed input-output tables with products sectors classified in as detailed a manner as possible, and my finding concurs with that of Iizuka (2005), who conducted firm-level field surveys. Thus, these findings provide important counter-evidence to the "enclave" features of exports on primary products in Chile.

However, this chapter also showed the persistent weakness of BL of the entire economy and the manufacturing sector, especially the heavy manufacturing sector. The findings indicated the limitations of Chile's current export-led development strategy, which promotes export diversification of natural resources, according to the principles of comparative advantage, and the absence of enabling industrial policies. Therefore, it is uncertain whether the non-traditional natural resource-based export sectors with high BL will be able to establish BL of a required range and depth. In other words, it is uncertain whether the intermediate inputs of these sectors will be able to repeatedly stimulate other intermediate inputs, as Hirschman (1958) assumed in the case of manufacturing sectors. In this regard, the findings of Chenery and Taylor (1968), that small primary export-oriented countries are slower to transform their industrial structure than industry export-oriented countries, is still suggestive.

This topic clearly needs further research. First, it will be interesting to analyze how increases in BL of non-traditional natural resource-based export sectors have contributed to sustainable economic growth in Chile since the mid-1980s. Second, it will also help to analyze how increases in BL of non-traditional natural resource-based export sectors have been related to the recent changes in the production chain, especially the global commodity chain. Moreover, a focus on the sustainability of Chile's primary export-led development strategy is also necessary. Since 2007, salmon aquaculture has been hit by an infectious disease, i.e., infectious salmon anemia (ISA), although it was said that the coast of Chile was safe from ISA. The ambient contamination caused by salmon aquaculture is also of concern. While Díaz and Ramos (1998) rejected the traditional negative assumptions on natural resource products as myths, they nevertheless admitted that the primary export-led development strategy is still not immune to ambient contamination and the Dutch disease. I hope to focus on these topics in future studies.

Appendices

Appendix to Chapter 2

Table A-1. Estimation Results of equation (2-3) by Heckman two-step procedure, 1974-2007

	1974	1975	1976	1977	1978	1979	1980
Wage equation							
cons	4.5941 ***	4.5254 ***	3.5721 ***	4.2168 ***	4.7871 ***	4.6604 ***	4.3899 ***
	(0.2118)	(0.2662)	(0.6356)	(0.2372)	(0.1560)	(0.1872)	(0.2163)
years of schooling	0.0370 ***	0.0450 ***	0.0980 ***	0.0760 ***	0.0627 ***	0.0641 ***	0.0757 ***
	(0.0099)	(0.0137)	(0.0261)	(0.0125)	(0.0105)	(0.0116)	(0.0140)
exp	0.0325 ***	0.0291 ***	0.0571 ***	0.0540 ***	0.0456 ***	0.0515 ***	0.0507 ***
	(0.0061)	(0.0068)	(0.0123)	(0.0068)	(0.0057)	(0.0053)	(0.0063)
exp2	-0.0005 ***	-0.0004 ***	-0.0008 ***	-0.0008 ***	-0.0007 ***	-0.0008 ***	-0.0007 ***
	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
d8*(school-8)	0.0858 ***	0.0891 ***	0.0899 ***	0.1129 ***	0.1140 ***	0.1273 ***	0.1311 ***
	(0.0168)	(0.0168)	(0.0221)	(0.0184)	(0.0179)	(0.0175)	(0.0187)
d12*(school-12)	0.0583 ***	0.0306 *	0.0267	0.0004	0.0418 **	0.0387 **	0.0248
	(0.0194)	(0.0178)	(0.0250)	(0.0184)	(0.0171)	(0.0172)	(0.0187)
Head of the household	0.2831 ***	0.2559 ***	0.1950 ***	0.2075 ***	0.2056 ***	0.2429 ***	0.2975 ***
	(0.0366)	(0.0388)	(0.0525)	(0.0388)	(0.0384)	(0.0368)	(0.0395)
Public Sectors	-0.0052	-0.0086	-0.1368 **	-0.1773 ***	-0.2180 ***	-0.2006 ***	-0.2059 ***
	(0.0422)	(0.0411)	(0.0537)	(0.0440)	(0.0414)	(0.0422)	(0.0521)
Agriculture	-0.0596	-0.0969	0.0721	-0.0320	0.0334	-0.2023 **	-0.2488 **
	(0.1022)	(0.1057)	(0.1290)	(0.1087)	(0.1082)	(0.1021)	(0.1229)
Mining	0.3419 **	0.3196 **	0.2951	0.3795 **	0.2798 *	0.0064	0.1242
	(0.1438)	(0.1371)	(0.2533)	(0.1874)	(0.1636)	(0.1560)	(0.1762)
NRBM	-0.0340	-0.0183	-0.1175	-0.0393	0.0179	-0.0731	-0.0115
	(0.0512)	(0.0557)	(0.0755)	(0.0622)	(0.0568)	(0.0580)	(0.0588)
Non-resource based manufacturing	0.0640 *	0.0308	0.0091	0.0495	0.0174	0.0112	0.0235
	(0.0438)	(0.0482)	(0.0674)	(0.0542)	(0.0497)	(0.0507)	(0.0511)
Commerce	-0.0344	-0.0608	-0.1233	-0.0387	-0.0946 *	-0.0701	-0.0009
	(0.0554)	(0.0544)	(0.0751)	(0.0604)	(0.0573)	(0.0560)	(0.0576)
Financial services	0.0108	0.0309	-0.0014	0.1477 **	-0.0606	-0.0120	0.1184 *
	(0.0645)	(0.0615)	(0.0813)	(0.0676)	(0.0594)	(0.0608)	(0.0671)
Personal services	-0.1507 **	-0.1833 ***	-0.3037 ***	-0.0675	-0.1166 *	-0.2562 ***	-0.2079 ***
	(0.0649)	(0.0673)	(0.0901)	(0.0791)	(0.0680)	(0.0689)	(0.0707)
Community services	-0.0764	-0.1239 **	-0.1640 *	-0.0036	-0.0233	-0.1071 *	-0.1769 ***
	(0.0607)	(0.0623)	(0.0862)	(0.0672)	(0.0604)	(0.0598)	(0.0653)
Transport	-0.0238	-0.0399	0.0721	0.1740 ***	0.0557	-0.0821	-0.0741
	(0.0558)	(0.0587)	(0.0788)	(0.0641)	(0.0581)	(0.0606)	(0.0651)
Inverse Mills ratio	0.2134	-0.0412	0.9039	0.5404 *	0.0931	0.5166 **	0.7225 ***
	(0.3053)	(0.2985)	(0.7073)	(0.3002)	(0.2089)	(0.2584)	(0.2688)
Participation equation							
cons	0.0705	-0.2569 *	-0.3295 **	-0.0397	0.1439	0.2349 *	-0.1068
	(0.1373)	(0.1344)	(0.1409)	(0.1420)	(0.1427)	(0.1335)	(0.1594)
years of schooling	0.0474 ***	0.0792 ***	0.0707 ***	0.0607 ***	0.0466 ***	0.0567 ***	0.0812 ***
	(0.0093)	(0.0089)	(0.0090)	(0.0090)	(0.0091)	(0.0088)	(0.0108)
exp	0.0369 ***	0.0446 ***	0.0339 ***	0.0437 ***	0.0430 ***	0.0290 ***	0.0369 ***
	(0.0091)	(0.0085)	(0.0091)	(0.0084)	(0.0089)	(0.0085)	(0.0103)
exp2	-0.0005 ***	-0.0007 ***	-0.0004 **	-0.0007 ***	-0.0008 ***	-0.0005 ***	-0.0005 **
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Non-employment income	-0.00492 ***	-0.01392 ***	-0.00183 **	-0.00107 ***	-0.00103 ***	-0.00054 ***	-0.00434 ***
	(0.00140)	(0.00399)	(0.00091)	(0.00027)	(0.00020)	(0.00013)	(0.00093)
Numbers of children	0.0158	-0.0198	0.0088	-0.0204	0.0232	-0.0438 *	-0.0038
	(0.0209)	(0.0202)	(0.0219)	(0.0217)	(0.0240)	(0.0246)	(0.0285)
Number of obs	1885	2155	1962	2184	2159	2186	1887
Censored obs	367	460	485	431	390	410	311
Uncensored obs	1518	1695	1477	1753	1769	1776	1576
Return to primary education	0.0370	0.0450	0.0980	0.0760	0.0627	0.0641	0.0757
Return to secondary education	0.1228	0.1341	0.1880	0.1889	0.1767	0.1915	0.2068
Return to higher education	0.1811	0.1647	0.2147	0.1893	0.2186	0.2302	0.2316

	1981	1982	1983	1984	1985	1986	1987
Wage equation							
cons	4.9956 ***	5.1494 ***	4.3616 ***	4.1380 ***	4.1485 ***	4.3140 ***	4.3350 ***
	(0.2855)	(0.3091)	(0.2151)	(0.3236)	(0.3530)	(0.3281)	(0.8072)
years of schooling	0.0467 ***	0.0422 **	0.0628 ***	0.0645 ***	0.0472 ***	0.0765 ***	0.0556 *
	(0.0179)	(0.0192)	(0.0134)	(0.0166)	(0.0170)	(0.0182)	(0.0329)
exp	0.0499 ***	0.0480 ***	0.0548 ***	0.0526 ***	0.0661 ***	0.0426 ***	0.0453 ***
	(0.0064)	(0.0055)	(0.0064)	(0.0067)	(0.0071)	(0.0069)	(0.0161)
exp2	-0.0008 ***	-0.0007 ***	-0.0008 ***	-0.0007 ***	-0.0010 ***	-0.0005 ***	-0.0006 **
	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0003)
d8*(school-8)	0.1447 ***	0.1467 ***	0.1269 ***	0.1393 ***	0.1565 ***	0.0903 ***	0.0997 ***
	(0.0288)	(0.0233)	(0.0210)	(0.0203)	(0.0196)	(0.0200)	(0.0205)
d12*(school-12)	0.0185	0.0291	0.0493 **	0.0621 ***	0.0308 *	0.0652 ***	0.1442 ***
	(0.0284)	(0.0199)	(0.0195)	(0.0187)	(0.0175)	(0.0170)	(0.0179)
Head of the household	0.2196 ***	0.2213 ***	0.2015 ***	0.2462 ***	0.1471 ***	0.1571 ***	0.1717 ***
	(0.0616)	(0.0453)	(0.0454)	(0.0435)	(0.0407)	(0.0411)	(0.0411)
Public Sectors	-0.2685 ***	-0.3438 ***	-0.3085 ***	-0.2674 ***	-0.2277 ***	-0.2071 ***	-0.1759 ***
	(0.0823)	(0.0580)	(0.0526)	(0.0486)	(0.0474)	(0.0477)	(0.0514)
Agriculture	-0.4706 **	-0.1709	0.0107	-0.0472	-0.0404	0.1872	-0.0545
	(0.2169)	(0.1839)	(0.2011)	(0.1573)	(0.1545)	(0.1262)	(0.1446)
Mining	0.4050	0.4818 **	0.3087	0.1119	0.4496 ***	0.4632 ***	0.1980
	(0.3431)	(0.2107)	(0.2556)	(0.1922)	(0.1698)	(0.1564)	(0.1473)
NRBM	-0.1659 **	-0.0367	0.0487	0.0463	-0.0181	-0.0756	0.0218
	(0.0835)	(0.0695)	(0.0794)	(0.0709)	(0.0711)	(0.0653)	(0.0606)
Non-resource based manufacturing	-0.1450 *	0.0611	0.0723	0.0574	-0.0417	-0.0275	0.0342
	(0.0742)	(0.0642)	(0.0736)	(0.0645)	(0.0601)	(0.0583)	(0.0571)
Commerce	-0.2704 ***	-0.0208	-0.1664 **	-0.0898	-0.1488 **	-0.1738 ***	-0.1128 *
	(0.0812)	(0.0648)	(0.0751)	(0.0675)	(0.0647)	(0.0619)	(0.0591)
Financial services	-0.0921	0.2472 ***	0.0688	0.0893	0.1631 **	0.0886	0.1898 ***
	(0.1001)	(0.0721)	(0.0787)	(0.0679)	(0.0674)	(0.0673)	(0.0678)
Personal services	-0.2973 ***	-0.1141	-0.2453 ***	-0.1808 **	-0.2013 ***	-0.2487 ***	-0.1476 **
	(0.1103)	(0.0868)	(0.0943)	(0.0891)	(0.0773)	(0.0731)	(0.0751)
Community services	-0.1707 *	-0.0092	0.0021	0.0214	-0.0762	-0.0690	-0.0782
	(0.1027)	(0.0799)	(0.0846)	(0.0727)	(0.0696)	(0.0678)	(0.0685)
Transport	-0.1868 *	-0.0631	-0.1825 **	0.0364	0.0142	0.0648	0.1356 **
	(0.0960)	(0.0727)	(0.0831)	(0.0726)	(0.0679)	(0.0691)	(0.0657)
Inverse Mills ratio	1.1413 *	-0.0015	0.5390 ***	0.6086 *	0.6345	0.2862	0.4998
	(0.6295)	(0.2757)	(0.1914)	(0.3325)	(0.4547)	(0.3479)	(1.0329)
Participation equation							
cons	0.6969 ***	-0.5068 ***	-0.2428 *	-0.3318 **	0.0241	-0.2988 **	-0.1357
	(0.1581)	(0.1374)	(0.1345)	(0.1432)	(0.1437)	(0.1496)	(0.1524)
years of schooling	0.0291 ***	0.0876 ***	0.0553 ***	0.0696 ***	0.0551 ***	0.0742 ***	0.0645 ***
	(0.0105)	(0.0088)	(0.0087)	(0.0093)	(0.0093)	(0.0098)	(0.0102)
exp	0.0202 **	0.0130	0.0288 ***	0.0211 **	0.0254 ***	0.0343 ***	0.0389 ***
	(0.0100)	(0.0086)	(0.0085)	(0.0091)	(0.0091)	(0.0089)	(0.0093)
exp2	-0.0004 *	-0.0001	-0.0005 ***	-0.0003	-0.0004 **	-0.0006 ***	-0.0006 ***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Non-employment income	-0.00273 ***	-0.00174 ***	-0.00389 ***	-0.00140 ***	-0.00122 ***	-0.00112 ***	-0.00020
	(0.00080)	(0.00049)	(0.00062)	(0.00043)	(0.00046)	(0.00036)	(0.00090)
Numbers of children	0.0168	0.0224	0.0056	0.0517 *	-0.0172	-0.0024	-0.0154
	(0.0298)	(0.0238)	(0.0250)	(0.0276)	(0.0257)	(0.0271)	(0.0288)
Number of obs	1963	1988	1968	1906	1942	1872	1862
Censored obs	258	639	635	509	427	444	355
Uncensored obs	1705	1349	1333	1397	1515	1428	1507
Return to primary education	0.0467	0.0422	0.0628	0.0645	0.0472	0.0765	0.0556
Return to secondary education	0.1913	0.1889	0.1897	0.2039	0.2037	0.1668	0.1554
Return to higher education	0.2099	0.2180	0.2390	0.2659	0.2345	0.2320	0.2995

	1988	1989	1990	1991	1992	1993	1994
Wage equation							
cons	4.2041 ***	4.5772 ***	5.2454 ***	4.1694 ***	4.3773 ***	4.8827 ***	5.0884 ***
	(0.4087)	(0.5764)	(0.5611)	(1.5537)	(0.6977)	(0.7850)	(0.7675)
years of schooling	0.0648 ***	0.0562 *	0.0186	0.0760	0.0900 **	0.0542	0.0626
	(0.0177)	(0.0294)	(0.0293)	(0.0708)	(0.0444)	(0.0351)	(0.0478)
exp	0.0413 ***	0.0429 ***	0.0268 ***	0.0400	0.0297 *	0.0448 *	0.0347 **
	(0.0107)	(0.0141)	(0.0088)	(0.0293)	(0.0163)	(0.0236)	(0.0161)
exp2	-0.0005 ***	-0.0006 **	-0.0004 ***	-0.0005	-0.0003	-0.0006	-0.0005 *
	(0.0002)	(0.0003)	(0.0001)	(0.0005)	(0.0003)	(0.0004)	(0.0003)
d8*(school-8)	0.0961 ***	0.0903 ***	0.1010 ***	0.0814 *	0.0457	0.0702	0.0619
	(0.0196)	(0.0207)	(0.0227)	(0.0442)	(0.0560)	(0.0434)	(0.0404)
d12*(school-12)	0.1124 ***	0.1067 ***	0.1482 ***	0.1334 ***	0.1348 ***	0.1160 ***	0.1212 ***
	(0.0176)	(0.0171)	(0.0174)	(0.0364)	(0.0484)	(0.0345)	(0.0305)
Head of the household	0.1961 ***	0.0956 **	0.2206 ***	0.1717 **	0.1725	0.1336 *	0.1828 **
	(0.0406)	(0.0383)	(0.0391)	(0.0808)	(0.1083)	(0.0804)	(0.0729)
Public Sectors	-0.1107 **	-0.0839	-0.1329 **	-0.0374	-0.0214	-0.1471	-0.1456
	(0.0537)	(0.0566)	(0.0547)	(0.1242)	(0.1725)	(0.1284)	(0.1056)
Agriculture	0.1649	-0.0123	0.0066	0.0648	-0.0293	-0.3511	-0.1911
	(0.1457)	(0.1482)	(0.1635)	(0.4306)	(0.3676)	(0.3461)	(0.2828)
Mining	0.6655 ***	0.5364 ***	0.3313 **	0.9217 **	0.6696	0.0302	0.1018
	(0.1589)	(0.1555)	(0.1536)	(0.3619)	(0.4518)	(0.4909)	(0.3607)
NRBM	0.0646	0.0023	-0.0463	0.0299	0.0416	-0.0866	-0.1394
	(0.0595)	(0.0572)	(0.0645)	(0.1283)	(0.1690)	(0.1192)	(0.1070)
Non-resource based manufacturing	0.1630 ***	0.0764	-0.0108	0.0823	0.0283	-0.0233	-0.1132
	(0.0526)	(0.0513)	(0.0578)	(0.1110)	(0.1402)	(0.1061)	(0.0953)
Commerce	0.1432 **	0.0288	-0.0698	-0.0155	-0.0890	-0.1373	-0.1876 *
	(0.0594)	(0.0547)	(0.0624)	(0.1245)	(0.1574)	(0.1144)	(0.1052)
Financial services	0.3102 ***	0.2908 ***	0.2925 ***	0.2537 *	0.2404	0.1990	0.1601
	(0.0648)	(0.0664)	(0.0689)	(0.1365)	(0.1858)	(0.1318)	(0.1174)
Personal services	-0.1003	-0.0293	-0.0448	-0.0897	-0.0856	-0.1998	-0.2287 *
	(0.0726)	(0.0731)	(0.0793)	(0.1507)	(0.2076)	(0.1677)	(0.1336)
Community services	-0.0586	-0.1412 **	-0.2401 ***	-0.2009	-0.2498	-0.2600 *	-0.2454 **
	(0.0695)	(0.0660)	(0.0711)	(0.1433)	(0.1937)	(0.1377)	(0.1193)
Transport	0.1508 **	0.0872	0.0877	0.0455	-0.0035	-0.1166	-0.1056
	(0.0635)	(0.0626)	(0.0651)	(0.1330)	(0.1683)	(0.1227)	(0.1130)
Inverse Mills ratio	0.5422	0.6195	0.0891	1.5172	1.9153	1.4291	1.2091
	(0.5797)	(0.8441)	(0.7962)	(2.2211)	(1.4662)	(1.6874)	(1.3683)
Participation equation							
cons	0.0465	-0.0444	-0.0768	-0.0809	0.5575 ***	0.3995 **	0.2096
	(0.1610)	(0.1858)	(0.1741)	(0.1640)	(0.2044)	(0.1864)	(0.2121)
years of schooling	0.0536 ***	0.0782 ***	0.0769 ***	0.0732 ***	0.0585 ***	0.0435 ***	0.0812 ***
	(0.0107)	(0.0122)	(0.0112)	(0.0107)	(0.0135)	(0.0122)	(0.0144)
exp	0.0447 ***	0.0491 ***	0.0291 ***	0.0375 ***	0.0235 *	0.0457 ***	0.0382 ***
	(0.0095)	(0.0111)	(0.0106)	(0.0099)	(0.0122)	(0.0113)	(0.0119)
exp2	-0.0007 ***	-0.0009 ***	-0.0004 *	-0.0006 ***	-0.0003	-0.0007 ***	-0.0007 ***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Non-employment income	-0.00036 *	-0.00015	-0.00005	-0.00007	-0.00019 *	-0.00006	-0.00014 *
	(0.00021)	(0.00018)	(0.00004)	(0.00010)	(0.00011)	(0.00004)	(0.00008)
Numbers of children	-0.0335	-0.0098	0.0153	0.0007	-0.0753 **	-0.0068	-0.0050
	(0.0294)	(0.0338)	(0.0339)	(0.0329)	(0.0380)	(0.0401)	(0.0429)
Number of obs	1826	1748	1761	1854	1712	1758	1632
Censored obs	305	215	251	264	153	164	139
Uncensored obs	1521	1533	1510	1590	1559	1594	1493
Return to primary education	0.0648	0.0562	0.0186	0.0760	0.0900	0.0542	0.0626
Return to secondary education	0.1610	0.1465	0.1196	0.1574	0.1357	0.1244	0.1246
Return to higher education	0.2733	0.2532	0.2677	0.2908	0.2705	0.2404	0.2458

	1995	1996	1997	1998	1999	2000	2001
Wage equation							
cons	4.8544 **	4.2381 **	4.6114 ***	3.6886 *	4.1749 *	4.8282 ***	5.7850 ***
	(2.0347)	(2.1267)	(0.9384)	(2.0517)	(2.4691)	(0.7361)	(0.3017)
years of schooling	0.0723	0.0920	0.0658 *	0.1448	0.0736	0.0585 *	0.0376 **
	(0.0809)	(0.0930)	(0.0563)	(0.1208)	(0.1003)	(0.0330)	(0.0176)
exp	0.0514	0.0557	0.0395 **	0.0484 *	0.0468	0.0450 ***	0.0176 *
	(0.0613)	(0.0476)	(0.0189)	(0.0293)	(0.0374)	(0.0150)	(0.0094)
exp2	-0.0008	-0.0008	-0.0005	-0.0005	-0.0006	-0.0006 **	-0.0002
	(0.0009)	(0.0008)	(0.0003)	(0.0005)	(0.0005)	(0.0003)	(0.0002)
d8*(school-8)	0.0280	0.0752	0.0509	0.0430	0.0851 *	0.0619 **	0.0481 **
	(0.0579)	(0.0865)	(0.0510)	(0.0939)	(0.0466)	(0.0280)	(0.0232)
d12*(school-12)	0.1850 ***	0.1070	0.1198 ***	0.1117	0.1275 ***	0.1591 ***	0.1391 ***
	(0.0445)	(0.0669)	(0.0432)	(0.0770)	(0.0355)	(0.0212)	(0.0160)
Head of the household	0.1200	0.1487	0.1928 *	0.1930	0.3025 ***	0.1738 ***	0.2085 ***
	(0.1066)	(0.1570)	(0.1020)	(0.1743)	(0.0852)	(0.0512)	(0.0369)
Public Sectors	-0.2087	-0.0313	-0.1121	-0.1801	0.0084	-0.1351 *	-0.1183 **
	(0.1622)	(0.2621)	(0.1675)	(0.2720)	(0.1399)	(0.0781)	(0.0592)
Agriculture	-0.4489	-0.3896	0.1063	-0.2427	-0.0055	-0.2551	-0.0819
	(0.4561)	(0.7394)	(0.4250)	(0.6479)	(0.2865)	(0.1870)	(0.1703)
Mining	0.4385	0.3125	0.0870	0.0748	0.2690	0.3731	0.2231
	(0.4467)	(0.6619)	(0.4957)	(0.8503)	(0.3931)	(0.2482)	(0.1833)
NRBM	-0.1219	-0.2099	-0.0573	-0.0594	-0.0538	-0.0287	-0.1056 *
	(0.1535)	(0.2373)	(0.1469)	(0.2585)	(0.1307)	(0.0800)	(0.0592)
Non-resource based manufacturing	-0.0812	-0.0695	0.0367	-0.1074	-0.0385	-0.0853	-0.2266 ***
	(0.1456)	(0.2174)	(0.1284)	(0.2299)	(0.1228)	(0.0749)	(0.0536)
Commerce	-0.1709	-0.2347	-0.0989	-0.0968	-0.1294	-0.0999	-0.1922 ***
	(0.1441)	(0.2192)	(0.1325)	(0.2271)	(0.1228)	(0.0753)	(0.0523)
Financial services	0.1307	-0.0030	0.1307	0.0691	0.0579	0.0709	0.0083
	(0.1618)	(0.2511)	(0.1529)	(0.2484)	(0.1324)	(0.0793)	(0.0559)
Personal services	-0.2669	-0.1786	-0.1328	-0.3067	-0.3134 *	-0.3483 ***	-0.3368 ***
	(0.2203)	(0.3297)	(0.1892)	(0.3525)	(0.1706)	(0.1022)	(0.0852)
Community services	-0.3383 *	-0.3109	-0.1139	-0.1475	-0.2609 *	-0.0782	-0.1299 **
	(0.1757)	(0.2569)	(0.1607)	(0.2861)	(0.1457)	(0.0859)	(0.0642)
Transport	-0.1505	-0.1175	0.0793	-0.1048	-0.1247	0.0032	-0.1147 *
	(0.1637)	(0.2552)	(0.1502)	(0.2574)	(0.1347)	(0.0801)	(0.0592)
Inverse Mills ratio	1.7643	2.6487	1.6586	3.1335	1.5965	0.9882	0.0278
	(4.5124)	(3.7294)	(1.4521)	(2.9234)	(2.2793)	(0.7360)	(0.2949)
Participation equation							
cons	0.4641 **	0.1083	-0.0148	-0.1967	-0.6912 ***	-0.6071 ***	-0.3530 **
	(0.1996)	(0.1860)	(0.2047)	(0.1813)	(0.1550)	(0.1582)	(0.1522)
years of schooling	0.0473 ***	0.0613 ***	0.0863 ***	0.0991 ***	0.0816 ***	0.0757 ***	0.0456 ***
	(0.0134)	(0.0123)	(0.0136)	(0.0122)	(0.0101)	(0.0104)	(0.0101)
exp	0.0405 ***	0.0382 ***	0.0332 ***	0.0287 ***	0.0361 ***	0.0391 ***	0.0617 ***
	(0.0120)	(0.0109)	(0.0115)	(0.0107)	(0.0085)	(0.0083)	(0.0081)
exp2	-0.0007 ***	-0.0005 **	-0.0005 **	-0.0002	-0.0004 **	-0.0006 ***	-0.0011 ***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Non-employment income	-0.00001	-0.00004	-0.00008 **	-0.00006 *	-0.0000001	0.0000000	-0.0000008 ***
	(0.00008)	(0.00004)	(0.00004)	(0.00004)	(0.0000)	(0.0000)	(0.0000)
Numbers of children	-0.0162	0.0223	0.0282	-0.0143	0.0058	0.0629 **	-0.0095
	(0.0430)	(0.0383)	(0.0407)	(0.0362)	(0.0297)	(0.0300)	(0.0289)
Number of obs	1565	1556	1592	1861	1888	1956	2003
Censored obs	140	178	163	201	470	445	495
Uncensored obs	1425	1378	1429	1660	1418	1511	1508
Return to primary education	0.0723	0.0920	0.0858	0.1448	0.0736	0.0585	0.0376
Return to secondary education	0.1003	0.1672	0.1467	0.1878	0.1587	0.1204	0.0857
Return to higher education	0.2853	0.2741	0.2665	0.2995	0.2861	0.2795	0.2248

	2002	2003	2004	2005	2006	2007
Wage equation						
cons	4.6390 ***	4.4991 ***	4.7337 ***	4.1711 ***	5.4805 ***	5.2798 ***
	(0.5255)	(0.7738)	(0.5462)	(0.7448)	(0.3314)	(0.3808)
years of schooling	0.0683 **	0.0823 **	0.0800 ***	0.0800 *	0.0233	0.0486 **
	(0.0294)	(0.0384)	(0.0301)	(0.0428)	(0.0200)	(0.0232)
exp	0.0563 ***	0.0510 ***	0.0342 ***	0.0602 ***	0.0360 ***	0.0358 ***
	(0.0156)	(0.0188)	(0.0120)	(0.0208)	(0.0102)	(0.0109)
exp2	-0.0009 ***	-0.0007 **	-0.0004 *	-0.0008 **	-0.0005 ***	-0.0005 ***
	(0.0003)	(0.0003)	(0.0002)	(0.0003)	(0.0002)	(0.0002)
d8*(school-8)	0.0505	0.0368	0.0325	0.0474	0.0651 **	0.0472 *
	(0.0363)	(0.0389)	(0.0341)	(0.0557)	(0.0273)	(0.0265)
d12*(school-12)	0.1504 ***	0.1237 ***	0.1389 ***	0.1424 ***	0.1309 ***	0.1385 ***
	(0.0284)	(0.0284)	(0.0240)	(0.0409)	(0.0201)	(0.0175)
Head of the household	0.1512 **	0.1449 **	0.2168 ***	0.2196 **	0.2155 ***	0.2035 ***
	(0.0653)	(0.0686)	(0.0543)	(0.0918)	(0.0471)	(0.0416)
Public Sectors	0.0688	-0.0245	0.0421	0.0594	0.0751	-0.0361
	(0.1040)	(0.1149)	(0.0950)	(0.1472)	(0.0767)	(0.0718)
Agriculture	-0.2221	-0.0523	-0.1338	0.0708	-0.2856	-0.0389
	(0.2183)	(0.2318)	(0.1870)	(0.4334)	(0.2005)	(0.1665)
Mining	0.5893	0.4725	0.7902 ***	0.5859	0.0045	0.1939
	(0.3598)	(0.3266)	(0.2352)	(0.3806)	(0.2583)	(0.1868)
NRBM	-0.1347	-0.1121	-0.0712	0.0857	-0.1922 ***	-0.0824
	(0.1052)	(0.1113)	(0.0858)	(0.1577)	(0.0705)	(0.0718)
Non-resource based manufacturing	-0.1624 *	0.0135	-0.0618	0.0105	-0.0367	-0.0667
	(0.0973)	(0.1057)	(0.0804)	(0.1365)	(0.0682)	(0.0637)
Commerce	-0.1748 *	-0.0738	-0.0924	-0.0959	-0.1987 ***	-0.0955 *
	(0.0974)	(0.1025)	(0.0766)	(0.1262)	(0.0620)	(0.0539)
Financial services	-0.0248	0.0668	-0.0065	0.0799	0.0076	0.0303
	(0.1054)	(0.1084)	(0.0855)	(0.1379)	(0.0677)	(0.0624)
Personal services	-0.1680	-0.2149	-0.2960 ***	-0.1248	-0.2671 ***	-0.1254
	(0.1306)	(0.1388)	(0.1053)	(0.1771)	(0.0957)	(0.0807)
Community services	-0.1733	-0.0168	-0.0468	-0.0998	-0.2576 ***	-0.0546
	(0.1119)	(0.1182)	(0.0933)	(0.1518)	(0.0798)	(0.0667)
Transport	-0.1735	-0.0656	-0.1134	-0.0469	-0.0705	0.0693
	(0.1084)	(0.1061)	(0.0824)	(0.1402)	(0.0691)	(0.0595)
Inverse Mills ratio	1.3298 **	1.3600	1.0942 **	1.7947 **	0.8921 **	0.8083 **
	(0.5446)	(0.8379)	(0.5544)	(0.8295)	(0.4248)	(0.4046)
Participation equation						
cons	-0.3886 **	-0.4516 ***	-0.5509 ***	-0.4466 ***	0.0128	-0.5478 ***
	(0.1558)	(0.1637)	(0.1590)	(0.1652)	(0.1677)	(0.1877)
years of schooling	0.0605 ***	0.0713 ***	0.0741 ***	0.0646 ***	0.0353 ***	0.0776 ***
	(0.0104)	(0.0108)	(0.0107)	(0.0113)	(0.0112)	(0.0125)
exp	0.0525 ***	0.0471 ***	0.0414 ***	0.0492 ***	0.0495 ***	0.0655 ***
	(0.0081)	(0.0083)	(0.0080)	(0.0082)	(0.0082)	(0.0083)
exp2	-0.0009 ***	-0.0007 ***	-0.0005 ***	-0.0006 ***	-0.0007 ***	-0.0010 ***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Non-employment income	-0.0000010 ***	-0.0000008 **	-0.0000006 **	-0.0000006 ***	-0.0000009 ***	-0.0000007 ***
	(0. 0000)	(0. 0000)	(0. 0000)	(0. 0000)	(0. 0000)	(0. 0000)
Numbers of children	0.0309	0.0480	0.0565 *	0.0822 **	-0.0181	0.0247
	(0.0307)	(0.0326)	(0.0333)	(0.0365)	(0.0351)	(0.0357)
Number of obs	2037	2044	1976	1984	1942	2021
Censored obs	444	385	405	363	363	315
Uncensored obs	1593	1659	1571	1621	1579	1706
Return to primary education	0.0683	0.0823	0.0800	0.0800	0.0233	0.0486
Return to secondary education	0.1188	0.1191	0.1125	0.1274	0.0884	0.0959
Return to higher education	0.2692	0.2428	0.2514	0.2697	0.2193	0.2344

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Note: Numbers in parentheses are standard errors.

Appendix to chapter 4

Calculating industry wage premiums and industry-specific skill premiums by using Haisken-Denew and Schmidt's (1997) restricted least squares (RLS) procedures.

We consider the following regression model:

(A.1) $$y = Z\delta + X\beta + \varepsilon,$$

where y is an $n \times 1$ vector of dependent variable, Z is an $n \times g$ matrix of repressors, X is an $n \times (k+1)$ matrix containing a constant term as its first element, and k dummy variables, that is, industry indicators and interaction terms between industry indicators and high-skilled dummies in the case of industry wage premiums and industry-specific skill premium, respectively, δ and β are $g \times 1$ and $(k+1) \times 1$ vector, respectively; ε is an $n \times 1$ vector of random errors. If we include k dummy variables in this equation, it necessarily causes multicollinearity. To estimate the coefficients of k dummy variables and their exact standard errors, we impose an additional restriction. In chapter 4, the coefficients of dummy variables are expressed as deviations from a weighted average; thus, the restriction is as follows:

(A.2) $$w'\beta = 0,$$

where the weights w are captured by $w = (0, w_1 \cdots w_k)'$ and $w'i = 1$ for $i = (1, \cdots, 1)'$. w is each industry's share in total employment, and the share of the number of high-skilled workers in each industry's employment weighted by each industry's share, in the case of industry wage premiums and industry-specific skill premiums, respectively.

In order to state the first-order condition for this minimization problem, we make use of the following Lagrangian function:

(A.3) $$L = (y - Z\delta - X\beta)'(y - Z\delta - X\beta) + \lambda(w'\beta),$$

where λ is the Lagrange multiplier associated with this restriction. The first-order conditions are as follows:

(A.4) $$\frac{\partial L}{\partial \delta} = -Z'(y - Z\delta - X\beta) = 0,$$

(A.5) $$\frac{\partial L}{\partial \beta} = -X'(y - Z\delta - X\beta) + \lambda w = 0, \text{ and}$$

(A.6) $$\frac{\partial L}{\partial \lambda} = w'\beta = 0.$$

If we express equations (A.4)–(A.6) in matrix form and denote estimates as $\hat{\delta}$, $\hat{\beta}$, and $\hat{\lambda}$, respectively:

(A.7) $$\begin{pmatrix} Z'Z & Z'X & 0 \\ X'Z & X'X & w \\ 0 & w' & 0 \end{pmatrix} \begin{pmatrix} \hat{\delta} \\ \hat{\beta} \\ \hat{\lambda} \end{pmatrix} = \begin{pmatrix} Z'y \\ X'y \\ 0 \end{pmatrix}$$

(A.8) $$\begin{pmatrix} \hat{\delta} \\ \hat{\beta} \\ \hat{\lambda} \end{pmatrix} = \begin{pmatrix} Z'Z & Z'X & 0 \\ X'Z & X'X & w \\ 0 & w' & 0 \end{pmatrix}^{-1} \begin{pmatrix} Z'y \\ X'y \\ 0 \end{pmatrix}.$$

Then, we obtain equation (2) of Haisken-Denew and Schmidt (1997). If we use the following notation

(A.9) $$\begin{pmatrix} Z'Z & Z'X & 0 \\ X'Z & X'X & w \\ 0 & w' & 0 \end{pmatrix}^{-1} = \begin{pmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{pmatrix},$$

the variance-covariance matrix of $\hat{\delta}$ and $\hat{\beta}$ is given by

(A.10) $$Var\begin{pmatrix} \hat{\delta} \\ \hat{\beta} \end{pmatrix} = \sigma_{\varepsilon}^2 \begin{pmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{pmatrix}.$$

Therefore, we obtain equation (3) of Haisken-Denew and Schmidt (1997). The industry wage premiums and their standard errors and industry-specific skill premiums and their standard errors, as reported in Tables 4-5 and 4-9, respectively, are calculated by using equations (A.8) and (A.10). However, σ_{ε}^2 is an unknown parameter, and thus I estimate it from the standard error of the OLS estimate of equation (A.1), which drops *X* from one base category.

Appendix to Chapter 5

Table A-2. Comparable product sectors in Chile's input-output tables for 1986 and 1996

1986		1996	
The number of original table	Product	The number of original table	Product
11	Stones, sand and clay products	10	Other mining products
12	Other mining products		
18	Grain milled products	16	Flour milling products
		18	Bread, noodles and pastas
23	Distilled alcoholic beverages and wine	21	Distilled alcoholic beverages
		22	Wine
22	Non-alcoholic beverages and beer	23	Beer
		24	Non-alcoholic beverages
38	Glass and glass products	39	Other non-metalic mineral products
40	Other non-metallic mineral products		
41	Basic metal products	40	Basic iron and steel products
		41	Basic non-ferrous products
44	Electrical apparatus, appliances and supplies	44	Electrical machinery and equipment
46	Other professional and scientific equipment		
52	Trade services	52	Trade services
73	Repair services not elsewhere classified		
4	Agricultural services	65	Business services
65	Business services except machinery and equipment rental and leasing		
71	Motion picture and other entertainment services	72	Recreational, cultural and sporting services
72	Amusement and recreational services not elsewhere classified		

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