Increasing Returns, Technological Progress and Cumulative Causation: The Case of Chile (1986-2008)

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Abstract

The ultimate proposal of the present research is to assess productivity regime which is defined as the route from demand growth to productivity growth of the Chilean economy since 1986 to 2008. In doing so, increasing returns are assessed by industrial sector and the technological progress pattern of the Chilean economy is analyzed. Two outcomes are presented. First, from productivity regime results, the Chilean economy presents dynamic increasing returns by 0.78 and the elasticity of employment to output has decrease being today 0.22. The latter imply that the main reason of the slowdown trend of the productivity growth and output growth in the Chilean economy since the Asia crisis was not a downward shift in the productivity regime, but a leftward shift in the demand regime.

Second, despite the slowdown of utilization rate of the copper mining industry in the period 2003-2008, the TP pattern of the Chilean economy is led by investment and led by the trade sector being the prevailing Marx Biased Technical Change. The latter imply that there is a possibility that precisely the increasing trend in capital coefficient against a decreasing trend in labour coefficient would be the cause of a shift in demand regime. Demand regime is defined as the route from productivity growth to demand growth through income distribution and income expenditure. Further empirical studies should be encouraged to investigate and clarify the dynamic between both routes in Chile.

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1 Introduction

Economic growth is eminently defined by technological progress which in turn depends on three factors: capital, labour and increasing returns to scales. The interaction among them and the forces which shape each of these sources of growth could not be considered static but cumulative and dynamic. Under this context the main goal of the present study was to clarify the productivity regime by assessing dynamic increasing returns by industry and the technological progress pattern of the Chilean economy. Three main inquiry are discussed and clarified. What is the nature of increasing returns and how its coefficient has evolved?, where does the Chilean technological progress trend come from? and what is the main reason for the slowdown of the productivity and economic growth trend. To analyze and discuss the former issue, the productivity regime is assessed through the dynamics Kaldorian version of increasing returns. The technological progress is analyzed by assessing the vertical integrated labour and capital input coefficient in Leontief-Passinetti's lines. The third inquiry is the main conclusion of the above two former issues.

The paper is organized as follows. In Section 2 the Chilean case macroeconomic background is presented. Section 3 assess dynamic version of increasing returns to scale by industry. Section 4 analyses the source of technological progress in Chile. In Section 5, conclusions and final remarks are summarized.

2 The Chilean Case Macroeconomic Background

Since technological progress patterns evolution is nothing else than the interaction between output, capital and labour overtime, it become convenient to briefly explain the macroeconomic atmosphere of the period including an starting point some years previous 1986. The main reason is that most of the institutions created in the Military regime 1973-1989 are maintained until today.

2.1 Policy Change After 1982 Crisis Toward Export Promotion

If we date back to the beginning of the liberalization process in Chile, it could be argued that it was a harmful experiment, especially in the period 1973 -1981. Ffrench-davis [1982][1]labeled the Chilean case as an monetarist experiment since Chile was pioneer country in the world applying neo-liberal policies after the military coup in 1973, moving from a regime with significant protectionist policies to one with a very open economy embracing free trade reforms liberalizing current and capital account. In less than 6 years almost all trade restrictions were lifted. By June 1979 all the non-tariff barriers were eliminated and across the board 10 per cent tariffs were imposed [Ffrench-davis and Sez, 1995].

During 1982 and 1983 it was experienced the worst economic recession in Chile since 1930. The GDP shrank 15 per cent during those years and only by 1987 did GDP recover to the level which was ascribed in 1981. The depth

of the crisis was the bottom stage toward change, and a new consensus among experts did not achieve easily. According to Meller [1990] there was chaos among Chicago Boys policy makers;[2]they did not know what to do. However, the promotion of exports became the focus of policy makers by increasing import tariff and through giving export incentives to the enterprises sector. Hence the heritage current account deficit from the first 9 years of the military regime administration was reduced from 4,733 million US dollars in 1981 (25.5 per cent of GDP) to 167 million US dollars in 1988 (less than 3 per cent of GDP: In 1988 imports were reduced 50 per cent if we compare to the levels of 1981 and exports increased GDP relative participation from 19.4 per cent in 1982 to 37.3 per cent in 1988. Figure 1 shows the BoP trend of Chile.

Figure 1: BoP Evolution 1973-2008
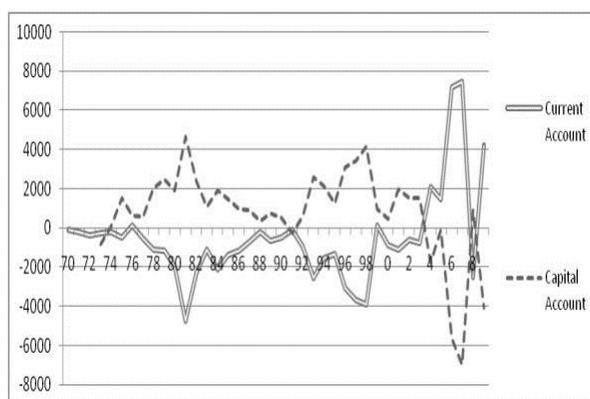
Source: Based on SNA, Chilean Central Bank

Though the current account was kept in deficit until 2003 it could be observed that the trade balance started to improve in the early 1980s. It worth to mention that the adjustment was undertaken simultaneously under the support of two International Monetary Fund (IMF) stabilization programs: in 1983-84 and 1985-87 as well as World Bank (WB) recommendations for stabilization and structural adjustment. The RER devaluation and fiscal policy restrictions were the main recipes of the period. Restrictions required by IMF and WB did not allow the Chilean government to focus on actual social problems [Meller, 1993].

2.2 Economic Boom in 1986-1997and its slowdown

The Chilean economy experienced its golden ages from 1986, the military regime finished in December 1989 and the 1990s decade can be named as the re-democratization period when the new social-democratic governments have maintained most of the institutions created by the military regime and proceeded to achieve some administrative and institutional reforms continuing with the implementation of outward orientated policies while achieving noteworthy growth

rate until the so called Asia Crisis started. The following Figure 2 shows the trend of productivity growth, economic growth and unemployment since 1986.

Figure 2: Labour productivity, GDP growth and unemployemnt evolution of the Chilean Economy
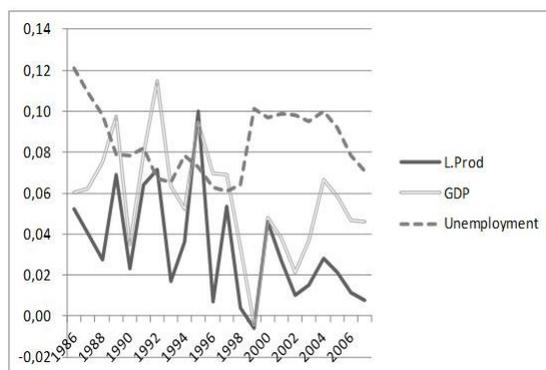
Source: Author's calculation based on ILO and SNA Central Bank of Chile. Labour productivity and GDP growth are in annual average growth from serie constructed base year 1986.

Chile has experienced economic growth at a rate by 5.1 per cent year with an annual average labour productivity growth rate by 3.2 per cent between 1985 and 2007. However, the trend has been toward slowdown both economic growth and labour productivity from an outstanding 7.0 per cent of the former and 4.5 per cent ascribed by labour productivity in the period 1985-1996 to a moderate economic growth by 3.3 per cent and a modest labour productivity by 1.6 per cent in the period 1997-2007. Is interesting to note that the period 1997-2003 which is consider highly affected by the Asia Crisis and it was, accounts for an annual average economic growth by 2.8 per cent and labour productivity growth by 1.6 per cent year being the latter the same as the trend of the whole period 1997-2007. Unemployment was kept in the vicinity of 10 per cent since Asia crisis started in 1998 until 2004. Today, unemployment still cannot reach the levels of the 1990s accounting for a rate by 8 per cent in 2008.

2.3 Economic Growth and Policy Response of the 1990s

Economic growth has been accompanied by many economic policies and institutional changes at every level. In this study, institutions regarding capital and labour become take particular relevance, that is to say, institutions with respect to investment, mainly regarding foreign investment and labour guaranties. Additionally, since it will be shown that technological progress pattern has been led by the trade sectors it worth to pay attention to some institutions regarding foreign trade.

Regarding foreign investment, the change of the composition of capital inflows towards foreign direct investment (FDI) has played an important role.

Capital inflows have been large since the 1980s; however its composition has changed considerably through time. Since the 1990s the main component of capital inflows has been FDI. The average levels of capital inflows of the first half of the 1990s in relation to GDP were marginally larger than the level of the 1960s and early 1970s where the main component was public funds. On the other hand bank lending was the main component of the late 1970s and early 1980s, in particular the period 1977-1981 ascribed an even bigger capital inflows average than the average of the 1990s [Ffrench-davis and Reisen, 1998]. Further, Agosin [1998] and Agosin [2001] have demonstrated how capital inflows have certainly been a positive factor in making possible the increase in investment in Chile. He showed how FDI has more favorable effects on investment than other kinds of capital inflows, which behave as a transitory variable. According to Ffrench-davis [2001] the great Chilean 1990s performance should be attributed to the policy response of both discouraging speculative round tripping favoring FDI and keeping a very low current account deficit, helping to prevent a Mexican style crisis (referring to the Tequila Mexican Crisis of 1995).

The macroeconomic agenda of the early 1990s was very proactive and a strong consistency was observed between macroeconomic and fiscal policy. The focus of the former was on discouraging short term capital inflows and keeping open the possibility of long-term inflows through the creation of an instrument named *encaje Chileno* (Chilean stile capital control), and through exchange rate intervention and monetary sterilization of international reserves to moderate the impact of capital inflows. Simultaneously, a very cautious fiscal policy was achieved with increment social spending financed by new tax income [Ffrench-davis, 2010]. There is no doubt that the *encaje Chileno* was an instrument with great influence on the change of capital inflows composition toward long term FDI, and it was nothing more than managing the relative cost of capital through a required reserve with no remuneration. The encaje Chileno started in June 1991 at a rate of 30 per cent, changing to 20 per cent in May 1992 until July 1995. It was applied over all kinds of foreign credit, broaden the scope to ADRs in 1995 including a credit tax of 1.2 percent, and extending the period of time from a minimum of 90 days to a deposit of one year [Agosin and Ffrench-davis, 2001].

Four stages regarding the legal framework and relevant policies related to foreign investment which led to a change within the capital inflows structure. The first stage was the DL (decree law) No 600 (1974) defined as the foreign investment statute which creates the legal framework for foreign investment embodying principles of non discriminatory and nondiscretionary treatment of foreign investors. Bank lending as the main component of investment described above could be attributed to this stage which evidently presented higher volatility and risk. The second stage began with the law No 18,657 (1987) which authorized the creation of a foreign capital investment fund. Even though the first two stages occurred during the military regime its effect toward FDI as the main component of capital inflows did not happened until the third stage took place during the early 1990s when various modifications regarding foreign investment and capital inflows were undertaken,[3]especially DFL (decree by law

force) No 523 in September 1993, in which it was fixed and re-defined the text of DL No 600.

After five years of effective capital inflows regulation, a fourth stage arose in 1996-1997 During 1996-1997 a huge wave of capital inflows arrived to Latin America and Chile was no exception. The policy response was not consistent with the reality of the impact of capital inflows at that time. After that, when the Asian crisis hit Chile in 1998 the *encaje* ratio was reduced to 10 per cent and then was kept in 0 per cent until 2001 when finally it was eliminated, changing the focus of the policy toward inflationary goals and fiscal policy determined by a surplus rule. Ffrech-davis [2010] attributes this sort of contradiction in the policy response mainly to fourth reasons: excessive self-confidence generated by the performance ascribed during the first five years of social democratic government; change in the priority of the Chilean central bank toward inflationary goals since 1995; international belief that financial crisis would no longer happened; the previous economic performance made Chile became one of the most popular destinations for foreign investors.

Regarding employment guaranties, trade unions and labour reforms there are much literature which argue that the backbone of the so call Plan Laboral of 1979 established by the military regime continues until today. Volker [2002] argues that the social democratic government goal of reforming the military regime labour legislation has been elusive. He explain in detail every reform undertaken during the three social democratic presidents since the 1990 and his main conclusion is that labour conditions has not improved as it was expected and that the labour legislation from military regime remains essentially incomplete. I would say, possible yes. Certainly, there is still much improvements to achieve yet. However, 1990-1992 reform under president Aylwin and all the attempts of reform reached during 1994-2000 under president Frei and Lagos have made evolved the prevailing previous legislation of the 1980s. The focus of the reform of 1990-1992 was on improve termination of contract, union organization structure, an collective bargaining power whilst the focus of the following attempts of reform during 1994-2000 was on bargaining power. From my point of view at least two of the changes undertaken in these regards could be considered extremely important regarding the impact thet could have on the mecanism of adjustment between capital and labour. The article 19010 of labour reform 1992-1994 which forces employer to justify dismissal and increase the unemployment compensation from 5 to 11 month and the Frei Law 19.269 in which is recognized the public employee's associations through giving them legal status.The latter was the beginning of progress toward collective bargaining power which until 1994 depends completely on the will of employers. Moreover, this law was the first step toward transitory unions which allows construction workers and miner to be protected. With the exception of trade union number 1 of CODELCO which was established during the 1930s, it was at that time when, labour mobilization in CODELCO, and not only in CODELCO but in many other enterprises at national level started to live again after 17 years of repression. Is important not to forget that CUT (Central Unica de Trabajadores), the main national union organization became legal again being allowed

to affiliate with federation and confederations. Today the collective bargaining power especially of the copper mining industry is highly recognized to be strong achieving extraordinary good conditions and stability for workers.

In regards to foreign trade, an adjustment to the previous trade reform was undertaken in 1992 and consisted of a change of trade policy and establishing of a new calculus based on an exchange money package of US Dollar-day-month-year including a duty of 5 per cent. This duty would soon change to 10 per cent then 12.5 per cent and increased up to 25 per cent. After all the increases, a new tariff reduction was obtained reaching a final average of this duty of 11 per cent in June 1993. Moreover, many integration agreements were signed: An EU agreement regarding the generalized system of preferences (GSP);[4]a free trade agreement with Canada, Mexico, Venezuela, Colombia, Bolivia and Argentina; an agreement with MERCOSUR[5]which focused on the establishing a free trade zone; a frame agreement with Central Easter Europe (CEE) and the affiliation of Chile to APEC. During the 2000s many other FTAs have also been signed;[6]nevertheless it seems to constitute an incentive to continue exporting primary products and semi-manufactured products based on natural resources.

Historically the resource-rich Chilean economy has long depended on primary product exports and even though the dominance of mining has lessened since 1973, natural resource-based products overall still account for an important portion of the total exports. After 1982 crisis, the trade trend evolutions have been led by the discovery of new export opportunities which have arisen almost entirely in the food and forestry sectors. Primary products, fresh fruit and rough wood had emerged as leading exports during the 1970s and early 1980s. These products have generated positive spillover toward diversification especially toward fishmeal, wood pulp, paper and shaped wood.[7]During the mid-1980s and 1990s new export leaders arose, in particular wine, blueberries and pork. Wine began to be exported in significant amounts since mid-1980s as did blueberries and pork in the mid-1990s.[8]Over time the trend of the trade structure did not evolve toward a more diversified trade structure including products with higher technological contents. The same opinion has been argued including different nuances by Lipsey and Meller [1997], Agosin [1999]; Ffrech-davis [2010], Agosin and Bravo [2009] and many other authors. All of them argued that the Chilean export process has been led by primary products while manufacturing has been practically absent from the Chilean process.

2.4 Income Distribution and some Insight Toward a New Consensus

To conclude this Section, the income distribution schedule evolution in Chile has been characterized by clear differences depending on the political regime. The relation between wage and profit was stable during the 1960s keeping a balanced liaison in the vicinity of 50 per cent. In President Allende period ascribed a drastic structural change reporting a high wage share by 61,7 and 62,8 per cent in 1971 and 1972.[9] After that, during Pinochet era it was a clear trend toward decrease of wage share from the above Allende figures to its

minimum historical level in 1988 with a rate by 39,9 per cent in 1988. During the 1990s and 2000s two more trends arose. The former decade trend toward rising wage share until 1999, accounting for an historical figure by 65 per cent at the moment when Chile was hit by the effect of the Asia Crisis. After that, a trend toward decrease in wage share until 2007 scoring 48,5 per cent in 2007 and changing again by the effect of the subprime crisis in 2008 accounting a share by 55,1 per cent. Ffrech-davis [2010] pointed out that today income distribution is less unequal than in the 1980s, rather similar to the 1970s, and more regressive than in the 1960s.

Figure 3: Income Indistribution and Corporate Profit Rate (1986 2003)
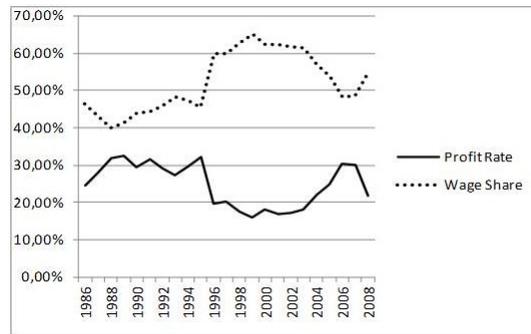
Source: Based on SNA, Chilean Central Bank

Besides, the corporate profit rate follows a cyclical trend accounting its maximum rate in 1989 by 32,5 per cent and its minimum level during recession period recording in 1999 by 15,91 per cent. If we compare period by period, the former one from 1986 to 1996 accounted an average corporate profit rate by 28,7 per cent whilst the period from 1996 to 2003 scored a 17,96 per cent in average. From 2003 to 2008 the average rate ascribed by 24,51 per cent.[10]

Today there is an increase trend toward understanding economics as embedded[11] in society implying that institutinal setting, political systems and legal structures matter to promote growth and eventualy development. If we comprenhend the economy as a complex system of rules macro, meso and micro levels are certently interconected [Dofter and Potts, 2004]. Thus, Sectoral organic compostions between capital inputs and employment could affect income distribution [Foley and Michl, 1999].

The following Table 1 shows the trend at macro levels of relevant variables regarding capital and labour. The speed of popolution and total employment increment has been marginally decreasing overtime whilst capital stock ascribes a marginally increase trend through time.

Recently social discontent has arisen not only regarding income distribution problems but education, lack of innovation, excessive of energy and resource using economic structure among other problems which have called to adjust the political system and to change the constitution instituted in 1981 under

Pinochet era. These forces toward adaptation, more than a problem could be understood as an opportunity to react according to society evolution.

The following section explains the nature of increasing returns and its relevance to understand determinant factor within the capital accumulation process.

3 Increasing Returns (IR) Assessment

3.1 IR Methodology

Verdoorn [1949] and Kaldor [1966] (Hereafter K-V) refer to IR through the statistical relationship between the long-run rate of growth of labour productivity and the rate of growth of output. This liaison is largely interpreted as being of a technological nature, hence it reflect the existence of both static and dynamic economies of scale and increasing returns [McCombie and Soro, 2001]. The difference between both is that the former indicates the presence of constant returns to scale only while the dynamic form, by using growth rates, yields to estimate increasing returns to scale. As K-V suggest, the productivity growth is likely to respond to output growth as follows.

$$g_p = a + bg_y \tag{1}$$

In Equation 1 g_p is the rate of labour productivity growth and g_y is the corresponding rate of output growth. The parameter a stands for an autonomous exogenous technical progress and b represents the size of return to scale. By definition, output is nothing else than labour productivity multiply by employment. By taking logs and deriving in both sides the productivity growth could be written as in equation 2.

$$g_p = g_y - g_n \tag{2}$$

This definition only tells us that the productivity growth is equal to the growth of the output discounting the growth of the respective labour, then g_n is the corresponding rate of growth of employment. From 1 into 2, it is obtained a similar relation for K-V law considering as relevant variables output and employment in equation 3.

Table 1: Capital and labour growth rate by period

	1986-1996	1996-2003	2003-2008	1986-2008
Population	0.76	0.52	0.43	0.59
Employment	3.58	1.82	1.37	2.52
Real wage	5.99	1.99	5.40	4.58
Capital Stock	7.05	6.93	8.38	7.31

Source: Author's calculations. Capital Stock based on Statistic Economic Studies NUM 63, Chilean Central Bank. Population and employment based on CASEN survey- MIDEPLAN. The latter includes from year 1987 to 2009

$$g_n = -a + (1-b)g_y \qquad (3)$$

Equations 1 and 3 constitute the basis to analyze IR. Equation 3 provides the background to relate the size of increasing returns to variations in employment level through the elasticity of employment to output. The remaining of this Section constitutes and attempt to assess IR by industry in the Chilean economy.

3.2 Kaldor-Verdoorn Coefficient Assestment by Industry

The dynamic form of K-V law is assessed by utilizing time series growth rates of both labour productivity and GDP by industrial sector of the Chilean economy in the period 1985-2007. Employment data is represented by the International Labour Organization and GDP is provided by the system of national accounts of the Chilean central bank.

As mentioned in the introduction, there is a lack of non orthodox research in the Chilean economy and most of the studies in economic growth and productivity growth are based on neoclassical production function which leaves total factor productivity as an exogenous factor. The slowdown of the trend of productivity growth of the Chilean economy showed in Figure 2 could not be explained by exogenous factors, but is determined by endogenous reasons.

The following Table 2 displays the results of IR the analyses. a represents the exogenous technical change and b represents the size of increasing returns.

Table 2: Results of IR Analyses by Industry 1985-2007

	a_1	b_1	R_1^2	a_2	b_2	R_2^2	a_3	b_3	R_3^2
Agriculture	0.0033	0.9093	0.504	0.0026	0.9699	0.6019	0.0035	0.9245	0.5784
Mining	0.0182	0.7239	0.261	-0.0291	1.7156	0.746	-0.0058	1.1535	0.472
Manufacturing	N.S	N.S	N.S	0.0149	0.5039	0.2284	N.S	N.S	N.S
Energy	-0.0209	0.9049	0.308	0.0125	1.2455	0.4309	-0.0062	1.0063	0.3498
Construction	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
Commerce	0.0003	0.7138	0.4216	-0.012	0.5834	0.4955	-0.0133	0.7801	0.5853
Trans and Comm	-0.0022	0.534	0.2703	-0.016	0.7989	0.2081	-0.0035	0.5728	0.2433
Finance	-0.0651	0.9013	0.1934	N.S	N.S	N.S	-0.029	0.5463	0.14
P.Adm and P.Serv	0.0742	-1.4505	0.2262	-0.0371	1.4199	0.4584	N.S	N.S	N.S
Whole Economy	0.0473	0.558	0.467	0.0249	0.8542	0.5315	0.0316	0.7837	0.6085

Source: Author's calculation based on ILO and SNA Chilean Central Bank. 1:1985-1996; 2:1997-2007; 3:1985-2007; N.S: Cases with R^2 less than 0.1

Results shows that the whole economy presents dynamic increasing returns to scale by 0.7837 considering the whole period of study between years 1985 and 2007. The Chilean economy has shifted its economic structure through its K-V coefficient. The former period 1985-1996 was governed by dynamic increasing returns by 0.558 changing to a coefficient by 0.8542. The influence of output growth on productivity growth has increase in almost 50 per cent.

The autonomous component of productivity growth accounts for 3.1 per cent. It was 4.73 per cent in the first period and 2.49 per cent in the second

period. The Chilean assessed K-V coefficient indicates that increase in 1 per cent of output affect positively to productivity growth by 0.7837. Moreover, base on equation 3, the employment elasticity to output of the Chilean economy is by 0.2163 which means nothing else than each percentage in addition to the growth of output requires a 0.22 per cent increase in the growth of employment. These outcome evidences two facts. First, the Chilean economy moved to high dynamic increasing returns. Second, the exogenous component contribution to productivity growth decreased. The both latter conclusion together imply that the dynamic of productivity growth became endogenous in Chile. That is to say depends greatly on domestic factors such as industrial structure, learning by doing, education and so on which in turn depend on institutional setting such as constitutions, political system and laws.

Today is consistent to say that there is an increasing trend toward awareness of how institutions matter. Institutional settings influence IR dynamics by dealing with the process of adjustment between labour and capital. Uni [2000] analyzes the period 1976-1996 and he found a K-V coefficient by 0.588 for Japan and 0.176 for USA in the manufacturing sector of both countries. The main reason for this gap is the differences between both countries institutional settings regarding employment adjustment. Because the degree of employment security is higher in Japan, the K-V coefficient is larger than in USA. When the amount of employment is elastic to the amount of output, fluctuation in productivity growth is small. Uni [2009a] found an increase in the K-V coefficient of The USA machinery manufacturing sector in the 1990s. According to Uni [2009a] the reason for this is as follows. The increase of employment in the boom period in the 1990s was slow and on a small scale. This is the result of the downsizing boom or the restructuring boom that began in the latter half of the 1980s. As a result, USA enterprises aimed to concentrate on core competence and advanced outsourcing (disposal of non-core businesses). Moreover, they employed IT technology, thereby reducing the number of middle-ranking managerial posts and white-collar workers. In addition, they introduced Japanese techniques such as team production, quality control circles and job rotations.

As explained in Section 2, the article 19010 of labour reform 1992-1994 which forces employer to justify dismissal and increase the unemployment compensation from 5 to 11 month and the Frei Law 19.269 in which is recognized the public employee's associations through giving them legal status were the base toward better employment conditions. However the elasticity of employment to output decrease because of similar reasons to USA.

At industrial level, except for the commerce industry, all sector have presented improvements of IR coefficient. The mining sector, the energy sector sector and transport and communication sector have increased greatly its dynamic contribution to productivity growth. After 1982 economic crisis there was a shift in policy response toward encourages export. Since the economy recovered by 1985-86, the main trade sector has been mining sector, which is supported by energy sector and transport sector.

By the contrary sectors related to non trade worsened its K-V coefficient. The commerce sector decreased its dynamic increasing returns from a strong

value by 0.71 to 0.58.

Based on the estimated results of the whole economy in Table 2 the following Figure 4 shows graphically the above explained shift of productivity regime in Chile.

Figure 4: Growth Regime in Chile

Figure . Growth Regime in Chile
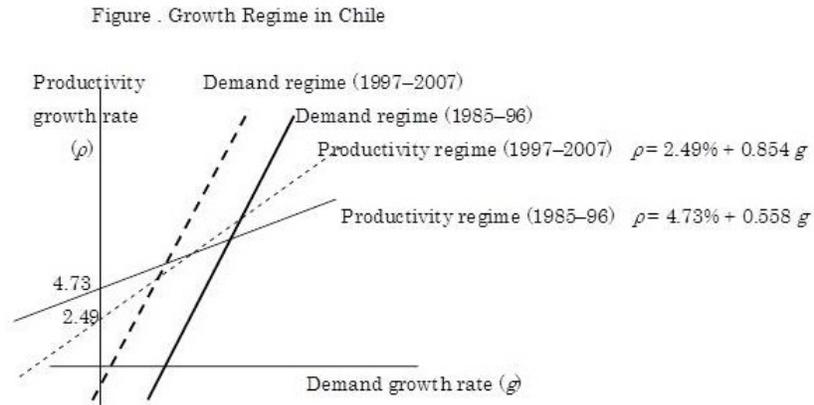
Source: From Table 2

The cause for economic slowdown since Asia crisis started is not a downward shift in the productivity regime, but a leftward shift in the demand regime. Since the productivity regime shifted upwards, it was supposed to accelerate the real economic growth, if the position of the demand regime did not change. However, demand regime shifted causing slowdown of economic growth and changing the economic structure of Chile. The position of demand regime in Figure 4 is anticipated one.

The dynamic of increasing returns would allow to the endogenous productivity growth interact as a force which shape the relation between capital and labour in a cumulative causation dynamic toward a virtuous cycle, if and only if, as the market expands, productivity increases, but the increase in productivity resulting from a larger market in turn enlarges the market for other goods, and this causes productivity in other industries to rise too. Dynamic increasing returns is a necessary condition but not sufficient to achieve cumulative causation toward virtuous cycle. Especial attention should be given to micro and macro institutional settings which shape the trade off between employment and capital. The former is leading by organizations namely enterprises and trade unions. The latter is the commitment of the state and the social compromise to take part of the diary interaction at micro level. The larger the state ensure the appropriate conditions to a partial interaction between different agents, the

larger the enterprises advantage of these conditions could catch by giving opportunity to its employees of working and developing themselves at the same time. That is to say through appropriate enterprises internal structure, the above explained dynamic of increasing returns becomes a reality shaping an economy toward coherence development.

The above paragraph is nothing else than an ordinary background attempting to provide some insight toward understanding determinant of demand regime. The cumulative causation dynamic between structural change and capital accumulation comprehend both demand regime and productivity regime. This research clarifies the dynamics of productivity regime which is the route from demand growth to productivity growth. Demand regime is defined as the route from productivity growth to demand growth through income distribution and income expenditure. Further empirical studies should be encouraged to investigate and clarify the dynamic between both routes in Chile.

4 Technological Progress (TP) Analyses

This Section seeks to analyze the patterns of TP of the Chilean economy. In doing so, direct labour and capital coefficient analyses and vertical integrated (VI) labour and capital coefficient analyses is taking into account. The former is the amount of labor and capital directly necessary to produce one unit of output of each industry. The latter is the amount of labor and capital that is directly and indirectly necessary to produce one unit of final demand of commodity.

Direct coefficient analyses provides a macro view of an economy in the sense of how the direct interaction between labour, capital and output evolves overtime. VI makes possible to capture spillover effects of labour and capital productivity in one industry on another. This, in turn, provides a linkage among industrial sector over time assuming that TP is reflected by the rate of growth of labour productivity which is demand determined and hence endogenous to the growth process. In simple terms, if production exhibit increasing return to scale, the average productivity would rise as a result of the deepening of the division of labour due to expansion of the market [[Young, 1928]; Verdoorn [1949]; Kaldor [1966]].

The remaining of this Section constitutes an attempt to assess the TP pattern of the Chilean economy.

4.1 Direct Labour and Capital Coefficient Analyses

By using Input Output Tables (IOT) of the Chilean economy and employment disaggregate data provided by CASEN survey of the Chilean Minister of Development, direct labour and capital coefficient by industry was measured. By defining direct capital and labour coefficient as the direct necessary capital and labour to produce one unit peso of GDP, both capital and labour coefficient became determined by K_i^t/GDP_i^t and L_i^t/GDP_i^t. K_i^t and L_i^t account for capital stock of the i industry in the period t whilst GDP_i^t represents the total GDP of

the i industry in period t. To obtain capital and labour coefficient in physical unit industrial deflactor coefficient were derived from the System of National Account. Three period were analysed between the years 1986, 1996, 2003 and 2008. The number of industries are defined to be 73 for years 1986, 1996 and 2003 while for the year 2008 the IOT are constituted by 111 industries.

To calculate capital coefficient, the capital stock by industry is required and literature in Chile on this subject is narrow compared to the rest of the world. Henriquez (2008) was selected among various studies as a base to calculate the capital stock by industrial sector. The total capital stock series are available from year 1985 to 2008 and from year 1996 by industrial sector considering the nine principal sectors of the economy.[12] Since the structure of capital stock varies depending on its depreciation, I calculate a weighted average depreciation vector by assuming that the national investment constitutes a representative indicator of the real depreciation of the country.

The following table 3 presents the results of direct capital and labour coefficient.

Table 3: Direct Labour and Capital Coefficient in Annual Average Growth Rate by Period

	X_a	K/X_a	L/X_a	X_b	K/X_b	L/X_b	X_c	K/X_c	L/X_c	X_d	K/X_d	L/X_d
Agriculture	4.05	-0.44	-3.89	2.81	1.43	-3.02	7.41	-2.69	8.22	3.07	0.99	0.49
Mining	3.99	6.87	-4.07	5.19	3.38	-6.91	-3.45	12.64	15.03	6.60	3.16	-4.55
Manufacturing	2.90	1.35	-1.63	0.52	4.94	-0.32	0.96	6.73	-7.49	2.28	3.14	-3.12
Energy	4.89	2.86	-2.98	2.83	3.45	-3.64	-9.28	15.91	18.82	4.55	2.48	-1.77
Construction	11.55	-12.86	-7.33	-0.66	1.52	2.01	5.85	2.02	-5.04	7.36	-5.90	-4.38
Commerce	6.36	0.42	-2.20	3.30	7.43	-0.76	9.27	-4.0	-9.90	5.16	2.54	-2.60
Trans and Comm	8.04	4.22	-4.62	10.00	-1.19	-6.99	6.18	8.65	-8.73	6.97	4.77	-5.04
FIRE	9.94	-0.47	-4.12	5.58	2.46	-2.94	10.58	3.46	-17.43	8.49	1.56	-6.56
P.Adm and P.Serv	8.34	-0.96	-1.03	1.98	4.26	1.09	4.37	1.49	-6.62	7.22	-0.55	-3.43
Total Economy	7.00	0.05	-3.42	3.55	3.38	-1.73	4.83	3.35	-3.46	6.07	1.24	-3.55

Source: Author's calculation based on IOT and CASEN Survey- MIDEPLAN. X: Real GDP
a:1986-1996; b:1996-2003; c:2003-2008; d:1986-2008

Table 3 shows the annual average growth rate of GDP in real terms, capital coefficient and labour coeffcient by industry. The Chilean economy presents a MBTC pattern since 1986. The pattern has been lead by the mining, the manufacturing and transport and the communication sectors. It is quite natural consequence in industrialization process.

In the case of agriculture, both employment and GDP increase were huge accounted by 15.6 per cent and 7.41 per cent respectively, however the amount of increase in employment was bigger compared to the increase in GDP causing a negative labour productivity. By contrary to the mining sector, though presents increase in total employment by 11.58 per cent year, the GDP decrease in real terms by -3.45 per cent causing the performance above mentioned. In the same period the tertiary sector accounted a huge decrease in labour coefficient. This could be attributed to an increase in labour productivity in each of the tertiary sectors.

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4.2 Vertical Integrated Labour and Capital Input Coefficient Analyses

Leontief [1966] framework of in Pasinetti's lines is utilized in this Section providing the background to measure TP considering the whole technical economic structure of a country.

Based on Leontief and introducing the Pasinetti's concept of vertical labour and capital input coefficients, the necessary direct labour and capital input to produce one unit of final demand product are defined as $L^t = (l_1^t, .., l_n^l)$ and $K^t = (k_1^t, .. k_n^t)$ respectively. With the identity matrix (I_n) and the technical structure of the Chilean economy (A^t), the vertically integrated labour and capital input coefficients $V_{L_i}^t = L^t(I_n - A^t)^{-1}$ and $V_{K_i}^t = K^t(I_n - A^t)^{-1}$ for sector $i = 1, .., n$ at year t are obtained. Both expressions represent the integrated labour and capital required to produce one physical unit of each commodity as final demand.

Using these coefficients, the annual average labour and capital productivity growth rate are defined as the annual decreasing rate of the vertically integrated labour and capital coefficients.

Following Uni [1995], the previously defined $V_{L_i}^t$ and $V_{K_i}^t$ can be re-written as $V_{L_i}^t X^t = V_{L_i}^t(M^t + O^t) = L^t$ and $V_{K_i}^t X^t = V_{K_i}^t(M^t + O^t) = K^t$. Column vector M^t and O^t denoted as $\sum M_i^t$ and $\sum O_i^t$, are the total domestic final demand and export demand respectively.

By defining the share of each commodity within the domestic final demand and export demand as the column vectors mn and o, M^t and O^t can be re-written as $M^t = mn \sum M_i^t$ and $O^t = o \sum O_i^t$. Then, it becomes possible to decompose the labour and capital productivity growth rates in both categories as follows:

$$V_{L_i}^t(mn \sum M_i^t + o \sum O_i^t) = V_{L_i}^t mn \sum M_i^t + V_{L_i}^t o \sum O_i^t \quad (4)$$

$$V_{K_i}^t(mn \sum M_i^t + o \sum O_i^t) = V_{K_i}^t mn \sum M_i^t + V_{K_i}^t o \sum O_i^t \quad (5)$$

Within expression 4 and 5, $V_{L_i}^t mn, V_{L_i}^t o, V_{K_i}^t mn$ and $V_{K_i}^t o$ are scalars representing the quantity of integrated labour and capital necessary to obtain one nominal unit of domestic final demand and that of export demand. By multiplying these quantities by its respective deflactors, the rate of decrease of these coefficients is obtained. This final result is defined as the vertical integrated labour and capital productivity growth rates of both categories. Explanation of the other categories decomposition are homologous to this method.

Table 4 shows the results of vertical integrated analyses. The first decomposition was calculated by demand factors: consumption, investment and export. From the results the **first stylized fact** is as follows: Both labour productivity increase and capital productivity increase have been led by investment.

In the long-run investment ascribes 6.93 per cent of labour productivity and 2.12 per cent of capital productivity annualy in whole period. These results could be attributed to the following institutional backgrounds. The social democratic government had a very proactive role between 1990 and 1995 in managing capital inflows [Agosin and Ffrench-davis, 2001], ascribing an increase in investment which is attributed to the change in the composition of capital in-

flows toward FDI [Agosin, 1998]. As FDI embodieds new technology, it brought about labour and capital productivity increase.

The second decomposition was calculated by the trade and non-trade sectors. From results of the second decomposition, the **second stylized fact** arises as follows: The leading source of TP pattern in Chile has shifted from trade sector to non trade sector since 2003. The trade sector led the TP from 1986 to 2003. However, by ascribing a negative annual average labour productivity in the period 2003-2008 by -5.73 per cent, the TP trend shifted to the non trade sector which accounts for a huge labour productivity by 10.91 per cent year in the period 2003-2008. As shown in the following Figure 5, this decline was caused by the evolution of the mining industry.

Figure 5: Labour productivity (PR) and GDP growth rates evolution of the mining sector
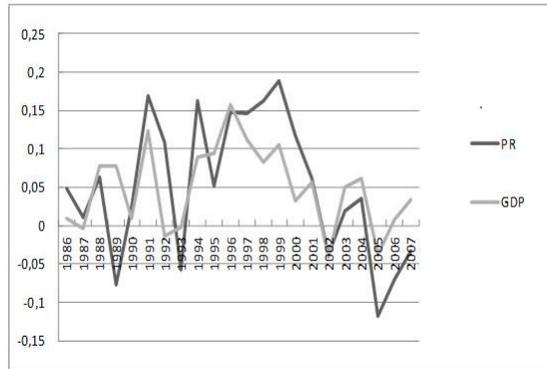
Source: Author's calculation based ILO and SNA Central Bank of Chile

The mining sector particularly the copper mining industry represents the 20 per cent of the whole country's exports. As shown in the increasing returns Section, the K-V coefficient of the mining industry greatly increased. Its K-V coefficient by 1.7 in the period 2003-2008 implies as follows: variations in output growth by 1 per cent triggers 1.7 per cent of change in labour productivity in the same direction of the change of output. Moreover, each percentage addition to the growth of output requires a decrease in labour by 0.71 per cent. The

Table 4: TP pattern decomposition using VI analyses

	1986-1996	1996-2003	2003-2008	1986-2008
Consumption	1.97/0.33	1.99/-2.08	8.44/-0.84	3.45/-0.70
Investmnet	**7.90/5.77**	**2.10/-0.74**	**11.75/-1.18**	**6.93/2.12**
Export	6.25/-0.91	2.05/-3.52	-5.73/-3.64	2.19/-2.36
Trade	**6.25/-0.91**	**2.05/-3.52**	-5.73/-3.64	2.19/-2.36
No-Trade	3.69/1.98	1.96/-2.02	**9.39**/-0.31	4.43/0.18

Source: IOT-SNA Chilean Central Bank and CASEN Survey-MIDEPLAN

negative labour and capital productivity of the mining industry in the period 2003-2008 was mainly caused by stagnation of production whilst capital stock and employment increase. Based on Jogmec reports 2007, 2008 and 2009, the reason for stagnation in production of the Chilean mining industry from 2003 could be attributed to three main aspects: labour disputes for wage rise based on high price of copper, quality-down of ores and shortage of electric power. The latter imply that the change in TP pattern in stylized fact number two could not be attributing to technological progress but decrease in utilization rate. The **third stylized fact** arises as follows: Despite the utilization rate slowdown of the period 2003-2008, the TP pattern of the Chilean economy is led by the trade sector in particular the copper mining sector. This pattern is led by investment and is defined by increase in capital coefficient against decreasing labour coefficient. As described above, this pattern is called Marx Bias Technical Change (MBTC).

Under MBTC pattern the economy never reach and steady state. Moreover, there is a possibility that profit rate of the economy tend to fall and consequently the rate of capital accumulation also fall. This possibility depends on labour guaranties as shown in equation. Under certain structural conditions, and in the absence of offsetting rises in the profit share, through increase capital coefficient, that is to say, by decreasing capital productivity and increasing labour productivity, the profit rate must fall [Foley and Michl, 1999]

As explained in Section 3, the dynamic of increasing returns in Chile moved to high dynamic increasing returns, the elasticity of employment to output decrease and the exogenous component of technical change decreased as well, the dynamic of economic growth in Chile became endogenous. The latter imply that today the Chilean economic structure is demand determined and the economic growth is wage led. As shown in Table 1 real wages has increase in the long run at a rate by 4.6 per cent year. Giving an especial attention to the wage-labour nexus between productivity growth and real wage growth, the speed of increase in wage is 1.03 per cent faster than the rate of increase in labour productivity.

5   Final Remarks and Conclussions

The present research attempted to clarify the productivity regime of the Chilean economy by investigating dynamic increasing returns and the technological progress patterns of the period 1986-2008. Productivity regime is defined as the route from demand growth to productivity growth. Firstly, Results of increasing returns are summarized as follows: The Chilean economy presents dynamic increasing returns to scale by 0.7837 considering the whole period of study between years 1985 and 2007. Its economic structure has shifted through its K-V coefficient. The former period 1985-1996 was governed by dynamic increasing returns by 0.558 changing to a coefficient by 0.8542. The influence of output growth on productivity growth has increase in almost 50 per cent and the autonomous component of productivity growth shifted from 4.73 per cent in the first period to 2.49 per cent in the second period. The two latter outcomes indi-

cate that increase in 1 per cent of output affect positively to productivity growth by 0.7837. Moreover, the employment elasticity to output of the Chilean economy is by 0.2163 which means nothing else than each percentage in addition to the growth of output requires a 0.22 per cent increase in the growth of employment. These outcome evidences two facts. First, the Chilean economy moved to high dynamic increasing returns. Second, the exogenous component contribution to productivity growth decreased. The both latter conclusion together imply that the dynamic of productivity growth became endogenous in Chile. The cause for economic slowdown since Asia crisis was not a downward shift in the productivity regime, but a leftward shift in the demand regime. Since the productivity regime shifted upwards, it was supposed to accelerate the real economic growth, if the position of the demand regime did not change. However, demand regime shifted causing slowdown of economic growth and changing the economic structure of Chile.

Secondly, from results of technological progress pattern analyses it could be concluded that despite the slowdown of utilization rate of the copper mining industry in the period 2003-2008, the technological progress pattern of the Chilean economy is led by investment and led by the trade sector being Marx Biased Technical Change the prevailing pattern. The latter imply that there is precisely the increasing trend in capital coefficient against a decreasing trend in labour coefficient a reason which could induce demand regime to shift. This research clarifies the dynamics of productivity regime. Demand regime is defined as the route from productivity growth to demand growth through income distribution and income expenditure. Further empirical studies should be encouraged to investigate and clarify the dynamic between both routes in Chile.

Notes

[1] Experiment because Chile was the first country in the world to apply such radical neoliberal economic policies. He argued that the balance of the period 1973-1981 was definitely negative: deficient production and significant increase and decrease of concentration and investment respectively.

[2] The Chicago Boys were a group of about 25 young Chilean economists who trained at the University of Chicago under Milton Friedman and Arnold Harberger, occupying important public working places during the military regime.

[3] Other important modifications related to DL600 (1974) were Law 19301(Mar-1994) relative to capital market, D291 (Ap-1994) relative to protection of foreign investment, D146 (AGO-1994) and D152 (AGO-1994) relative to CODELCO among others.

[4] The GSP is a trade arrangement through which the EU provides preferential access to the EU markets to 176 developing countries and territories, in the form of reduced tariffs for their goods when entering the EU market.

[5] Regional trade agreement among Argentina, Brazil, Paraguay and Uruguay founded in 1991.

[6] Including South Korea, China, Japan, USA, Central America, EFTA, Canada, Australia and Mxico among others.

[7] Fruit and vegetables, fishmeal, other ocean products, cultivated salmon, poultry and milk products are some of the product which have a relative high importance, however note that their participation is less than 1.5 per cent to the total export. It worth to mentioning that the two biggest Chilean forestry companies, CMPC and Arauco Forestry, are the second and fourth largest companies in the world respectively.

[8]Wine and pork exported 10 and 6 million of US dollars in its beginning of this new category exceeding 1 billion 300 millions of US dollars by 2008 while blueberries have increased its participation from zero in 1992 to 100 millions of US dollars by 2008.

[9]Author's calculation based on SNA an Chilean Central Bank response of requirement 13,097

[10]This research do not consider year 2009, year in which subprime crisis hit the Chilean economy harder than in 2008

[11]The term embeddedness refers to Polanyi [1944] idea that the economy is not autonomous, but suborninated to politics, religion and social relations.

[12]Herriquez(2008) is the Statistic Economic Research number 63 of the Chilean Central Bank. Harberger methodology and the Perpetual Inventory Method (PIM) are utlilized in Henriquez research

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