Prospects for Chile-Korea relations: a turning point for economic integration?

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Abstract: This paper focuses on the effects trade liberalization in Latin America and East Asia taking into account the recent Free-Trade Agreement signed in 2003 between Chile and Korea as a case study. Korea has experienced a history of success dealing with Asian Regionalism on trade in terms of ASEAN countries but the efforts towards Latin America are still uncertain. On the other hand, Chile is often called one of the most opened economies in the world and has been benefited from a well developed social and economic system and since 1996 has started several trade agreements with countries around the five continents, this aggressive approach is due to its reliable political stability and solid economic structure based on copper and other manufactures. The two countries are divided not only by geographic distance, but a disparity in economics, politics, culture and history. The paper first introduces a literature review analyzing the economic development paths of Chile and Korea for a sustainable growth route. Analyzing the economic consequences of Korea-Chile FTA after six years of implementation with structural breaks methodology, a mainstream econometric tool, we can infer that the FTA has indeed changed the flow of trade, with different valence among export and import goods. A Korean expansion in the region given these results shall follow a very asymmetric strategy.

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1. Introduction

1.1. The Quest for Economic Integration

The aim of this project is to analyze whether or not the rising of trade liberalization in Latin America and East Asia has lead to an effectively new economic architecture. The recent Free-Trade Agreement signed in 2003 between Chile and Korea will serve as a case study to provide more insights for a broader economic integration in the near future. Korea has experienced a history of success dealing with Asian Regionalism on trade in terms of ASEAN countries. The steady growth and deep integration of East Asia was due to three major waves of trade and industrial transformation. It first started with Japan, then with the so called Newly Industrialized Economies – NIE´s and more recently China. Korea, although has emerged from a differentiated member of NIE´s and its presence in Latin America dates back a century ago and after the trade liberalization period in the region many Korean Chaebols had successfully settled their operations even without solid economic agreements. Until this first initiative of economic integration most of the trade policies followed the general rules of World Trade Organization-WTO, but after the emergence of China as global international trade partner, Korea had to galvanize its relationship with Latin America in order to take advantage of the previous trade experience. On the other hand, Chile is often called one of the most opened economies in the world and has been benefited from a well developed social and economic system. And since 1996 has started several trade agreements with countries around the five continents, this aggressive approach is due to its reliable political stability and solid economic structure based on copper and other manufactures. We first start analyzing the economic development paths of Chile and Korea given attention to how both governments implemented crucial reforms that provided the roots for a sustainable growth route. In section 2 we then analyze the architecture of Korea-Chile FTA after six years of implementation. The following section focus attention on the dataset and the econometric tools applied to detect the presence of structural shifts. In section 5 we discuss the main empirical results adding evidence from both aggregated and disaggregated sources. Section 6 ends the paper.
1.2 Case of Analysis: Chile-Korean Relations

Several papers both in structural change and international trade literature have dealt with the fact that if the membership to an international organization such as WTO in Rose (2004) or GATT as shown in Abu-Bader and Abu-Qarn (2008) and the globalization process itself in Ben-David and Papell (1998) can lead to an increase in the trade flow. These wider agreements have proved not effective for all members while some bilateral agreements could be more effective as suggest by Jayanthakumaran and Pahlavani (2006). So we decided to test a change in the parameters (at least one) for a Free Trade Agreements, thereafter FTA’s, based on our case study. Determination of the structural breaks suggests a turning point for each trading equation that is useful in a comparative analysis of trade behavior after a process of economic integration.

To analyze structural breaks and economic integration, we take the case of Chile and Korea as microcosm for Latin American and East Asia. The South American country which is worldwide recognized as one of the most stable and opened economies in the region and for being able to sign FTAs, with different countries of any kind: developed or underdeveloped ones. Chile main aim at finalizing this FTA is to maximize the welfare of consumers and net gains of producers. (Wehner, 2009). Their main export resource, the copper ore and its derivates, is a very demanding industrial input worldwide and hence a strategic product for every manufactured oriented economy as Korea. We might also note the Chilean efforts to diversify its export products in the sense of forestry products and agricultural varieties.

On the other side of the Pacific Ocean, Korea is an export-driven economy and very competitive not only among ASEAN but also under WTO standards. The Korean economic structure based heavy-industry, automotive and electronics demands needs to search for markets but it intrinsic political institutions may want to protect their agricultural and other potential substitutes from Chilean competition as stated in (Yu, 2006). Hence an evaluation of the FTA knowing a priori this “stress” on commercial disputes might to very interesting results.
1.2 The Free Trade Agreement Ratification Process

Chile and Korea first announced their intent to negotiate a free trade agreement at the APEC leaders meeting held in Auckland, New Zealand in 1999. They held six rounds of intense negotiations and frequent technical meetings. The last round of negotiations took place in Geneva on October 17 - 21, 2002. The agreement was signed on 15 February 2003. The Chilean Senate and the South Korean Parliament approved the agreement on 22 January 2004 and 16 February 2004, respectively. After the Parties exchanged written notifications certifying the completion of the required legal procedures, the agreement entered into force on 1 April 2004. We will save these dates and reported back on the empirical results section. We can take an eye inspection on the trade flow series:

**Graphic 1 - Quarterly Trade Flow Chile and Korea**
2. Data

We test for structural breaks in quarterly nominal merchandise imports (CIF) from FTA members and in the nominal merchandise exports (FOB) to FTA members in nominal exports to the world. The data is classified as follows:

#QXCK - Quarterly Exports from Chile to Korea (FOB)

#QXKC - Quarterly Exports from Korea to Chile (FOB)

#QICK - Quarterly Imports Chile from Korea (CIF)

#QIKC - Quarterly Imports Korea from Chile (CIF)

Data for nominal merchandise imports and merchandise exports were obtained from the IMF Directorate of Trade Statistics (DOTS). For each country, trade (imports or exports) with FTA members at a specific quarter was calculated as the sum of the country's trade with FTA members for that year. Our sample covers Chile and Korea over the period 1980-2008 or 120 observations. A monthly data was also tested but not reported to its low efficiency gain. One additional topic on section 5 reports data from United Nations COMTRADE statistics with a disaggregated data by product. Other sources were also taken into account throughout this paper such as KOTRA and PROCHILE statistics.

3. Methodology

3.1 Structural breaks at a glance

A structural break is a statement about parameters, which only have meaning in the context of a model. According to Hansen (2001) the assumption of stationarity implies that parameters are constant over time. We say that a structural break has occurred if at least one of these parameters has changed at some date. It may affect any or all of the model parameters. The econometrics of structural change looks for systematic methods to identify structural breaks. The classical test for structural breaks is the Chow test, which requires splitting the sample into two subperiods and estimating the parameter for each of these subperiods and then testing the equality of the two sets of parameters by using a
classic F statistic. However, a limitation of this test is that the break date must be known a priori. This may lead to reach different conclusion by different people analyzing the same data. This point makes the Chow test a quite weak method to estimate structural breaks, that’s why the methods we apply in this paper are OLS-CUSUM, OLS-MOSUM, ME and fluctuations, which may detect the years of the test with an unknowing date following Ploberger-Kramer-Kontrus (1989). Notwithstanding even though we relax the “a priori” constraint we also proceed an unknowing data endogenously using Zivot-Andrews test for one single break on the intercept, trend or both. This is to increase the robustness of our econometrics exercise. For the recursive class tests we follow an AR (1) series of trade flows as basic model, see section 3.2.

3.2 Basic Model:

The quest for model stability: model stability is necessary for prediction and econometric inference. Because a parametric econometric model is completely described by its parameters, model stability is therefore equivalent to parameter stability.

Model instability may be caused simply by the omission of an important variable, or due to some kind of “regime shift”, see Hansen (1992). Let us consider the following linear regression model:

\[ y_i = x_i \beta_i + \mu_i \quad (i = 1, \ldots, n) \]

We will test the null hypothesis for “no structural change”:

\[ H_0 = \beta_i = \beta_0 \quad (i = 1, \ldots, n) \]

Regressors are non-stochastic: \[ \| x_i \| = O(1) \]

\[
\frac{1}{n} \sum_{i=1}^{n} x_i x_i \to Q
\]
For some finite regular matrix $Q$. $\hat{\beta}^{(i,j)}$ is the ordinary least squares (OLS) estimate of the regression coefficients based on the observations $i + 1, \ldots, i + j$ and $\hat{\beta}^{(i)} = \hat{\beta}^{(0,i)}$ is the OLS estimate for all the observations. $x^{(i)}$ is the regressor matrix for all observations. The residuals are

$$\hat{\mu}_i = y_i - x_i \hat{\beta}^{(n)}$$

with the estimated variance $\hat{\sigma}^2 = \frac{1}{n-k} \sum_{i=1}^{n} \hat{\mu}_i^2$.

Recursive residuals can be defined as follows:

$$\bar{\mu}_i = \frac{y_i - x_i \hat{\beta}^{(i-1)}}{\sqrt{1 + x_i^T (X^{(i-1)^T} X^{(i-1)^T})^{-1} x_i}} \quad (i = k + 1, \ldots, n)$$

Under the null hypothesis this has zero mean and $\sigma^2$ the corresponding variance estimate is $\hat{\sigma}^2 = \frac{1}{n-k} \sum_{i=k+1}^{n} (\bar{\mu}_i - \bar{\mu})^2$.

Moreover we must keep in mind the absence of endogeneity problems. This issue relates with the possibility of regime shifts connected with the own nature of the variable that promote some sort of endogenous dynamics, i.e. the cyclical movement of Gross Domestic Product with overheating situation. In our very case the Free Trade Agreement act as an external shock, therefore diminishing endogeneity problems.

3.2.1 CUSUM$^3$ processes:

The first type of processes that can be computed are CUSUM processes, which contain cumulative sums of standardized residuals, it can be estimated for either OLS or recursively. This process is also considered essentially a test to detect instability in the intercept alone. The cumulative sum of recursive residuals:

$$W_n(t) = \frac{1}{\sigma \sqrt{\eta}} \sum_{i=k+1}^{k+(\eta t)} \bar{\mu}_i \quad (0 \leq t \leq 1)$$

where $\eta = n - k$ is the number of recursive residuals.

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$^3$ Therefore we aim to calculate a total of six different methodologies in the light of empirical fluctuation processes using strucchange package on R provided by Zeileis A. et. al (2002).
Under the null hypothesis the limiting process for the empirical fluctuation \( W_n(t) \) is the Standard Brownian Motion \( W(t) \). The following central limit theorem holds:

\[ W_n \Rightarrow W \]

\( n \to \infty \), weak convergence of associated probability measures.

OLS-CUSUM type empirical fluctuation process is defined by:

\[ W_n^0(t) = \frac{1}{\sigma \sqrt{n}} \sum_{i=1}^{[nt]} \hat{\mu}_i \quad (0 \leq t \leq 1). \]

The limiting process for \( W_n^0(t) \) is the standard Brownian bridge \( W^0(t) = W(t) - tW(1) \).

### 3.2.2 MOSUM-processes:

Another possibility to detect a structural change is to analyze moving sums of residuals (instead of using cumulative sums of the same residuals) as the CUSUM-processes may be not very sensitive to certain types of parameter changes, and proposed a MOSUM test based on moving sums of recursive residuals. This approach is intuitively appealing because all moving sums are equally sensitive to parameters changes, whereas cumulative sums become less sensitive to parameter variation when the number of residuals gets larger. It is also natural to consider an OLS-MOSUM test based on the least square residuals. It also can be estimated by OLS and recursively. Recursive MOSUM process defined by:

\[ M_n(t|h) = \frac{1}{\sigma \sqrt{n}} \sum_{i=k+[N_\eta t]+[\eta h]}^{k+[N_\eta t]+[\eta h]} \hat{\mu}_i \quad (0 \leq t \leq 1 - h) = W_n \left( \frac{[N_\eta t]+[\eta h]}{\eta} \right) - W_n \left( \frac{[N_\eta t]}{\eta} \right), \]

Considering that \( N_\eta = \frac{(n-[nh])}{(1-h)} \). On the other way the OLS-based MOSUM process is defined by:

\[ M_n^0(t|h) = \frac{1}{\sigma \sqrt{n}} \left( \sum_{i=[N_\eta t]}^{[N_\eta t]+[nh]} \hat{\mu}_i \right) \quad (0 \leq t \leq 1 - h), \]

\[ = W_n^0 \left( \frac{[N_\eta t]+[nh]}{n} \right) - W_n^0 \left( \frac{[N_\eta t]}{n} \right), \]

where \( N_n = (n - [nh])/(1 - h) \)
3.2.4 Estimates-based processes:

We can also provide good results for generalized fluctuation on the basis of residuals by estimating the unknown regression coefficients. These can be done estimating a recursively growing number of observations or with a moving data window of a constant bandwidth $h$ and then compared to the estimates from the original sample. More generally we define a Fluctuation test as:

$$Y_n(t) = \frac{\sqrt{i}}{\hat{\sigma} \sqrt{n}} (X^{(i^*)} X^{(i)})^{\frac{1}{2}} (\hat{\beta}^{(i)} - \hat{\beta}^{(n)})$$

where $i = [k + t(n - k)]$ with $t \in [0,1]$

As well as the moving estimates (ME):

$$Z_n(t|h) = \frac{\sqrt{[nh]}}{\sigma \sqrt{n}} (X^{([nt],[nh])^*} X^{([nt],[nh])})^{\frac{1}{2}} (\hat{\beta}^{([nt],[nh])} - \hat{\beta}^{(n)})$$

where $0 \leq t \leq 1 - h$.

As described in Chu et al (1995) while ME is motivated from the Fluctuation test, it can be shown that, in the standard situation where heteroskedasticity and serial correction are not present, the ME test is asymptotically equivalent to the likelihood ratio (LR) test for a general class of testing problems in which a nuisance parameter, for the alternative of double structural changes where parameters temporarily deviate from a "normal" level. This is in contrast with many existing tests, including the Fluctuation test, which primarily focuses on the alternative of a one-time structural change. The alternative of temporary parameter instability is appealing in some applications. For example, after a policy is announced, the economy may shift to a different regime for a period of time and then return to its original level; the effectiveness of this policy is thus characterized by the duration of parameter change.

Compared to the Fluctuation test, which is based on recursive estimates calculated from a sequence of subsamples of increasing size, an ME test is determined by the fluctuation of moving estimates computed from a sequence of subsamples of the same size. Moreover, as moving estimates implement a locally weighted regression, the ME test can also be interpreted as a non-parametric test for a non constant mean function.
3.2.5 Setting Boundaries of Generalized Fluctuation Tests:

The idea that is common to all generalized fluctuation tests is that the null hypothesis of "no structural change" should be rejected when the fluctuation of the empirical process efp(t) gets improbably large compared to the fluctuation of the limiting process. Following we describe briefly how these boundaries are derived for MOSUM and CUSUM (Recursively and OLS based).

\[ b(t) = \lambda \sqrt{t} \]
\[ b(t) = \lambda \sqrt{t(1 - t)} \]

The boundaries of the two processes are of the type:

\[ b(t) = \lambda (1 + 2t) \]
\[ b(t) = \lambda \]

3.2.6 Significance testing with the empirical fluctuation processes:

Although calculating and plotting the empirical fluctuation process with its boundaries provides and visualizes most of the information, it might still be necessary or desirable to carry out a traditional significance test. Test statistics are defined as follows for \( S_r \) for the residual based processes and \( S_e \) for the estimated-based processes:

\[ S_r = \max_t efp(t) f(t) \quad \text{and} \quad S_e = \max_t \|efp(t)\| \]

Where \( f(t) \) depends on the shape of the boundary \( b(t) = \lambda f(t) \).

3.2.7 F tests

A different approach to find whether the null hypothesis of "no structural change" holds, is to use \( F \) test statistics. While generalized fluctuation tests are suitable for various patterns of structural changes, the \( F \) tests are designed to test against a single shift alternative.
3.3 Monitoring with the generalized fluctuation test:

Monitoring linear regression models where new data arrive over time is an important feature when we are dealing with structural breaks. The forward looking nature of the tests is closely related to sequential tests. When new observations arrive, estimates are computed sequentially from all available data and compared to the estimate based only on the historical sample.

\[ y_t = x_t^T \beta_i + \mu_i \quad (i = 1, \ldots, n, n + 1, \ldots) \]

In other words a monitoring situation means that given a history period for which a regression relationship is known to be stable, we test whether incoming data are consistent with the previously established relationship.

3.4 Zivot-Andrews Unit Root Test with one single break:

The basic specification of the Zivot and Andrews model for any time series \( Y_t \) is:

\[ \Delta Y_t = \alpha + \beta t + \gamma DI_{1t} + \omega DS_{1t} + \mu Y_{t-1} + \sum_{i=1}^{k} c_i \Delta Y_{t-i} + \varepsilon_t \]

for \( t = 1, T \); where \( c(L) \) is a lag polynomial of known order \( k \) and \( 1-c(L)L \) has all its roots outside the unit circle. \( DI_{1t} \) is the indicator dummy variable for a mean shift occurring at time \( SB_1 \) and \( DS_{1t} \) is the corresponding trend shift variable such that \( DI_{1t} = 1 \) for \( t > SB_1 \). \( DS_{1t} = (t-SB_1) \) if \( t < SB_1 \). The \( k \) extra regressors are taken to address the problem of autocorrelation, i.e., the temporal dependence in the error terms. A test of the unit root hypothesis has the null \( \mu = 0 \).

The alternative hypothesis is that the series is \( I(0) \) with one structural break. Restricted version of (16) discussed by Zivot and Andrews include:

\[ \Delta Y_t = \alpha + \beta t + \gamma DI_{1t} + \mu Y_{t-1} + \sum_{i=1}^{k} c_i \Delta Y_{t-i} + \varepsilon_t, \]

This model allows for a one-time change in levels at \( SB_1 \).

\[ \Delta Y_t = \alpha + \beta t + \omega DS_{1t} + \mu Y_{t-1} + \sum_{i=1}^{k} c_i \Delta Y_{t-i} + \varepsilon_t \]

This model permits a one-time change in the slope at \( SB_1 \).

In these specifications, the choice of the lag length, \( k \), is crucial. Hall (1994) suggests that for moderate to large samples a general-to-specific approach performs better than
standard information criteria such as those due to Hannan, Quinn and Akaike and Schwarz. We, therefore, use the general to specific approach adopted by mainstream literature. In accordance with this we begin with a large value of $k (= 12)$ and keep reducing this until the $t$-value (calculated from ADF test) on $\mu(k)$ is greater than 1.6 in absolute value and that of $\mu(l)$ is less than 1.6 for $l > k$.

### 4. Empirical Results

To perform the generalized fluctuation tests as well as the other class of recursive methods we considered an AR(1) for both aggregate exports and imports for Chile and Korea, which means that we took the first difference and a lagged first difference. We applied specific generalized fluctuation tests with moving Windows ranging from $h=1$ and $h=0.5$. As usual we start getting the significance test statistics for every single equation, then using trimming from 0.5% to 85% we attempt to cut the extremes when getting F-stats. Notice that for all estimation we are considering a 5 percent critical value but in some regressions although we pursue a 10 percent critical value. By analyzing the significance test statistics at Table 3 (see Appendix A) for each $efp$ on the AR(1) models for Chilean and Korean trade at the critical value mentioned above we can infer that for statistically significant p-values the estimated based process dominates over CUSUM and MOSUM based tests.

Fluctuations tests are weakly dominated by Moving Estimates (ME) but as theory suggests as observations grows this gap tend to narrow and sometimes (ME) outperform Fluctuations tests. P-values ranges from (2.2e-16) at all Fluctuations tests and goes to (0.6372) for OLS-CUSUM. The results suggest that Fluctuations, ME, OLS-MOSUM are reliable estimates while OLS-CUSUM has low statistical power. To confirm the suggestion of breakdates on the time series we proceed a monitoring situation based on four $efp$ methods since for Rec-CUSUM and Rec-MOSUM is Alma Gemini of the other estimated based process we dropped those estimates.
The results are shown on Table 1(a). Panel A, reports the main results for each trade equation with the respective break.

**Table 1(a): Monitoring Breakdates with Generalized Fluctuation Tests**

<table>
<thead>
<tr>
<th>Models</th>
<th>OLS- CUSUM</th>
<th>OLS- MOSUM</th>
<th>ME Moving estimates</th>
<th>Fluctuations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chile</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QXCK</td>
<td>2004Q2</td>
<td>2007Q1</td>
<td>2004Q2</td>
<td>2004Q2</td>
</tr>
<tr>
<td>QICK</td>
<td>2004Q2</td>
<td>2007Q4</td>
<td>2004Q2</td>
<td>2004Q2</td>
</tr>
<tr>
<td>Korea</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QXKC</td>
<td>No break detected</td>
<td>No break detected</td>
<td>2004Q4</td>
<td>2004Q3</td>
</tr>
<tr>
<td>QJKC</td>
<td>2006Q2</td>
<td>No break detected</td>
<td>2004Q2</td>
<td>2004Q3</td>
</tr>
</tbody>
</table>

Breakdates are mostly connected with the period comprising the data of FTA’s legal enforcement which is April 2004 and posterior implementation of the in both QXCK and QICK for OLS-MOSUM and QICK OLS-CUSUM. As reported by the F-Stats the ME and Fluctuations offer more reliable estimates and provide breakdates on the second quarter of 2004 as well as 2004Q3 and 2004Q4. Hence we can infer that the entry into force has provided a path change in the flow of trade between the two countries over the year 2004, which seems to be in line with the background theory that suggests that takes some time to achieve a strong shift. However these results are not robust enough since they are very sensitive to changes on the end data during the moving windows procedure. If we set a date other than 2004 the breakdates slightly changes but remain around our confidence time spam interval which begins in 1999 when they first started negotiations and 2006 when the FTA was mature enough.

For the sake of robustness we then apply the Zivot-Andrews test, where there is no interference from the researcher setting up an end date. Moreover the Breakdate is determined endogenously and we do not expect to match the exact break in 2004Q2, instead we focus around our time spam. The main side effect using the test is its single break detection, which means that Zivot-Andrews test can detect breaks other than the one caused by the FTA, for example the international financial crises in 2007. On the other
hand the test also detect whether or not the increase in trade was due to a time trend experienced by Chile and Korea and in this case the FTA only provided a more friendly environment to keep the bilateral trade flowing instead of creating trade from the ground zero. The main findings are reported in table 1(b):

**Table 1(b): Monitoring Breakdates with Zivot-Andrews Test**

<table>
<thead>
<tr>
<th>Models</th>
<th>Intercept</th>
<th>Trend</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QXCK</td>
<td>2005Q2</td>
<td>2001Q3</td>
<td>2000Q4</td>
</tr>
<tr>
<td>QICK</td>
<td>2006Q1</td>
<td>2004Q1</td>
<td>2002Q3*</td>
</tr>
<tr>
<td>Korea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QXKC</td>
<td>2006Q4</td>
<td>2003Q4*</td>
<td>2001Q3</td>
</tr>
<tr>
<td>QIKC</td>
<td>2005Q3</td>
<td>2002Q3</td>
<td>2000Q3</td>
</tr>
</tbody>
</table>

We can infer that all breakdates were detected and only two of them QXKC 2003Q4 “Trend” and QICK 2002Q3 “Both” were unable to provide relevant critical values to reject the hypotheses of no change in the sample. The Zivot-Andrews test detected breakdates with changes in the intercept at the end of the sample as QXCK 2006Q4 and QXCK 2005Q2 but also earlier and around precise FTA implementation as QICK 2004Q1, see panel C on Appendix. This is due to the fact that trade takes time to really shift its path and if we analyze both Zivot-Andrews test with the Recursive Moving Estimates from Table 1(a) we can assure that a break has occurred satisfactorily for both countries and for the breakdates detected too early in the time spam such as QXCK 2000Q4 and QIKC 2000Q3 this is in part due to the “natural” trend in Chilean exports and Korean imports respectively and in this case the FTA instead of creating new opportunities it provided an good environment for the existing ones.

From the disaggregated point of view we also detected important shifts around the same time spam. This innovative approach in economic integration and structural breaks were limited to existing data solutions. The reason is twofold, although KOTRA and PROCHILE provides monthly statistics for import and export by product the time spam is right after the FTA’s implementation which harms the methodology since we also need pattern of trade dating back the FTA. Then we decided to use yearly export and import data by
product from UN COMTRADE dating back 1988 and 1990, this approach gives us a reduced sample which implies that the breakdates detected must be viewed with caution and as “potential breakdates”. To perform this section we analyzed the top export products from each country to the FTA partner. The products and its breakdates are reported in Table 2.

Table 2: Disaggregated Level Zivot-Andrews Test

<table>
<thead>
<tr>
<th>Models/Products</th>
<th>Intercept</th>
<th>Trend</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chile</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper ores and concentrates 2603</td>
<td>2003*</td>
<td>2005*</td>
<td>1999*</td>
</tr>
<tr>
<td>Copper cathodes and sections of cathodes unwrought 740311</td>
<td>2002</td>
<td>2007</td>
<td>2006</td>
</tr>
<tr>
<td>Coniferous chemical pulp 4703</td>
<td>2001</td>
<td>2008</td>
<td>No Break</td>
</tr>
<tr>
<td>Edible fruit, nuts, peel of citrus fruit, melons 08</td>
<td>1999*</td>
<td>2000*</td>
<td>1999*</td>
</tr>
<tr>
<td><strong>Korea</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear reactors, boilers, machinery 24</td>
<td>1999</td>
<td>2006</td>
<td>2008*</td>
</tr>
<tr>
<td>Cars for Transport of persons 87</td>
<td>1999</td>
<td>2003</td>
<td>2000*</td>
</tr>
<tr>
<td>Telecom products 85</td>
<td>2007</td>
<td>2006</td>
<td>2002*</td>
</tr>
</tbody>
</table>

Obs: Those considered statistically insignificant or fails to match the critical values are marked with an asterisk.

The Zivot-Andrews test regards the limitation of dataset capture a break with trend for automotive and telecom products from Korea as well as copper cathodes and coniferous pulp from Chile. For a graphic interpretation please check panels A and B (Appendix A)
5. Concluding remarks

Applying the different methods of detecting structural changes we can see that it is possible to attribute the different breaks in imports and exports after Chile signed the different free-trade agreement with Korea exhibiting a clear dominance of Zivot-Andrews test and estimated based process over CUSUM and MOSUM methods.

Data on trade could be analyzed in a panel procedure by getting longer datasets dating back the FTA, which will allow for testing between a random walk or a structural change in the data. The first one refers to the assumption of non-linear data, this means, the data is suppose to follow a linear trend but this one changes due to breaks or shocks. After each of these breaks, data follows a trend which seems linear until the next break occurs and will change the trend again. Thus, will allow for proving this assumption, otherwise one should assume the linearity in data, and apply the test to detect structural breaks as done in this paper.

In addition one can argue that using AR (1) we incur in severe loss of information and using a cointegrated error correcting model we could capture the long and the short run dynamics of the model, on the spirit of Hansen (1992). Although, in some cases, breaks were not detected, some authors suggests that using more disaggregated data level would allow to a better understanding on the behavior of specific market sectors.

From what was inferred the economic integration process among the two nations has lead to increase flow of trade with different valence for exports and imports, this due to singularities in each economy, or in other terms, to its comparative advantages. One important feature is that Korea has become a major partner for Chile outperforming traditional partners. The results also suggests that from the Korean point of view a more aggressive economic integration with other Latin American partners must follow the same structure with a slight change regarding agricultural commodities in the case of Brazil and Argentina.
References


## Appendix A

### Table 3: Significance Test Statistics for each Empirical Fluctuation Process

<table>
<thead>
<tr>
<th>Models</th>
<th>OLS-CUSUM</th>
<th>Recursive – CUSUM</th>
<th>Fluctuations (Recursive estimates)</th>
<th>ME Moving estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chile</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QXCK</td>
<td>0.8416 (0.4782)</td>
<td>0.7102 (0.2353)</td>
<td>36.7558 (&lt; 2.2e-16)*</td>
<td>25.7178 (0.01)*</td>
</tr>
<tr>
<td>QICK</td>
<td>0.8611, (0.4486)</td>
<td>2.3993 (1.987e-10)*</td>
<td>12.5978, (&lt;2.2e-16)*</td>
<td>12.642 (0.01)*</td>
</tr>
<tr>
<td>Korea</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QXKC</td>
<td>0.8926 (0.6372)</td>
<td>1.4743 (0.0003213) *</td>
<td>13.3352, (2.2e-16)</td>
<td>5.87 (0.01)*</td>
</tr>
<tr>
<td>QIKC</td>
<td>0.8452 (0.4727)</td>
<td>0.9815 (0.03872)</td>
<td>11.6896 (2.2e-16)*</td>
<td>10.6319 (0.01)*</td>
</tr>
</tbody>
</table>

Obs: p-values of each significance test statistics between parentheses (). Those considered statistically significant are marked with an asterisk.

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**Figure 1 - Quarterly Exports from Chile to Korea (FOB)**

**Figure 2 - Quarterly Exports from Korea to Chile (FOB)**

**Figure 3 - Quarterly Imports Chile from Korea (CIF)**

**Figure 4 - Quarterly Imports Korea from Chile (CIF)**
Figure 5 - Yearly Imports of Copper ores

Figure 6 - Yearly Imports of Copper cathodes and sections

Figure 7 - Yearly Imports of Coniferous chemical pulp

Figure 8 - Yearly Imports of Edible fruit, nuts, peel of citrus fruit

Figure 9 - Yearly Imports of Boilers and machinery

Figure 10 - Yearly Imports of Cars for Transport of persons

Figure 11 - Yearly Imports of Telecom products
Panel A - Korean Automotive Breakdate

Zivot and Andrews Unit Root Test

Time t-statistics for lagged endogenous variable
5 10 15
-6 -5 -4 -3 -2 -1 0
Model type: trend
1% c.v. 2.5% c.v. 5% c.v.

Panel B - Korean Telecom Breakdate

Zivot and Andrews Unit Root Test

Time t-statistics for lagged endogenous variable
5 10 15
-10 0 10
Model type: trend
1% c.v. 2.5% c.v. 5% c.v.
Panel C – Chilean Imports from Korea

Zivot and Andrews Unit Root Test

Time

Model type: trend

1% c.v. 2.5% c.v. 5% c.v.