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M. Cortes
*University of Wollongong*, mcortes@uow.edu.au

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# Examining Patterns of Bilateral Trade between Australia and Colombia by Using Cointegration Analysis and Error-Correction Models

**Maria Cortes***

Universidad del Valle **, Cali, Colombia

## Abstract

The main objective of this paper is to understand whether there is a long-term relationship between Australia and Colombian imports by using macroeconomic fundamentals such as the real exchange rate, income, population and openness. We use multivariate cointegration techniques and error correction models along with time-series data (1960-2005). We focus on testing for cointegration in the presence of structural breaks. The findings suggest that the value of Australian imports from Colombia is cointegrated with three economic series: income of both participating countries and the Colombian population. The real value of Colombian imports from Australia is cointegrated with the real bilateral exchange rate and total Colombian world imports. The relationship between the value of bilateral imports and the cointegrated series can be seen as long-running bilateral import elasticities. High coefficients of the cointegrated variables indicate that opportunities exist to improve long-term trade relationships between the two countries.

*JEL classification codes:* F10, F14, F17
*Key words:* Australia, Colombia, bilateral imports, Cointegration analysis, ECM

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* Corresponding author: mvcortes@univalle.edu.co Facultad de Ciencias de la Administracion, Universidad del Valle, Sede San Fernando Cali- Colombia. Phone number: (57-2) (5185756).

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## 1. Introduction

Australia has increased economic ties with some of the Latin American countries, especially Mercosur countries and Mexico during the last decade. However, Colombia has yet to be part of this trend. Colombia is the fifth largest economy in Latin America after Brazil, Mexico, Argentina, and Venezuela. In the region, it is the sixth foreign direct investment destination in Latin America and its population size is the third largest after Brazil and Mexico (IMF IFS, 2006). Colombia is one of the best managed economies in Latin America (Frankel, 1999) and it is the only South American country that has not experienced military regimes or dictatorships after 1960. Bilateral trade between Colombia and Australia is very low. In 2005-06, total trade amounted to AU$49 million and Colombia ranked as the 83rd largest Australian trading partner (Department of Foreign Affairs and Trade, 2006). The main motivation of this paper is the potential of this trade. Although bilateral trade is modest in value, there is good potential for trade expansion when Colombia obtains APEC membership, expected to occur in 2008.

Political relations between Australia and Colombia in terms of trade liberalisation lies in their common agricultural trade as both countries have been members of the Cairns Group for over 20 years. Both seek free and fair trade[1] in agricultural products. Colombia has worked with Australia on a range of issues such as the environment and disarmament. Colombia's role in the Asia-Pacific has recently increased due to its membership in the Pacific Basin Economic Council (PBEC) and two APEC working groups. Colombia will seek inclusion in APEC in 2008, when the forum's moratorium ends on accepting new members (Dominican Today, 29th August

[1] This included cuts to all tariffs, the elimination of all trade-distorting domestic subsidies and clear rules to prevent circumvention of export subsidy commitments.

2006). Like Australia, Colombia is a member of the Forum for East Asia and Latin America Cooperation (FEALAC).

In the last two decades, there has been increased interest between the two countries. A number of organisations have recently been established to promote closer commercial links between both regions. The Australia-Latin America Business Council (ALABC) is a private non-profit company established in 1989; the Western Australia Latin America Business Association (WALABA) was formed in 1996 and the objectives of encouraging and promoting international business between Western Australia and Latin America. The Council on Australia Latin America Relations (COALAR) [2] was established in 2001 by the Australian Government. COALAR supports Australia's broad diplomatic and economic relations in the Latin American region. In 2002, a Colombia-Australian Chamber of Commerce was also established in Bogota.

This paper attempts to understand the pattern of bilateral trade between Australia and Colombia, taking into account traditional economic variables such as income, population, the real exchange rate, and trade openness over the period from 1960 to 2005. The analysis will use cointegration analysis and Error Correction Models (ECM) to understand the long- and short-run dynamics of such a relationship. Pursuing the above objective, the remainder of this paper is structured into three parts: the first section provides an overview of the bilateral trade. It describes the most important general settings of bilateral trade such as the importance of the Latin American region for Australia, comparison of economic indicators between Colombia and Australia, and commodity composition of bilateral

[2] "The Council on Australia Latin America Relations will seek to advance Australia's relationship with the region at an economic, social, and political level, delivering initiatives that will build the relationship and raise awareness among Australians of the opportunities that the region presents". (Downer and Vaile, 2001).

trade. The second section presents a brief review of the empirical model by using cointegration analysis and ECM results. The last section of this paper provides a brief summary of the main findings and their policy implications.

## 2. Background

This part of the paper provides a summary statement of the various features of the trade setting between Australia and Colombia. It contains a brief review of the geographical, socio-political, and macroeconomic environment of Australia and Colombia, as well as the evolving nature of trade and political regimes and trends in openness. It also provides an overview of bilateral trade composition and trading partners of the two sides.

Traditionally, Australian export trade has focused on northern hemisphere countries of Europe and North America and, more recently, on Asia. Since the 1970s, Australia has shown interest in the Colombian market. In 1974, the Australian Trade Commissioner in Lima stated that Australian firms should consider gaining a share of the Colombian market (Hargreaves, 1974). Some years later, Australia participated in an agricultural fair in Bogota "Agroexpo 83", where Australia displayed farm machinery, tools and equipment, and animal health products (Overseas Trading, 1982).

Australian trade with South American countries became more relevant in 1992, when a report to the Federal Parliament by the Senate Standing Committee on Foreign Affairs, Defence and Trade considered the potential of the region for Australia (Joint Standing Committee FADT, 2000). In 2000, this Committee made recommendations to increase Australian trade and investments with South America. These recommendations included a strategy to develop and establish Australia as a

bridge between Asia and the South American countries and the establishment of an Australia-Andean community parliamentary group. By 2006, Australia had developed good ties with Mercosur countries; *i.e.* Argentina, Brazil, and Chile. However, other potential South American trade partner countries such as Colombia and Ecuador have remained mostly peripheral players.

Historical differences in social, economic, and cultural development between Australia and Colombia have produced different rules of law, different government institutions, different societies, and different degrees of economic development (Australia is a developed country and Colombia is a developing one). Nevertheless, Australia and Colombia have many common features and they have now established economic and business links. The economic histories of both countries have similar characteristics, both have been exposed to many external shocks due to the large swings in the terms of trade and commodities exports account for over half of the total exports. During the 1980s, both countries had episodes of external deficits (Caballero et. al, 2004).

**Table 1. Comparison of geographic and economic indicators: Australia and Colombia**

| **General information** | **Australia** | **Colombia** |
|---|---|---|
| Surface area (thousand sq km) | 7,692 | 1,139 |
| Population 2005 | 20 million | 44 million |
| Population 2015 | 22.2 million | 52.1 million |
| GDP per capita (PPP US$) 2003 | 29,632 | 6,702 |
| Geographical distance Sydney - Bogota (km) | 14,327 | |
| Average level of exports (km) 1962-2000 | 10,718.1 | 6,071.1 |
| Average level of imports (km) 1962-2000 | 12,993.0 | 6,401.6 |
| Change in distance of exports (%) 1962- | - 22.7 | - 16.2 |
| Change in distance of imports (%) 1962- | - 20.2 | -1.8 |

Source: UNDP, 2005; Carrere and Schiff, 2004.

The geographical distance between Sydney and Bogota is 14,327 km. It is a closer distance than many other Australian trade partners such as UK (London) 16,997km, the USA (Washington DC) 15,707 km, or Canada (Toronto) 15,562 km (Table 1). However, from the Colombian point of view, this distance makes Australia a distant market taking into account that its traditional trade partners are the USA (Miami) 2,429 km and Venezuela (Caracas) 1,020 km.

Trade similarities between the two countries include the fact that both have mineral sectors representing more than 4% of their respective GDP: Australia with 5.1% and Colombia with 4.2% (Maxwell, 2005). This characteristic offers considerable scope for Australian direct investment in Colombia. Colombia has the largest coal reserves in Latin America and about 90% of the domestic production is exported. Coal is a very important source of revenues for Colombia. The Cerrejon[3] site has been estimated to contain 930m tonnes of coal reserves. Cerrejon is owned in three equal parts by Anglo American, BHP Billiton, and Glencore International (Webb-Vidal, 2006). Recently, in 2005, Australia signed the free trade Agreement with the USA; while a free trade Agreement between Colombia and the USA is still under study by the USA Congress. Bilateral trade has evolved from very small values to a significant level in 1997 (from $AU 2.8 million to $AU 42.8 million at constant year 2000 prices), however this value decreased in 2005 ($AU 21.4 million at year 2000 prices). The actual evolution in constant year 2000 dollars is shown in Figure 1. During the 1960s, bilateral trade appears to have been not only small, but irregular and erratic. From 1969 to 1974, Colombian imports were higher than Australian imports. Between 1976 and 1984, Australian imports from Colombia were higher than Colombian imports from Australia. Beginning in 1985 and almost

[3] Colombia's biggest producer and the world's largest open-cast coal mining export operation

throughout the rest of the study period, Australia managed a bilateral surplus (except 1990, 1992, 2000, and 2005).

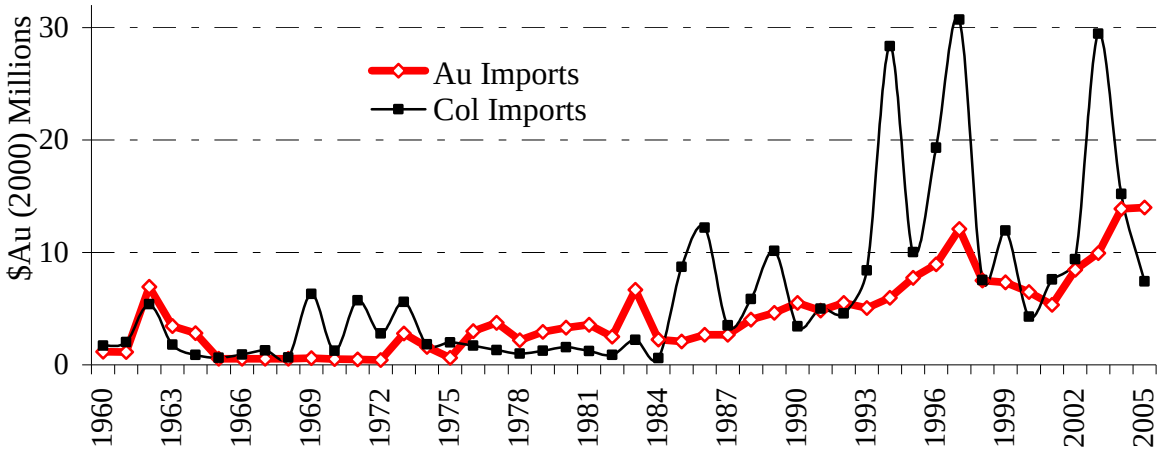



**Figure 1. Real Bilateral trade $Au (2000) over the period 1960-2005.**

Source: IMF, Direction of Trade Statistics.

**Commodity Composition of bilateral trade**

Australian imports from Colombia have been stable and concentrating highly on coffee (Table 2). Other Australian imports from Colombia are chemical products (53.4% of total Australian imports from Colombia in 2003), specially yarn and textile fabrics and of vinyl chloride polymers.

Colombian imports from Australia constitute a diverse range of commodities such as dairy products, cereals, cotton, wool, chemicals, leather, tubes, pipes, iron, steel, manufactures, machinery, telecommunication equipment, vehicle parts, transport equipment, optical, toys, games, sporting goods, artwork, and antiques.

In 2005, major Colombian imports from Australia were toys, games and sporting goods; veneers, plywood and particle board; chemicals products, and electrical equipment for circuitry (18%, 14%, 9%, and 9% of the total Colombian imports from Australia, respectively) and others such as internal combustion piston

engines, woven and cotton fabrics (Department of Foreign Affairs and Trade, 2006). Colombia is second only to Brazil as a source of international students to Australia from South America (around 834 student visas were issued in 2003-4). Since 1996, Colombian students have been travelling to Australia. IDP Education Pty Ltd (IDP) opened its office in Bogotá in September 1999, and Australian education in Colombia has attracted thousands of interested students. More than 12,000 Colombian students have studied in Australia (Department of Foreign Affairs and Trade - Australian Government, 2005).

**Table 2. Changes in the composition of trade between Australia and Colombia**

| | **Quantity** | **Year** | **Composition of trade** |
|---|---|---|---|
| Imports from Colombia | High >30% | 1990 | Coffee and substitutes (37.5%). |
| | | 2000 | Coffee and substitutes (49.9%). |
| | Medium >10% | 1990 | Man-made woven fabric (18.1%), carboxylic acids and derivates (12%). |
| | | 2000 | Insecticides, herbicides (20.0%). |
| | Low > 5% | 1990 | Pearls and gems (8.4%), polymers of styrene primary forms (5.6%). |
| | | 2000 | Special yarns and fabrics (9.5%). |
| | Very low < 5% | 1990 | Confidential items (4.5%), insecticides, herbicides (1.2%). |
| | | 2000 | Leather (3%), cereal preparation (1.8%), sugar confectionery (2.3%), cutlery (2.1%), starches and insulin (1.3%). |
| Exports to Colombia | High > 30% | 1990 | Barley (63.9%) |
| | | 2000 | |
| | Medium > 10% | 1990 | Wool (16.1%) |
| | | 2000 | Wool (19.9%), cotton (17.1%). |
| | Low > 5% | 1990 | |
| | | 2000 | Manufactures of metal (8.2%), specialised machinery (6.3%), |
| | Very low < 5% | 1990 | Tubes, pipes, iron, steel (3.7%), crude vegetable materials (1%), chemicals and related products (0.8%), perfumes and cosmetics (0.5%). |
| | | 2000 | Confidential items (2.7%), medical instruments (2.1%), machinery and transport equipment (1.6%), miscellaneous manufactured articles (1.2%). |

Source: DFAT, Composition of trade with Australia; DFAT Australian trade with the Americas.

It is recognised that among the major impediments to trade growth between Australia and Colombia are inadequate air links and scarcity of maritime transport. As a result, Australian representatives have visited Colombia only a few times. The scarcity of maritime transport is also significant since nearly all (98.98%) of the total Colombian exports to Australia used maritime transport (DANE, 1999).

Most Australian investments in Colombia are concentrated in mining and services. In coal, two companies BHP and Sedgman have investments in Cerrejon Norte; Mincom has investments in information technology (IT) and technical support for the mining sector (DFAT, 2006). There is a good relationship in complementary technology in sugar cane production, mining – specially – coal, energy, and education sectors. There are a number of areas, mainly in the agriculture, mining (oil, gas, and coal), and telecommunications sectors, that have potential in providing further long-term opportunities for Australian investments in Colombia (DFAT, 2005).

There is no Australian Embassy in Colombia and there is no Colombian Embassy in Australia; the Australian Ambassador to Brazil is accredited to Colombia on a non-resident basis and the Colombian Ambassador to Japan is accredited to Australia. In 1989, Australia established an Honorary Consulate in Bogotá. The Consulate General of Colombia, with jurisdiction throughout Australia is located in Sydney, New South Wales and there is an Honorary Consulate in Queensland.

## 3. Empirical Analysis

There are a number of studies undertaking trade analysis using disaggregated data at the bilateral level to reduce the aggregation bias since the late 1980s. Examples of this group of studies include Cushman (1987, 1990), Summary (1989), Marquez (1990), and Bahmani-Oskooee and Brooks (1999). Most of these studies have

estimated bilateral trade elasticities between the United States and its major trading partners and concluded that the real bilateral exchange rate is a significant determinant of bilateral trade balance. There are also similar studies for other countries, for example: Bahmani -Oskooee and Goswami (2004) studied the bilateral trade flows between Japan and nine major trading partners. Bahmani-Oskooee, Goswamil and Talukdar (2005b) studied the short-term and the long-term effects of real depreciation of the Australian dollar on the trade balance between Australia and 23 trading partners. Bahmani-Oskooee, Goswamil, Talukdar (2005a), studied the relationship of the import and export values with the exchange rate using time series modelling to estimate bilateral trade between Canada and 20 trading partners. Some scholars found that the results from bilateral data are similar to the results of the aggregate data (Bahmani-Oskooee and Ardalani, 2006). There have not been previous studies of bilateral trade between Australia and Colombia.

Cointegration analysis was introduced by Granger (1981) and Granger and Weiss (1983). However, this technique has become a fashionable tool only since 1987, when Engle and Granger formalized their work to test the correlation between non-stationary time series variables. Cointegration analysis provides a technique to establish long-term and short-term dynamics in non-stationary series processes, which are found to be integrated in the same order. The series are cointegrated if a linear combination of the two exists, which is itself stationary (Engle and Granger, 1987). The traditional methodology for co-integration involves two steps. The preliminary step is the test for non-stationarity of the series. If the null hypothesis of non-stationarity is not rejected, the following step is to test for a unit root on the first difference of the series to specify the order of integration (Engle and Granger, 1987; Sarno and Taylor, 2002). In recent years, the concepts of cointegrated variables and

the error correction model *(*ECM*)* have played an important role in much of the time-series econometric work on trade. The ECM captures short-term dynamics and the long-term relation between the selected variables. Cointegration has two improvements as compared to other methods such as differentiated demand for imports, market share, propensity to imports, and trade flow matrices. The first improvement refers to the inclusion of the stochastic properties of the time series accounting for estimation and testing; and the second improvement deals with short-term and long-term impacts (Sanso and Montanes, 2002).

Recent studies on cointegration analysis have accounted for the lack of data on import and export prices at the bilateral level by using relations of import and export values directly on the exchange rate (Bahmani-Oskooee, Goswamil, Talukdar, 2005a; Bahmani-Oskooee Goswamil, Talukdar, 2005b). Some scholars have found that imports are sensitive to the real bilateral exchange rate but exports are not (Bahmani-Oskooee and Goswami, 2004; and Bahmani-Oskooee, Goswamil, Talukdar, 2005a). Balloo (2000) found that currency devaluation has a positive long-term effect on bilateral trade between Canada and the US. However, Bahmani-Oskooee and Ardalani (2006), using cointegration analysis, found that in the long run real depreciation of the US dollar stimulates export earnings of many US industries; although it has no significant impact on most importing industries. Horton and Wilkinson (1989), using cointegration analysis, found that the main determinants of imports in Australia were the relative price of imports, movements in domestic demand, and the level of overtime during the period 1974-1989. Metwally, Hodgkinson and Jordaan (2006) analysed trade between Australia and South Africa by using the cointegration test and identified a long-term relationship of Australian

bilateral trade with other countries. These authors also developed a simultaneous equation model to evaluate this trade relationship.

**Data**

We use annual time series data for the period 1960 – 2005. IMF is the source of the data related to income GDP in national currencies, real aggregate exports, real aggregate imports, and real exchange rates. ABS and DOTS-IMF are the sources of information for bilateral trade data and population.

Original data in current US dollars was converted to constant Australian dollars as a convenient benchmark, and aggregated accordingly for the purpose of analysis. Unless otherwise stated, figures in AU$ denote constant Australian dollars at year 2000 prices.

Conventional cointegration has no predetermined variables. Nevertheless, some scholars have used import and export demand equations, usually including a scale variable and a relative price term (Bahmani-Oskooee and Brooks, 1999). We start the co-integration analysis by first examining the order of integration in each series, i.e., to determine whether it is stationary in levels or in first differences. The dependent variables used to study the bilateral trade are total trade and their respective imports: Australian imports from Colombia and Colombian imports from Australia. The first step is to know the properties of univariate time series. Prior to conducting the co-integration or causality tests, each time series was checked for stationarity and structural breaks. We applied the ZA (Zivot and Andrews, 1992) approach to endogenously determine the most important structural breaks in the variables selected for the empirical analysis.

H0: $y_t = \mu + y_{t-1} + e_t$ (1)

H1: $$\Delta y_t = \mu + \beta t + \theta DU1_t + \gamma\, DT1_t + \alpha\, y_{t-i} + \sum_{t=1}^{k} ci\, \Delta y_{\,t-1} + \varepsilon_t \qquad (2)$$

Where:

DU1= dummy variable capturing a shift in the intercept

DT1= dummy variable capturing a shift in the trend.

Equation (2) allows the possibility of structural changes in both the intercept and the trend. The alternative hypothesis H0 is that the series $y_t$ is I(0) with one structural break. Structural changes of the variables were endogenously determined by using the ZA (Zivot and Andrews, 1992) test (see Table 3 and Figure 2). For more specific information on ZA test procedures see Valadkhani and Pahlavani (2007).

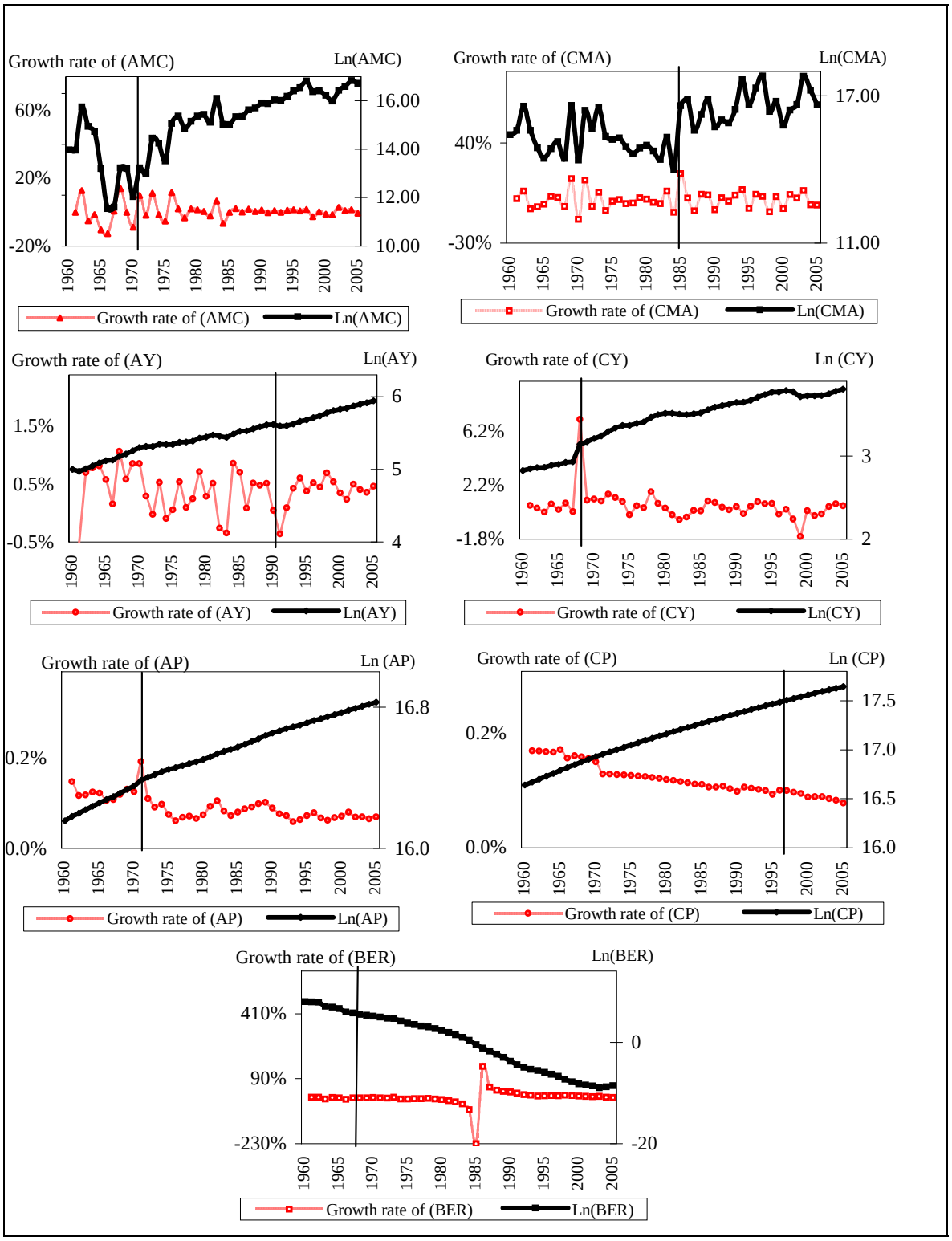
The ZA test results show that the series have structural breaks. The results of the Zivot and Andrew unit root tests are available from the authors upon request. In order to obtain a correct specification of the model it is important to know the order of integration of each variable. All the variables, namely, Australian imports from Colombia (AMC), Colombian imports from Australia (CMA), Australian income (AY), Colombian income (CY), Australian population (AP), Colombian population (CP), bilateral exchange rate (BER) are I(1). The hypothesis that the first differences of the series AMC, CMA, AY, CY, AP, CP, and RBER have a unit root can be rejected. The empirical results based on the ZA model show no evidence of the unit root null hypothesis in the first difference for ten out of the eleven variables examined (except Colombian openness).

**Table 3. The Zivot-Andrews test results: breaks in both intercept and trend**

| Variable | Definition | Data | TB1 | μ | β | Θ | γ | A | κ | Possible explanation for TBs |
|---|---|---|---|---|---|---|---|---|---|---|
| *Ln(AMC)* | Australian imports from Colombia | 1960-2005 | 1971 | 9.739 (4.88) | -0.230 (-3.17) | 1.610 (3.75) | 0.278 (3.48) | -0.620 (-4.90) | 0 | Australian dollar fixed to pound sterling. |
| *Ln(CMA)* | Colombian imports from Australia | 1960-2005 | 1985 | 14.973 (4.54) | -0.037 (-1.66) | 1.441 (3.23) | 0.071 (1.79) | -0.951 (-4.54) | 1 | IMF-Macroeconomic Adjustment Program. |
| *Ln(AY)* | Australian income | 1960-2005 | 1990 | 1.429 (3.88) | 0.005 (3.32) | -0.022 (-2.12) | 0.003 (-2.91) | -0.281 (-3.80) | 1 | Australian recession, property market collapse. |
| *Ln(AP)* | Australian population | 1960-2005 | 1971 | 4.048 (4.11) | 0.005 (4.19) | 0.005 (1.96) | -0.002 (-3.82) | -0.250 (-4.10) | 1 | Australia's indigenous population included in Census. |
| *Ln(CY)* | Colombian income | 1960-2005 | 1968 | 0.965 (6.07) | 0.005 (1.09) | 0.126 (5.46) | -0.000 (-0.06) | -0.339 (-6.04) * | 0 | |
| *Ln(CP)* | Colombian population | 1960-2005 | 1998 | 0.599 (3.99) | 0.001 (3.53) | 0.000 (0.05) | -0.000 (-2.10) | -0.035 (-3.96) | 1 | |
| *Ln(BER)* | Real bilateral exchange rate | 1960-2005 | 1967 | 0.809 (1.59) | -0.076 (-1.12) | 0.304 (1.77) | 0.034 (0.56) | -0.094 (-2.13) | 1 | The AU dollar $ replaced the AU pound $. |
| *Ln(OA)* | Australian openness | 1960-2005 | 1982 | 2.147 (3.61) | 0.005 (2.48) | -0.023 (-0.93) | 0.018 (3.67) | -0.707 (-3.57) | 2 | |
| *Ln(OC)* | Colombian openness | 1960-2005 | 1992 | 1.838 (4.62) | 0.003 (2.51) | 0.227 (4.38) | -0.001 (-0.32) | -0.579 (-4.67) | 2 | Liberalization process and openness. |
| *Ln(ATM)* | Australian total imports | 1960-2005 | 1983 | 9.739 (3.16) | 0.013 (1.94) | -0.272 (-2.58) | 0.012 (1.99) | -0.406 (-3.14) | 0 | Australian economic deregulation. |
| *Ln(CTM)* | Colombian total imports | 1960-2005 | 1987 | 12.884 (3.48) | -0.039 (-3.52) | -0.367 (-2.82) | 0.024 (2.86) | -0.479 (-3.49) | 0 | Colombian deregulation. New programs in place. |

Notes: (1) Critical Values at 1% level -5.57 and 5% level -5.08. (2) * Indicates that the corresponding null is rejected at the 5% level.

**Figure 2. Plots of series and estimated timing of the structural breaks using the ZA test.**




Source: IMF, DOTS, IFS, Population data from (Australian Bureau of Statistics ABS and Banco de la Republica, Colombia).

Assuming that all variables are I(1), we now test for the existence of a long-term relationship between the bilateral trade variables. In other words, after investigating the univariate time series properties of income, population, real exchange rate, openness, total imports and total exports of each country, we start modelling the system of bilateral imports. In addition to these stochastic variables, the system includes a constant and a time trend variable. Our estimation spans from 1960 to 2005. Before conducting a causality test, the variables were found to be stationary individually (we drop the series of Colombian openness because it was not an I (1) series. The optimal lag length was assumed to be equal 2. It was determined on the basis of the traditional Akaike information criterion and Schwartz (AIC and SC).

Since there are structural breaks in the series, we introduced dummy variables for the Colombian imports from Australia and Australian imports from Colombia equations. We include three dummies: the first dummy variable (D1) represents the structural break of the Australian imports from Colombia, it takes the value 0 in the period 1960 to 1971 and 1 elsewhere; the second dummy variable (D2) represents the structural break of the Colombian imports from Australia, it takes the value 0 in the period 1960 to 1985 and 1 elsewhere; the third dummy (DIE) has been built-in taking the value 1 when there are international events such the oil shocks, Latin American countries debt crises, the Faulkland Islands war and the closing of the Australian Embassy in Caracas, all of these events have affected this bilateral trade (although these are not directly related to both countries).

The second step requires testing for cointegration using the Johansen maximum likelihood approach (trace and max-eigen values). This analysis allows us to determine explicitly for the number of cointegration vectors among the variables. In the case of Colombian imports from Australia there is at least one cointegrating vector. In the case

of Australian imports from Colombia there is more than one vector (at least 2 or 3, depending on the five specifications of trend in the test options). The results for Australian imports from Colombia are acceptable, taking into account that some scholars like Bahamani-Oskooee (1999) and Burke and Hunter (2004) have argued that due to different economic theories more than one vector is possible. We reject the hypothesis of no cointegration in various test options using the Johansen cointegration test.

The Granger causality test was used to investigate whether observations of a variable like income or population are potentially useful for anticipating future movements in bilateral imports. If there is cointegration then Granger causality must exist, at least in the I(1)variables. Three time series BER, OA and ATM impacted on Australian imports from Colombia. Four time series AY, CP, ATM and ATX are useful in forecasting Colombian imports from Australia. However, there is no evidence that CY, AY, CP, AP, CTM, CTX and ATX cause movement in AMC (its probability of F statistics is less than 0.05). The results of Granger Causality test are summarised in Table 4.

The rejection of Granger's null does not imply that the alternative hypothesis should be accepted. That is the case of Colombian imports from Australia where Granger's null was rejected for Colombian income, Australian population, Colombian total imports, Colombian total exports, and Australian openness. However, these series were dropped in the final step.

**Table 4. Pair-wise Granger Causality Test, Lags: 2**

| Null Hypothesis: | Observations | F-Statistic | Probability |
|---|---|---|---|
| **Ln (Australian imports from Colombia) = AMC** | | | |
| BER does not Granger Cause AMC | 44 | 2.718 | 0.08 |
| CY does not Granger Cause AMC | 44 | 3.912 | 0.028*** |
| AY does not Granger Cause AMC | 44 | 4.086 | 0.024*** |
| CP does not Granger Cause AMC | 44 | 4.674 | 0.015*** |
| AP does not Granger Cause AMC | 44 | 3.669 | 0.03*** |
| CTM does not Granger Cause AMC | 44 | 3.721 | 0.03*** |
| CTX does not Granger Cause AMC | 44 | 3.492 | 0.04*** |
| ATM does not Granger Cause AMC | 44 | 2.056 | 0.14 |
| ATX does not Granger Cause AMC | 44 | 3.637 | 0.04*** |
| OA does not Granger Cause AMC | 44 | 2.762 | 0.08 |
| **Ln (Colombian imports from Australia) = CMA** | | | |
| BER does not Granger Cause CMA | 44 | 3.472 | 0.041*** |
| CY does not Granger Cause CMA | 44 | 4.000 | 0.03*** |
| AY does not Granger Cause CMA | 44 | 2.142 | 0.13 |
| CP does not Granger Cause CMA | 44 | 2.537 | 0.09 |
| AP does not Granger Cause CMA | 44 | 3.332 | 0.046*** |
| CTM does not Granger Cause CMA | 44 | 4.460 | 0.018*** |
| CTX does not Granger Cause CMA | 44 | 3.306 | 0.047*** |
| ATM does not Granger Cause CMA | 44 | 0.218 | 0.81 |
| ATX does not Granger Cause CMA | 44 | 1.319 | 0.28 |
| OA does not Granger Cause CMA | 44 | 3.834 | 0.03*** |

The sensitivity of Colombian imports from Australia to movements in the real bilateral exchange rate is -0.086 (Table 5) and it is low with respect to some developed countries (Bahmani-Oskooee and Brooks, 1999), but it is comparable to exchange rate elasticities in developing countries such as Greece (Bahmani-Oskooee, 1998). The magnitude of elasticity is somewhat larger than other scholar's findings, but it means that there is a large capacity for increasing Australian imports from Colombia. Nevertheless there are not many studies on non-traditional partners over the same

sample period, which present any extensive comparison of our results being made. Table 5 shows the long-term relationship for Colombian imports from Australia and the long-term relationship for Australian imports from Colombia.

**Table 5. Estimated Co-integrating Coefficients derived by normalizing on natural logarithm of bilateral Imports: 1960- 2005.**

| | | |
|---|---|---|
| **Ln Colombian imports from Australia** | | |
| Ln Colombian total imports | 0.632 | *(0.01***)* |
| Ln Bilateral real exchange rate | -0.086 | *(0.04*)* |
| **Ln Australian imports from Colombia** | | |
| Ln Colombian population | -25.513 | *(9.59*)* |
| Ln Australian population | -4.472 | *(2.79)* |
| Ln Colombian income | 6.281 | *(2.24**)* |
| Trend | 0.457 | *(0.16**)* |
| Constant | 445.941 | |

The estimated long-term coefficients indicate that Colombian imports from Australia could be reduced through an increase in the real bilateral exchange rate. The series of Colombian total world imports is included in our model since total imports reflect the consistence of bilateral imports with total imports, this relationship is positive. The bilateral real exchange rate is important for Colombian imports from Australia but its elasticity is smaller than the elasticity of total Colombian imports (-0.497 and 2.215, respectively).

In the long-term relationship for Australian imports from Colombia, some of the coefficients of the ECM are much larger than others. *E.g*. the coefficients of the Colombian population (93.501 and -387.618 lag 1 and lag 2, respectively) must have a bigger impact than the Australian income (0.221 lag 2). These results imply that some

variables have more important influence than others, but all of the variables in the model do indeed make a significant contribution. Thus, to eliminate any of the variables in the system would clearly introduce omitted-variable bias. Table 6 shows the error correction mechanism, which is made up of the first differences of the variables included in the long-term model.

**Table 6. Error Correction Model**

| **Ln (Colombian Imports)** | | **Ln (Australian Imports)** | |
|---|---|---|---|
| CointEq1 | 1.153 *(0.24***)* | CointEq1 | -0.957 *(0.13***)* |
| $\Delta LNCM_{t-1}$ | -0.025 *(0.18)* | $\Delta LNAM_{t-1}$ | 0.292 *(0.13)* |
| $\Delta LNCM_{t-1}$ | -0.075*(0.13)* | $\Delta LNAM_{t-2}$ | 0.130 *(0.12)* |
| $\Delta LCTM_{t-1}$ | -1.453*(0.63*)* | $\Delta LCP_{t-1}$ | -93.501*(99.91)* |
| $\Delta LCTM_{t-2}$ | -1.582*(0.61**)* | $\Delta LCP_{t-2}$ | -387.618*(99.41***)* |
| $\Delta LBER_{t-1}$ | 0.821*(0.52)* | $\Delta LAY_{t-1}$ | 11.208*(4.52*)* |
| $\Delta LBER_{t-2}$ | 2.660*(0.60***)* | $\Delta LAY_{t-2}$ | -0.221*(3.94)* |
| *D2* | 2.800*(0.55***)* | $\Delta LCY_{t-1}$ | -5.002*(2.73)* |
| | | $\Delta LCY_{t-2}$ | -9.806*(2.57***)* |
| | | *C* | 11.895*(2.04***)* |
| | | $D_1$ | -1.054*(0.45)* |
| | | *DIE* | -0.386*(0.15*)* |
| R-squared | 0.666 | 0.725 | |
| Adj. R-squared | 0.599 | 0.628 | |
| Sum sq. resides | 13.843 | 5.521 | |
| S.E. equation | 0.629 | 0.422 | |
| F-statistic | 9.954 | 7.443 | |
| Log likelihood | -36.646 | -16.881 | |
| Akaike AIC | 2.077 | 1.343 | |
| Schwarz SC | 2.404 | 1.835 | |

## 4. Discussion and Conclusions

This section aims to discuss the major results of this paper and present some concluding remarks. In this paper, the over 46-year evolution of bilateral imports between Australia and Colombia (from 1960 to 2005) was studied. The objective of the empirical analysis is to test if there is a long-term relationship between the real value of the bilateral imports between Australia and Colombia and several macroeconomic variables were used to model bilateral trade. The variables include the real bilateral exchange rate, income, population, and trade openness of the participating countries.

Unit root tests on each of the time series found that all of these variables are non-stationary. As the majority of the series were integrated of order one, suggesting that cointegration analysis was an appropriate technique. The main conclusion is that there is a long-term equilibrium relationship between Colombian imports from Australia and the following two variables: real bilateral exchange rate and total Colombia world imports. Australian imports from Colombia are cointegrated with three economic series, viz., the incomes from both participating countries and the Colombian population. Australian bilateral imports in the long run also have a negative relationship with a dummy that captures the international events (significant at 10% level). One possible explanation is that there are weak commitments of the bilateral imports and, therefore, the relationship is negatively affected by international events that do not directly involve Australia and Colombia. Examples of such events include: the closing of the Australian Embassy in Venezuela, the Faulkland Islands War and the two oil shocks. The short run indicates that there are 2 lag years significant in bilateral imports. We could not find support for the impact of real bilateral exchange rate, Australian openness, and total Australian world imports in the Australian imports from Colombia.

It seems that economic variables have governed the bilateral trade under review in the long run. However, it is difficult to conclude that the reason for the low bilateral imports between Australia and Colombia is one of just an economic nature. The general impression is that this trade has been characterised by weak commitments from both nations and may have been influenced by external environmental and international events.

The future trade relationship between Australia and Colombia will be influenced by trade reforms promoting free trade and regional integration including the agendas of free bilateral trade agreement and the possibility of the formation of a trade group linking the Americas. Both Australia and Colombia are eager to improve their trade relationships. It is our belief that bilateral trade could improve in the future because of the new trade policy of openness in Australia and Colombia, and the increasing possibility of trading in commodities, investments, and services. The coefficients of the cointegrated variables indicate that there are opportunities to improve trade between the two countries. It seems that the growth of Colombian income could lead the growth of Australian imports from Colombia in the future. On the other side, the growth of Colombian total imports, as a proxy of Colombian openness, could lead the growth of Colombian imports from Australia.

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