# Do International Clearing Unions enhance trade? An empirical evaluation of the Asian Clearing Union*

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## Abstract

The Asian Clearing Union (ACU) is expected to enhance international trade of its member countries without the need for them to hold excessive international reserves, either as assurance or for external trade settlements. This study investigates the effect of ACU (having nine members) on external trade using bilateral trade data of 963 country pairs over a thirty three year period from 1980 to 2013. Accommodating the selection bias caused by zero trade observations, the results of various estimations including Heckman two-step and pseudo poisson maximum likelihood suggests that median trade growth within ACU is lower than their trade growth of the ACU members with non-members within a range of 45 to 68 percent. Results of the study can be generalized to indicate that a clearing system has the potential to obstruct trade in the absence of alternative channels for settlements.

*Keywords*: International Clearing Union, Asian Clearing Union, Trade, Gravity Model, International Trade, Zero trade observations

*JEL Classification*: E02, F00, F02, F15, F33, O19

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# 1 Introduction

Firms in one country can gain competitive advantage over other firms in other countries if they have access to more efficient payment systems (Gourinchas, 2006; Grant, 2017). Domestic settlements rely on a strong inter-bank clearing mechanism. International settlement relies on efficient foreign exchange markets for supply of foreign exchange for timely settlements. In the absence of such efficiencies, firms seek Governments support either for settlements or regulatory forbearance for retaining a competitive edge. Countries in South Asia felt such a need for institutional support in the 1970's as tight controls on flow of foreign exchange restricted the development of efficient international settlement systems. Around this time, the ideas of Keynes (1942), Triffin (1968), Frenkel (1974) for creation of regional clearing arrangements for enabling international trade settlements gained prominence. Such regional clearing arrangements were essentially the traditional model of International Clearing Union (ICU) as postulated by Keynes (1942). ICUs were expected to function in regimes where foreign exchange markets and domestic payment systems were controlled by Government. The ICU for South Asia is called the Asian Clearing Union (ACU) set up in 1974[1]. Its primary objective is increasing regional trade by giving domestic firms a competitive advantage through efficient settlements while conserving foreign exchange reserves by routing "nationally compensable trade[2]" through a net clearing mechanism. ACU has been settling trade for its nine member nations with the underlying assumption that its presence will enhance the international trade among the members. In the last 45 years of operations, numerous reports were published on its conservation of reserves, but no study was done to quantify its effect on trade. The objective of this paper is to empirically estimate the effect of the ACU on the external trade of the

[1] ACU, which was set up in 1974, currently has nine members. These members and the year in which they joined the union are – Nepal, Sri Lanka, Pakistan, Bangladesh, India, Iran (all in 1974), Myanmar (1977), Bhutan (1999) and Maldives (2009).

[2] Nationally compensable trade implies that a country can offset its import dues with export income within the same financial year. Such a country will not be required to use its foreign reserves for making the import payments leading to savings in reserves. See Triffin (1968) for an exhaustive explanation on how nationally compensable trade results in saving of reserves.

members with an expectation that it should be higher as compared to non-ACU members. The study becomes particularly interesting now since ACU continues to exist in the presence of active foreign exchange markets in some of the larger members like India, Pakistan, Bangladesh and Sri Lanka. The study uses bilateral trade data of 963 country pairs covering 174 countries over a thirty three year period from 1980 to 2013 to estimate the change in trade growth caused by presence of ACU. The large sample allows comparison of trade growth within ACU and of ACU members with majority of their larger trade partners and compare it to the trade growth of other similar country pairs that do not rely on ICUs for trade settlement.

After handling the concerns on zero trade observations and endogeneity by using poisson pseudo maximum likelihood (PPML) and Heckman two-step (with the zeroes) specifications, based on a non-random selection model, we estimate the effects of presence of ACU on the external trade of the members. This methodology has been used in studies quantifying the impact of Economic Integration Agreements (EIA) covering regional trade agreements (RTA), customs unions (CU) and currency unions or optimal currency areas (OCA)[3] (For instance see Glick and Rose, 2002; Gómez-Herrera, 2012; MacPhee and Sattayanuwat, 2014; Yang and Martinez-Zarzoso, 2014). Results indicate a substantial causal but negative relation between ACU membership and trade. This suggests that the ACU trade settlement process may be causing trade diversion rather than trade creation. Disaggregated estimates for exports and imports suggest positive (adverse) selection into ACU and point towards self-selection by countries that subscribe to export-led growth theories.

The present study makes two significant contributions to the literature. First, it assesses the effect of a functioning ICU i.e., ACU on the external trade of member countries. Secondly, it provides a generalized framework for assessment of any Payment and Clearing Mechanism on the trade.

[3] RTAs are agreements between countries belonging to the same or different geographical regions, that contain specific conditions for preferential trade liberalization by the members. A customs union (CU) is a type of trade bloc, which is composed of a free trade area with a standard external tariff. An OCA is a geographical region, which shares a single currency to maximize economic efficiency in the entire region. On the other hand, an ICU is a system for settlement of funds between countries on a net basis, with the specific objective of enhancing trade and conserving foreign reserves. ICUs are not concerned with trade barriers, tariffs, etc. but with a settlement of trade.

The remaining paper is organized as follows: Section 2 presents a brief rationale and historical perspective on ICUs followed by a review of the literature in Section 3. Section 4 first talks about the methodological issues in investigating the effect of ICUs on trade and then gives the methodology for empirical evaluation of the impact of ICUs on trade. Section 5 reports and discusses the results and section 6 concludes.

## 2 Rationale and historical perspective on ICUs

An ICU is a multilateral mechanism for periodic settlement of trade, on a net basis, through payments by central banks without relying on any particular country to supply the gross volume of currencies needed for such settlement (Zhou, 2000; Duggan, 2013). A typical example is when a customer in country A imports goods from country B and exports items to customers in Country B, there is a possibility of netting the payments against the receipts. Such a net settlement reduces the requirement of funds for both customers as now only the net of the payments and receipts needs to be paid by either of them. ICU is a mechanism for such periodic net settlements. The first functional ICU was set up immediately after the second world war, when over 200 bilateral agreements between European Countries and the USA caused a multilateral settlement to emerge as banks in each country started netting off their receivable and payable positions (Kaplan and Schleiminger, 1989). ICUs accounted for 54 percent of the total world exports by mid-1990s covering 46 percent of the world population (Auguste, 1997).

## 3 Literature review

Even though trade settlements are now handled through inter-bank payments directly and ICUs have become relics, there is interest in the idea of a global ICU for providing accounting and administrative discipline to the international monetary system. The move to a cashless system of settlement has also been prompting the introduction of ICUs. Correa (2012)

applies a partial equilibrium framework to ICUs and recommends a global ICU for financial intermediation among countries for lending savings of surplus countries to deficit countries. Most researchers accept that the presence of an ICU for trade settlements may presumably benefit trade. Fritz (2012) also finds that such ICUs will lower transaction costs but such lowering will depend on the netting and provision of credit. Apart from benefits to transaction costs and financial stability, Duggan (2013) postulated that ICUs can also facilitate higher foreign direct investments and can alter the prospects of a financial crisis as investors assume a long-term interest in investments. An empirical estimate of these benefits can be found in Auguste's (1997) study that computes the Reserve Saving Effect (RSE[4]) by using trade flows and reserves data of existing ICU members. The study also uses this RSE as a measure of the efficiency of settlement systems within the ICU. In the same line, a recent study by Shekhawat and Kathuria (2016) also computes the RSE for ACU and finds it small but positive. A few other studies focus on the operational framework, extrapolation to the Eurozone or on building counterfactual models (Hein *et al.* 2011; Paus and Troost 2011; Lin *et al.* 2012). The interesting question that remains unanswered is whether such gains from an ICU have been observed in the form of increased trade between the members when compared to the rest of the world. The answer lies in estimating such difference in trade growth in the presence of an ICU.

# 4 Methodology

The objective of the paper is to discern the differential effect of ACU on the trade of its members. In order to meet this ultimate objective, a three step approach was used. In the first step, a suitable model was developed based on the Gravity Model for estimating the trade. In the next step, the data on the variables included in the gravity model was sourced. Some of

[4] RSE is a measure of the reduction in requirement for the members to maintain liquid reserves for meeting external trade obligations. In a simple two country model, if bilateral trade of these two countries is netted, we arrive at net obligation payable by one of the members. The difference between the gross obligation on account of these countries imports and the net obligation is RSE. The measure is more effective in the case of a multi-country netting as in the case of an International Clearing Union.

the data was directly relevant for the estimation like the data on exports and imports, whereas some data for the binary variables was generated using actual data. In the third step, the suitable estimation technique was used that provides reliable estimates for the model.

## 4.1 Model for estimation

There are multiple theories on international trade based on endowment and technological differences, increasing returns to scale and Armington demands. These theories are based on the flow of labour, goods or capital (for example the Ricardian theory of comparative advantage, Samuelson specific factor model, Heckscher-Ohlin model etc.) and are used for estimation of the trade flows. One such model that is used for estimation of trade flows is the gravity model. The Gravity model is preferred as it is simple, intuitive, and can be scaled to include more explanatory variables that improve the estimation power of the model.

Conventional log-linear formulation of the Gravity model is usually used for estimating such differences in trade. The Gravity model states that the trade between two countries is directly proportional to the sum of their GDPs and inversely proportional to the distance between them. The model is preferred because it allows the introduction of additional macro-economic and control variables. In its most rudimentary form, the gravity model assumes that bilateral interactions can be estimated through multiplicative relation of the size of each country and distance effects. A very comprehensive discussion on the Gravity model and its efficacy in estimating the bilateral interaction can be found in Head and Mayer's paper (Head and Mayer, 2013).

## 4.2 Method for handling gaps in data

There remain some issues as it is likely that some countries may not have any trade and hence the data appears zero-valued bilateral trade flows. Such zeros could also appear due to either lack of trade or misreporting. [5] As these zero observations do not occur randomly,

[5] Gleditsch (2002) in his study of trade flows between sovereign states over a 48 year period (1948 to 1996) observed that 25 percent of all observations coded as zeros were, in fact, missing information. The missing data is attributed to misreporting by traders, especially of developing

disregarding zero flows can bias the results. Anderson and van Wincoop (2003) (henceforth, AW) argue a possible solution could be including a multilateral trade resistance term (MRT) in the form of importers and exporters fixed effect. MRT uses a price index as "multilateral resistance" variable in the gravity model that depends on all the bilateral resistances that rise with a rise in trade barriers with all the trading partners. The inclusion of this term in many recent studies (Felipe *et al.*, 2013; Yang and Martinez-Zarzoso, 2014) has yielded consistent estimates.

The other methodological concern is to isolate the effect of ACU in the presence of multiple such agreements that may be affecting bilateral trade. One effective method is to introduce a control group along with the treatment group. Similar to Roy (2014), this study also uses a control group to estimate the effects of ACU on the trade of its members. Kohl (2014) goes a step further and refines the control group by using agreement specific average treatment effects obtained through a fixed-effects version of the gravity equation. The paper finds that traditional estimates of the effect of such agreements tend to be exaggerated if the possibility of endogeneity and phase-in-effects remain unaccounted for. Surprisingly, the study finds that individual country's agreement effect on trade is often zero when endogeneity bias has been eliminated. We use these methods to build the methodology for isolating the estimating the effect of ACU on the external trade of the member countries.

## 4.3 Econometric method for estimation

In terms of estimation techniques, bivariate probit estimates is preferred due to the presence of extensive zero trade observations and a high degree of self-selection bias. (Roy, 2014). Positive estimates for dummy variables, can be interpreted in the context of either Armington (1969) or Krugman (Helpman and Krugman 1985) models.[6]

countries for tax evasion and for evading capital controls (Ferrantino *et al.*, 2009).

[6] The Armington (1969) model disaggregates commodities by country of origin and the import demand is then determined in a separable two-step procedure. The effects of EIA are studied with disaggregation at merchandise and direction of trade levels with a focus on trade between countries that produce specialized products. Krugman's general equilibrium model of non-comparative advantage trade allows examination of aggregate trade data of nations with same tastes, technology, and factor endowments (Helpman and Krugman, 1986). Evaluation of effects of EIA using this model does not distinguish between countries based on product

The paper addresses these issues to get unbiased estimates of the effects of ACU on trade while accounting for observed time-invariant (say distance or language) and time-varying (e.g., GDP) heterogeneity among the trading partners. First, a panel dataset with country-pair fixed effects is preferred as it overcomes the endogeneity problem partly due to the omitted variable bias. This approach has limited success in addressing endogeneity as ACU membership itself should be treated as an endogenous rather than an exogenous determinant of trade (Egger *et al.*, 2011). The paper assumes that ACU membership of one country-pair only affects its bilateral exports.

Second, the log-linearized OLS is estimated on the three-dimensional dataset with importing country, exporting country, and time. The linear gravity equation to be estimated is like that used by AW.

$$\ln M_{ijt} = \beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln d_{ij} + \beta_4 ICU_{ijt} + \beta_5 B_{ij} + \beta_6 L_{ij} + \varepsilon_{ijt} \quad (1)$$

Where $\beta_0$ is the intercept which gives the mean trade (exports plus imports) of the countries, $M_{ij}$ denotes the trade between country-pair *i* and *j* at time *t*, Y denotes their Gross domestic products (GDPs) that proxies the demand and supply sizes, $d_{ij}$ is the distance between the capitals of countries in kilometers. Our key variable, ICU is a dummy which has a value 1 if trading country pairs are members of ICU and 0 otherwise. *B* and *L* are dummy variables that assume value one if trading country pairs have a common border or common language respectively or else 0. $\beta_4$ is the significant differential intercept coefficient for comparing the mean trade between ICU members and non-members. ε is the error term representing the other unaccounted influences on bilateral trade between the two countries over time.

Third, multilateral resistance term (MRT) is added to proxy multilateral trade costs that affect the external trade between countries. This MRT bears some resemblance to the proxy developed by Wei (1996) which is one-fourth the distance of a region's capital from the nearest capital of another region. The inclusion of MRT is crucial as an omission of the

specialization.

relative prices that form a part of GDP, produces biased results. The direction of this bias is unknown if only traded goods prices are included. Baldwin (2006) has explained that "If non-traded goods are idiosyncratically high in these nations, they will be idiosyncratically open and are more likely to engage in pro-trade policies". In such cases the coefficient of ACU will be upward biased. As most ACU members are following pro-export trade policies, especially since 1990s (Wijeweera *et al.*, 2008; Fatima *et al.*, 2011; Felipe *et al.*, 2013) and due to constraints on capital flows to provide for their trade deficits, this may result in over-estimation of the effects of ACU on trade in the absence of MRT that controls for such idiosyncratic bias.

The inclusion of MRT is based on observed variables namely distances, borders and income share and it uses differentiation of goods according to the place of origin to estimate the impact of a border on provincial trade. In AW's model, each country specializes in the production of few goods and consumers' preferences are assumed as identical. This method is more efficient due to its ability to factor in multilateral price indices. However, it is highly data consuming as it requires price indices for individual goods and hence has not frequently been used. We employ the alternative suggested by Gomez-Herrera (2012) that use both importing and exporting countries GDP to proxy transaction costs. As per this, MRT for a country pair $i$ and $j$ at time $t$ will be

$$MRT_{ijt} = \sum_{j=1}^{n} \frac{d_{ij}}{(y_j t \,/\, y_{(row)t})} \tag{1a}$$

$$\ln MRT_{ijt} = \ln d_{ij} + \ln y_{(row)t} - \ln y_{jt} \tag{1b}$$

Where n is number of countries trading with country $i$, $d_{ij}$ is the distance between the major cities of the country pairs and $y_j$ is country j's GDP share of rest of the world. Including the term in equation (1) above gives

$$\ln M_{ijt} = \beta_0 + \beta_1 \ln y_{it} + \beta_2 \ln y_{jt} + \beta_3 \ln d_{ij} + \beta_4 \ln MRT_{ijt} + \beta_5 ACU + \beta_6 B_{ij} + \beta_7 L_{ij} + \varepsilon_{ijt} \tag{2}$$

Equation 2 is estimated first with standard panel techniques for random / fixed effects and Tobit for isolating the effects of ACU as has been done in numerous previous studies (see for example, Frankel 2008; Mohsin and Rivers 2011; Prasai 2014). The idea is to first obtain standard estimates and thereafter address the issues of heteroskedasticity and zero trade observations that are quantitatively and qualitatively important, by applying other maximum likelihood estimations (Martínez-Zarzoso 2013).

In terms of the issues in the dataset being analyzed, we find that thirty-six percent of the values in our dataset with 30,186 country pairs is zero, and their elimination is likely to lead to sample selection bias (Westerlund and Wilhelmsson, 2011). Santos Silva and Tenreyro (2006, 2011) postulate that poisson pseudo maximum likelihood (PPML) method estimates the gravity equation avoiding the zero-valued observation and the observed heterogeneity. The method also avoids the under-prediction of large trade volumes and flows by generating estimates of trade flows. The PPML estimates the slope coefficient β ( $\beta \in \beta_{1\ to\ n}$ ) for all explanatory variables $x_{ijt}$ ($x = \{y_{it}, y_{jt}, B_{ij}, L_{ij}, d_{ij}, y_{row}\}$) by solving the first order condition for equation 2.

$$\sum_{i=1}^{n}[\, M_{ijt} - e^{x_{ijt}\beta}]x_{ijt} = 0 \qquad (3)$$

The equation 3 now represents a PPML estimator for the gravity model.

Heckman's two-step sample selection model also tackles the problem of zero trade observations and the sample selection bias. Unlike the truncation and OLS methods that treat zero flows as nonexistent, Heckman's model considers them to be unobserved. The model estimation identifies if a variable (e.g., geographic distance, different language, etc.) reduces potential bilateral trade to zero. In such cases, the OLS regression could underestimate the effect of such a variable on trade, and the correlation between the disturbance terms of both equations in the selection model will be positive. A positive value of the variable causes the disturbance term in the selection equation to be positive (Greene, 2010). As a result, the observed trade will be expected to be higher than potential trade. The Heckman model estimator is found to exhibit the most desirable properties by adjusting for the sample selection bias by treating the zero as unobserved rather than as non-existent. The outcome of the

first step (Probit equation) and the second step results of the inverse Mills ratio are used to confirm the existence of a sample selection bias.

In the next step, we decompose the impact on trade volumes into their import (import volume) and export (export volume) components. Such decomposition is done with country-level data for trade flows. We use country-level data since a substantial proportion of trade adjustment takes place at the export level? and as we cannot obtain consistent firm-level data with export destinations for many countries in the sample. Helpman (2008) recommended a similar method where the number of exporting firms is used as to proxy for the export trade. The measure of import trade is estimated as volume traded per firm. We use a simplifying assumption of equating import volume to import trade instead.

## 4.4 Data

Data used for gravity model is annual data from 1980 to 2013. International Financial Statistics (IFS) and Direction of Trade (DoT) dataset compiled by the IMF are the sources of data. Exports are reported as free-on-board (FOB), and imports are on cost-insurance-freight (CIF) basis. We could not include Myanmar and Maldives for the analysis. This is because of significant gaps in data for Myanmar. Maldives is excluded as it joined the ACU in 2009 only and moreover, it has a very low trade. The trade of Maldives in 2013 was USD 1.65 billion as compared to India's trade of USD 467 billion (i.e., 0.35 percent of India's trade). Bhutan has also been excluded due to lack of data and the fact that the Indian Rupee is used for trade settlements, converting it into an implicit currency union rather than a payment union.

The, six ACU countries namely Bangladesh, Islamic Republic of Iran (henceforth Iran), India, Nepal, Pakistan, and Sri Lanka are paired with 165 other countries for cross-sectional purposes. Of these countries, 27 countries pairs are excluded as there was no trade observed between these countries and the six ACU members during the study period. The list of countries used in the analysis classified based on their per capita GDP are listed in Appendix A. The data on bilateral trade is an aggregation of the export and import data as reported in DoT converted to SDR using the USD per SDR rates from IFS.

Before we carry out the analysis, this section gives a brief description of

the ACU mechanism. United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) set up ACU with cooperation from the central banks and monetary authorities of India, Iran, Nepal, Pakistan, and Sri Lanka in December 1974. The ACU started its operations in November 1975 with its headquarter in Tehran. Bangladesh and Myanmar are the sixth and seventh signatories to this agreement. Bhutan and Maldives joined in 1999 and 2009 respectively. Table 1 reports the select critical economic indicators of the member countries.

Table 1. Select critical indicators of ACU members from 1980 to 2013

| Country | GDP (Billion USD -2013) | Average GDP Growth rate (1980-2013) | External Trade (Exports and Imports) (Billion USD –End 2013) | Foreign Exchange Reserves (Million USD –End 2013) | Average Exchange Rate Change per annum* | Average IMF Credits & Loans Outstanding (Million SDRs) |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Bangladesh | 150 | 7% | 76.0 | 16,580 | 5% | 376 |
| Bhutan | 2 | 8% | 1.5 | 980 | 7% | 0 |
| India | 1861 | 7% | 778.0 | 267,703 | 7% | 1325 |
| Iran | 493 | 5% | 131.0 | 93,950 | 93% | 0 |
| Nepal | 19 | 7% | 8.7 | 5,230 | 7% | 31 |
| Maldives | 3 | 14% | 2.0 | 381 | 3% | 2 |
| Sri Lanka | 67 | 9% | 36.6 | 6,522 | 7% | 404 |
| Pakistan | 232 | 7% | 71.0 | 4,306 | 7% | 1587 |

Data Source: IFS and World Bank Database.

*Notes:* * All member countries have witnessed depreciation of their currencies over the 33-year period.

As per Table 1, India is the leading member of the ACU with its GDP (Column 1) and external trade twice that of all other members put together. The average GDP growth rate (column 2) experienced by all the nations is similar (except for the Maldives) during the period of the analysis. The share of external trade (column 3) is higher for the countries with low GDP and vice versa. For example, Bhutan exported three-fourth (≈ 75 percent) of its GDP while India's exports were only 40 percent of its GDP in 2013. Countries with a higher external trade to GDP ratio maintain higher foreign exchange reserves (column 4). Again, India has the maximum foreign exchange reserves in the group indicating its ability to be the single most significant creditor. The similarity in the adjustment of

exchange rates (column 5) indicates that all countries are prone to similar external flows. The high depreciation of Iranian Rial as indicated in the table is due to financial sanctions imposed on them by the United Nations. Average outstanding IMF loans and credits reflects vulnerability to external flows requiring these countries to borrow from IMF (column 6). India and Pakistan have the maximum average outstanding loans while Bhutan has not availed any such loans. The mean values indicate the similarities among these countries in reliance on foreign exchange reserves and external capital for their sustenance.

# 5 Results and discussion

## 5.1 Descriptive statistics

Before we see the impact of ICU on external trade, we compare the ACU members with other sovereign countries. Table 2 gives the comparison. Columns 1 and 2 compare all 9 ACU members with 165 sovereign countries, whereas columns 3 and 4 give comparison only of the sample countries (6 ACU members against 138 other countries). The sample excludes 3 ACU members (Myanmar, Bhutan and Maldives) due to their irregular and relatively small value trade. Similarly, 27 countries[7] with zero trade for the entire period from 1980 to 2013 with the ACU members were excluded.

[7] Angola, Antigua & Barbuda, Bosnia and Herzegovina, Botswana, Central African Republic, Hong Kong, Congo, Côte d'Ivoire, Dominican Republic, Ecuador, Equatorial Guinea, French Polynesia, Gambia, Jamaica, Lebanon, Lesotho, Macedonia, Maldives, Myanmar, Namibia, South Africa, St. Kitts and Nevis, St. Vincent and the Grenadines, Syrian Arab Republic, Venezuela, República Bolivariana de, Bhutan have been excluded from the sample as their trade with ACU members has been zero for majority of the period.

Table 2. Comparison of ACU versus non-ACU member countries: 1980 to 2013

| Variables | ACU Members (9 countries) (1) | Non ACU Members (165 countries) (2) | Selected Sample | |
|---|---|---|---|---|
| | | | ACU Members (6 countries) (3) | Non ACU Members (138 countries) (4) |
| Average Trade (exports+ imports) (Million SDR) | 144 (608) | 110* (765) | 179 (686) | 166 (958) |
| Average GDP (In million SDR) | 116 (188) | 1110* (14200) | 110 (185) | 1020* (15900) |
| Distance (Kilometers) | 2262 (1333) | 5040* (2724) | 1420 (664) | 5318* (2736) |
| Land Border[a] | 27% | 1% | 27% | 0.01% |
| Common Language[a] | 30% | 11% | 30% | 13% |
| Foreign exchange reserves (Billion USD as in 2009) | 33.5 (82.3) | 47.2* (202.9) | 33 (82) | 47*(200) |
| Observations | 2144 | 29344 | 1472 | 23264 |
| Zero observations for Trade | 504 [≈24%] | 19198 [≈65%] | 384 [≈18%] | 14684 [≈50%] |

*Notes: a* is the percentage of countries with common language or shared land border within the group; * indicates statistical significance at minimum 5%. Standard deviation is in parenthesis. Figures in brackets are percentage of the total observations.

As can be seen from Table 2, the mean value of trade (row 1) among non-ACU members is significantly different from intra-ACU trade. A t-test comparing the mean values of GDP (row 2) shows that the difference in GDP of the two groups is also statistically significant. The members have much lower GDP than the non-member countries. The mean distance between capital cities (row 3) of the ACU members is significantly less than the distance between capital cities of the rest of the world. Row 4 shows that 27 percent of the ACU country pairs or half of the countries in ACU share land borders while randomly created country pairs share land borders only in one percent of the cases. Similarly, it is observed (row 5) that 30 percent of the ACU members' pairs share a common language or 60 percent of the countries have similar languages spoken compared to only 11 percent for the rest of the country pairs. The foreign exchange reserves of ACU members are also significantly lower than that of the non-members. The summary statistics, however, indicate selection bias on observables into the ACU. For example, ACU members prefer to trade more with each other despite having lower average GDP and are more likely to share border and language than the rest of the world. ACU may also be helping them to have lower foreign exchange

reserves.

Last row of Table 2 gives the number of observations for zero trade flows for ACU and non-ACU members. The percentage of observations rises from 18 percent for ACU members to 50 percent for non-ACU members (selected sample), which is expected. On a theoretical premise, even 18 percent observations with zero trade flows challenge the natural trading partner hypothesis according to which preferential trade agreements are formed among countries that are naturally predisposed to trade with each other. The zero trade between ACU members is better explained by Schiff (2001) that volume of trade is not an objective measure of natural trading partners or selection into an agreement like ACU. The author postulates that comparing volumes of trade before and after an EIA is not a useful criterion for selecting a partner as the pre-agreement volume is equal to zero if they settle trade bilaterally without exchange of currency and it is indeterminate if the partner exports that good (p. 258). Thus, one cannot conclusively argue that ACU will increase the trade among member countries. Analogously, one cannot say that such agreement adversely affects the welfare. Firms in larger countries may be agnostic to EIAs as they would prefer to satisfy their import demands from world markets rather than from agreed partners. Correspondingly, any EIA like ACU is likely to be better off if each country imports what the other exports. It is interesting to note there are a few instances where the ACU members move from zero to positive trade in the post-ACU period. To give an example, Bhutan and Bangladesh had zero trade in 2008, which increased to USD 7.74 million in 2009 after Bhutan joined ACU.

These mean statistics caution against drawing any inferences without accounting for the bias. Table 3 presents the results of different linear and maximum likelihood models to deal with the zero trade observations to get unbiased and consistent estimates for trade because of ACU membership. Similar estimates for EPU for the period from 1949 till 1959 are given in Appendix B.

## 5.2 Gravity model results

The results of pooled OLS estimation of the Gravity equation in the log-linearized form to see the impact of ACU on trade is given in column 1 of Table 3. Validity of a log-linear gravity model however hinges on the

homoscedastic assumption, as the error term should be statistically independent of the regressors. As is often observed (and verified by our data in the last row of Table 2), trade between any two randomly chosen countries can be zero during a selected period. For such situation, Tobit model is applied to deal with zero-valued trade flows by censoring the dataset (Andersen and Marcoiller 2002; Rose 2004). Even though the model censors zero trade flows that may significantly influence the regression results, we apply it if all zero trade observations are merely omissions and not absence of trade. The PPML method suggested by Santos Silva and Tenreyro (2006) for maximum likelihood is employed (column 5). Except for the PPML, all models use semi-logarithmic equations and are estimated using clustered robust standard errors. PPML is estimated using nominal trade values with GDP in millions of SDRs and distance in kilometers.

Table 3. Results of alternative estimation methods
– Testing the effect of ACU on Trade

| Sr | Estimators | Pooled OLS | Tobit | Panel | | PPML | Heckman two-step & |
|---|---|---|---|---|---|---|---|
| | | | | Random | Fixed | | |
| | | (1) | (2) | (3) | (4) | (5) | (6) |
| 1. | $GDP_i$ | 0.8 (0.0)*** | 1.0 (0.02)*** | -0.0 (0.1) | -0.2 (0.0)*** | 0.0 (0.0)*** | 0.96 (0.0)*** |
| 2. | $GDP_j$ | 1.8 (0.0)*** | 2.4(0.01)*** | 3.0 (0.1)*** | 2.8 (0.0)*** | 0.0 (0.0)*** | 1.4 (0.0)*** |
| 3. | Distance | -2.5 (0.1)*** | -4.4 (0.0)*** | -3.8 (0.2)*** | -2.9 (0.2)*** | -0.01(0.0)*** | -3.1 (0.0)*** |
| 4. | MRT | 1.3(0.1)*** | 1.7(0.06)*** | 2.9(0.1)*** | 2.9(0.0)*** | -0.38 (0.01)*** | -0.9 (0.0)*** |
| 5. | ACU | -0.8 (0.1)*** | -0.9(0.2)*** | -0.5 (0.5) | -6.5 (0.5)*** | -0.6 (0.00)*** | -1.14(0.0)*** |
| 6. | Land border | -1.2(0.2)*** | 2.7(0.1)*** | -0.1 (0.8) | -3.8 (0.5)*** | -0.3 (0.2) | -1.1(0.0)*** |
| 7. | Language | 2.0 (0.12)*** | 2.8(0.11)*** | 3.7 (0.4)*** | -1.4 (0.5)*** | 0.8 (0.10)*** | 1.5(0.0)*** |
| 8. | Constant | -47.5(1.4)*** | -56.3(2.0)*** | -77.5 (2.1)*** | -73(1.7 )*** | 20.0 (0.2)*** | -26.3(0.0)*** |
| 9. | N | 18,016 | 20,906 | 18,016 | 30,186 | 30,816 | 30,186 |
| 10. | $R^2$ | 0.46 | 0.10 | 0.26 | 0.79 | 0.45 | 3,500(0.0)# |
| 11. | AIC | 94,340 | 1,43,379 | - | 1,39,354 | 91,08,993 | - |
| 12. | BIC | 94,395 | 1,43,446 | - | 1,39,379 | 91,09,042 | - |

*Notes:* ***,**,* indicates significance at minimum 1%, 5% and 10% levels respectively; Standard error is in parenthesis; # is p-value for the chi-square. & has mills lambda of 3.5 and P>|z| = 0.000 where the exclusion restriction was based on the GDP of the pair of countries; ~ indicates that these coefficients are omitted due to collinearity in a country pair and time fixed OLS. The coefficients have been estimated using country-pair fixed effects.

The pooled OLS estimation of equation (1) is specified as censored OLS and hence the constant $\beta_0$ represents the entire zero trade observations. The model assumes the error term to be linearly and independently distributed with zero mean and constant variance $\varepsilon \sim N(0, \sigma^2)$. As the regression excludes the zero trade observations, the dispersion of the error term indicates a strong bias towards the countries with low or zero trade.

As postulated, we find that for pooled OLS estimates (column 1) trade increases with GDP and decreases with physical distance. As expected, sharing a common language has positive effect on trade. The remoteness variable (MRT) and border both have significantly negative coefficients contrary to the theory. This implies that the increase in remoteness and having no common border contributes to more trade. One possible reason could be that many bordering countries including ACU members have been involved in border / military conflicts resulting in decline in trade (Forhad, 2014). Our crucial variable, ACU also comes up with opposite (negative) sign and is statistically significant. However, given the problem discussed earlier this result may be biased. On the other hand, the Tobit model (column 2) overestimates the effects (due to exclusion of zero trade observations), as the coefficients values are higher than as obtained in OLS estimations. Differing from the OLS results, Tobit estimates that having a common border significantly contributes to border trade. The panel fixed and random effects (column 3 and 4) models rely on the presence of longitudinal data with constant mean and variance. While several coefficients are statistically significant in both cases, Hausman test ($Chi^2(3) = 1039.45$; $Prob>Chi^2 = 0.000$) suggests that the initial hypothesis that random-effects adequately model the individual-level effects is rejected. The results are however biased as they are affected by the presence of zero trade. Similar to Gomez-Herrera (2012), we also find that different estimation technique affects the magnitude but not the sign of the parameters. For all the models except Tobit, the coefficients of the GDP elasticity (rows 1 and 2) of ACU member countries is far below the theoretical value of one. In the case of Random effect estimation (column 4), it is statistically insignificant also. Coefficients of GDP for partner countries is significantly higher than one. A comparison of the standard error indicates that PPML exhibit the least standard errors, except in the case of ACU and land border. This suggests that their estimates are more

accurate than all other tests except the Heckman two-step procedure.

Interpretation of these coefficients is required to be done based on whether they are dichotomous or continuous. Continuous variables indicate the rate of increase on trade for a unit change in the GDPs or distance. The coefficient of dichotomous or dummy variable (ACU, Land border and Language) indicates the discontinuous effect on trade of the presence of ACU membership or sharing a border or speaking the same language. The Tobit estimator (column 3) shows that rho[8] is not zero. It implies that the panel-level variance component is essential, and the panel estimator is different from the pooled estimator. The Akaike's Information Criterion (AIC) and the Bayesian Information Criterion (BIC) given in rows 11 and 12 of Table 3 are information-based criteria that assess model fit. Typically, when comparing the values for two models, the model with the smaller value is considered a better fit. However, results of different estimation methods may not be comparable at all as they differ in the definition of observations. For instance, the pooled OLS uses independent observations and Tobit model assumes independent panels.

Instead of using AIC or BIC, we prefer the estimators that have the least standard errors. As can be seen from the table, PPML estimators have the least standard errors[9], the coefficients are efficient even when the dependent variable is affected with measurement errors and excessive zeros (Santos Silva and Tenreyro, 2006). PPML estimator is well behaved even when it is far from being optimal and appears more robust to departures from the implicit heteroskedasticity assumptions (Santos Silva and Tenreyro, 2006). PPML can deal with zero trade flows except where the dependent variable is contaminated with excessive zeros. Given the high incidence of zero trade observations (Appendix C), which are not random, for some of the countries, the coefficients of ACU, land border and language generated using Heckman two-step (column 6 of Table 3) are considered theoretically sounder.

The appropriate impact of the dichotomous variables can be calculated using the transformation given by Halvorsen (1980).[10] As per Halvorsen,

[8] rho is the correlation between the errors in the two equations

[9] The standard error (SE) of PPML estimators is the lowest for GDP, Distance and MRT estimator (SE<0.01). SE for coefficients of ACU, Land border and Language is lowest in Truncated OLS estimation (SE<0.01).

[10] The conversion is needed as unlike continuous variable, interpretation of a dichotomous variable is not possible by multiplying it by 100. This is because the derivative of the dependent

the consistent and unbiased estimator for these variables is estimated by [exp($\hat{c}$) - 1] where $\hat{c}$ is the estimator. Based on coefficient value, the ACU member may experience a 68 percent decline ($e^{-1.14} - 1 \approx 68\%$) in its external trade when other factors are considered.[11] A commonality of language enhances the trade by 325 percent while the increase in distance by 1 kilometer reduces the trade by 0.01%. Presence of border significantly enhances the trade prospects for most of countries. PPML based coefficient values for ACU indicate that its members may experience a decline of 45 percent ($e^{-0.6} - 1 \approx 45\%$). Commonality of language contributes to an increase in trade while land border impairs trade by around 25%. We also carried out analysis for EPU members. Incidentally, the findings for EPU (Appendix B) are opposite to what we find in the case of ACU. The results of EPU find similar significant effect of GDP, distance and language. However, EPU is found to have a significantly positive and substantial impact on trade. EPU impact on trade is favorable, as its members strictly enforced trade flows of the Union with the ultimate objective of maximizing reserve savings and minimizing persistent trade imbalances.

Decomposing the trade into export and import components would provide further evidence on the impact of ACU on external balances. The methodology for estimation of the PPML and Heckman two-step selection is the same as used above except that the trade is now distinctly examined as exports and imports. Table 4 indicates that ACU settlements do not uniformly affect trade, as the effect is mainly on import (row 1).

Table 4. Effect of ACU on import and export

| S. No | Estimators | PPML (1) | Heckman two-step (2) |
|---|---|---|---|
| 1. | Import | -1.0 (0.2)** | -0.7 (0.12)** |
| 2. | Export | -0.15 (0.81) | -0.1 (0.14) |
| 3. | Number of Observations | 30186 | 30816 |
| 4. | Number of censored Observations (Zeros) | 0 | 8323 |

*Notes:* ***,**,* indicates significance at 1%, 5% and 10% levels respectively; Standard error is in parenthesis.

variable for dummy variable does not exist.

[11] Similar negative coefficient are obtained by Gómez-Herrera while examining the effects of RTAs on trade.

The negative and significant association is similar in magnitude for ACU as a group in the sample. The decline in import (row 1) is higher than export (row 2) in the presence of ACU. In other words, ACU has been detrimental to trade but it has caused imports to decline more than exports. The result suggests that ACU members have higher propensity to export rather than engage in bilateral trade. This conclusion is essential as ACU mechanism leads to higher reserve savings for countries where exports exceed imports. Hence, the bias for higher export as firms in each country augment their export abilities by export production.

# 6 Conclusions

ICUs are expected to facilitate international trade to settle without the need for members to hold excessive foreign reserves, either as assurance or for trade settlements. This paper looks at the role of ACU having nine members in enhancing trade. This is examined in two stages. First panel estimates using different techniques are carried out for ACU's effect on bilateral trade over a thirty three year period from 1980 to 2013 for six members for which consistent data is available. Subsequently, the effect is investigated for both - the import and export. The various methodologies used in the paper are to accommodate excessive zero trade observations and the self-selection bias that affects data in any such trading arrangement.

ACU share the characteristics with other trade cost proxies like distance, common land border etc., whose effects on bilateral trade are conceived to be susceptible to selection bias. Paucity of reliable instruments to characterize these characteristics amplifies the bias causing overestimation of the effects. The Heckman two-step and pseudo poisson maximum likelihood (PPML) procedures efficiently estimate that median trade growth within ACU is lower than the trade growth of ACU members with non-members within a range of 45 to 68 percent. Past studies find a similar negative causal relationship between government / institutional intervention and external trade. The intuition is that foreign exchange markets are driven by dynamic interaction between hedging requirements, demand / supply positions and speculative interests of various participants

in the market. Institutional arrangements like ICUs limit this participation by recognizing only trade-related flows as critical for settlements. This motivates sizeable foreign exchange traders to divert their trade settlements to more unregulated markets promoting trade diversion to more unstructured market settlement systems.

The study could have used Helpman, Melitz, and Rubinstein (2008) generalized gravity equation to decompose the impact on trade volumes of all trade resistance measures into their intensive (trade volume per firm) and extensive (number of exporting firms) components. This study is however limited by the existing dataset that does not contain data on entry regulation measures for country pairs. Future work can extend the dataset to include indicators for fixed-costs for country pairs. Attempt can also be made to isolate the effects of infrastructural factors like development of telecommunication, correspondent banking network, and trade financing options on ACU members.

Concerning other findings, countries within the region that share a common language are more likely to benefit from higher trade. Border disputes are found to adversely affect the trade in the region. These findings are contrary to findings for EPU, where the settlement mechanism caused its members' external trade to rise significantly.

From a policy perspective, the findings suggest that the decision for gaining membership to an ICU may depend on whether the country intends to conserve reserves (as found by earlier studies, see for example Auguste (1997); Shekhawat and Kathuria (2013)) or wants to enhance trade, as achieving both is not feasible. Existing ACU members may consider expansion of its membership to augment their reserve savings but new entrants may not benefit from higher trade growth.

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# Appendix A

## Countries in the sample grouped based on per capita GDP

| Low Per capita GDP | Middle Per capita GDP | Middle Per capita GDP | Middle Per capita GDP | High per Capital GDP | High per Capital GDP |
|---|---|---|---|---|---|
| Burundi | Senegal | Iran, I. R.* | Swaziland | Poland | Italy |
| Malawi | Kenya | St. Vincent & Grenadines | Egypt | Chile | United Arab Emirates |
| Liberia | Kyrgyz Republic | Belarus | Morocco | Uruguay | Japan |
| Congo, DR | Pakistan* | Azerbaijan | Congo, Republic of | Hungary | United Kingdom |
| Niger | Mauritania | Colombia | Georgia | Croatia | France |
| Ethiopia | Myanmar* | Botswana | Indonesia | Latvia | Germany |
| Central African Rep | Cameroon | South Africa | Guatemala | Lithuania | Belgium |
| Madagascar | Lao, P. D. Rep. | Dominica | Guyana | Barbados | Iceland |
| Guinea | Yemen, Republic of | St. Lucia | Mongolia | Estonia | Kuwait |
| Gambia | India* | Bulgaria | Armenia | Trinidad and Tobago | Canada |
| Mozambique | Ghana | Maldives* | Ukraine | Slovak Republic | Finland |
| Rwanda | Djibouti | Grenada | Paraguay | Czech Republic | Singapore |
| Togo | Sudan | Suriname | Cape Verde | Malta | Austria |
| Guinea-Bissau | Vietnam | Costa Rica | El Salvador | Oman | United States |
| Uganda | Solomon Islands | Mauritius | Tonga | Bahamas, The | Netherlands |
| Sierra Leone | Zambia | Romania | Samoa | Saudi Arabia | Ireland |
| Nepal* | Nicaragua | Panama | Fiji | Portugal | Sweden |
| Burkina Faso | Papua New Guinea | Malaysia | Tunisia | Bahrain | Australia |
| Mali | Moldova | Mexico | Albania | Korea | Denmark |
| Haiti | Honduras | Gabon | Bosnia & Herzegovina | Slovenia | Switzerland |
| Benin | Bhutan* | Turkey | Jordan | Greece | Qatar |
| Zimbabwe | Nigeria | Libya | Belize | Cyprus | Norway |
| Tanzania | Bolivia | Kazakhstan | Macedonia | Spain | Luxembourg |
| Comoros | Philippines | Brazil | Algeria | Israel | |
| Bangladesh* | Sri Lanka* | Russian Federation | Thailand | New Zealand | |
| Tajikistan | | Argentina | | Brunei Darussalam | |
| Cambodia | | Seychelles | | | |
| Chad | | Venezuela | | | |
| Lesotho | | Iraq | | | |
| | | Peru | | | |

*ACU Members

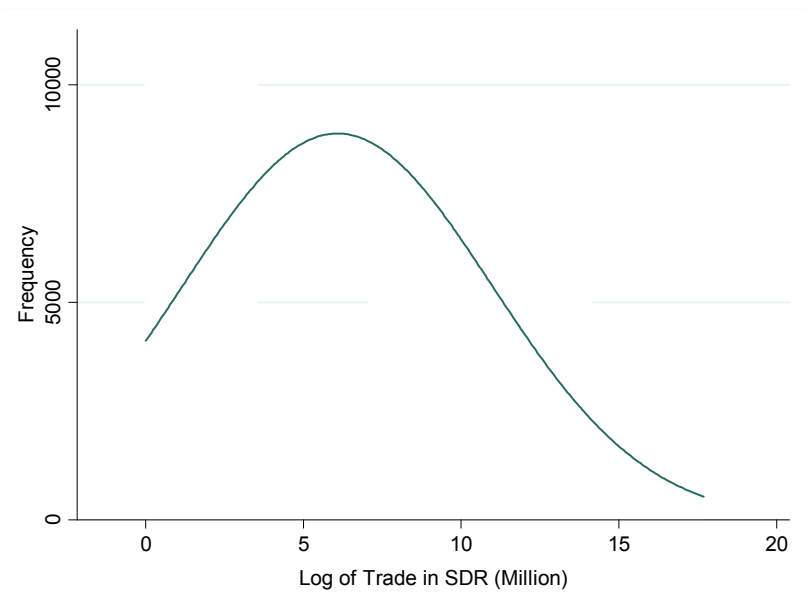
# Appendix B

## Parameter estimates of panel regression using gravity equation for EPU

| | Pooled OLS | Tobit# | Random Effect | Fixed Effect | PPML |
|---|---|---|---|---|---|
| ln $GDP_i$ | 1.0(0.0)*** | 0.9(0.0)*** | 0.6(0.0)*** | 1.0(0.0)*** | 0.0(0.0)*** |
| ln $GDP_j$ | 0.8(0.0)*** | 0.8(0.0)*** | 0.6(0.0)*** | 0.8(0.0)*** | 0.0(0.0)*** |
| ln Distance | -1.0(0.0)*** | -0.9(0.0)*** | -1.0(0.0)*** | -1.0(0.0)*** | -0.0(0.0)*** |
| EPU | 0.7(0.0)*** | 1.2(0.0)*** | 2.7(0.1)*** | 0.7(0.0)*** | 2.3(0.0)*** |
| Land border | 0.2(0.0)*** | 0.4(0.0)*** | 1.0(0.1)*** | 0.2(0.0)*** | 1.3(0.0)*** |
| Language | 0.7(0.0)*** | 0.7(0.0)*** | 0.4(0.1)*** | 0.7(0.0)*** | 0.1(0.0) |
| Constant | -24.2(0.2)*** | -24.9(0.1)*** | -10.2(0.4)*** | -24.2(0.2)*** | -0.5(0.0)*** |
| Observations | 219558 | 218087 | 219558 | 219558 | 219558 |
| R Square | 0.53 | 0.15 | 0.47 | 0.31 | 0.33 |

*Notes:* *** indicates level of significance at 1%; Standard error is in parenthesis; # left censored at trade < 0

# Appendix C




Frequency distribution of Log of Trade between country pairs