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An Overview of Bayesian Approach for Economists

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Introduction

Bayesian analysis is essentially based on the well-known conditional probability theory formulated by Reverend Thomas Bayes (1702-1761). Further, contributions to these ideas, particularly in terms of inverse probability, were made by Pierre-Simon Laplace (1749-1827). Bayesian approach allows us to associate probability to statistical problems thereby enabling us to use mathematical tools to update our beliefs about random events considering new data or evidence about such events. However, the use of Bayesian methods was not widely evident in the second part of the 19th century and it was partly due to the unavailability of proper methods to handle prior probabilities effectively. During the first half of the 20th century the focus was on a very different theory, now called frequentist statistics. The modern Bayesian analysis tends to flourish in the 2nd half of the 20th century, pioneered by Jimmy Savage in the USA and Dennis Lindley in Britain. Bayesian inferences, however, were not easy to implement until the late 1980s and early 1990s when personal computers with adequate computational power became widely available and affordable. The subsequent sharp interest inspired in Bayesian concepts led to extensive research in Bayesian applications to answer demanding questions in many disciplines including machine learning, weather forecasting, structural bioinformatics, health care, astrophysics, risk assessment as well as in economics. Today, Bayesian analysis is being taught in great depths in many of the leading universities in the world.

The adaptation of Bayesian concepts to econometrics was pioneered by A Zellner in 1960s and his early contributions are published in the highly influential book *Introduction to Bayesian Influence in Economics*, Zellner (1971). Poirier (1989, 1992 and 2006) described the penetration of Bayesian articles in econometrics and statistics journals, by examination of individual articles and classifying each as Bayesian or non-Bayesian. By the beginning of the new millennium, Bayesian methods were introduced in estimating and evaluating the Dynamic Stochastic General equilibrium (DSGE) models which are the workhorse models in modern macroeconomics.[1]

An Overview of Bayesian Approach

Bayesian approach is founded on a few simple rules of probability and it is one of the main advantages of the approach. A researcher or an econometrician may be interested in estimating

1 Among others, DeJong, Ingram, and Whiteman (2000), Schorfheide (2000), and Otrok (2001) were the first papers that used Bayesian techniques to estimate DSGE models.

parameters of a model, comparing different models or making predictions of a model; all of which involve a great deal of the same rules of probability. As such, Bayesian method is a generic approach which can be applied in any instance where the researcher is interested in learning about a phenomenon using data.

To illustrate the underline thinking of the approach, let us consider two random variables, A and B. Then, the conditional probability of A given B (i.e. the probability of A occurring conditional on B having occurred) is given by,

$$P(A|B) = P(A \cap B)/ P(B) \qquad (1)$$

where $P(A \cap B)$ is the joint probability of occurrence of A and B and P(B) is the marginal probability of B. The equation (1) tells us that the probability of an event A given B equals the probability of A and B happening together, divided by the probability of B.

As an example, let us think about two sets A and B which are overlapping with each other (See Figure 1). We are interested in calculating the probability of A, given B has already occurred. Let *the happening of event* B be represented by making it brown in colour. Since the event B has already taken place, the part that could influence A is the dark brown section which is $A \cap B$ and accordingly, the probability of A given B is given by, $P(A|B)$ = Dark Brown Area/ (Dark Brown Area + Light Brown Area) and this gives rise to the equation (1) above.

Alternatively, we can reverse the roles of A and B and find an expression for the joint probability, as follows:

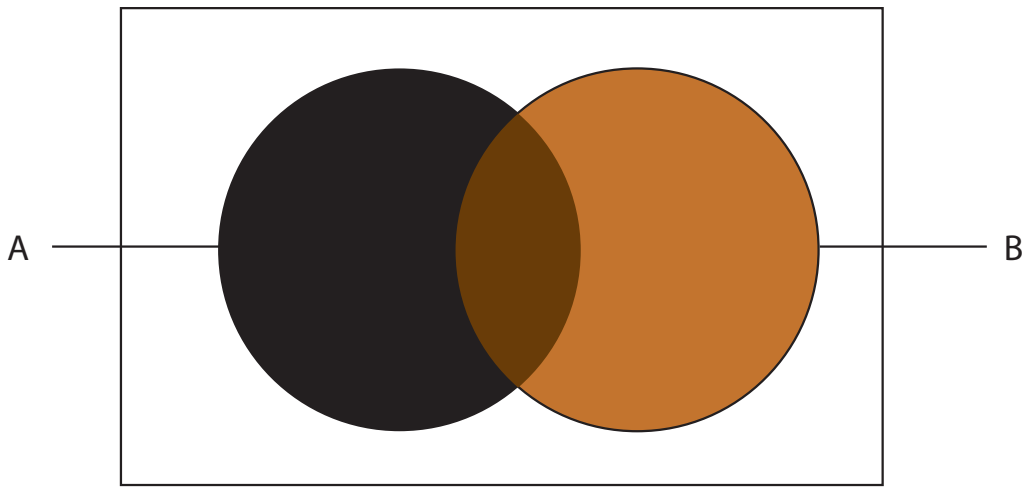
$$P(B|A) = P(A \cap B)/ P(A) \qquad (2)$$

By equating $P(A \cap B)$ in the above two equations and rearranging the terms provides us with Bayes' rule, which lies at the heart of Bayesian statistics:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)} \qquad (3)$$

To demonstrate the use of Bayes' rule, let us consider an example of picking a card form a traditional card pack, randomly. Assume that we

Figure 1: The Venn diagram depicting sets A and B



are interested in the probability of the card being a King, given that we know the card is a face-card.[2] Accordingly, let us assume that picking a King be event A and card being a face-card be event B. Thus, P(A|B) in the equation above can be presented as P(King|face-card) and this is the probability which we are interested in. As per the equation (3) above, we should determine, P(B|A), P(A) and P(B) in computing P(King|face-card). In this example, P(A) = P(King) = 4/52, since there are four Kings in a pack of cards. P(B) = P(face-card) = 12/52 for the reason that there are 12 face-cards in a pack of 52 cards. Further, the conditional probability P(B|A) = P(face-card|King) = 1 for the simple reason that a King is obviously a face-card. Hence, substituting these numbers into the equation (3) above, we get P(A|B) = P(King|face-card) = 1/3 which is the probability of the selected card being a King, given that we know the card is a face-card. Accordingly, *the probability of picking a King* is substantially different from *the probability of picking a King given that the it is a face-card*. This illustrates how the outcome of an event can vary with the availability of additional information and it also displays how useful the Bayes' rule is in gauging such scenarios.

Bayes' rule specified by the above equation (3) is the backbone of Bayesian inference which is used to update the probability for a hypothesis, as more evidence or information becomes available. As such, Bayesian inferences are extensively used in the establishment of parameters and models since models are essentially a mathematical formulation of observed events while parameters are factors in models affecting observed data.

2 In a standard deck of 52 playing cards, there are four suits: spades, diamonds, clubs and hearts (♠♦♣♥). Each suit has one Jack, one Queen, and one King as the face-cards. Hence there are 12 face-cards in a deck of 52 playing cards.

What is special about Bayesian approach?

Bayesian method interprets probability as a means of gauging one's belief or confidence of occurrence of an event. Accordingly, Bayesian approach allows introducing *prior belief* about the occurrence of an event. These beliefs, however, are expected to be updated once new information is available. The beauty of Bayesian approach is that it facilitates quantitative means of associating one's *prior* beliefs and new information to produce new *posterior* beliefs. As such, Bayesian approach provides us with mathematical tools to update our subjective beliefs in the backdrop of new evidence.

Bayesian statistics is different to classical *frequentist* statistics where probabilities are the frequency of random events occurring in a long run of *repeated trials*. For instance, as we roll a fair coin repeatedly, we would observe that each of the two sides of the coin tends to appear ½ of the times. Classical frequentist statististicians collect data to confirm a null hypothesis or to reject it at an assumed level of statistical significance. On the contrary, Bayesian approach is employed to synthesize information known about a parameter prior to conducting a study with new data from the study to estimate a 'posterior' distribution for that parameter. Carrying out statistical inferences using the two approaches, Bayesian and frequentist, have therefore fundamentally very different approaches. In particular, frequentist statistics attempts to *eliminate* uncertainty by delivering *estimates* while Bayesian statistics tries to *preserve* and *refine* uncertainty by adjusting *individual* beliefs in the backdrop of new information.

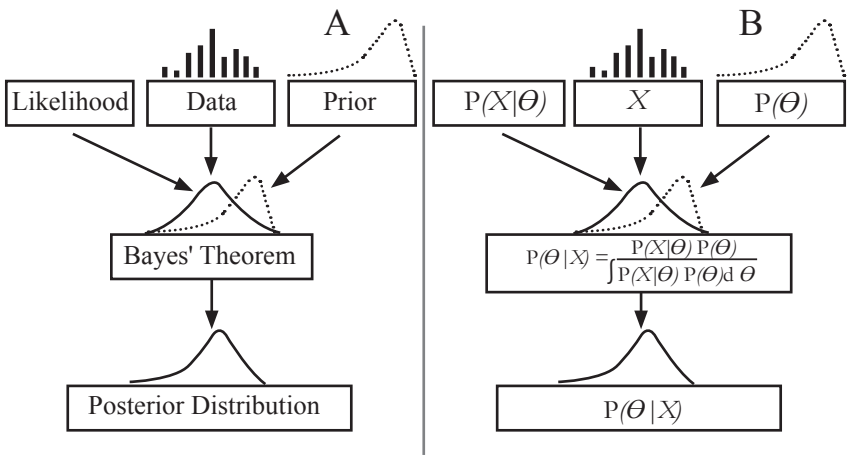
Bayesian applications in Econometrics

Econometrics is a branch of economics, which shares concepts of economics, mathematics and statistics to learn about something that the researcher is interested in, by using data. Econometricians extensively use models for the purpose that depends on model parameters. For instance, in a simple linear regression model, the main focus is on the coefficients in the regression and accordingly the researcher is interested in estimating these coefficients (i.e., parameters). As such, consider an example where X is a matrix of data and Θ is a matrix, which contains the parameters for a model deem to explain X. We seek to learn about Θ based on data, X. In Bayesian approach, Bayes' rule is used for this purpose. Thus, Bayesian econometricians would replace B by Θ and A by X in equation (3) above.

$$P(\Theta|X) = \frac{P(X|\Theta)P(\Theta)}{P(X)} \quad (4)$$

In Bayesian terminology, P(Θ) is the **prior** which indicates the strength of our belief, before some evidence is taken into consideration. For instance, in the case of tossing a coin, it is our belief in the fairness of coin before the toss. It can have any degree of fairness between 0 and 1. P(X|Θ) is the **likelihood** of observing our result, given our distribution for Θ. If it is given that the coin is fair, for instance, P(X|Θ) gives the probability of observing the number of heads in a particular number of flips. P(X) is the evidence. This is the probability of data as determined by summing across all possible values of Θ with weights assigned according to our belief on the strength of each of those particular Θs. Finally, P(Θ|X) is referred to as the **posterior** in Bayesian terms. This represents the belief of our parameters after observing the evidence. Accordingly, posterior belief P(Θ|X) depends on the likelihood function P(X|Θ) and the distribution of prior beliefs P(Θ), given the evidence P(X). As such, to define the model sufficiently, we require the likelihood function, the posterior beliefs and data. The product of these two functions, gauged by evidence, results in the distribution of posterior belief. Accordingly, Bayesian approach provides us with the tools to update our beliefs in the evidence of new data, as depicted in the Figure 2, given below.

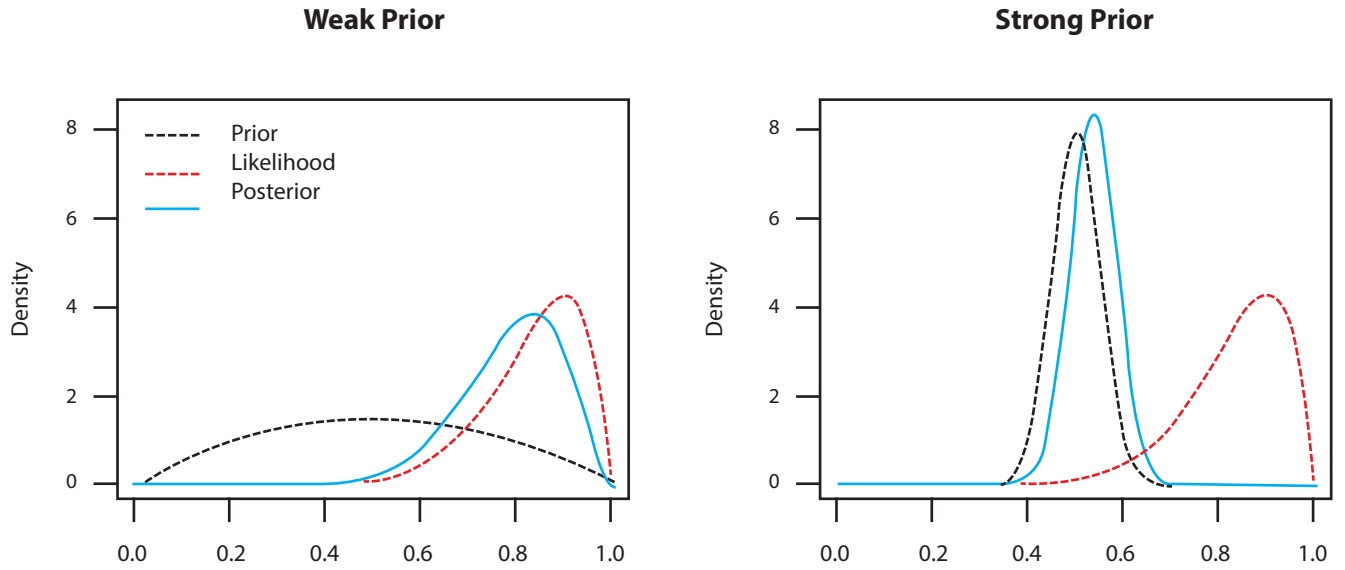
Figure 2: Bayesian inference flow chart



Source: Doll J C and Jacquemin S J (2018)

When the prior is a weak belief, the posterior distribution follows the shape of the likelihood since the posterior belief is dominated by the data (the first graph in Figure 3). However, when there exists a strong prior belief, posterior beliefs are strongly influenced by the prior giving less prominence to data (the second graph in Figure 3).

Figure 3: Bayesian inference



Source: https://jimgrange.wordpress.com/2016/01/18/pesky-priors/

Bayesian approach and frequentist criticism

Sims (2007) states that Bayesian inference is a way of thinking, not a basket of methods. Unlike the frequentist inferences which make only pre-sample assertions, Bayesian approach facilitates characterising uncertainty about parameter values, given the sample that has actually observed and this enables people to use uncertainty as a guide in decision making.

One criticism against Bayesian approach is that it is subjective whereas frequentist approach is objective.[3] However, Sims (2007) explains that this is simply untrue: The key aspect of Bayesian inference is the set of rules for transforming an original distribution into an updated distribution, conditional on new information. Bayesian approach makes it clear that for decision-making, prior beliefs are important. However, econometricians usually do not make decisions, instead, they report data analysis for an audience that is likely to have diverse initial beliefs. Accordingly, the task is to present useful information about the shape of the likelihood.

Don Berry, an eminent statistician and one of the proponents of Bayesian statistics once stated that "Bayesian inference is hard in the sense that thinking is hard". Sims (2007) explains that Bayesian inference is usually described and often implemented in a bottom-up way: (1) define your model, (2) define your prior, (3) apply Bayes rule, emerge with unique, optimal, correct inference

3 The use of the subjective prior probabilities in the Bayesian framework has been criticized since prior information available for different people could be different and some statisticians argue that this is a main drawback to the Bayesian statistics. Bayesian statisticians, in response, point out that this is unavoidable, and that frequentist methods also involve subjective choices.

and accordingly implementing Bayesian inference is indeed often hard. It is hard not only as it is computationally challenging in the third step above, but also intellectually in the first two steps, sometimes.

The debate between the supporters of two statistical paradigms continued for last several decades. Owing to its practical approach together with the rapid increase in the computational power of modern computers, the use of Bayesian methods increased in a variety of different fields in the past few decades. Bayesian method allows users to handle large and complex statistical problems relatively easily while frequentist methods can only approximate or fail tackle such problems. More flexible Bayesian modelling methods provide natural ways for users in a variety of fields to organize information in a more user-friendly manner such that they yield direct and intuitive answers to diverse questions.

Bayesian methods and macroeconomic analysis

Bayesian methods are increasingly used in macroeconomic policy modeling. Sims (2007), for instance, states that the European Central Bank (ECB) and the New York Fed have research groups working on models using a Bayesian approach. Presently central banks all over the world and many academic researchers extensively use Bayesian methods in estimating their models. Sims (2007) provides three reasons as to why Bayesian methods have gained increasing attention in macroeconomic policy modeling. Firstly, modeling is directly tied to repeated decision-making use. Secondly, it involves large models with many parameters, so that attempting to proceed without any use of prior distributions is a dead end. Thirdly computational power and Markov Chain Monte Carlo (MCMC)[4] methods now make Bayesian analysis of large models feasible.

Bayesian methods are increasingly used by central banks all over the world in the recent past. The quarterly projection model (QPM) which is a reduced form DSGE model used for forecasting and policy analysis purposes by the Central Bank of Sri Lanka (CBSL), for instance, employs Bayesian methods in estimating the model parameters. Further, a few research studies published in the *Staff Studies* journal of the CBSL used Bayesian methods in estimating their model parameters.

Conclusion

There are diverse motives to adopt Bayesian approach, and their applications are visible in many fields. Philosophical consistency is one of the key strengths in Bayesian method. It is proven that Bayesian approach leads to consistent and sound policy recommendations, particularly where there is a high degree of uncertainty. Bayesian inference is substantially different to conventional frequentist inference since it treats model parameters as random variables in contrast to constants. The frequentist analysis begins with lack of information about the parameters of interest, and accordingly depends on observations to estimate the parameters. Bayesian analysis, on the other hand, starts with prior knowledge regarding the parameters,

4 Even though the theoretical properties of Bayesian methods have been known for decades, computational difficulties continued to be a great hindrance for their use. The emergence of MCMC algorithms has diminished the computational challenge and made these methods attractive in a variety of practical applications as illustrated in many macroeconomic analyses including Robert and Casella (2004) and Liu (2001).

and employs data to update the prior to derive posterior.

The Bayesian paradigm, thus allows for prior information to be formally taken into account. The explicit use of the priors in Bayesian approach can be seen as an advantage as it allow us to incorporate information available from previous studies, expert judgements and various economic restrictions. However, priors are to be selected carefully since they can have a large impact on inferential results in small samples and in any other cases where the identifiability of parameters crucially relies on restrictions brought by the prior.[5] In the backdrop of the discussion we had so far, it is worthwhile to conclude the article with a proactive quote of an eminent Bayesian, Dennis Lindley:

> "… the only good statistics is Bayesian statistics. Bayesian statistics is not just another technique to be added to our repertoire alongside, for example, multivariate analysis; it is the only method that can produce sound inferences and decisions in multivariate, or any other branch of, statistics. It is not just another chapter to add to that elementary text you are writing; it is that text. It follows that the unique direction for mathematical statistics must be along the Bayesian roads…."- Lindley (1975, pp. 106-115)

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5 Priors should have little impact on the inferential results when the identifiability of parameters does not crucially rely on the prior and when sample sizes are large (Chernozhukov and Hong)2004)).

Money Broking Industry in Sri Lanka

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1. Who is a money broker?

Money broker is a mediator to suppliers of funds (lenders) and users of funds (borrowers) enabling them to enter into a contract for money market transactions such as short-term loans. Money brokers disseminate market information acting as a market facilitator. They provide broking services in the inter-bank call money, foreign exchange and government securities markets. These transactions are arranged mostly between corporate customers such as Licensed Commercial Banks (LCBs) and Primary Dealers (PDs). Money brokers do not themselves lend or borrow money or buy and sell foreign exchange on their own account. In essence, their working is necessarily that of an agent for both the buyer and the seller and not as a principal. They work for a commission for arranging contracts, often for short-term loans on overnight basis or in the form of buy and sell contracts.

2. What is the role of money brokers?

Money brokers act as intermediaries in money, foreign exchange and government securities markets. They facilitate transactions between participating institutions by providing bids and quotes. They play a significant role in the price discovery process in the money, foreign exchange and government securities markets and hence are a vital source of information for market analysis and policy actions. Money brokers have a specialized knowledge of the specific markets and they are in a better position to provide comprehensive and efficient service to their clients at a competitive price. Since the money brokers disseminate current prices across the market, prices determined in such market would be more competitive. In addition, efficient role of money brokers is important to facilitate a healthy development in the domestic money market.

3. Legal and Regulatory Framework for money brokers in Sri Lanka

3.1 Under what legal provisions are money brokers regulated?

The business of money broking has been in operation since 1980s and not subjected to proper regulation by the Central Bank of Sri Lanka (CBSL) or any other regulatory authority until 2013. However, the CBSL responded to requirements by prospective money brokers by issuing a letter known as "No Objection" letter to carry out its businesses.

Considering the necessity for improving the operations in money market and with the intention of increasing the coverage of monitoring activities on different types of financial institutions operating in the economy, CBSL issued the Money Broking Regulations No. 1 of 2013 under Section 10 (c) of the Monetary Law Act, No. 58 of 1949 and came into effect from 15 February 2013.

As per the Money Broking Regulations No. 1 of 2013 the firms/individuals who intend to enter into money broking activities shall obtain the "Certificate of Authorisation" issued by the Monetary Board of the CBSL. A total of nine companies were issued this "Certificate of Authorisation" under this regulation in 2013 and designated as "Authorised Money Brokers" (AMBs). The said Regulation mainly includes among others, the minimum eligibility criteria, legally permissible activities, operating requirements, authorization process, internal policies and procedures, reporting requirements and revocation of the certificate. This regulation was amended in June 2016 introducing a new online data reporting system for AMBs similar to the system which is available for LCBs and PDs.

Moreover, the Money Broking Regulations No. 1 of 2018 was issued with effect from 05 March 2018, repealing the Money Broking Regulations No. 1 of 2013 as amended by Money Broking Regulations No. 01 of 2016. New additions included, among others, delegation of regulatory powers on foreign exchange market operations to International Operations Department of the CBSL, introduction of new fit and proper rules for key officers and significant shareholders, inclusion of new sanctions for breaches of regulations and inclusion of reporting requirement of Central Integrated Market Monitor (CIMM) which is an online data reporting system available for AMBs, LCBs and PDs. Further with effect from 14 February 2019, Money Broking Regulations No.1 of 2019 was issued incorporating several new regulations.

3.2. Why are money brokers regulated?

The purpose of regulating AMBs is to obtain information on the efficiency of price discovery in the sub sectors of the money market for market analysis and policy actions while facilitating maintenance of professional standards of the best business practices ensuring healthy development of the overall money market, government securities market and foreign exchange market in the country. Accordingly, regulating of AMBs facilitates maintenance of standards of the best business practices/ operations by preventing the entrance of non-qualified persons to the important business segments of the economy. This is also important since developments in the money market have a direct bearing on the CBSL policies. Moreover, regulating of AMBs are expected to give credence to the operations of AMBs and provide confidence for financial institutions that use their broking services.

3.3 How are money brokers regulated?

The Money Broking Regulations No. 01 of

2018 issued on 05 March 2018 empowers Domestic Operations Department (DOD) to oversee and supervise the operations of AMBs in Sri Lanka. DOD is responsible for ensuring the enforcement of the said regulation. There are two supervisory methods for this purpose. One is the off-site surveillance (continuous supervision) where AMBs are supervised through information obtained via online and off-line methods. The second method, on-site surveillance, is carried out on an annual basis (or when need arises) to ensure that AMBs are performing their role in accordance with laws, rules and regulations and internal guidelines. Supervision of AMBs is aimed at ensuring that AMBs act ethically and refrain from any unethical activity such as market manipulation, insider dealing and providing misinformation and rumors to clients which can hamper market functioning. Accordingly, supervision of AMBs would help to ensure that the price signals in the market segments in which AMBs operate are undistorted by the actions of AMBs.

4. Recent developments/ trends of the money broking industry

With a view of further strengthening the market conduct and practices of the AMBs, CBSL took several measures recently to improve the money broking industry. In 2018, an online system (CIMM) to AMBs was introduced to report details of transactions handled by them. Through the CIMM, AMBs report their transactions in the call, government securities and foreign exchange markets. Moreover, to upload financial statements and performance reports of AMBs, an online reporting system was introduced in 2018. Further, the Money Broking Regulations No. 1 of 2018 was issued with effect from 05 March 2018, repealing the Money Broking Regulations No. 1 of 2013. Incorporating several new regulations, Money Broking Regulations No. 1 of 2019 was issued with effect from 14 February 2019. CBSL issued a code of conduct for AMBs in 2018 to ensure that operations of AMBs are carried out with high standards of integrity and professionalism in line with the international best practices. These measures are expected to further develop the money broking industry through enhanced mutual trust and confidence between AMBs and its clients.

Since 2013 there are 9 AMB companies (Annex 1) operating in Sri Lanka providing broking services in the foreign exchange, call money and government securities markets. As per the market information, it was revealed a greater share of money market transactions was routed through AMBs. Performance of AMBs during the first half of 2018 are shown in Table 1, Figure 1 and 2. Around 89 per cent of the transactions in the foreign exchange markets are intermediated through AMBs. Interbank call money transactions intermediated through AMBs accounted 77 per cent of the total market volume. However, AMBs share in the government securities market is relatively low at about 28 per cent because of the direct dealings by the PDs in the market.

Annex 1 List of Authorized Money Broking Companies;

1. Bartleet Mecklai & Roy (Pvt) Ltd.
2. Central Forex & Money Brokers Ltd.
3. First Alliance Money Brokers (Pvt) Ltd.
4. MVS Money Brokers Ltd.
5. Vishwin Money & Exchange Brokers Ltd.
6. George Steuarts Investment (Pvt) Ltd.
7. Piggot Chapman and Company (Pvt) Ltd.
8. Taprobane Investment (Pvt) Ltd.
9. SMB Money Brokers (Pvt) Ltd.

Table 1: Sectorial Composition of Money Broking Industry by Volume (January - June 2018)

Rs. Bn

Product Type	2018 Jan-June		
	Total Market	AMBs	Mkt Share (%)
Foreign Exchange Transactions	1,416.8	1,264.0	89.2
Call Market Transactions	2,250.3	1,731.1	76.9
Government Securities Transactions	4,023.2	1,133.8	28.2
Total	**7,690.3**	**4,128.8**	**53.7**

Source: Central Bank of Sri Lanka

Figure 1: Transactions Intermediated by AMBs in the Call Market

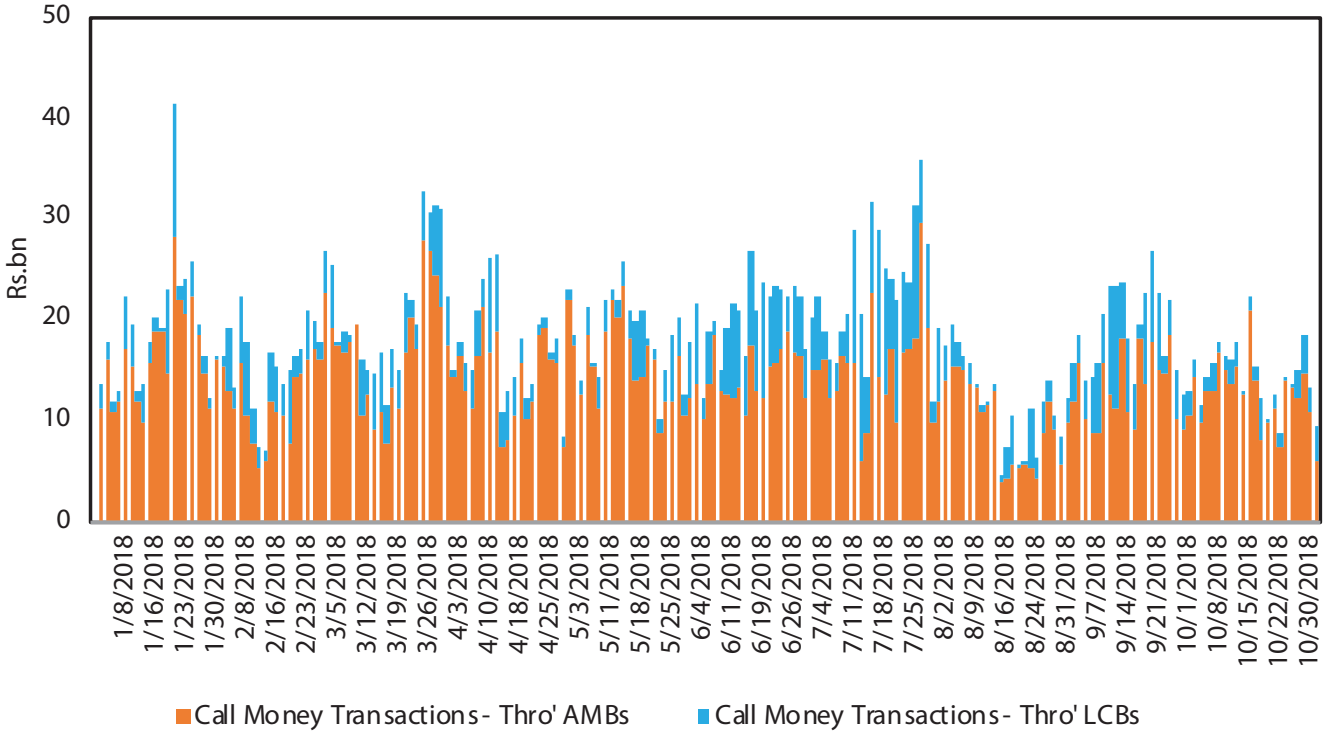
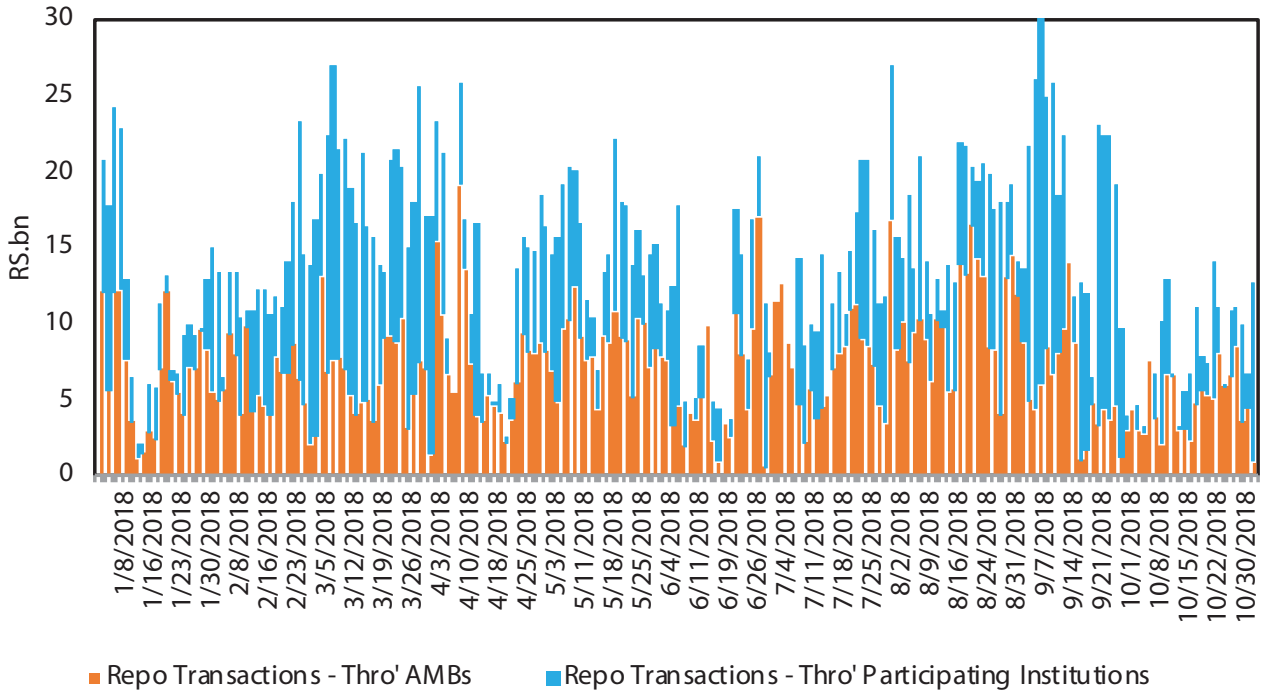


Figure 2: Transactions Intermediated by AMBs in the Repo Market



Source: Central Bank of Sri Lanka

ROLE OF THE ASIAN CLEARING UNION (ACU) MECHANISM

K. A. Thamara Nilmini Senaratna, Senior Assistant Director, Payments and Settlements Department

Introduction

Asian Clearing Union (ACU) is a Regional Clearing System that facilitates member countries to settle their payments for intra-regional eligible transactions (trade and trade related transactions) among the member central banks and monetary authorities on a multilateral basis. The ACU was established in 1974 with the initiative of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and commenced its operations in November 1975. India, Iran, Nepal, Pakistan, Sri Lanka, Bangladesh and Myanmar obtained the membership at the inception of ACU. At present, there are nine member countries including Sri Lanka namely, Bangladesh, India, Iran, Nepal, Pakistan, Myanmar, Bhutan and Maldives.

ACU transactions are performed in terms of ACU Dollar (ACUD) and ACU Euro (ACUE). ACUE was introduced from 1st January 2009. In order to ensure proper functioning of the Union, in terms of Article VIII Section 2(f) of the ACU Agreement, Board of Directors (BODs) adopted the ACU Procedure Rules, i.e. a set of rules and regulations that are necessary to execute ACU operations in a systematic way (http://www.asianclearingunion.org/ProcedureRules.aspx). Further, ACU annual report is published after the approval of the Board of Directors and it consists of entire details of ACU activities done by all member countries during the preceding year.

Objectives of ACU

ACU was established with the following objectives.

1) To provide a facility to settle payments, on a multilateral basis, for current international transactions among the territories of participants;

(2) To promote the use of participants' currencies in current transactions between their respective territories and thereby effect economies in the use of the participants' exchange reserves;

(3) To promote monetary cooperation among the participants and closer relations among the banking systems in their territories and thereby contribute to the expansion of trade and economic activity among the countries of the ESCAP region; and

(4) To provide for currency SWAP arrangement among the participants so as to make AMUs available to them temporarily (http://www.asianclearingunion.org/Introduction.aspx).

Organization Structure of ACU

ACU Board of Directors (BoDs) i.e. Governors of the member central banks and monetary authorities is the decision making body of the ACU and the Board elects Chairman and Vice Chairman from its members annually and the Director Board meets each year. Each member shall assign a Director, Alternate Director and ACU Officer-In-Charge. ACU Secretariat performs administrative functions of ACU and is located in Tehran, Iran. The ACU Secretary General acts as the representative of the Board of Directors.

Transaction Types of ACU Mechanism

The ACU Division of Payments and Settlements Department of the Central Bank of Sri Lanka (CBSL) executes ACU operations and is responsible of handling ACU related issues. There are four types of ACU transactions such as,

a) **ACU Nostro** : Making payments to foreign currency accounts denominated in ACUD or ACUE maintained by local commercial banks in member foreign banks with respect to imports.

b) **ACU Vostro** : Receiving foreign currency, in terms of ACUD or ACUE to the bank accounts maintained by member foreign banks in local commercial banks with respect to exports.

c) **Repatriation From** : Return of surplus funds in terms of ACUD or ACUE from Vostro Accounts to foreign banks.

d) **Repatriation To** : Receipt of surplus funds in terms of ACUD or ACUE from Nostro Accounts to domestic banks.

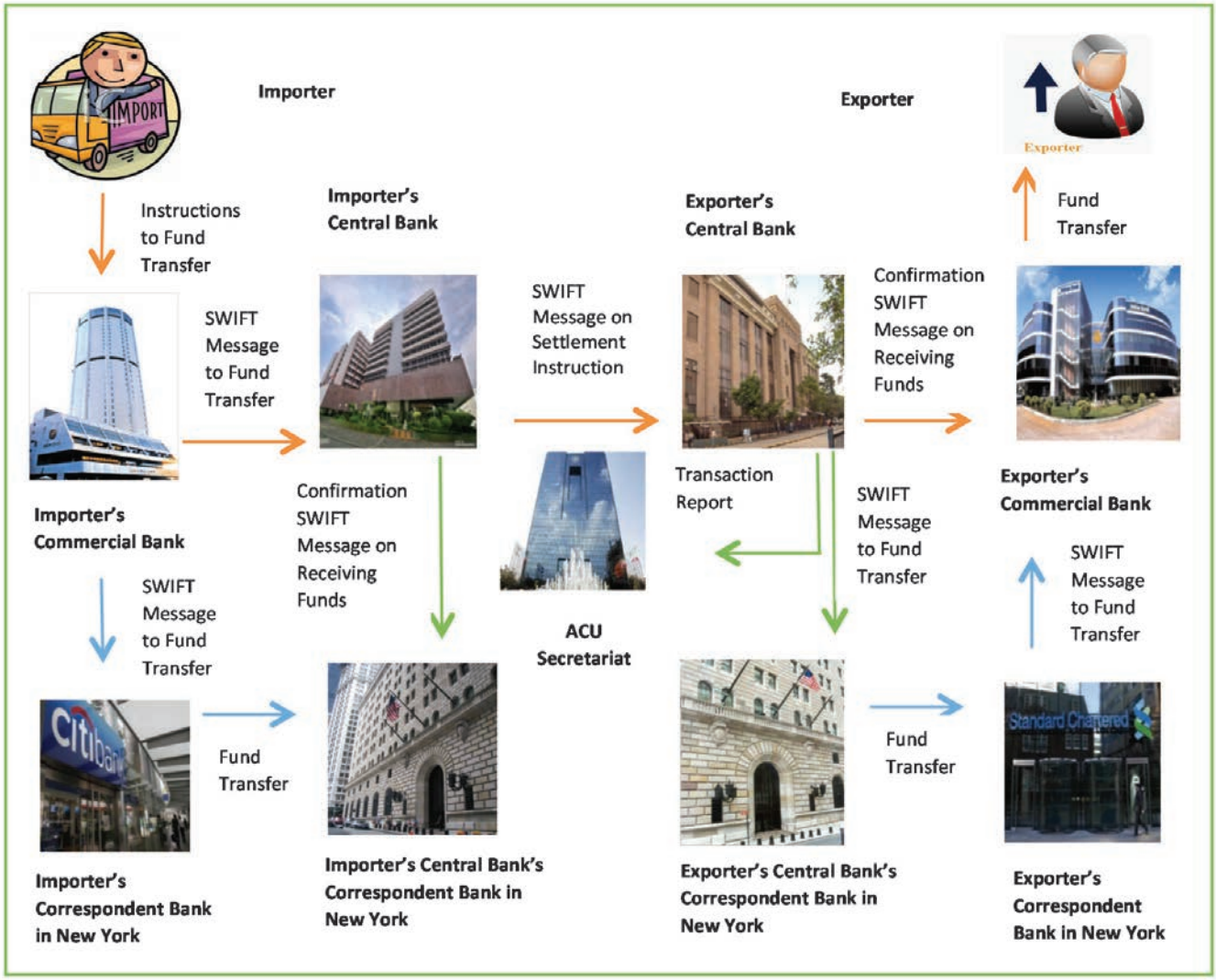
a) **ACU Mechanism for ACU Nostro Transactions**

Domestic Licensed Commercial Banks (LCBs) must maintain separate USD/EURO denominated Nostro accounts with their correspondent banks in member countries for the sole purpose of processing ACU transactions.

As illustrated in Figure 1, importers can make the payments in USD to their exporters in foreign member countries through the ACU mechanism. Importers should inform payments with respect to their imports through their respective domestic LCBs. Accordingly, domestic LCBs shall inform such payment instructions via Society for Worldwide Interbank Financial Telecommunication (SWIFT) system by sending authenticated SWIFT messages to the ACU Division of the Central Bank (CB). Subsequently, CB of importer's country informs such payment instructions to exporter's CB by sending authenticated SWIFT messages. Simultaneously CB of importer's country sends confirmation SWIFT message on receiving of funds to its correspondent banks in New York. Those funds are accumulated in the accounts held in New York by the importer's CB, until the settlement falls due.

Conversely, CB of the exporter's country makes the payments to their LCBs through their USD correspondent banks as per the payment instructions

Figure 1: Flow of Funds under ACU mechanism in terms of ACU Dollar



given by the importer's CB. Flow of funds in terms of ACUE is also operating as same as flow of funds of ACUD, replacing the Euro correspondent banks of participating LCBs and CBs.

- **ACU Mechanism for "Repatriation From" Transactions**

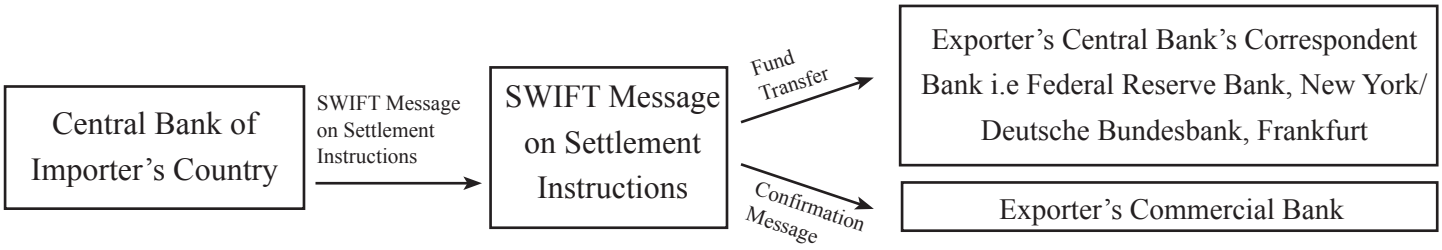
Commercial banks of foreign member countries may be required to surrender excess liquidity in the ACUD/ACUE Nostro accounts maintained by them with local LCBs. Accordingly, as per the instructions sent by local LCBs, "Repatriation From" transactions are processed by the respective CB. Transaction procedures are almost same as ACU Nostro transactions. However, different SWIFT messaging formats are used for this transaction type.

LCBs are strongly advised that when remitting surplus funds in Vostro Accounts, they should ensure that such funds are only the surplus funds received for ACU transactions from the same correspondent bank in other member country.

b) **ACU Mechanism for ACU Vostro Transactions**

Based on the instructions given by CB of importer's country via SWIFT messages, CB of exporter's

country transfers the said funds to the relevant correspondent banks of local LCBs by debiting respective Nostro Account of CB in New York or Frankfurt, Germany.



After executing ACU Vostro transactions, ACU Division sends a report to ACU Secretariat on the same value date.

- **ACU Mechanism for "Repatriation To" Transactions**

Local LCBs may be required to surrender excess liquidity in the ACUD /ACUE Nostro accounts maintained by them with foreign member countries. Accordingly, local LCBs request their foreign correspondent banks to return such excess funds through the respective CBs. As per the advices sent via SWIFT messages by participating CBs on such requests, "Repatriation To" transactions are processed by the respective CBs. Transaction procedures are almost same as ACU Vostro transactions.

Settlement of ACU Balances

Settlement is made every two months period and ACU Secretariat notifies each participant its net debtor or creditor position including accrued interest. Closing interest rate on the first working day of the last week of the previous calendar month offered by the Bank for International Settlements (BIS) for one month US dollar and Euro deposits is the rate of interest applicable for a settlement period. Further, based on the daily outstanding balances of member countries, ACU Secretariat calculates interest on the net debit and net credit balances, taking a year as comprising 360 days and shall be debited or credited to the participants' accounts at the end of each settlement period.

On receipt of the notice from the ACU Secretary General, the debtor participants shall make the payment in USD/EUR or any other mutually acceptable currency within 4 working days as prescribed under the ACU Procedure Rules.

Recent developments of ACU Transactions

India remains as the major creditor among ACU member countries recording USD 11,024.85 million credit balance in the year 2017 while registering USD 7,094.62 million debit balance, Bangladesh holds the main debtor position during the same period (Chart 1 and Chart 2).

Sri Lanka was the second largest debtor among member countries recording USD 3,258.09 million debit balance in the year 2017.

Both the Values of Vostro and Nostro transactions have improved in 2017 compared to the year 2016. However, the total number of transactions have shown a slight decrease after 2015 and this may be due to termination of ACU Euro transactions from 1st July 2016. Values of both Vostro and Nostro

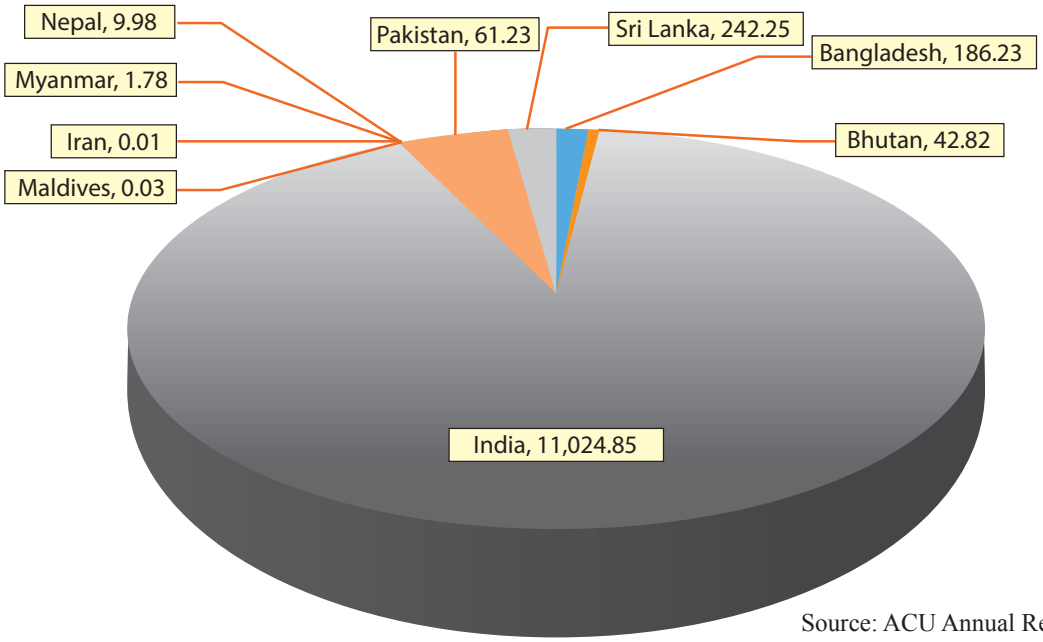
transactions have increased by 2.9 per cent and 7.1 per cent respectively, during 2017 compared to 2016 (Table 1).

Issues and Challenges of ACU

Despite the ACU was established with broader objectives, ACU operations have been limited

Chart 1: Credit Position of the Member Countries - 2017

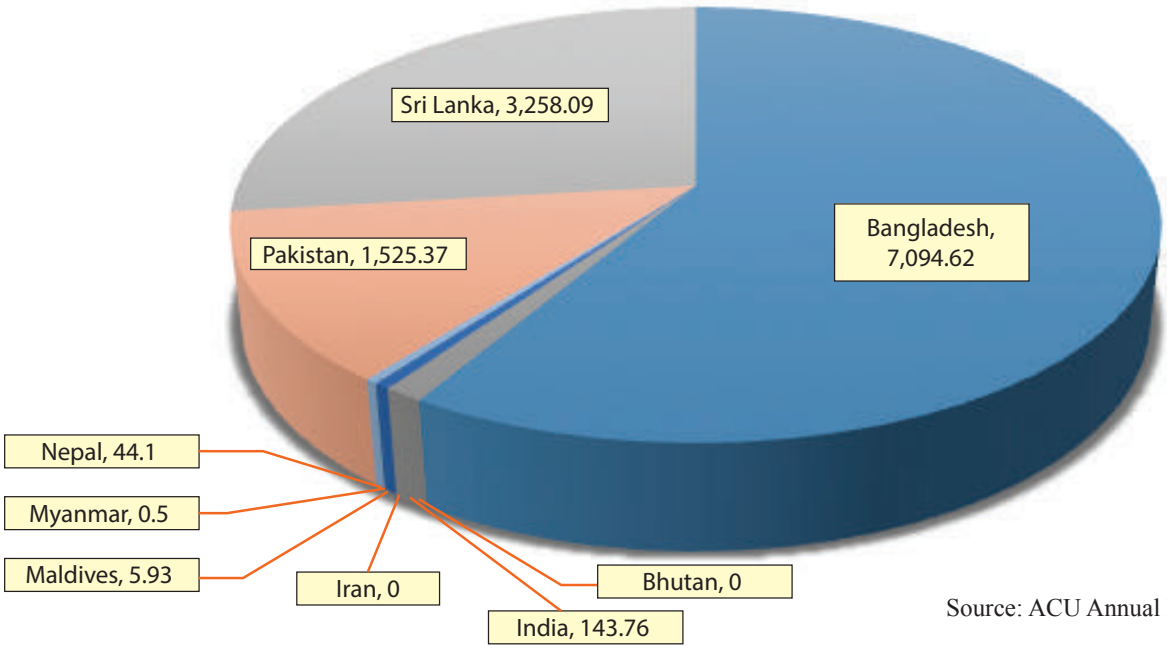
(USD Million)



Source: ACU Annual Report, 2017

Chart 2: Debit Position of the Member Countries in 2017

(USD Million)



Source: ACU Annual Report, 2017

Table 1: ACU Transactions

Year	2013	2014	2015	2016	2017
Value of Vostro Transaction (In millions of USDs)	172.83	215.76	270.87	235.49	242.25
Value of Nostro Transaction (In millions of USDs)	1,710.13	2,416.22	3,020.74	3,042.24	3,258.09
Total No. of Transaction	5,017	6,222	6,663	6,510	6,335

Source: Central Bank of Sri Lanka

to facilitating payment and settlement of current account transactions among member countries in present context. Monetary cooperation (i.e. cooperation among member countries in the region in resolving monetary and financial matters and building up a cooperative link among the monetary systems, policies and operations) and close trade relations between regional members would lead to expand regional trade. However, lack of close cooperation among member countries hinders the expansion of ACU.

After the global financial crisis in 2008-2009 occurred due to high default rate in subprime mortgage sector in United States of America, all financial institutions of the world inclined to emphasize the importance of ensuing Know Your Customer (KYC) policy in their operations not only to prevent possible financial losses but also to suppress money laundering, terrorist financing activities and other financial disputes. Accordingly, risk management policy decisions taken by financial institutions would be affected the smooth operations of ACU in terms of facilitating correspondent banking facilities, information sharing procedures and implementation of any other integrated operating system upgrades etc. Therefore, existence of continuous functioning of ACU is facing higher uncertainty in current context.

Moreover, with the rapid development of the state-of-the-art technology, cyber security risks would also be affected the intra-regional transactions and that may lead to limit the regional cooperation in terms of trade, information sharing and flow of funds.

Enhancing the active participation of the trading community to make their trade and trade related payments through ACU mechanism has become a challenging task. However, if all participating agents of ACU member countries could provide efficient and cost-effective services, ACU mechanism will become more attractive payment method among traders in the region.

How to Strengthen the ACU Platform

In view of the above drawbacks faced by ACU mechanism, it is suggested to implement following measures for the future success and existence of the ACU.

Expansion of ACU membership with the countries in the region that are having close trade relationships and monetary cooperation would lead to strengthened trade and trade related transaction among member countries. Since Sri Lanka is running negative trade balance, expansion of membership would lead to overcome foreign exchange difficulties and manage foreign reserves

with the accumulated funds in Nostro account of CBSL.

Existing security measures need to be strengthened further with the current developments to face possible cyber and other security attacks in order to ensure secured operations of ACU.

Establishment of interdependent industries in member countries would lead to enhance trade and monetary cooperation among member countries and as a result, country specific productions could be promoted. Further, enhancing export diversification process and encouraging the exports of more value-added products while entering into new trade agreements with ACU member countries would facilitate to expand the ACU platform. Accordingly, ACU mechanism would be more attractive among traders and all members of the region could make gain from the intra-regional trade and thereby reach the objectives of ACU.

Knowledge and information sharing programmes among member central banks and commercial banks could be implemented to enhance awareness of ACU mechanism. Eventually, that will lead to expand and strengthen the trade and monetary cooperation among member countries.

Reference:

Asian Clearing Union. *Annual Report*. 2017.

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