IS SOUTH ASIAN ASSOCIATION OF REGIONAL COOPERATION AN OPTIMAL CURRENCY AREA? AN EMPIRICAL ANALYSIS

by

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Abstract

This study examines the feasibility to form a common currency area in the South Asian Association for Regional Cooperation (SAARC) countries. A group of countries facing symmetric shocks are benefited to introduce a common currency. This thesis employs a five-variable Structural Vector Autoregressive (SVAR) model to test the symmetry of five types of shocks i.e., external global and regional; domestic supply, interest rate and exchange rate shocks. The results show asymmetric correlations among domestic shocks. In addition, lower factor mobility, lower degree of intra-regional trade, and lack of political integration suggest that the SAARC countries are not yet ready to introduce a common currency.

List of Abbreviations and Symbols Used

ADF	Augmented Dickey-Fuller
AFG	Afghanistan
APEC	Asia-Pacific Economic Cooperation
APTA	Asia Pacific Trade Agreement
ASEAN	Association of Southeast Asian Nations
ASEAN+3	ASEAN and three East Asian countries i.e., China, Japan, South Korea
BGD	Bangladesh
BHU	Bhutan
BIMSTEC	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation
BRICS	Brazil, Russia, India, China and South Africa
CEC	Committee on Economic Corporation
CPI	Consumer Price Index
EMU	European Economic and Monetary Union
EU	European Union
FDI	Foreign Direct Investment
GCC	Cooperation Council for the Arab States of the Gulf
GNI	Gross National Income
GNP	Gross National Product
IFS	International Financial Statistics
IND	India

ISLFTA	India-Sri Lanka Free Trade Agreements
G-PPP	Generalized-Purchasing Power Parity
LDCs	Least Developed Countries
MLD	Maldives
NAFTA	North American Free Trade Agreement
NLDCs	Non-Least Developed Countries
NPL	Nepal
OCA	Optimal Currency Area
PAK	Pakistan
PSLFTA	Pakistan-Sri Lanka Free Trade Agreement
REER	Real Effective Exchange Rates
SAARC	South Asian Association of Regional Cooperation
SAFTA	South Asian Free Trade Area
SAPTA	SAARC Preferential Trading Arrangement
SRI	Sri Lanka
UAE	United Arab Emirates
UK	United Kingdom
US	United States
VAR	Vector Autoregressive
WDI	World Development Indicators
r	Coefficient of correlation
Σ	Variance-covariance Matrix
ϵ_t	Vector of structural shocks
u_t	Vector of residuals

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Chapter 1

Introduction

A common currency among a group of countries refers to the adoption of a single currency and common monetary and exchange rate policy. The adoption of a common currency also leads a single central bank replacing the existing central banks of the member countries. Mundell (1961), first introduced the concept of Optimal Currency Area (OCA), and asked the following question: under what conditions a common currency leads to have better economic integration among the member countries. Following Mundell's (1961) work on OCA, numerous studies have been examined the feasibility of introducing a common currency in various groups of countries, including the European Union (EU), Association of Southeast Asian Nations (ASEAN), MERCOSUR (Argentina, Brazil, Paraguay, Uruguay, and Venezuela), North America (Canada, Mexico, and the United States), and Western Africa.

Mundell (1961) argues that countries with positively correlated shocks are better candidates for forming a currency union. When a country joins in a currency union, it loses its own monetary policy as a policy instrument to respond to various kinds of shocks. If these shocks are symmetric (i.e., positively correlated) among the group of member countries, then it is feasible to form a monetary union, and implement a common monetary policy. However, if these shocks are imperfectly correlated, the member countries will not be able to implement a union-wide monetary policy that would be optimal for all the member countries.

Economic and monetary integration tends to maximize the economic efficiency and increase mutual benefits. For instance, Rose (2000) argues the two countries that share a common currency, the trades will be three times as much as they would with different currencies. A regional currency area can also be formed based on historical, geographical, cultural, economic and political relations among the member countries. For example, after their reunification in 1990, East and West Germany circulated a common currency Deutsche Mark until the adoption of Euro in 2002.

Smaller countries such as El Salvador, Kiribati, Liechtenstein, Monaco, Nauru and Vatican circulate foreign currency. Also, Hong Kong and Macao circulates more than one currency. Euro zone countries within the European Union have introduced a common currency; although they have been facing a deep crisis since 2008.

The South Asian Association of Regional Cooperation (SAARC) is a regional group of countries in South Asia, established in 1985, containing seven founding members Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. Afghanistan joined SAARC in 2007. The objectives of SAARC include promotion of socio-economic development within the South Asian countries. One of the objectives is to move towards more economic integration and ultimately towards a common currency in South Asia. This was emphasized by the Prime Minister of India, Mr. Atal Bihari Vajpayee, in the twelfth SAARC Summit held in Islamabad, Pakistan on 4-6 January, 2004. This study reviews the economic structures of the member countries, discusses the similarities of economic indicators among the SAARC member countries, and examines the feasibility of a common currency based on the correlation of the shocks among the SAARC member countries. This study uses a Structural Vector Autoregressive (SVAR) model (Bayoumi and Eichengreen, 1992), which is an extension of the variance decomposition method of Blanchard and Quah (1989). Bayoumi and Eichengreen (1992) use the SVAR model to determine aggregate demand and supply shocks in the European Union (formerly known as European Economic Community). They then compare the correlation of these shocks among the countries. This study incorporates three additional shocks; external global supply shocks, regional supply shocks, and domestic exchange rate shock of each of the member countries.

Most of the SAARC economies are moderately open; total trade of most of the countries is 40-50% of GDP, except Maldives and Bhutan where it is more than 100% of GDP. Most SAARC economies are small (except India), and their exports go to other parts of the world which make them susceptible to external shocks. Thus, incorporating external shocks in the model is relevant. Regional shocks are also important for the potential member countries, especially for the small economies. Since most of the SAARC member countries are small open economies (except India), the regional shocks would have a significant impact on the feasibility assessment

of OCA. The objective is to determine whether the dominant shocks are country-specific and therefore uncorrelated across the region. If this is the case, then the costs associated with a loss of monetary independence and flexible exchange rate adjustments could be high (Chow and Kim, 2003).

The contribution of this thesis is to incorporate the external global supply shocks, regional supply shocks and domestic exchange rate shocks into the analysis. The previous studies on optimal currency areas have ignored the importance of these shocks. Yet, a positive correlation of the exchange rate shocks would also strengthen the argument for forming a currency area in SAARC countries.

The rest of the thesis is organized as follows. The background for the South Asian Association of Regional Cooperation (SAARC) and literature review of optimal currency area are presented in Chapter 2. Chapter 3 discusses the Structural VAR (SVAR) modeling for the assessment of optimal currency area and the data which are used in the study. Chapter 4 discusses the descriptive statistics of the variables and the analysis of the empirical results from the SVAR model, and interprets the results. Chapter 5 concludes.

Chapter 2

Background

2.1   History of SAARC

In 1980, the president of Bangladesh Ziaur Rahman proposed to form an organization for the regional cooperation among the South Asian countries. This proposal set the stage for regional negotiations. The foreign Secretariats of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka met for the first time in Colombo in 1981. The foreign ministers of these countries adopted the Declaration on South Asian Association of Regional Cooperation (SAARC) in their first meeting held in New Delhi, on August 1983. The Declaration initiated an "Integrated Program Action" on different areas including agriculture, rural development, telecommunications, meteorology, health, and population to promote regional cooperation. The heads of the member countries signed the Charter of the South Asian Association of Regional Cooperation (SAARC) with headquarters in Kathmandu, Nepal, at the first summit held in Dhaka on 7-8 December, 1985. The meetings of the heads of the member countries are normally held once a year and the foreign ministers of the member countries are held twice a year.

The objectives of SAARC include to promote the welfare of the people in South Asia, to accelerate economic growth, social and cultural progress, and to promote active collaboration and mutual assistance on matters of common interest. The cooperation within the SAARC framework respects the principles of sovereign equality, territorial integrity, political independence, non-interference in the internal affairs of states and mutual benefits and is to work as a complement to the bilateral or multilateral relations among the member countries.

Table 2.1: South Asia and other regional groups in the world: A comparison, 2009

	South Asia (SAARC)	North America	European Union	East Asia and Pacific all countries	World
Land (million sq. km)	4.77	18.24	4.18	24.32	129.56
Surface area (million sq. km)	5.13	19.82	4.33	24.86	134.12
Population (million)	1,567.72	340.81	498.64	2,183.05	6,775.24
Population density (per sq. km)	329.00	19.00	119.00	90.00	52.00
Rural population (million)	1,100.00	61.84	130.52	1,123.00	352.00
Population growth (annual %)	1.47	0.91	0.36	0.69	1.16
Life expectancy (years)	64.43	78.91	79.40	73.42	69.18
GNI (constant 2000 US $, billion)	1,101.31	12,603.75	9,416.19	10,545.30	39,541.94
Growth rate (%)	8.11	-2.66	-4.30	-0.61	-2.05
Per capita income(current US $)	1,084.62	45,364.64	32,845.28	6,466.14	8,598.93
Agricultural value added(% of GDP)	18.33	1.29*	1.47	1.62*	2.90*
Industry value added (% of GDP)	26.77	28.01*	23.83	31.61*	26.96
Services value added(% of GDP)	54.90	77.48	74.70	64.76	70.16
Imports of goods and services(% of GDP)	24.16	14.98	34.65	23.29	24.29
Exports of goods and services(% of GDP)	18.94	12.31	35.68	25.17	24.20
Trade (% of GDP)	43.10	29.27	70.33	48.46	48.49
Merchandise trade (% of GDP)	31.05	21.04	56.34	48.51	42.79

Sources: World Development Indicators, 2009. The values marked by * stand for those of 2008.

2.2 SAARC Member Countries: An Overview

2.2.1 SAARC Economies: An Overview

The SAARC member countries comprise almost 5.13 million square kilometers, which is almost 4% of the total world surface area.[1] About 1.57 billion people, which is 23% of the world population live in the SAARC countries. Table 2.1 summarizes the geographical and economic structure of different regional group of countries. The population growth rate in South Asia is higher than any other economic bloc as well as the average world population growth. The population density in South Asia is 329 persons per km^2, where the average population density is 52 persons per km^2 in the world. The life expectancy or the literacy rates in this area are the lowest compared to any other regions. South Asia contributes only 2.5% of the world income (measured

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[1]The geographical location of SAARC member countries is given in Appendix A.1.

by GNI). Although there are a number of substantial policies taken to reform the South Asian economies, the per capita income of this regional group is the lowest compared to other regions across the world. Agricultural contribution to GDP in South Asia is higher than any other regions of the world. Although the contribution of manufacturing sector to the GDP is almost closer to other groups, the contribution of the service sector to the GDP of SAARC countries is the lowest than any other regions; see Table 2.1.

2.2.2 Economic Structure of SAARC Countries

There is a huge variation among the SAARC member countries in terms of their size, geography, political systems, languages and cultures. Table 2.2 summarizes and compares the economic infrastructure of the SAARC member countries. The per capita income in South Asia is US $ 1,084.62 where the Maldives has the highest and Nepal has the lowest per capita income among the member countries. Although the share of GDP in services is important, most of the SAARC countries still heavily rely on their agricultural sectors. The share of GDP in agriculture is similar among the member countries except in Maldives, which has a large tourism sector,[2] Industry also has similar contribution to GDP among the member countries. The contribution of agriculture to GDP has been decreasing, where the share of industry has been increasing in the past decades except in Maldives.

There are wide disparities in trade within the SAARC member countries. Maldives and Bhutan have the highest trade openness,[3] whereas Pakistan has the lowest trade openness. Saxena (2005) argues that India has the largest domestic market, hence trade forms a substantially smaller percentage of GDP, especially when compared to other SAARC member countries. She finds that most of the SAARC countries are specialized in the production of few goods i.e., textiles, garments, cotton fabrics; see also appendix, Table A.1. However, the contribution of industry has been increasing in these countries over the past decades. Table 2.2 also indicates that there is substantial variation among the SAARC member countries in terms of net inflow of foreign direct investment (FDI).

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[2]See Niyaz (2010).
[3]Trade openness is measured by $100 \times (exports + imports)/GDP$.

Table 2.2: Economic structure of SAARC countries, 2009

	AFG	BGD	BHU	IND	MLD	NPL	PAK	SRI	S. Asia
Growth and Economic Structure									
GDP (current US $, billion)	11.76*	89.36	1.27	1,380.64	1.32	12.90	161.99	42.07	1,702.67
GDP growth(annual %)	3.40*	5.74	6.73	9.11	-2.29	4.41	3.63	3.54	8.11
GDP per capita (current US $)	425.07	607.76	1,772.10	1,192.08	5,587.38	438.19	949.12	2,035.30	1,084.62
Agriculture, value added (% of GDP)	32.53	18.73	17.57	17.76	5.05	33.85	21.55	12.60	18.33
Industry, value added (% of GDP)	22.12	28.66	45.01	26.79	17.42	15.91	24.26	29.72	26.77
Service, value added (% of GDP)	45.36	52.61	37.42	55.27	77.53	50.24	54.18	57.68	54.90
Manufacturing, value added (% of GDP)	13.28	17.92	6.40	14.76	6.82	7.00	17.11	18.15	15.27
Internal and External balances									
Remittances and compensation of employees received (% of GDP)	NA	11.78	NA	3.59	0.25	23.83	5.38	8.01	4.48
Imports of goods and services (% of GDP)	NA	26.55	48.33	24.02	94.24	37.42	20.37	27.87	24.16
Exports of goods and services (% of GDP)	NA	19.43	57.99	19.58	67.00	15.70	12.84	21.86	18.94
Trade (% of GDP)	NA	45.98	106.32	43.61	161.28	53.12	33.22	49.24	43.10
Current account balance (% of GDP)	NA	3.74	NA	-1.93	-27.35	-0.08	-2.21	-0.51	NA
External debt shocks (% of GNI)	NA	23.97	57.65	18.22	59.98	28.71	31.28	41.47	20.68
FDI. Net inflows(% of GDP)	1.28	0.75	2.85	2.51	7.63	0.30	1.47	0.96	2.26
Inflation, consumer prices (annual %)	-13.23	5.42	4.36	10.88	3.98	11.61	13.65	3.51	NA

Source: World Development Indicators, 2009. The values marked by * stand for those of 2008. NA means not available.
Note: AFG=Afghanistan, BGD= Bangladesh, BHU=Bhutan, IND=India, MLD= Maldives, NPL=Nepal, PAK= Pakistan, SRI=Sri Lanka.

2.2.3 Economic Cooperation among SAARC Member Countries

One of the objective of the formation of SAARC was to develop a cooperative environment among the member countries. For instance, the Committee on Economic Corporation (CEC) formulates and monitors the programs to facilitate the intra-regional cooperation among the member countries, and the preferential trading area, SAARC Preferential Trading Arrangement (SAPTA) signed in 1993 promotes trade. This agreement was the crucial step towards trade liberalization and economic cooperation through the reduction of tariffs among the member countries.[4] Since 2006, the SAARC member countries also have a free trade area, South Asian Free Trade

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[4]In November 1998, there were more than 5,000 tariff lines out of total of 6,500 covered by this agreement.

Area (SAFTA), whereby the member countries are committed to a ten year plan to taking out tariffs.[5] SAFTA would be fully implemented by the end of 2016. The ultimate objective of SAFTA is to form an economic union among these countries.

2.2.4 Political Cooperation among SAARC Member Countries

When the Bangladesh president Ziaur Rahman proposed to form a regional group, then other smaller countries like Bhutan, Maldives, Nepal and Sri Lanka welcomed the proposal, whereas India and Pakistan were skeptical about the ultimate objective of forming such a regional cooperation (Dash, 1996). This section will discuss the political relationships among the SAARC member countries.

The two smallest countries Bhutan and Maldives showed their keen interest to form an effective regional economic groups by which they would be beneficial in terms their trades and security. Table 4.7 also indicates that the intra-SAARC trade of Maldives is now increasing after the formation of SAARC. Galey (2000) investigates the economic characteristics of Bhutan and he finds that 90% of total exports go to (and about 70% of total imports come from) India, which indicate that Bhutan is highly integrated with India. However, the given the size of these two countries as well as their economies, it is not expected to make much difference to the SAARC economies (Maskay, 2003).

India is the largest country and it has bilateral disputes with all its neighbor countries, except for Bhutan and Maldives. The bilateral relationships between Bangladesh and India are improving in the period of new elected Bangladesh Government after 2008 (Pattanaik, 2010; Vaughn, 2011). However, it is not sufficient to solve all disputes within a short period. The relationship between India and Pakistan is the most crucial factor for the integration in South Asian countries. After the independence in 1947, these two countries have fought three wars, two of which were about Kashmir (1948 and 1965) and one on the Bangladesh liberation issue (1971). Dash

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[5]The member countries are divided in two groups; least (LDCs) and non-least developed countries (NLDCs). India, Pakistan and Sri Lanka are considered as LDCs, where the other members are considered as NLDCs. The decrease in tariffs would be implemented in two phases. In the first phase, the NLDC's would reduce the existing tariffs to 20% in two years from the date of entry in the force of the agreement, whereas the LDC's reduce the tariffs to 30% of the existing level during the same of period of time. In the second phase, LDC's will take another five more years (six more years for Sri Lanka) to reduce the tariff rates to 0-5%, where the NLDC's will require eight more years.

(1996) finds the following factors are responsible for Indo-Pak conflicts: (a) structural imbalances between the two countries; (b) India's desire to maintain a hierarchical regional order and Pakistan's opposition to this, and Pakistan's effort to achieve parity with India with external military and economic support; (c) divergent political systems (for most of its history Pakistan has been ruled by the military while India has been a functioning democracy since independence); (d) Pakistan's emphasis on Islam as the basis of the state as opposed to India's secularism; and (e) scapegoating (blaming the external enemy, often the neighbour) by the ruling elites of India and Pakistan in order to ensure their political survival. However, the successive Indian and Pakistani governments often repeat the desire for a peaceful relation, reaching a comprehensive agreement that settles outstanding disputes, increase the potential gains by trade in their high official meetings. The Indo-Pak relationships can be treated as "One Step Forward, Two Steps Back" situations.

Pakistan has shown a modest interest to strengthen the growth of SAARC as it believes that the development of SAARC would stimulate the Indian dominance across the region. Dash (1996) argues that Pakistan has very cordial bilateral relationships with other SAARC member countries, expect for India. Pakistan improved bilateral relationships with Bangladesh after a brief disruption during 1971-1975. However, the Bangladesh government wants to investigate the tribunals of War Crime in 1971 as it claims the Pakistani leaders killed three million people during the period of independence war (Linton, 2010).

Bangladesh showed enormous interests to establish a SAARC as a regional organization of economic and political cooperation across the South Asian countries. After the independence from Pakistan, Bangladesh always maintains a cordial relationship with other neighbor countries. However, SAARC does not play any significant role to solve the Indo-Bangladesh conflicts over the water sharing of Ganga River. In addition, the Indo-Bangladesh relationship deteriorates further when India desires to construct a barrage in Tipaimukh on the Borak River, just one kilometer away from the Bangladeshi boarder (Hossain, 2009). The most relevant concern for Bangladesh is to improve the political and economic relationship with India as it is land locked by India and the Bay of Bangal.

Nepal maintains a very cordial relationship with its neighbor, which brings unanimous support for establishing the permanent secretariat of SAARC in Kathmandu. Dash (1996) argues that Nepal is highly interested in a regional and economic cooperation in South Asia because of its desire to promote the security through multilateral diplomacy, and to promote balanced interdependence as opposed to an absolute dependence on India.

Sri Lanka is an island in the Indian Ocean, which does not have boarder with India. It shows interests initially with Bangladesh and Nepal to form a regional economic group as it would like to maintain its relationship with neighboring countries in two phases as: small state and large state relationship. Sri Lanka realizes its geographical location; and the importance of its closest neighboring country, India which is superior in size as well as economy, is interested to enhance its economic activities by forming a regional cooperation under the SAARC framework (Dash, 1996). Sri Lanka signed several regional trade agreements (RTA's), including the South Asian Free Trade Agreement (SAFTA), the India-Sri Lanka Free Trade Agreement (ISLFTA), and the Pakistan-Sri Lanka Free Trade Agreement (PSLFTA) which increase its intra-regional trade over the last decade. Sri Lanka also shows its interest to join the Non-Aligned Movement (NAM), the Asia Pacific Trade Agreement (APTA), and Association of Southeast Asian Nations (ASEAN).

2.3 Optimal Currency Area: A Brief Literature Review

The theory of optimal currency area (OCA) was first developed by Mundell (1961), and later refined by McKinnon (1963), Kenen (1973), Fleming (1971), Corden (1972), Ishiyama (1975), Tower and Willett (1976), Bayoumi and Eichengreen (1992), Frankel and Rose (1996), Corsetti and Pesenti (2002), and De Grauwe (2007). This section will discuss both the theoretical and empirical literatures on OCA.

2.3.1 Theoretical Perspectives

In an influential paper titled "The Case for Flexible Exchange Rates", Friedman (1953) argued that a flexible exchange rate is the most favorable exchange rate regime as an instrument to bring back the economy to the initial external and internal equilibrium. According to (Friedman, 1953, p.173),

"The argument for a flexible exchange rate is, strange to say, very nearly identical with the argument for daylight savings time. Isn't it absurd to change the clock in summer when exactly the same result could be achieved by having each individual change his habits? All that is required is that everyone decides to come to his office an hour earlier, have lunch an hour earlier, etc. But obviously it is much simpler to change the clock that guides all than to have each individual separately change his pattern of reaction to the clock, even though all want to do so. The situation is exactly the same in the exchange market. It is far simpler to allow one price to change, namely, the price of foreign exchange, than to rely upon changes in the multitude of prices that together constitute the internal price structure."

Under a flexible exchange rate regime, a depreciation of the domestic currency can reduce unemployment when the external balances is in deficit, and the appreciation can be used when the economy faces inflationary pressures. Also Mundell (1961) observes that balance of payments crises would remain an integral feature of the international economy as long as there are fixed exchange rates, as the rigidity of wages and prices would prevent such adjustments. Despite these known advantages of flexible exchange rates, Mundell (1961) asks whether countries should have their own currencies.

Mundell (1961) defines an optimal currency area as a group of countries, which experiences symmetric supply and demand shocks along with the flexibility in wages and prices, and high labor mobility. He argues that factor mobility is a crucial criterion for forming a monetary union. He investigates the possible adjustment mechanisms. Suppose, there are two regions: A and B. Each of the regions faces internal and external shocks. If there is disequilibrium in region A affected by an external shock (for example, region B), then a change in relative prices can restore the equilibrium. If these two regions have their own currency and monetary policy, then the equilibrium can be restored by the adjustment of the individual monetary policies. If these regions have a single currency and common monetary policy, then the equilibrium will be achieved only by price and wage flexibility, and labor mobility across the regions. Mundell (1973) also argues that portfolio diversification can mitigate the differences

associated with asymmetric shocks, where the member countries could hold multinational financial assets and mitigate the consequences of asymmetric shocks.

Following Mundell (1961), McKinnon (1963) argues that the size and degree of openness to international trade could be another criteria along with factor mobility across the region. He argues that factors of production may be specialized in different industries in two regions. In this case, factor mobility cannot be a crucial criterion as an adjustment mechanism facing the external shocks as both regions should use their own monetary or fiscal policy for the adjustment process. McKinnon (1963) argues that the more open an economy, the more it would be inclined to adopt a fixed exchange rate as the degree of openness reduces the cost of a peg with a foreign currency and instability of domestic prices, specially for a small country.

In addition, Kenen (1973) argues that countries with diversified products are more likely to have advantages to form a currency area than those with highly specialized economies. The external shocks to an exportable good cannot bring a large impact on terms of trades for the highly diversified economy compared to the specialized economy. The more goods the economy exports, the more likely having the ability of a country to offset the shocks on a certain exported good by compensating the price changes in other goods. So, a highly diversified economy may prefer a fixed exchange rate, whereas a specialized economy may prefer a flexible exchange rate.

Fleming (1971) explains how to determine the desirability of unifying exchange rates for a group of countries. He argues that member countries in a common currency area will have to accept a higher employment along with inflationary pressure or lower inflationary pressure along with the higher unemployment level. Fleming (1971) also argues that similar inflation rates could be a criterion for forming an OCA. And, if there is flexibility in wages and prices, then there would no need to use the exchange rate as a policy instrument in response to asymmetric shocks.

Corden (1972) is suspicious on the role of labor mobility in the adjustment process to asymmetric shocks. He argues that factor mobility could be helpful in the short run but it cannot solve the adjustment problems in the long run. If a country is affected by a negative demand shock, then the adjustment can be conducted through the reduction of wage rates, and prices. When the country cannot use its own monetary policy, then it can use the fiscal policy. He advocates that the wage and price flexibility

are the most important criteria for an OCA as these variables can respond quickly to asymmetric shocks. He also supports Fleming's (1971) argument on the importance of similarities in the inflation rates among the potential member countries.

Tavlas (1993) summarizes the literatures on OCA and suggests a "new" theory of optimum currency area. He evaluates the costs and benefits of a single currency. He considers the political tensions that emerge in cooperative monetary unions under conditions of asymmetric shocks, and the tendency of such shocks to aggravate the business cycle in the periphery in hegemonic unions. He concludes that the "new" optimum currency area theory indicates that there are somewhat fewer costs (in terms of the loss of autonomy of domestic macro policies), and somewhat more benefits (e.g., gains in inflation credibility) associated with monetary integration. The new theory also emphasizes the coordination of fiscal policies, which would be a constraint on the policy makers. Buiter (1995) reviews the familiar arguments for and against monetary union among the member countries of European Union. He notes that exchange rate flexibility is undesirable in the case of financial shocks.

The gains from monetary unification and adoption of monetary policy come from lower transaction costs and lower real effective exchange rate variability. The magnitude of losses of an independent monetary policy depend on the incidence of disturbances and the speed of adjustment of the economy. If the disturbances and the responses are similar across the region, then a symmetric monetary policy would be effective across the group of countries, suggesting they can form a monetary union (Bayoumi and Eichengreen, 1992, 1994). Bayoumi and Ostry (1997) argue that countries with similar economic structure and with similar sector-specific shocks are more suitable to form a currency area. They also argue that the countries having different industrial structure along with higher correlation in their economic activities would be suitable candidate to form a monetary union.

Frankel and Rose (1996) argue that the business cycles and shocks, and the degree of openness are endogenous, and the historical data give an ambiguous direction of a country's suitability to join a currency area. Countries might be more sensitive to industry-specific shocks, resulting in idiosyncratic business cycles. However, the closer is their trade, the more convergence in business cycles. If the trade patterns among the member countries and their business cycles are highly correlated, then the

countries are better candidates for forming a currency union. Engel and Rose (2000) show that joining in a common currency area significantly increases international business cycle correlations. If the monetary integration fails to boost the economic convergence and intra-industry trades, then how does monetary union meet the OCA criteria? Corsetti and Pesenti (2002) answer this question within a general equilibrium framework. They argue that the currency area can be a self-validating optimal policy regime even though the monetary unification is not as fast as economic integration. They conclude that flexible exchange rates deliver a superior welfare gain whereas the common currency helps to synchronize the business cycles across the region.

2.3.2   Empirical Perspectives

In the 1990s, the proposal of the European Economic and Monetary Union (EMU) generated large number of empirical studies on monetary unions (for example, see Bayoumi and Eichengreen (1992), Clarida and Gali (1994), Chadha and Hudson (1998), and Kenen (2000)). The empirical analysis of OCA seeks to assess why and how the potential member countries could form a currency area by analyzing and comparing the criteria of OCA (Mongelli, 2002). Most empirical studies on OCA incorporate the degree of labor mobility among the potential member countries, the existence of fiscal transfers, and the role of credit and capital markets in smoothing the impact of region-specific shocks (Lafrance and St-Amant, 1999).

For instance, generalized-purchasing power parity (G-PPP) model proposed by Enders and Hum (1994), focuses on the convergence of the macroeconomic variables. If a macroeconomic indicator of a country (for example, the real exchange rate) is stationary, then it satisfies convergence in the long run. The convergence of the macroeconomic indicators among the potential member countries suggests that they can form a monetary union. However, it is not clear in the G-PPP model which macroeconomic factors (i.e., price level, real output, real exchange rates etc.) can influence the region to form a currency area and how the member countries face external shocks.

The Structural Vector-Autoregressive (SVAR) model by Bayoumi and Eichengreen (1992) identifies the symmetry of macroeconomic shocks within a group of countries. The correlation of shocks is a crucial criterion for a country deciding to join currency

union. The potential countries facing positively correlated economic shocks will be better candidate for a currency union because it allows the use of union-wide policies to correct imbalances (Mundell, 1961). Each member country loses its own monetary policy as a policy instrument to face the shocks. If the shocks are uncorrelated, the countries will not be able to use monetary policy to facilitate adjustment process. Bayoumi and Eichengreen (1992) use the SVAR model following by Blanchard and Quah (1989) to isolate demand (transitory) and supply (permanent) shocks in a selection of economies using time series data of nominal and real output growth. Bayoumi and Eichengreen (1992, 1994) examine several countries and regional groups, and study the degree of symmetry of shocks affecting regions. They argue that SVAR provides a simple and intuitive method to identify the macroeconomic disturbances using relevant economic indicators.

Finally, Artis and Zhang (2002) assess the similarity of a broad range of optimal currency area properties within a regional group or cluster of the potential member countries. The purpose of cluster analysis is to find the similarity and dissimilarity of five macroeconomic indicators among the member countries. This analysis examines business-cycle correlations, exchange rate variability; correlations of real interest rates to capture the degree of conformity of monetary policy with the anchor country; and correlations between imports and exports of the countries under study with the exports and imports, respectively, of the anchor countries. This analysis examines the degree of homogeneity across the countries in terms of the above OCA criteria, and then classifies the countries in different groups according to their similarity.

There is little empirical literature on the feasibility of a currency area among SAARC countries. Maskay (2003) examines the correlation of various macroeconomic indicators among the SAARC countries and checks the feasibility of a monetary integration across the region. He finds that most of the pair-wise correlations of macroeconomic indicators between two SAARC member countries are statistically insignificant. He also finds that the SAARC economies face asymmetric shocks and concludes that these countries are not suitable candidates for a currency union. Rasheed and Ansari (2004) examine the feasibility of introducing a common currency for Pakistan with its major trading partners; India, Bangladesh, Saudi Arabia and

Sri Lanka by using the Generalized-Purchasing Power Parity (G-PPP). They consider the real per capita income, trade balance, terms of trade, volumes of trade, and bilateral real exchange rate with US dollar and Japanese Yen as base currencies. They find that the business cycles measured by output and unemployment among Pakistan, Bangladesh and Sri Lanka are highly synchronized. However, the business cycles of Pakistan and India are weakly synchronized. Saxena (2005) examines the criteria of OCA in South Asian countries following the SVAR model of Bayoumi and Eichengreen (1992, 1994). She considers the demand and supply shocks and finds that these shocks are highly correlated for most of the SAARC countries. Jayasuriya et al. (2005) evaluate the performance of SAARC as a regional group of economic and political integration. They argue that it would not be feasible to consider the highest level of monetary cooperation (i.e., a currency union). However, they argue that a single SAARC currency would symbolize a major step towards a peaceful, stable and integrated South Asia. Banik et al. (2009) investigate the feasibility of forming a common currency area in South Asian countries by using a state space model with a stochastic trend. They find evidence for common trends in the growth of industrial production for India, Bangladesh and Pakistan as these economies are similar in composition, enhance considerable labor mobility, and bilateral trade. They conclude that these countries are suitable candidates for forming an OCA.

The previous empirical studies did not discuss how the SAARC countries face the external global and regional shocks as a common currency area. This study incorporates the external global and regional shocks to investigate the feasibility of introducing a common currency across the region.

Chapter 3

Methodology and Data

3.1 Methodology

Following Bayoumi and Eichengreen (1992) this study uses a five-variable Structural VAR (SVAR) model to obtain the underlying shocks of the South Asian Association of Regional Cooperation (SAARC) member countries. Economic variables of the SAARC countries can be explained using a Moving Average (MA) representation as:

$$\Delta x_t = A_0 \epsilon_t + A_1 \epsilon_{t-1}..... = \sum_{i=0}^{\infty} A_i \epsilon_{t-i}, \tag{3.1}$$

or, alternatively

$$\Delta x_t = A(L)\epsilon_t, \tag{3.2}$$

where $\Delta x_t = [\Delta y_t^{sw}, \Delta y_t^{sr}, \Delta y_t, \Delta r_t, \Delta e_t]'$, representing the world GDP excluding the SAARC GDP (y_t^{sw}), the SAARC GDP excluding the concerned member country's GDP (y_t^{sr}), domestic GDP (y_t), real interest rate (r_t), and real effective exchange rate (e_t) for each country. These variables are in log difference form. A is a 5×5 coefficient matrix, representing the impulse response of the variables to the structural shocks. The vector of structural shocks, $\epsilon_t = [\epsilon_t^{sw}, \epsilon_t^{sr}, \epsilon_t^s, \epsilon_t^i, \epsilon_t^{er}]'$ consists of the external global supply shocks (ϵ_t^{sw}), the regional supply shocks (ϵ_t^{sr}), domestic supply shocks (ϵ_t^s), interest rate shocks (ϵ_t^i) and the exchange rate shocks (ϵ_t^{er}) respectively. It is assumed that these shocks are serially uncorrelated, with a variance-covariance matrix normalized to the identity matrix:

$$E(\epsilon_t \epsilon_t') = I_n, \tag{3.3}$$

and

$$E(\epsilon_t \epsilon_{t+i}) = 0, \forall_i \neq 0. \tag{3.4}$$

The system of equations 3.1 can be written as:

$$\Delta y_t^{sw} = A_{11}(L)\epsilon_t^{sw} + A_{12}(L)\epsilon_t^{sr} + A_{13}(L)\epsilon_t^{s} + A_{14}(L)\epsilon_t^{i} + A_{15}(L)\epsilon_t^{er}, \tag{3.5}$$

$$\Delta y_t^{sr} = A_{21}(L)\epsilon_t^{sw} + A_{22}(L)\epsilon_t^{sr} + A_{23}(L)\epsilon_t^{s} + A_{24}(L)\epsilon_t^{i} + A_{25}(L)\epsilon_t^{er}, \tag{3.6}$$

$$\Delta y_t = A_{31}(L)\epsilon_t^{sw} + A_{32}(L)\epsilon_t^{sr} + A_{33}(L)\epsilon_t^{s} + A_{34}(L)\epsilon_t^{i} + A_{35}(L)\epsilon_t^{er}, \tag{3.7}$$

$$\Delta r_t = A_{41}(L)\epsilon_t^{sw} + A_{42}(L)\epsilon_t^{sr} + A_{43}(L)\epsilon_t^{s} + A_{44}(L)\epsilon_t^{i} + A_{45}(L)\epsilon_t^{er}, \tag{3.8}$$

$$\Delta e_t = A_{51}(L)\epsilon_t^{sw} + A_{52}(L)\epsilon_t^{sr} + A_{53}(L)\epsilon_t^{s} + A_{54}(L)\epsilon_t^{i} + A_{55}(L)\epsilon_t^{er}. \tag{3.9}$$

Therefore, the equations 3.5 to 3.9 can be written as:

$$\begin{bmatrix} \Delta y_t^{sw} \\ \Delta y_t^{sr} \\ \Delta y_t \\ \Delta r_t \\ \Delta e_t \end{bmatrix} = \begin{bmatrix} A_{11}(L) & A_{12}(L) & A_{13}(L) & A_{14}(L) & A_{15}(L) \\ A_{21}(L) & A_{22}(L) & A_{23}(L) & A_{24}(L) & A_{25}(L) \\ A_{31}(L) & A_{32}(L) & A_{33}(L) & A_{34}(L) & A_{35}(L) \\ A_{41}(L) & A_{42}(L) & A_{43}(L) & A_{44}(L) & A_{45}(L) \\ A_{51}(L) & A_{52}(L) & A_{53}(L) & A_{54}(L) & A_{55}(L) \end{bmatrix} \begin{bmatrix} \epsilon_t^{sw} \\ \epsilon_t^{sr} \\ \epsilon_t^{s} \\ \epsilon_t^{i} \\ \epsilon_t^{er} \end{bmatrix}. \tag{3.10}$$

As the vector of structural shocks (ϵ_t) is unobservable, the system in equation 3.10 cannot be estimated directly. It is not possible to recover the estimates from a structural moving average model (Amisano and Giannini, 1997). Equation 3.1 can be rewritten as a reduced Vector Autoregressive (VAR) model for Δx_t as:

$$\Delta x_t = B_1 \Delta x_{t-1} + B_1 \Delta x_{t-2} .... + B_p \Delta x_{t-p} + u_t, \tag{3.11}$$

where B represents the estimated coefficients, u_t is the vector of residuals. Equation 3.11 can be written as:

$$\Delta x_t - B(L)\Delta x_t = u_t, \tag{3.12}$$

or, alternatively

$$\Delta x_t = [I - B(L)]^{-1} u_t, \tag{3.13}$$

which can be written as:

$$\Delta x_t = C(L)u_t, \tag{3.14}$$

where $C(L) = [I - B(L)]^{-1}$. The lead matrix of $C(L)$ is, by construction $C(0) = I$

(Zhang et al., 2004), which implies $\Delta x_t = u_t$. Comparing equations 3.2 and 3.14, it yields:

$$u_t = A_0 \epsilon_t, \tag{3.15}$$

which implies that the vector of reduced-from residuals (u_t) is linked to the vector of structural shocks (ϵ_t) by the coefficient matrix (A_0). If A_0 is estimated, then the structural shocks of the model can be easily recovered. The variance-covariance matrix of the residuals is as:

$$E(u_t u_t^{'}) = \Sigma, \tag{3.16}$$

and

$$E(u_t u_t^{'}) = A_0 E(\epsilon_t \epsilon_t^{'}) A_0^{'} = A_0 A_0^{'}, \tag{3.17}$$

or, alternatively

$$E(u_t u_t^{'}) = A_0 A_0^{'} = \Sigma. \tag{3.18}$$

Combining equations 3.2 and 3.14, it can be written as:

$$A(L)\epsilon_t = C(L)u_t, \tag{3.19}$$

such that

$$A(L)\epsilon_t = C(L)A_0\epsilon_t. \tag{3.20}$$

Therefore,

$$A(L) = C(L)A_0. \tag{3.21}$$

The equation 3.21 shows the relationship between the matrix of long-term effects of structural shocks and the equivalent matrix of reduced-form shocks, which can be written for a VAR(1) process as:

$$A(1) = C(1)A_0, \tag{3.22}$$

where $A(1)$ is the matrix of long run effects of the structural shocks in equation 3.2; $C(1)$ is the long run coefficient of the reduced-from shocks in equation 3.14 and it is obtained from the reduced-form estimates.

From equations 3.18 and 3.22,

$$C(1)\Sigma C(1)^{'} = A(1)A(1)^{'}, \tag{3.23}$$

which suggests to identify $A(1)$ by using a Cholesky-decomposition of the left-hand side that contains known elements. Thus equation 3.22 alows us to recover the estimated A_0 as $A_0 = C(1)^{-1}A(1)$, where $C(1)$ is known. Then the structural shocks, ϵ_t can be derived as:

$$\hat{\epsilon}_t = \hat{A}_0^{-1}\hat{u}_t. \tag{3.24}$$

This methodology is used to estimate the global, regional, and domestic shocks for each member country. Then, a pair-wise correlation matrix is computed for each type of shock to examine their symmetry across the SAARC countries. The higher the correlation of shocks among the member countries, the more suitable the currency union is (Blaszkiewicz and Wozniak, 2003; Soffer, 2007). A positive correlation of supply shocks indicates that countries would require a synchronous policy response (Saxena, 2005).

3.2 Data and Variables

This study uses annual data for world GDP, regional GDP for each of the member country, the domestic GDP, the real interest rate, and real effective exchange rate for Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka during the period 1974-2010.[1] All data are from the World Development Indicators and is supplemented by International Financial Statistics (IFS) via DataStream.[2] The world GDP excludes the SAARC GDP. The regional GDP excludes the GDP of that country from the SAARC GDP. To calculate the REER, trade relevant data are collected from the Direction of Trade Statistics of IFS. The real effective exchange rate (REER) is

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[1]This study excludes Afghanistan as it joins SAARC in 2007. In addition, there is no stable economic history during the sample period (Enterline and Greig, 2008). There is not a significant bilateral or multilateral trade relationships between any other SAARC member country (except in Pakistan) and Afghanistan before joining in SAARC (Pandey and Dixit, 2009; Weerakoon, 2010), although it is increasing now (Alam et al., 2011). Also, the necessary data for Afghanistan are not available during the sample period.

[2]The detail sources for each country is given in Appendix B.1.

calculated by the following way.[3] The weight for a partner country is calculated as the ratio of the trade volume with the partner and the total trade volume with all the major partner countries. The bilateral nominal exchange rate index of each country is transformed into real exchange rate index using the consumer price index (CPI) of a member country and its trading partner country. Then the real effective exchange rate of each of the member country is obtained by calculating the arithmetic weighted average value of the real exchange rate indices of their domestic currency against the US dollar. The real effective exchange rate is converted into a single index using 1974=100 as it is assumed the base year is 1974.

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[3]For details, see Appendix B.2.

Chapter 4

Empirical Analysis

4.1 Descriptive Statistics

During the sample period the average growth rates of SAARC (the South Asian Association of Regional Cooperation) were between 4.50% - 7.66%, and the world average growth rate was 2.93%. Bhutan had the highest average growth rate (7.66%), following by Maldives (7.49%) and India (5.80%). The other member countries had similar patterns of average growth rates (4.50% - 5.10%). The standard error of the average growth rate of these countries is smaller than Maldives which means that there is no huge variation in growth rates of these countries.

Table 4.1: Basic statistics of variables

	Growth Rate		Real Effective Exchange Rate		Real Interest Rate		Regional Growth Rate	
	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
World	2.9300	0.23601						
Bangladesh	4.5901	0.35709	56.5761	2.54857	7.8581	1.19074	8.5738	1.34323
Bhutan	7.6606	0.57636	36.5782	2.92723	7.7134	0.33217	8.3884	1.30062
India	5.8021	0.49776	46.8869	2.22268	6.5963	0.37316	7.7904	1.51103
Maldives	7.4911	2.08006	53.3540	2.34019	10.7148	0.51727	8.3875	1.30129
Nepal	4.2282	0.41803	44.6108	3.50986	1.2416	1.20226	8.3982	1.30752
Pakistan	5.0773	0.34273	56.4690	2.68597	2.8862	0.95224	8.4019	1.42808
Sri Lanka	4.9334	0.29395	134.8800	27.6180	3.9056	0.69644	8.4140	1.32506

Note: This table shows average values and standard error of the variables.

Bhutan has the lowest average real effective exchange rates (REER) and Sri Lanka has the highest, whereas the other member country's REER is between 44-56 in terms of their local currencies against US dollar. The variation of real effective exchange rates are almost similar among the member countries except in Sri Lanka.

Table 4.2 shows the correlation coefficients of the real effective exchange rate among the member countries. The higher pair-wise correlations among them indicate the REER of these countries move to the same direction. Bhutan and Sri Lanka show the lowest correlation coefficient (0.61) and Bhutan and Nepal show the highest

Table 4.2: Correlations of real effective exchange rates across SAARC countries

	Bhutan	Bangladesh	India	Maldives	Nepal	Pakistan	Sri Lanka
Bhutan	1.00						
Bangladesh	0.92	1.00					
India	0.95	0.94	1.00				
Maldives	0.90	0.95	0.94	1.00			
Nepal	0.99	0.95	0.96	0.92	1.00		
Pakistan	0.97	0.93	0.90	0.88	0.97	1.00	
Sri Lanka	0.61	0.80	0.69	0.78	0.68	0.67	1.00

Note: The table shows the correlation coefficients of real effective exchange rates between pairs of SAARC member countries. All currencies are measured against the US dollar.

coefficient (0.99). The real effective exchange rates (REER) of SAARC member countries (Figure 4.1) also show the same direction over the sample period except in Sri Lanka.[1]

The trends of real effective exchange rates of India and Pakistan were almost similar until 1999, and then the Pakistani currency depreciated with respect to the Indian currency; see Figure 4.1. The nominal exchange rate of these two countries also show the almost similar patterns before 2000 (Khawaja, 2007; Butt and Bandara, 2009), and then the State Bank of Pakistan depreciates its currency to gain the competitiveness in international trades (Abbas, 2010). Abbas (2010) also finds that the Pakistani Rupee depreciated by more than 23% against US dollar in 2008 compared to 2007 because of its political uncertainty, internal conflicts, and current account deficits.

The average real interest rates of Maldives are highest, whereas Nepal has the lowest real interest rate than any SAARC member countries. The regional growth rate of most of the SAARC countries is almost 8%, whereas it is 7.79% for India. As the regional GDP is calculated excluding the GDP of the concerned member country from the SAARC GDP and the average growth rate regional GDP for India is lower, it can be said the SAARC economy is dominated by the Indian economy.

Table 4.3 shows the percentage share of GDP contribution to the SAARC economy. India has the largest contribution (more than 75%) to the SAARC economy over the

[1]The real effective exchange rate of Sri Lanka has become stronger after 2002. The probable reason is the peace agreement between the Sri Lankan government and the rebel Tamil Tigers in 2002 (Schulenkorf, 2010), which ended a 19 years of fighting. See also DeVotta (2011). In Sri Lanka, the average growth rates have been 4.60% (1974-2002) and 5.95% (2003-2010).

Figure 4.1: The real effective exchange rates
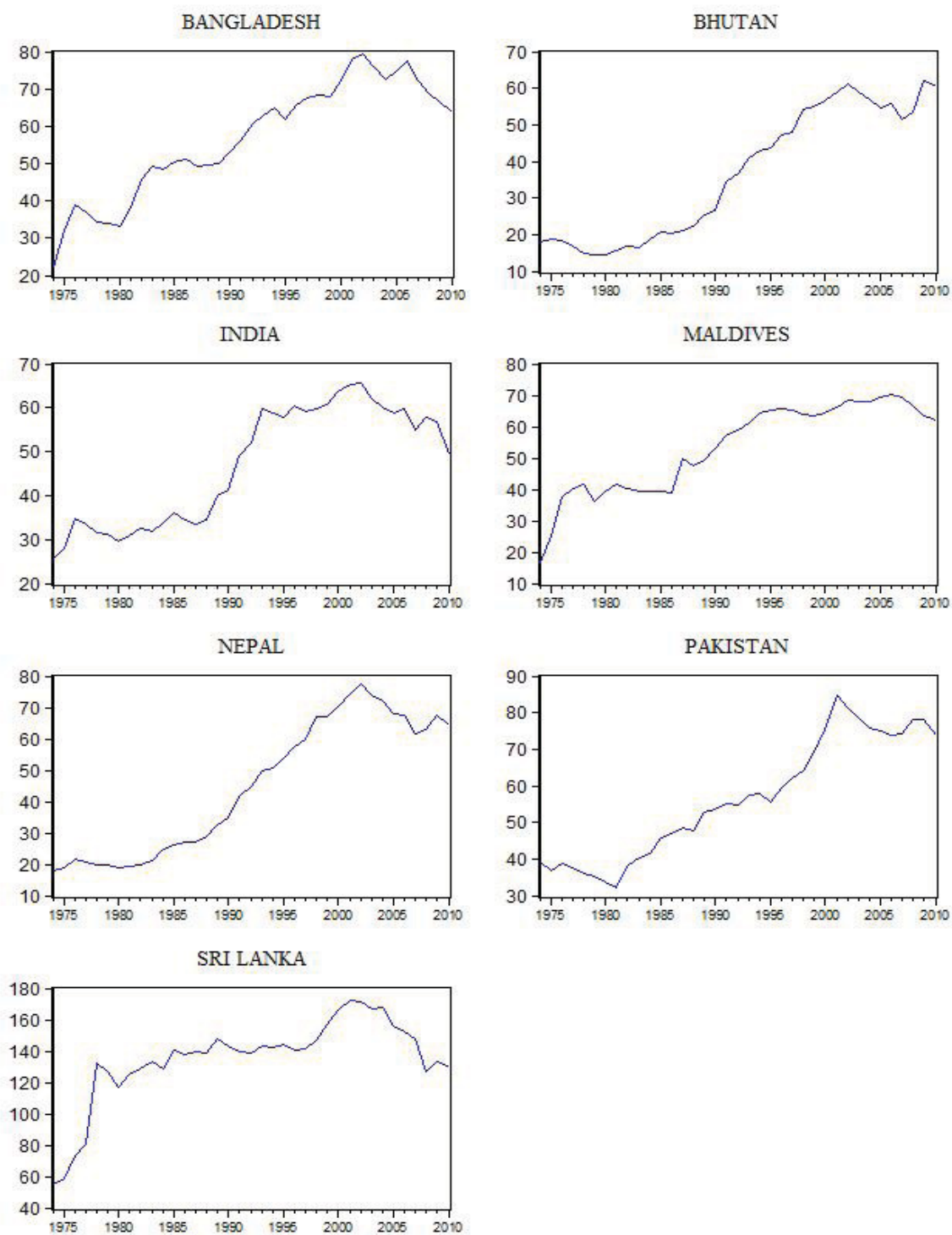
Note: This figure shows the real effective exchange rates of SAARC member countries in terms of their national currency to US dollar over the period from 1974 to 2010. The real effective exchange rate is converted into a single index using 1974=100 as it is assumed the base year is 1974.

sample period. Bangladesh and Pakistan have 7.50% and 10.89% contribution to the SAARC economy respectively. Bhutan, Maldives, and Nepal contribute less than 1% to the SAARC economy, and Sri Lanka contributes 2.38%.

Table 4.3: Share of individual countries in SAARC GDP (%).

Country	1974	1980	1990	2000	2010	Average (1974-2010)
Bhutan	0.06	0.05	0.07	0.07	0.07	0.07 (0.01)
Bangladesh	9.98	7.82	7.54	7.80	4.83	7.45 (1.70)
India	79.08	79.31	79.41	76.17	83.44	78.24 (2.51)
Maldives	0.02	0.02	0.05	0.10	0.07	0.06 (0.03)
Nepal	0.98	0.84	0.91	0.91	0.76	0.91 (0.10)
Pakistan	7.02	10.22	10.01	12.24	8.44	10.90 (1.41)
Sri Lanka	2.86	1.74	2.01	2.70	2.39	2.38 (0.40)

Note: This table shows the percentage contribution of each member country to the SAARC GDP. The values within parentheses are standard errors.

4.2 Structural VAR Models

In the baseline model, the relation between the reduced form and structural shocks is as $u_t = A_0 \epsilon_t$, which is shown in equation 3.15. More specifically, for each country

$$
\begin{bmatrix} u_t^{sw} \\ u_t^{sr} \\ u_t^{s} \\ u_t^{i} \\ u_t^{er} \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix} \begin{bmatrix} \epsilon_t^{sw} \\ \epsilon_t^{sr} \\ \epsilon_t^{s} \\ \epsilon_t^{i} \\ \epsilon_t^{er} \end{bmatrix}, \tag{4.1}
$$

where the vector of the left-hand side presents the reduced form shocks. They are interpreted as external global supply shocks (u_t^{sw}), regional supply shocks (u_t^{sr}), domestic supply shocks (u_t^{s}), domestic interest rate shocks (u_t^{i}), domestic exchange rate shocks (u_t^{er}). The vector of right-hand side residuals (ϵ_t) present structural shocks, and are divided in two parts; external shocks and domestic shocks. The first two rows show the external (i.e., external global and regional) shocks, where the rest of the rows show the domestic (supply, interest rate, and exchange rate) shocks. A_0 is the structure which links reduced form shocks to the structural shocks.

The variance-covariance matrix of the reduced-form shocks, $E(u_t u_t') = A_0 A_0' = \Sigma$

is a symmetric matrix. Sims (1986) argues that the Cholesky decomposition of Σ can be used to identify A_0. Then A_0 can be used to recover the structural shocks (ϵ_t) in equation 3.15. Lütkepohl (2005) suggests to normalize A_0 and impose additional $n(n-1)/2$ restrictions on the off-diagonal elements of A_0 to ensure an exactly identified shocks. This procedures make A_0 a lower triangular matrix. This is also the case for A_0'. The resulting impulse response would be same as orthogonalized impulse response following a Cholesky decomposition.

Thus, the baseline SVAR model for each of the SAARC member country is:

$$
\begin{bmatrix} u_t^{sw} \\ u_t^{sr} \\ u_t^{s} \\ u_t^{i} \\ u_t^{er} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \begin{bmatrix} \epsilon_t^{sw} \\ \epsilon_t^{sr} \\ \epsilon_t^{s} \\ \epsilon_t^{i} \\ \epsilon_t^{er} \end{bmatrix}, \tag{4.2}
$$

which implies the regional supply shocks or the domestic shocks of each of these countries cannot affect the world output simultaneously. Since the contribution of each of these countries to the world economy is very little and the world GDP here excludes SAARC GDP, this restriction is plausible. Also domestic shocks cannot affect the regional shocks, as the regional GDP is calculated excluding GDP of the concerned country. The interest rate and exchange rate do not affect the domestic GDP. And the interest rate does not respond to contemporaneous changes in the effective exchange rate (Peersman and Mojon, 2001; Sousa and Zaghini, 2007).

4.3 Empirical Results and Interpretations

The Augmented Dickey-Fuller (ADF) tests are conducted to check whether the series are stationary. The results are shown in Appendix Table C.1. All variables are log differenced form as they are not stationary in levels. The log difference of most of the series are stationary. The exceptions are the domestic GDP and the real interest rate of Bhutan, and the real interest rate of Nepal. These three non-stationary variables are made stationary after taking first difference.

In the following section the estimation of underlying structural shocks,[2] and how these shocks are related among the SAARC member countries are reported.

4.3.1 Correlation of Structural Shocks

To examine the degree of symmetry of the structural shocks among the SAARC member countries, this study examines the correlation coefficients of the shocks; the external shocks (global and regional) and the domestic shocks (supply, interest rate and exchange rate). The correlation coefficients that are positive and statistically significant correspond to symmetric shocks, and the negative and statistically insignificant shocks correspond to asymmetric shocks. Pearson's correlation coefficient statistics is used to check whether the coefficients are statistically significant at 5% level. The statistic, $\frac{r}{\sqrt{(1-r^2)/(N-2)}}$ is distributed as t statistic with degree of freedom, $df = N - 2$; where r is the coefficient of correlation, and N is the number of observations. The null hypothesis is that the coefficient of correlation is zero (i.e., $r = 0$). The results for the five structural shocks are reported in Table 4.4 and 4.5.

Table 4.4: Correlation of external shocks

	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
Correlation of global shocks							
Bangladesh	1.00						
Bhutan	0.76	1.00					
India	-0.12	-0.03	1.00				
Maldives	0.83	0.65	-0.05	1.00			
Nepal	0.94	0.75	-0.16	0.82	1.00		
Pakistan	0.90	0.74	-0.15	0.80	0.89	1.00	
Sri Lanka	0.71	0.57	-0.03	0.76	0.71	0.66	1.00
Correlation of regional shocks							
Bangladesh	1.00						
Bhutan	0.83	1.00					
India	0.86	0.81	1.00				
Maldives	0.92	0.83	0.83	1.00			
Nepal	0.81	0.72	0.80	0.79	1.00		
Pakistan	0.81	0.81	0.73	0.82	0.77	1.00	
Sri Lanka	0.76	0.63	0.59	0.75	0.58	0.73	1.00

Note: The shaded values indicate positive correlations that are significant at 5 percent level.

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[2]The estimation is undertaken in Eviews 7.

Correlation of External Shocks

Table 4.4 shows that the correlation of the external shocks among the SAARC member countries is highly positive and statistically significant. However, the external global correlation coefficient between India and any other SAARC country is not statistically significant, which imply the external shocks between India and any of the SAARC member country are asymmetric. Since India is the largest country in the region, with a large domestic market (Büthe and Milner, 2008; Ali and Talukder, 2009), it is plausible that India's response to external global shocks would be different than other countries. Also India experiences major trade policy changes (for example, trade liberalization) and institutional reforms to boost up trade with different other regions, including EU (European Union), BRICS (Brazil, Russia, India, China, and South Africa), ASEAN (Association of Southeast Asian Nations), BIMSTEC (Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation), MERCO-SUR (Argentina, Brazil, Paraguay, Uruguay, and Venezuela), and North America.[3] These regions also show more enthusiasm to India compared to any of SAARC member countries (Ganguly and Pardesi, 2009). These privileges may help India facing the external global shocks in different ways. The pair-wise correlation of SAARC member countries based on external regional shocks are statistically positive significant.

Correlation of Domestic Shocks

Table 4.5 displays the cross correlations of the domestic disturbances among SAARC member countries. The pair-wise correlation of domestic supply shocks between Bangladesh and Maldives (0.34), Bhutan and India (0.49) are statistically significant. Neither of the other pair-wise correlation coefficients of SAARC member countries experiences any symmetry in terms of their domestic supply shocks. Thus the empirical evidence on domestic supply shocks among the SAARC countries does not provide any strong evidence to form a monetary union as well as introducing a common currency area. The pair-wise correlation of domestic real interest rate shocks of India with Bangladesh (0.39) and Bhutan (0.67); Nepal with Bhutan (0.64) and India (0.59); India with Pakistan (0.46) are statistically significant. However, the real interest rate shocks among the SAARC member countries are not highly correlated

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[3]See, Aggarwal and Mukherji (2008); Henry (2008).

with each other, see Appendix C.2. Maskay (2003) also finds that the correlation coefficients of real and nominal interest rates among the SAARC countries are not

Table 4.5: Correlation of domestic shocks.

	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
Correlation of domestic supply shocks							
Bangladesh	1.00						
Bhutan	0.21	1.00					
India	0.24	0.49	1.00				
Maldives	0.34	-0.19	-0.33	1.00			
Nepal	0.10	0.00	0.12	0.05	1.00		
Pakistan	0.19	-0.01	-0.18	0.20	-0.10	1.00	
Sri Lanka	0.21	0.28	0.19	0.12	-0.05	-0.02	1.00
Correlation of domestic interest rate shocks.							
Bangladesh	1.00						
Bhutan	0.24	1.00					
India	0.39	0.67	1.00				
Maldives	0.22	-0.01	0.00	1.00			
Nepal	0.09	0.64	0.59	-0.22	1.00		
Pakistan	0.03	0.31	0.46	-0.12	0.30	1.00	
Sri Lanka	0.17	-0.07	0.12	0.07	-0.12	0.04	1.00
Correlation of domestic exchange rate shocks.							
Bangladesh	1.00						
Bhutan	0.05	1.00					
India	-0.06	-0.12	1.00				
Maldives	-0.06	0.03	0.24	1.00			
Nepal	0.11	0.00	-0.18	0.33	1.00		
Pakistan	0.01	0.35	-0.02	0.09	0.19	1.00	
Sri Lanka	0.05	-0.14	0.07	-0.20	-0.02	-0.17	1.00

Note: The shaded values indicate positive correlations that are significant at 5 percent level.

statistically significant. Chow and Kim (2003) argue that the highly correlated real interest rates of a group of countries can be a criterion for a common currency area. The exchange rate shocks are also asymmetric among the member countries. There is no evidence of symmetric relationship of the domestic shocks, which indicates the SAARC countries do not have similar domestic shocks. Thus the symmetric shocks criteria following by SVAR methodology suggest that the SAARC member countries are not ready yet to form a currency union, although the regional shocks are symmetric.

Figure 4.2: Impulse responses of real effective exchange rates to the external shocks (one standard deviation innovations)
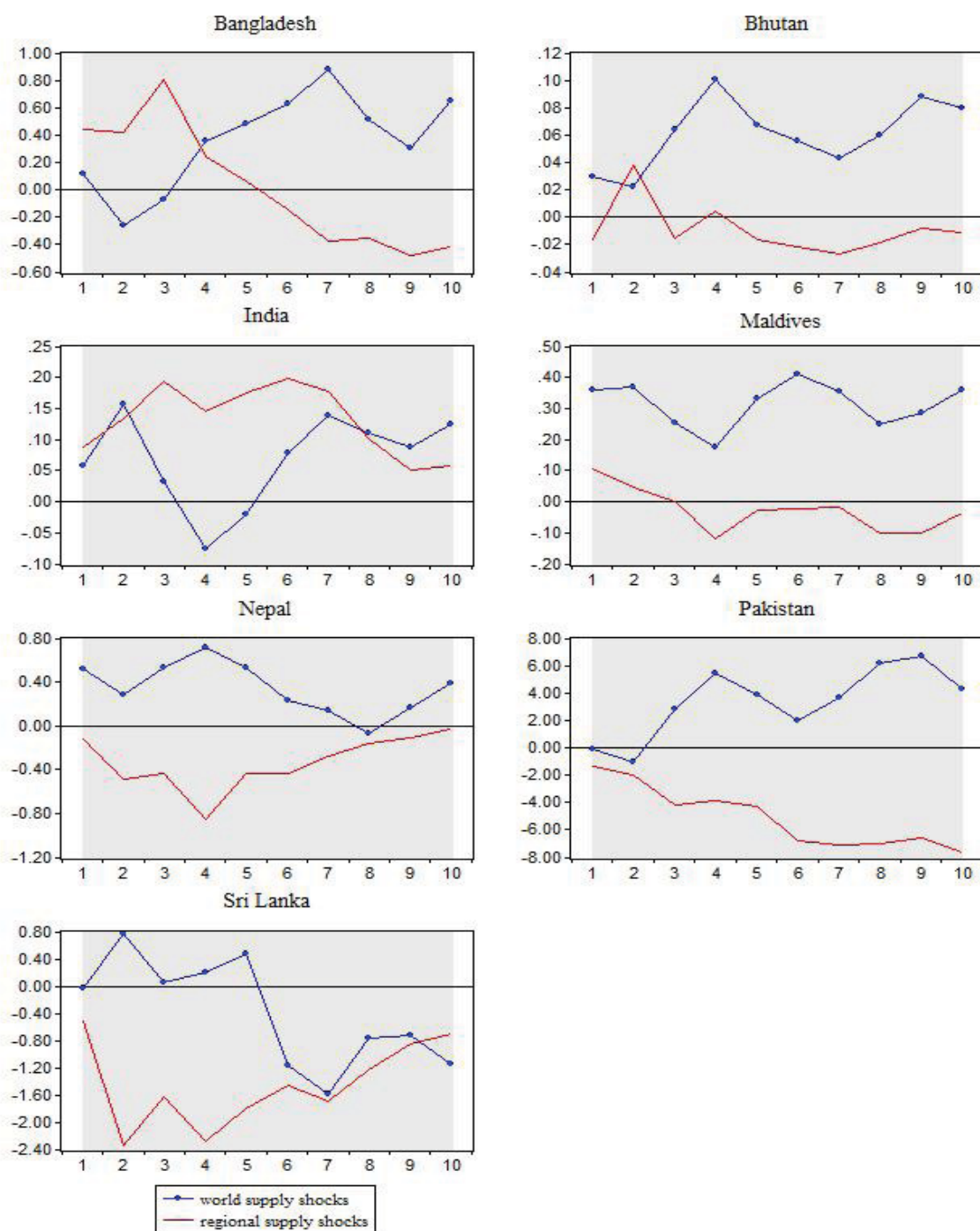
Note: These graphs show the responses of the real effective exchange rates among the SAARC member countries to external global and regional shocks over a next 10 year period. All variables are in logarithms. The confidence interval is 95 percent. The error bands are computed with Monte Carlo simulations.

4.3.2   Impulse Response Analysis

If the response patterns of the endogenous variables (for example, the real effective exchange rate) are similar among a group of countries, then the exchange rate becomes a less compelling adjustment instrument. Hence, a common currency can be introduced among these countries (Huang and Guo, 2006). Figure 4.2 shows the dynamic effect of a one standard deviation structural shock on real effective exchange rates among the SAARC member countries over a 10 year period. The symmetric global (except India) and regional shocks among the SAARC member countries may indicate to expect that the real effective exchange rates would respond to these external shocks in a similar way.

In Figure 4.2, the real effective exchange rates of Bhutan and Maldives exhibit a positive long-run response to a global shock, even though their magnitudes and paths are different among themselves. The REER of other SAARC member countries show mixed responses (positive and negative) to the external global shocks. The responses of Bhutan and Maldives to global shocks are expected since Bhutan and Maldives are highly open economies, whereas the other countries are moderately open which are shown in Table 2.2. Overall the adjustment process of SAARC member countries to the global shocks is not similar to each other. The regional supply shocks lead to a positive long-run response of REER in India; negative response in Nepal, Pakistan and Sri Lanka; mixed responses in Bangladesh, Bhutan and Maldives. Also, the magnitudes of these responses to regional supply shocks are not similar to each other. Given the differences in magnitudes in responding to external shocks, the cost of relinquishing autonomous monetary policy of SARRC economies would be high. This suggests that introducing a common currency is not economically advantageous.

4.4   Alternative Criteria for Currency Union in SAARC Economies

The previous section used a five-variable SVAR model to investigate the feasibility of introducing a common currency based on asymmetric shocks criteria among SAARC member countries. This section discusses briefly SAARC economies for the assessment of optimal currency area based on alternative criteria, such as factor mobility, openness in trades, intra-regional trade.

Labor mobility is one of the most important criteria for OCA as it helps the potential member countries of a monetary union to adjust to asymmetric shocks by allowing labor mobility. There is very little evidence of labor mobility between India and Pakistan; whereas India and Nepal experience perfect labor mobility (Saxena, 2005). However, most SAARC countries restrict labor mobility (Ali, 1995; Dubey, 2005), which suggests that the amount of labor movement among these countries is not significant for assessing OCA criteria, see also (Saxena, 2005). In addition, there are no reliable data on labor movement among SAARC countries.

Table 4.6: Foreign direct investment, net inflows as a percentage of GDP

	1980	1990	2000	2010
Bangladesh	0.047	0.011	0.595	0.964
Bhutan	NA	NA	NA	0.771
India	0.043	0.075	0.779	1.399
Maldives	0.000	2.790	3.574	8.584
Nepal	0.015	0.164	-0.009	NA
Pakistan	0.269	0.613	0.416	1.140
Sri Lanka	1.069	0.540	1.059	0.965
South Asia	0.084	0.135	0.723	1.344
Euro area	0.440	1.224	11.623	2.716
European Union	0.640	1.478	10.950	2.230
North America	0.749	0.885	3.647	1.607
East Asia Pacific	0.334	0.653	2.048	2.271
(all income levels)				

Source: World Development Indicators. NA implies not available.
Note: These figures show the net inflow of FDI as a percentage to GDP of SAARC member countries, and different regional groups.

Capital mobility could be another criterion for the assessment of OCA as capital is assumed to be perfectly mobile. Mundell (1961) argues that perfect capital mobility can substitute labor mobility among the member countries of a currency union, thereby easing the burden of symmetric policy responses to external shocks when labor is not perfectly mobile across the member countries. Most of SAARC member countries adopted various industrial policies to attract foreign direct investment (FDI) resulting an increase net inflow of capital during the past decades, see Table 4.6. However, the intra-regional investment of SAARC economies is very low (1% of the total investment) compared to other group of countries. Harun (2010) argues that this is driven by variation in FDI policies, the absence of any cross-border investment movements within the region, the absence of any bilateral and multilateral

investment guarantees for intra-SAARC investment, the limitation in foreign owner-
ship, the absence of support from financial institutions for intra-SAARC investment,
and transit problems to the landlocked areas of the region. In a recent study, Alam
and Zubayer (2010) report that the leading source of FDI inflow to Bangladesh is UK
(175.71 million US dollar followed by USA (105.36), Singapore (88.02), UAE (82.96),
Norway (70.48) in 2007). In case of India the sequence is Mauritius (6363 million
US dollar followed by UK (1878), USA (856), Netherlands (644), Singapore (578). In
case of Pakistan, the major source of FDI are UK (1820 million US dollar) then USA
(1767), Netherlands (778), Peoples Republic of China (712) and UAE (677).

McKinnon (1963) argues that the higher openness in trade reduces the cost of
fixing an exchange rate. The higher openness in trade of a country, the more fluctua-
tion in international prices, which would impact directly and indirectly in its domestic
prices. The exchange rate fluctuation would also be transmitted into the domestic
prices of tradable goods and cost of living, which suggests that an independent ex-
change rate regime would be less effective as a policy instrument for a highly open
economy (Mongelli and Wyplosz, 2008). Table 2.1 shows the trade openness of South
Asian countries is 43.10%, whereas it is more than 78% in EU countries, which play
the pioneering role for introducing a common currency.

Table 4.7: Intra-regional trade of SAARC countries (% of total trade)

	1980	1985	1995	2000	2005	2010
Bangladesh	4.84	4.65	12.82	7.86	10.32	11.28
India	1.92	1.56	2.68	2.41	2.70	2.21
Maldives	10.05	12.47	14.35	22.23	17.36	17.12
Nepal	35.62	37.66	12.57	20.95	56.21	46.80
Pakistan	3.62	2.76	2.16	2.73	3.48	5.47
Sri Lanka	6.72	5.65	7.81	7.39	17.28	19.26

Note: These figures represent trade of a SAARC nation with other SAARC countries compared to their
respective total trades, are calculated following by 100*(trade with SAARC)/total trade based on data from
IMF, *International Financial Statistics.*

Table 4.7 shows the intra-regional trade of SAARC countries, which indicates
these countries are not highly integrated. Although the formation of SAARC in-
creases intra-SAARC trade slightly, there is no significant variation among the mem-
ber countries. Figure 4.3 shows that the average intra-SAARC exports is consistent
under 5% over the past decades. The intra-SAARC trade of Nepal is the highest

Figure 4.3: Intra-regional exports as a share of total exports of different groups.
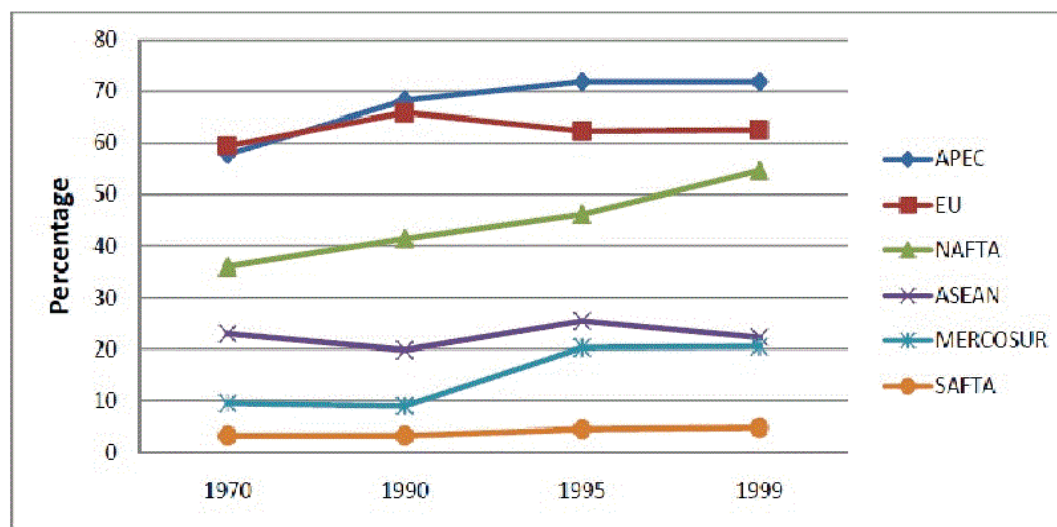
than any SAARC countries. India and Pakistan are the least trading with SAARC members countries. Saxena (2005) argues that there is also significant illegal trades happened among these member countries. For example, the values of formal and informal trade between Bangladesh and India is roughly the same, while informal trade value is almost one-third of formal trade between India and Sri Lanka (Taneja, 2001, 2004; Banik and Gilbert, 2008). The intra-regional trade of SAARC economies remains a tiny fraction of total trade, despite considerable liberalization following the free trade agreement (SAFTA, 2006).

Ali (1995) argues that the SAARC economies are endowed with labor resources, the exports of this region are generally dominated by labor-intensive manufacturing products and these countries are not diversified in their production (Razzaque, 2010), which leads to reduce the regional trade (North, 1955; Streeten, 1993) is also evident in case of SAARC countries.

The geo-political factors are also equally considerable factors as the economic factors for a feasibility study of monetary union (Goodhart, 1990). The political cooperation among SAARC member countries remains limited after the formation of SAARC, which is also evident in their intra-regional trade. The intra-regional exports of SAARC economies as compared to other regional groups also remain very low and

Table 4.8: Trends in intra-regional group trade (% of total trade)

Regional Group	1950	1960	1970	1980	1990	1995	2000	2008
AFTA	35.50	30.40	36.00	33.20	37.20	42.00	46.80	40.00
APEC	44.20	47.00	57.90	57.50	67.70	71.70	72.50	65.50
ASEAN	2.80	12.70	22.40	15.90	17.00	21.00	22.70	25.80
ASEAN +3	16.10	21.90	25.80	29.00	26.80	34.90	33.70	34.0
GCC	NA	NA	4.60	3.90	8.10	7.50	6.20	5.50
SAARC	11.60	5.00	3.20	3.50	2.70	4.30	4.50	4.80
EU 25	47.90	51.80	61.00	61.80	67.40	66.40	67.20	66.70
MERCOSUR	6.10	7.60	9.40	9.70	11.00	19.20	19.90	15.50

Source: Jain and Singh (2009) based on data from UNCTAD.
Note: AFTA= ASEAN Free Trade Area; ASEAN= The Association of Southeast Asian Nations; APEC= Asia-Pacific Economic Cooperation; ASEAN+3= ASEAN and three East Asian countries i.e., China, Japan, and South Korea; GCC=Cooperation Council for the Arab States of the Gulf, NAFTA= North American Free Trade Agreement, and SAARC= South Asian Association For Regional Cooperation. NA implies not available.

stagnant under 5%, see Figure 4.3. Haq (2003) argues that the trade flow within the SAARC region is not significant compared to other regional area. Table 4.8 also shows that the intra-regional trade in South Asia is the lowest compared to other regional area. Despite SAPTA and the SAFTA agreement, the intra-SAARC trade has been low. By 2008, there was no significant increase in the intra-SAARC trade, which was lowest among other regional trade area. Jain and Singh (2009) argues that the disparities of the market size could be responsible for the lower intra-SAARC trade. For example, Bhutan, Maldives and Nepal cannot be a major exports destination of India and Pakistan.

Chapter 5

Conclusion

This thesis used the criteria for optimal currency area to evaluate the feasibility of introducing a common currency across the South Asian Association for Regional Cooperation (SAARC) countries. Since the seminal work on OCA of Mundell (1961) and McKinnon (1963), most of the literatures have focused on the following four inter-relationship among the potential the members that would impinge on the benefits of adopting a common currency,[1] namely: (i) the degree of labor mobility; (ii) the extent of intra-trade; (iii) the natures of disturbances; and (iv) the risk-sharing mechanism, a federal fiscal system which ensure a regional insurance to attenuate the impact of regional shocks on interregional income differentials.

This study finds that the SAARC countries experience symmetric global (except in India) and regional shocks. It also finds asymmetric domestic shocks among the member countries. This indicates that the SAARC countries may be better off having independent monetary policy. This study concludes that given the symmetry and magnitudes of external and domestic shocks, the SAARC countries are not yet to ready to introduce a common currency across the region.

In addition, the SAARC countries are moderately open, which is susceptible to the policy makers to introduce a common currency across the region. The SAARC countries signed and started to implement free trade agreements (SAPTA in 1995, and SAFTA in 2006) to increase their mutual trades across the region. But the share of intra-regional trade among these countries has remained low compared to the other regions. The lower degree of factor mobility, lack of political integration, lower degree of intra-regional trade would also suggest that the desirability of intro-ducing a common currency is not feasible. The formation of a currency union is the ultimate objective in a consequence of policy initiatives towards a regional economic integration. The policy makers should consider the policies to strengthen the regional

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[1]See Frankel and Rose (1996), Saxena (2005), Huang and Guo (2006).

political and economic integration as a priority, rather than thinking on a monetary integration across the South Asian countries.

The five-variable Structural VAR developed in this study may have the following shortcomings. This study uses yearly observation as the unavailability of the quarterly or monthly data for the SAARC countries. The availability of quarterly or monthly data will certainly enrich the policy implication. The ordering of variables within a Vector Autoregressive system is arbitrary. And the SVAR methodology might be claimed as a controversial tool for monetary transmission analysis. There is a doubt on the underlying shocks following by SVAR model- whether the estimated shocks are related to the central bank. Different identification procedures of SVAR may provide different policy innovations.

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Appendix A

A.1 Geographical Location

Figure A.1: Geographical location of SAARC member countries.

Note: SAARC is a regional group in South Asia, which comprises the countries of Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. The surface area of SAARC member countries is 5.13 million square km. It is the second most populous and most densely populated geographical region in the world.

A.2 Export Composition of SAARC Countries

Table A.1: Major exported goods of SAARC countries (% of total exports)

	2003	2004	2005	2006	2007
Afghanistan					
Total exports	NA	NA	NA	483.00	NA
(million US $)					
Carpets	NA	NA	NA	38.71	NA
Dried fruits	NA	NA	NA	26.10	NA
Fresh fruits	NA	NA	NA	8.10	NA
Skins	NA	NA	NA	4.76	NA
Medicinal plants	NA	NA	NA	2.07	NA
Bangladesh					
Total exports	5,741.30	6,885.10	8,654.50	10,526.20	12,177.90
(million US $)					
Ready made garments	62.80	64.62	74.16	75.06	75.64
Fish and prawns	5.60	5.63	4.85	4.36	4.23
Jute products	3.82	3.13	3.55	3.43	2.63
Leather	3.68	3.55	2.54	2.44	2.19
Bhutan					
Total exports	132.89	182.52	258.12	308.10	612.70
(million US $)					
Electricity	NA	42.10	42.10	26.50	36.00
Calcium carbide	NA	9.20	9.40	10.00	12.00
Cement	NA	6.20	8.70	9.00	9.45
Particle board	NA	2.60	7.90	8.00	9.50
India					
Total exports	63,843.00	83,536.00	103,091.00	126,331.00	154,914.00
(million US $)					
Textiles and textile products	20.10	16.22	15.92	13.45	12.00
Engineering goods	19.44	20.76	21.08	23.08	21.50
Petroleum products	5.59	8.36	11.23	14.69	15.00
Gems and jewelery	1.66	1.48	15.06	12.34	12.00
Nepal					
Total exports	666.60	753.72	840.18	885.06	864.45
(million US $)					
Ready made garments	24.21	18.45	10.82	12.59	9.50
Woolen carpets	10.48	10.25	9.79	9.50	8.90
Vegetable ghee	7.51	5.57	7.56	6.23	6.58
Raw Jutes products	3.75	3.41	4.49	4.29	4.38
Polyester yarn	1.29	2.75	3.16	5.65	3.56
Pakistan					
Total exports	11,869.00	11,869.00	13,297.00	15,433.00	16,999.00
(million US $)					
Cotton fabrics	11.00	12.00	14.00	12.45	14.45
Bed wear	10.00	9.00	8.00	12.05	13.14
Knitwear	7.00	8.00	8.00	8.54	7.00
Rice	6.45	5.00	5.56	6.45	4.68
Cotton yarn	5.50	7.00	12.00	6.67	8.50
Sri Lanka					
Total exports	5,124.80	5,770.80	6,351.10	6,895.90	7,745.30
(million US $)					
Textile and garments	50.25	48.58	45.60	44.78	43.15
Tea	13.75	12.82	12.76	12.78	12.50
Diamonds and gems	4.21	4.28	4.20	4.52	4.50
Petroleum products	1.26	1.73	2.06	2.70	2.18

Source: Economist Intelligence Unit. NA implies not available
Note: This table shows the major composition of the exported goods of the SAARC member countries, is compiled from various issues of country profiles of Economist Intelligence Unit.

Appendix B

B.1 Data Sources

Table B.1: Data sources

	GDP	Growth Rates	Real Effective Exchange Rates*	Real Interest Rates	Regional Growth Rates
World	WDI	WDI			
Bangladesh	WDI	WDI	IFS, WDI	WDI	WDI
Bhutan	WDI	WDI	IFS, WDI	WDI	WDI
India	WDI	WDI	IFS, WDI	WDI	WDI
Maldives	WDI	WDI	IFS, WDI	WDI	WDI
Nepal	WDI	WDI	IFS, WDI	WDI	WDI
Pakistan	WDI	WDI	IFS, WDI	WDI	WDI
Sri Lanka	WDI	WDI	IFS, WDI	WDI	WDI

Note: IFS and WDI imply International Financial Statistics and World Development Indicators respectively. * means the real effective exchange rates are calculated following the procedures given in B.2

B.2 Real Effective Exchange Rates

The real effective exchange rate (REER) is the weighted average of the indices of real exchange rates. This study uses the REER as a measure of exchange rates of each of the SAARC member countries. The relevant data for calculating the REER are retrieved from IFS, WDI and IFS Direction of Trade Statistics. To calculate REER of each for the SAARC member countries, this study follows the steps given as:

1. The formula used for calculating the weight for a partner country, i is as:

$$w_i = \frac{X_i + M_i}{\sum_{i=1}^{n} X_i + \sum_{i=1}^{n} M_i}, \tag{B.1}$$

where, w_i is the weight for trading partner country i among the selected major partners of a SAARC member country (for example, Bangladesh) and $\sum_{i=1}^{n} w_i = 1$; M_i and X_i are the import and export volume of Bangladesh with trading partner country

i respectively; $\sum_{i=1}^{n} M_i$, $\sum_{i=1}^{n} X_i$ and $\sum_{i=1}^{n} X_i + \sum_{i=1}^{n} M_i$ are the total import, total export and total trade volume of Bangladesh with all major trading partner countries respectively.

The lists of major trading partners of each of the SAARC member are given in Table B.2, which cover more than 85% of its total trades.

Table B.2: Major trading partner countries of SAARC economies

Country	Major trading partners
Bangladesh	Belgium, Canada, China, France, Germany, Hong Kong, India, Indonesia Italy, Japan, Malaysia, Netherlands, Pakistan, South Korea, Singapore, Thailand, UK, US.
Bhutan	Bangladesh, Belgium, China, Germany, Hong Kong, India, Japan, Malaysia, Pakistan, Singapore, UK, US.
India	Australia, Belgium, China, France, Germany, Hong Kong, Iran, Indonesia Japan, Saudi Arabia, Singapore, South Korea, Switzerland, UAE, UK, US
Maldives	France, Germany, India, Italy, Japan, Malaysia, Netherlands, Singapore, Spain, Sri Lanka, Thailand, UAE, US.
Nepal	Australia, Bhutan, Brazil,, China, France, Germany, India, Italy, Japan, Kuwait, Malaysia, South Korea, Spain, Thailand, Turkey, UAE, UK, US.
Pakistan	Afghanistan, China, France, Germany, Italy, Iran, Japan, Kuwait, Saudi Arabia, South Korea, Spain, Turkey, UAE, UK, US.
Sri Lanka	Belgium, Canada, China, France, Germany, Hong Kong, India, Indonesia Iran, Italy, Japan, Malaysia, Singapore, Thailand, UAE, UK, US.

Sources: UN Comtrade, IFS Trade Direction, Economist Intelligence Unit, Central Banks and Ministry of Trade/Commerce of the SAARC member countries.
Note: This table shows the list of SAARC member countries and their respective major trading partners which covers more than 85% of their total trades.

2. Calculation the index of bilateral nominal exchange rates (NBER) of Bangladesh (to the US dollar) in the following way;

$$NBER_{BD_t} = 10 \times \frac{ER_{BDt}}{ER_{BDt0}}, \tag{B.2}$$

where $NBER_{BD_t}$ is bilateral nominal exchange rate index for Bangladesh; ER_{BDt} and ER_{BDt0} are nominal exchange rates at period t and base year respectively. This

study considers 1974 as base year.

3. Calculating the index of bilateral real exchange rates $(RBER_{BDit})$ as:

$$RBER_{BDit} = NBER_{BDt} \times \frac{CPI_{it}}{CPI_{BDt}}, \tag{B.3}$$

where CPI_{it} and CPI_{BDt} are the Consumer Price Index (CPI) of the trading partner country i and Bangladesh at period t.

4. Real effective exchange rates of Bangladesh is calculated as the weighted average of indices of bilateral real exchange rate:

$$REER_{BDt} = \sum_{i=1}^{n} w_i RBER_{BDit}. \tag{B.4}$$

In this way, the real effective exchange rate for other SAARC countries are calculated.

Appendix C

C.1 Unit Root Tests

Table C.1: Augmented Dickey-Fuller unit root tests

Variables	Test Statistics	P-Values
World GDP	-3.356150	0.0745
Bangladesh		
Regional GDP	-3.326946	0.0790
Domestic GDP	-10.632210	0.0000
Real Interest Rates	-6.801996	0.0000
Real Effective Exchange Rates	-4.127259	0.0135
Bhutan		
Regional GDP	-3.349019	0.0756
Domestic GDP	-5.120701(1)	0.0012
Real Interest Rates	-6.264756(1)	0.0001
Real Effective Exchange Rates	-6.749241	0.0000
India		
Regional GDP	-5.117664	0.0011
Domestic GDP	-3.562622	0.0485
Real Interest Rates	-4.202591	0.0113
Real Effective Exchange Rates	-5.213159	0.0009
Maldives		
Regional GDP	-3.347860	0.0757
Domestic GDP	-3.846896	0.0260
Real Interest Rates	-8.028650	0.0000
Real Effective Exchange Rates	-5.355031	0.0006
Nepal		
Regional GDP	-3.356213	0.0745
Domestic GDP	-4.745631	0.0029
Real Interest Rates	-5.355379(1)	0.0006
Real Effective Exchange Rates	-4.211295	0.0111
Pakistan		
Regional GDP	-3.573336	0.0474
Domestic GDP	-3.644248	0.0407
Real Interest Rates	-3.332783	0.0781
Real Effective Exchange Rates	-4.349187	0.0079
Sri Lanka		
Regional GDP	-3.354145	0.0748
Domestic GDP	-4.360291	0.0077
Real Interest Rates	-3.778919	0.0302
Real Effective Exchange Rates	-4.391610	0.0071

Note: All tests are conducted with trends and constant and 2 lags. The 1%, 5% and 10% critical values for first set (level) of variables are -4.27328, -3.55778 and -3.21236 respectively. The 1%, 5% and 10% critical values for second set (first differenced) of variables are -4.28458, -3.56288 and -3.21526 respectively. The parenthesis values indicate the number of difference making the series stationary.

C.2 Correlation of Macroeconomic Indicators

Table C.2: Correlation of macroeconomic indicators

	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
Correlation of growth rates							
Bangladesh	1.00						
Bhutan	0.00	1.00					
India	0.48	0.15	1.00				
Maldives	-0.15	0.16	0.07	1.00			
Nepal	0.07	-0.15	-0.08	-0.14	1.00		
Pakistan	-0.29	0.26	0.24	-0.08	-0.17	1.00	
Sri Lanka	0.24	-0.19	0.15	-0.04	-0.05	0.05	1.00
Correlation of real interest rates							
Bangladesh	1.00						
Bhutan	0.21	1.00					
India	0.11	-0.08	1.00				
Maldives	0.03	-0.39	0.20	1.00			
Nepal	-0.06	-0.17	0.13	0.28	1.00		
Pakistan	-0.21	-0.34	0.03	0.27	0.25	1.00	
Sri Lanka	0.19	-0.13	0.22	0.00	-0.33	-0.04	1.00

Note: This figures show the correlation coefficients of growth rates and real interest rates among the SAARC countries during the sample period.