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Contents

EDITORIAL NOTE

I have the pleasure to give you the first Special Issue of the Journal of Economic Cooperation and Development with a focus on 'International Trade and Finance'. The cartography of the articles in this special issue - selected to fit the theme - gives a prospect for the new geography of exchanges of knowledge and information among and outside the OIC region. International trade with its international finance strategies is not any more what it used to be due to the emergence of new profiles of operators, the volatility dynamics of exchange rates, exchange rate policies as well as the evolution of the impact of remittances on real exchange rates. An article investigating the effect of various socio-economic and law enforcement variables on crime rate has also been included as an extra. By opening a window to various scholars, researchers and academicians within and outside the OIC region to continue demonstrating an increased interest in sharing the outcome of their valuable studies with the readers of our Journal, I am proud to share the valuable information in these articles with our Member countries and the world to provide all with a chance to keep up with the pace of changes occurring in the world economy.

This September 2015 issue – Special Edition on International Trade and Finance - contains six remarkable articles which accentuate a detailed analysis of remittances, exports, regional economic integration, foreign direct investment and economic growth as well as the recent tendencies of international trade and finance. An article investigating crime rates in the Punjab region has also been included as an extra.

The first article analyses the Free Trade Agreement (FTA) strategies of China, Japan and Korea (CJK) toward ASEAN countries using a three-player game. It explores the implications of China, Japan, and/or Korea participating in an FTA with ASEAN and the corresponding rewards in a payoff matrix.

The second article focuses the successful exchange rate regimes in Singapore, a country which has maintained low and stable rates of inflation and stability in its exchange rate.

The third article presents an empirical analysis of the impact of remittances on the real exchange rate in the Ghanaian economy using an error correction model approach. Disaggregating capital flows into other capital (CAP) and remittances, increasing levels of all forms of capital have been found to lead to real exchange rate appreciation in the long run.

The fourth article empirically investigates the volatility dynamics of Pak Rupee exchange rates and its effects on market efficiency through using GARCH models.

The fifth article highlights the relationship among remittances, Foreign Direct Investments, exports and economic growth is known to have important role in economic literature for countries suffering from technological distress and unemployment problems. It also explores the long and short run relationship between remittances, exports, foreign direct investment and economic growth using data of South Asian countries.

The six paper examines the determinants of intra-regional trade in the Arab Maghreb Union (AMU) countries. Using a data set of 1989-2009 and a standard gravity model, the results indicate that there are strong positive and negative relationship between trade and GDP, population, distance, foreign currency reserves (FOC) and real exchange rate (RER) among AMU countries.

The seventh and last article, included as an extra, empirically investigates the effect of various socio-economic and law enforcement variables on crime rate by using cross-sectional time series data set of 35 districts of Punjab.

Amb. Musa KULAKLIKAYA
Editor-in-chief

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China-Japan-Korea (CJK)'s FTA Strategy towards ASEAN Countries: A Game Theoretical Approach

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This paper analyzes the FTA strategies of China, Japan and Korea (CJK) toward ASEAN countries using a three-player game. It explores the implications of China, Japan, and/or Korea participating in an FTA with ASEAN and the corresponding rewards in a payoff matrix. The Nash equilibrium occurs when China, Korea and Japan all choose to participate in an FTA with ASEAN. Dominant strategies and response functions for each country are analyzed using Error Correction Mechanism (ECM) and Vector Auto Regression (VAR) models. The paper also finds that Japan's action to create FTA will be the most effective for regional settings. Although the game analysis is backward looking, it is a useful benchmark for understanding future FTA policies in East Asia.

1. Introduction

The new millennium has witnessed the on going process of East Asian intra regional trade expansion that establish Regional Trade Agreements (RTAs) in the form of Free Trade Agreements (FTAs) and Economic Partnership Agreements (EPAs). Regionalism acts as a powerful mantra that spells the word "whether you with us or against us". The act of exclusion from regionalism will only lead to marginalization. Therefore, the general idea is how to make it work. Having said this, the study of regionalism is very vital since the trend has indeed created a profound regional and indeed global significance (Harvey and Lee, 2002).

Unfortunately, there have been only a limited number of efforts that empirically evaluated the degree of economic integration among East Asian economies based on FTA analysis. In addition, no study has yet critically investigated the possible formation of an East Asian FTA

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related mainly to FTA strategies consisting of ASEAN and CJK countries using a game theoretical approach. This paper defines FTA strategies as the choices between two options of creating or withholding FTAs. This paper sets up three player game incorporating China, Japan and Korea (CJK) with their FTA strategies toward ASEAN member countries. Regionally speaking, it is very important to see how CJK countries decide their FTA strategies as to reach the goal of setting East Asian wide FTA.

The remainder of this paper is organized as follows. The second section studies the basic concepts from literature review. The third section covers materials and methods. The fourth section examines the result of the regressions. The last section presents conclusion and some concluding remarks.

2. Literature Review

Since Baldwin and Clarke in 1985, there have been very limited literatures discussing FTA strategy using game theory. Harrison and Rutstrom (1987) and Gander (2008) are among the relatively few. Baldwin and Clarke (1985) use actual trade and tariff data for the United States and the European Community to demonstrate how to model a Tokyo Round (as a form of trade negotiation) into a game among countries attempting to minimize individual welfare loss functions. They found that, while the game model tracks closely the decisions of the negotiators in the Tokyo Round, later unilateral political decisions resulted in less optimal tariffs.

Harrison and Rustrom (1987) suggest an alternative approach to the quantitative analysis of trade policy evaluation suggested by the notions of non-cooperative trade wars and cooperative trade negotiations. They specifically illustrate their approach by computing the outcome of a trilateral trade war between the United States, the European Union (EU) and Japan, and then a bilateral trade war between the United States and Canada. In each case they assume that other trading blocs do not react against the warring blocs. They found that the United States and the EU would each 'win' in the former trade war whilst Japan would lose, using the trilateral Free Trade outcome as a basis for comparison. They also found that both Canada and the United States would lose from a bilateral trade war, with the losses to Canada around ten times larger than those

of the United States as a percent of GNP. They show that most of the substantive aspects of a trilateral agreement between the EU, the United States and Japan can be achieved bilaterally by the EU and the United States, whether or not Japan reacts strategically to that bilateral negotiation process.

Gander (2008) uses a game theoretical approach to FTA made within ASEAN countries and between ASEAN countries and outside countries and the rest of the world (ROW). Using dynamic game theory, he found that as the number of players within ASEAN increases, the number of potential coalitions increases very rapidly. The FTA's multiply and become very complex. The same potential complexity holds for FTA's between ASEAN as a single entity and non member countries.

What is the incentive (Payoff) for countries in doing FTA? On the theoretical side, we have the so-called "endogenous growth theories" embracing the proposition that trade liberalization with greater openness might promote long-run economic growth under certain conditions. For example, Grossman and Helpman (1991) and Feenstra (1996) argue that if a free trade system is formed under conditions in which technology transfer occurs between the involved economies, production efficiency can be improved, and thus free trade can ultimately induce economic growth among the FTA member countries. Another theoretical link between trade and growth was described in a "learning-by-doing" model, as emphasized by Lucas (1988) and Young (1991). If free trade allows countries to specialize in industries with economies of scale, then their long-run economic growth can be increased. These examples demonstrate that certain economic conditions are required in order to realize a positive relationship between free trade and economic growth; thus, it can be inferred that the theoretical models do not necessarily yield an unambiguous prediction regarding the relationship between free trade and economic growth.

Given the limited amount of scholars using game theory for FTA strategy, let alone East Asian FTA, this paper aims to enrich the shelf of knowledge by doing a game theoretical approach on CJK FTA strategy towards ASEAN countries.

3. Methodology

3.1 Assumptions

1. Non Cooperative game

The most fundamental solution concept in game theory is Nash equilibrium. A game model with n-countries and their strategies can be formulated as G = (S, u) , where S = $(s_1, s_2, ...s_i)$ is the strategy of every country i and u = $(u_1, u_2, ...u_i)$ is the utility (payoff) of country i. From a specific combination of possible strategies of n-country game, a collective strategy s_i^*' for every country i, is Nash equilibrium if no country i could improve her payoff by changing only her own strategy. In other words, in Nash equilibrium, no country wants to deviate from her strategy if the other countries do not deviate from their strategies. A collective strategy (s_i^*' s_{-i}^*), where s_i^* played by country i and s_{-i}^* played by other countries (except country i), is a Nash equilibrium if and only u_i (s_i^*' s_{-i}^*) $\geq u_i$ (s_i' s_{-i}^*) for every country i, and s $\in$ S .We can say that for country i and her strategy s_i, (s_i^*' s_{-i}^*) is at least as good as (s_i' s_{-i}^*). Under the non-cooperative Nash game model, a country is assumed to have concern only for the impact of proposed tariffs on its own welfare. We can find the Nash equilibria of a game in which each country has only a few actions by examining each action profile in turn to see if it satisfies the conditions for equilibrium. Consider country i, for any given actions of the players other than i, country i's actions give her various payoffs. We denote the set of country i's best actions when the list of the other country's actions is a_{-i} by B_i (a_{-i}). Then we can define function B_i by B_i (a_{-i}) = { a_{-i} in A_i : u_i (a_i, a_{-i}) $\geq u_i$ (a_i', a_{-i}) for all a_i' in B_i }: any action in B_i (a_{-i}) is at least as good for country i as every other action of country i when the other countries' actions are given by a_{-i}. We call B_i the best response function of country i. The function B_i is set-valued as it associates a set of actions with any list of other countries' actions. Every member of the set B_i (a_{-i}) is the best response of country i to a_{-i} if each other countries adheres to a_{-i}, then country i can do no better than choose a member of B_i (a_{-i}).

2. Players

The players involved in this game are China, Japan and Korea. Being acknowledged as the economic front runners, Japan, China and Korea are assumed to have heavy responsibility for the economic welfare in the

East Asian region. It is very obvious that East Asian regionalism cannot be put into practice without these countries' strong support.

3. Strategies

This paper divides the strategies into two: (i) creates FTA with ASEAN member countries or (ii) withholds FTA with ASEAN member countries. The agreement data is compiled from UNESCAP Interactive Trade Indicators (ITI) component of Asia Pacific Trade and Investment Agreement Database (APTIAD). Given the nature of the data (*ex post*), the strategies is described as backward looking in a way that strategy selection is based on experience measured by relative past realized outputs. Although the China, Japan and Korea are involved in a non cooperative game, this paper assumes each countries share a common goal which is to reach a sound regional economic growth in East Asia. A sound trading partner within the region is prerequisite for ensuring sustainable market in the future.

3.2 Payoff scheme

As we have defined that the players are aiming regional target (economic growth) as their common goal, we can now set the payoff for each countries. The Payoff scheme is taken from the work of Robert Barro (1996) on GDP determinants. He finds that GDP is enhanced by higher initial schooling and life expectancy, lower fertility, lower government consumption, better maintenance of the rule of law, lower inflation, and improvements in the terms of trade. A year after, Edwards (1997) suggests adding productivity as one of influential variable for GDP. Many recent studies including Hansen and Rand (2004), Agrawal and Khan (2011) also include FDI as one of GDP determinants. Furthermore, Grossman and Helpman (1991) and Feenstra (1995) show that FTA is also enhancing the signatory country's economy. The macroeconomic data is taken from World Development Indicators (WDI) while the FTA data is taken from the UNESCAP Trade Agreement database. The data is ranging from the year of 1998 to 2007 in a way that it can match the emerging FTA which mostly took part within this period.

The paper employs a panel data model to generate the payoff schedule. There are several reasons for the increasing interest in panel data sets. An important one is that their use may offer a solution to the problem of

bias caused by unobserved heterogeneity, a common problem in the fitting of models with cross-sectional data sets. A second reason is that it may be possible to exploit panel data sets to reveal dynamics that are difficult to detect with cross-sectional data. The static panel data model is specified as follows:

$$GDP_{it} = \beta_1 \text{Wage}_{it} + \beta_2 Governance_{it} + \beta_3 FTA(CJK)_{it} + \beta_4 Tax_{it} + \beta_5 FDI_{it} + \varepsilon_{it} \quad (1)$$

Where GDP_t, $Wage_t$, $Governance_t$, FDI_t , Tax_t are Gross Domestic Product, monthly wage, governance indicator, FDI inflows and Tax rate for CJK and ASEAN4 at time t. The monthly wage is used to measure labor productivity within the East Asian region. We expect to have a positive and significant impact of labor productivity on regional GDP. Along with productivity, we also expect to have positive and significant impact of FDI inflows on GDP. Tax rate is rather ambiguous since it could create positive and negative impact to GDP, although the latter is more common.

Governance is measured by the six governance indicators following the work of Kaufmann (2003). These indices describe various aspects of the governance structures of a broad cross section of countries, including measures of Voice and Accountability, Political stability, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. In general, the Governance index provides explanatory power to explain the capability and quality of governance from each member country. The better indicator a country has the more it has the chance to enhance the regional welfare.

$FTA(CJK)_t$ is the key variable in this paper that explains China, Japan and Korea FTA to ASEAN countries. The variable is taken from the number of FTAs for each country. The coefficient (incremental) value of the FTA of China, Korea and Japan to the GDP will serve as a corresponding value for the payoff matrix.

3.3 Response Function

In some cases, we cannot decide player's best response function. Thus said, Nash Equilibrium cannot be decided. Fortunately for this FTA

game, we have an alternative that is called Baldwin's domino effect. The interest to become a hub for Regional Trade Agreement (RTA) will create Baldwin's (2006) domino effect that is expected makes the most of East Asian countries join the RTA. The big signings in FTA can trigger other countries to have similar signings. This is true even for the countries whose governments that were previously decided the "no FTA" as their politically optimal objective function. We have two major actors here, which are pro-membership (export competing firms) and anti-membership (import competing firms) forces. The model describes a political equilibrium resulting from a balance on the two major forces. The pro-membership will gain preferential access if the nation decides to join the RTA and go through with marginalization if the nation stays out. On the other hand, the anti-membership forces will be marginalized if the nation decides to join while it will win the domestic market if the nation stays out. Naturally, the export competing firms have larger output than the import competing one. Having said this, the shock resulted from nation's decision for not joining the RTA would be bigger for the pro-membership side. This in turn will force the policy makers to join the existing RTA. As the membership expands, the incentive to join the RTA becomes more attractive even for those who previously found the political optimal decision by staying out. The cycle repeats itself until a new political equilibrium membership in RTA is met.

The basic logic is simple, as Baldwin (2006) argues, the decision to join or not to join FTA is a function of a political equilibrium that meets the balance of anti-FTA and pro-FTA forces (Typically the pro-FTA group is made up of exporters who would like better market access; the anti-FTA group is made up of import competing firms and workers employed by them.). Deeper integration among CJK countries is very beneficial to be considered as South East Asian countries benchmark decision. Moreover Baldwin (2006) has the faith that the economic grouping in the North East Asia stimulates exporters in South East Asia to be engaged in greater pro-FTA political activity. The mechanism is as follows; if one of the other nations' government was previously close to indifferent, politically speaking, to signing an RTA with CJK countries then the extra political activity of their exporters may tilt the balance, leading the country to sign an RTA. This can be thought of as one domino knocking down the next one (think of the first RTA signing as someone pushing over the first domino, and the second FTA as the second domino falling). Countries that are out of the scheme will be

marginalized due to the shrinkage of foreign market access. In the political sphere this new disadvantage will result in greater political pressure – pressure on their own governments to negotiate with the existing RTA.

To simulate this logic, the author constructs a simultaneous equation model on RTA/FTA in China, Japan and Korea. Although they have individual action, most of them are influencing each other. The paper employs Vector Auto Regression (VAR) as a part of simultaneous equation model. VAR model is one of the most successful, flexible, and easy to use models for the analysis of multivariate time series. It is a natural extension of the univariate autoregressive model to dynamic multivariate time series. VAR is a statistical model used to capture the linear interdependencies among multiple time series. VAR models generalize the univariate autoregression (AR) models. All the variables in a VAR are treated symmetrically; each variable has an equation explaining its evolution based on its own lags and the lags of all the other variables in the model. VAR modeling does not require expert knowledge, which previously had been used in structural models with simultaneous equations.

The VAR approach assumes all variables in the system are potentially endogenous, so each variable is explained by its own lags and lagged values of the other variables. The author will start by formulating a general VAR model of the relationship between China, Japan and Korea Individual RTA.

$$CFTA_t = \alpha_1 + \sum \beta_{1j} CFTA_{t-j} + \sum \lambda_{1j} JFTA_{t-j} + \sum \gamma_{1j} KFTA_{t-j} + \varepsilon_1 \qquad (2)$$

$$JFTA_t = \alpha_2 + \sum \beta_{2j} JFTA_{t-j} + \sum \lambda_{2j} KFTA_{t-j} + \sum \gamma_{2j} CFTA_{t-j} + \varepsilon_2 \qquad (3)$$

$$KFTA_t = \alpha_3 + \sum \beta_{3j} KFTA_{t-j} + \sum \lambda_{3j} JFTA_{t-j} + \sum \gamma_{3j} CFTA_{t-j} + \varepsilon_3 \qquad (4)$$

The equations above show that all variables are endogenous variables within the simultaneous equation. The variables are influencing each other, as for example the growth of Chinese FTA in year "t" is influenced by the Chinese FTA, Japanese FTA and Korean FTA from previous period. Likewise, the growth of Japanese FTA at year t is influenced by Japanese FTA, Chinese FTA and Korean FTA from

previous period. Furthermore, Korean FTA at year t is influenced by Korean FTA, Japanese FTA and Chinese FTA from the previous period.

3.4 Dominant Strategy

A strategy is dominant if, regardless of what any other countries do, the strategy earns a country a larger payoff than any other. Hence, a strategy is dominant if it is always better than any other strategy, for any profile of other countries' actions. Depending on whether "better" is defined with weak or strict inequalities, the strategy is termed strictly dominant or weakly dominant. If one strategy is dominant, the other is dominated. This paper employs Error Correction Mechanism (ECM) to describe this phenomenon.

According to the Engle-Granger (1987) theorem, if two variables *y* and *x* are cointegrated, then the relationship between the two can be expressed as an ECM in which the error term from the OLS regression, lagged once, acts as the error correction term. In this case the cointegration provides evidence of a long-run relationship between the variables, whilst the ECM provides evidence of the short-run relationship. A basic error correction model would appear as follows:

$$\Delta y_t = \chi_0 + \chi_1 \Delta x_t - \tau(u_{t-1}) + \varepsilon_t \quad (5)$$

Where τ is the error correction term coefficient, which theory suggests should be negative and whose value measures the speed of adjustment back to equilibrium following an exogenous shock. The error correction term u_{t-1}, which can be written as: $(y_{t-1} - x_{t-1})$,is the residual from the cointegrating relationship. From this explanation we can say that ECM is a technique to correct short-run disequilibrium to its long run long run equilibrium. The equation of ECM is as follows:

$$\Delta GDPCountryX = \beta_0 + \beta_1 ExportCountryY + \beta_2 u_{t-1} + e_t \quad (6)$$

u_{t-1} is a cointegrated error lag 1, or could be noted mathematically as:

$$u_{t-1} = \beta_0 GDPCountryX_{t-1} + \beta_1 ExportCountry_{t-1} \quad (7)$$

In this equation, $\Delta GDP\ CountryX$ is the difference in GDP for Japan, Korea and China, while $\Delta ExportCountryY$ is the difference in export from country X to Country Y. As for example, $\Delta GDP\ Japan = \beta_0 + \beta_1 \Delta Export\ China + \beta_2 u_{t-1} + e_t$ applies for the effect of Japan's export to China on Japan's GDP.

4. Results and Discussion

4.1 Payoff Matrix

Table 1: Payoff Matrices

Japan: Creates			
		China	
		Creates	Withholds
Korea	Creates	3240.14, 4809.101, 5362.959	3194.533, 0, 5679.006
	Withholds	0, 4788.361, 5265.277	0, 0, 1097.702

Japan: Withholds			
		China	
		Creates	Withholds
Korea	Creates	2368.986, 6090.883 , 0	815.0657, 0, 0
	Withholds	0,-82.75891, 0	0, 0, 0

Note: the numbers in the matrices are taken from the coefficient value of the CJK FTA to the GDP after regressing equation 1.

This game scheme yields the payoff matrices in Table 1. Payoffs in the three-player game are given to the row player (Korea), the column player (China), and the matrix player (Japan) respectively. Below is the detailed explanation

i. Japan
If Japan decides to conduct FTA with ASEAN member countries, she will yield several payoffs given other countries' actions. Japan will yield 5362.959 if China and Korea decide the same thing. Japan will have

5679.006 as a reward if Korea decides to create the FTA while China withholds her action. 5679.006 will serve as Japan's payoff if Korea decides to withhold while China creates FTA. If China and Korea withhold from the FTA, Japan will have 1097.702.

On the other hand Japan's action to withhold from FTA with ASEAN member countries will give zero (0) contribution given other countries' actions. Having these facts in mind, we can say that Japan best response function is to create FTA with ASEAN member countries. This is true since it produces the most favorable outcome for Japan, taking other countries' strategies as given. This is also a dominant strategy in view of the fact that creating FTA earns Japan larger payoffs than withholding it.

ii. Korea

Korea's strategy to create FTA with ASEAN member countries, will give her several payoffs given other countries' actions. Korea will take 3240.14 if China and Japan decide to do the same thing. 3194.533 will serve as her reward if Japan decides to create FTA while China withholds her action. Korea will get 2368.986 as her payoff if China decides to do the same while Japan withholds. If China and Japan withhold from the FTA, Korea will have 815.0657.

Alternatively Korea's action to withhold from FTA with ASEAN member countries will give zero (0) contribution given other countries' actions. Since FTA creating strategy to ASEAN member countries produces the most favorable outcome for Korea, taking other countries' strategies as given, we can say that it is the best response function for Korea. This also functions as dominant strategy for Korea in since creating FTA gives better payoffs than withholding it.

iii. China

Following the same scheme, China's strategy to create FTA with ASEAN member countries, will give her several payoffs given other countries' actions. China will get 4809.101 if Korea and Japan are moving along the same line. If Korea withholds while Japan decides to create FTA, China will yield 4788.361 as her payoff. China will have 6090.883 as payoff if Korea chooses to create FTA while Japan withholds. But China will suffer from the game if she is the only country that creates FTA with ASEAN since she will receive -82.75891 as payoff.

Then again China's strategy to withhold from FTA with ASEAN member countries will give zero (0) contribution given other countries' actions. From the payoff matrix, China's best response function and dominant strategy are still ambiguous. It is fair to say this since China's strategy still has the possibility to deviate from creating FTA with ASEAN.

Given the less ideal situation above for China, we cannot decide the Nash Equilibrium yet. It still has the tendency to deviate from *Pareto superior* to *Pareto inefficient* equilibrium that is often associated with strategy traps. Baldwin's domino effect using VAR simulation below will bring the answer.

4.2 Response Functions

From the VAR result in Table 2, we can see that Chinese FTA is influenced by her own FTA in t-1 and Japanese FTA in t-2 while Korean action to conduct FTA does not give significant influence to Chinese FTA strategy. Japanese FTA, on the other hand, is clearly influenced by her FTA in t-1, Chinese FTA in t-1 and Korean FTA in t-2. Implicitly speaking, Japanese put more attention in Chinese FTA rather than Korean FTA. It is stated from the difference in time lag. Korean strategy in conducting FTA is rather unique compared with Japanese and Chinese FTA. Korean FTA is surely neglecting her previous FTA policy and put more focus on Japanese and Chinese action. Chinese FTA in t-1 and t-2 give an abundant dominance for Korean FTA while Japanese FTA gives different influence in t-1 and t-2. Japanese FTA in t-2 boost the tendency of the Koreans to have their FTA with others while Japanese FTA in t-1 stalls the Korean FTA.

From the regression, we can find that China's strategy is relatively dependant with Japan's strategy. Since we already have Japan's best response function, the decision to create FTA with ASEAN countries will be the Nash Equilibrium for China. The analysis of dominant strategy in the next section will serve to complement this finding.

Table 2: VAR Result

Sample(adjusted): 1992 2009			
Standard errors & t-statistics in parentheses			
	CHINA_FTA	JAPAN_FTA	KOREA_FTA
CHINA_FTA(-1)	0.628205	0.948718	0.410256
	(0.26004)	(0.27010)	(0.09456)
	(2.41582)	(3.51246)	(4.33861)
CHINA_FTA(-2)	-0.517094	-0.726496	0.811966
	(0.42724)	(0.44377)	(0.15536)
	(-1.21033)	(-1.63711)	(5.22641)
JAPAN_FTA(-1)	0.088034	0.391453	-0.331624
	(0.19291)	(0.20037)	(0.07015)
	(0.45636)	(1.95364)	(-4.72749)
JAPAN_FTA(-2)	0.873504	0.223932	0.408547
	(0.25506)	(0.26493)	(0.09275)
	(3.42467)	(0.84524)	(4.40483)
KOREA_FTA(-1)	0.191453	-0.663248	-0.294017
	(0.51012)	(0.52986)	(0.18550)
	(0.37531)	(-1.25173)	(-1.58500)
KOREA_FTA(-2)	-0.141880	1.670085	-0.960684
	(0.34976)	(0.36330)	(0.12719)
	(-0.40565)	(4.59701)	(-7.55333)
C	0.084615	0.046154	0.030769
	(0.09355)	(0.09717)	(0.03402)
	(0.90453)	(0.47500)	(0.90453)
R-squared	0.866164	0.914038	0.951648
Adj. R-squared	0.793162	0.867149	0.925275
Sum sq. resids	1.137607	1.227350	0.150427

4.3 Dominant Strategy

In this part, two scenarios are included. In the first scenario, the author used the period when FTAs/EPAs were not a major trend while in the second scenario the author used the period when it has emerged as snowball. From the trade agreement database, we have the most FTAs/EPAs in force after the year of 2005. Therefore, the scenarios are

differentiated by the time period. In the first scenario, the author uses the data from 1985 to 2005. As for the second scenario, the data from 1990 to 2009 is employed.

i. First Scenario

China: The residuals for the relationship between China's GDP with China's Export to Japan and Korea are significant. These suggest that there is an equilibrium error in the short run. The negative signs put the Export for a constant rise to reach the long run equilibrium. In China's case, the adjustment rate or the phase of acceleration for the long run equilibrium is very fast. It can be seen through the absolute value of the equilibrium error coefficients which are 1.09 and 1.33 for China's relationship to Korea and Japan respectively.

Japan: In the short run, there is an equilibrium error for Japan's Export to China with its relation to Japan's GDP. The coefficient of residual gives negative sign (-0.18), which means that Japan's Export to China is below the long run equilibrium. This will only lead to a rise of export for the following periods. But it is important to note that the absolute value of the coefficient (adjustment rate) is very small (0.18). This suggests that Japan's Export to China is moving in a slow phase to reach the long run equilibrium.

As for the relationship between Japan and Korea, the equilibrium error of the export trend is not significant. These suggest that Japan's GDP is adjusting to the change in Japan's export to Korea in the same period of time. In other words, Japan and Korea relationship in terms of export has already reached steady state level.

Korea: Korea's case is somewhat similar to China. The residuals for the relationship between Korea's GDP with Korea's Export to Japan and China are significant. It yields similar explanation with China's case. However, the adjustment rate for the case of Korea is slower than China's but it is still faster than Japan's. It gives the absolute value of 0.23 and 0.48 for Korea's trade relationship to Japan and China respectively.

Table 3: Equilibrium Errors

Dependent Variables / **Independent Variables**	***GDP (Japan)***	***GDP (China)***	***GDP (Korea)***
Equilibrium error for Export to Japan	*na*	*-1.0 9 ****	*-0.23 **
Equilibrium error for Export to China	*-0.18 ****	*na*	*-0.48 ****
Equilibrium error for Export to Korea	*0.0178*	*-1.33 ****	*na*

Note: Statistical significance is indicated by *(10%), **(5%), and ***(1%)

From the ECM result in scenario one (see Table 3), we can see that china has the highest coefficient of equilibrium error (1.09 and 1.33) followed by Korea (0.23 and 0.48) and Japan (0.18 and 0.0178). This indicates that North East Asian region is not moving at the same phase to reach the long run equilibrium, which in this case Japan is the slowest one. Although the coefficient of acceleration is usually ranging between 0 and 1, the case of China that has it more than 1 gives an explicit message that the equilibrium errors have an overshooting. So it will accelerate in a very high phase towards long run equilibrium that might pose equilibrium overshooting.

The insignificant value of acceleration rate for the case of Japan trade relationship with Korea is also important point to note since it can be interpreted as an exhausted Korean market for Japanese products (steady state condition). These facts are very crucial since it diminishes Japan's role as the sole leader in the north East Asia. The stalled effect of a country's economic growth in this region will only serve as stumbling blocks in creating East Asian welfare. The rising growth of China and Korea will soon meet its end mimicking the pattern of Japan if no serious action is sited. The absence of an appropriate action will only lead to a shock for the long run equilibrium hence lowering the projected welfare growth. Therefore, in order to strengthen regional welfare and accelerate the phase of adjusting, regional action should take place.

ii. Second Scenario

The majority of FTAs/EPAs that are in force since 2005 has given a considerable impact in the CJK countries constellation. In scenario one, we see Japan as a sick partner for the CJK triangular scheme. But here in scenario two, Japan has been successfully proven in revitalizing their

condition. It can be seen from the change in coefficients of acceleration (0.54 and 0.57) which are getting better compared with the one in scenario one. In particular, we can see the Japan is no longer facing a steady state level with Korea, or to put it in other words, Japanese products have recovered its market in Korea. Korea has also grown well in this scheme with the coefficients of acceleration (0.88 and 1.07) which is bigger than it is in scenario one, hence giving a major boost in welfare. Korea's GDP, as shown by the equilibrium error for export to China, also depicts an equilibrium error that is more than one. This also shows that the coefficient of acceleration is posing an overshoots.

However, the improving condition of Japan and Korea has given a slight shock for China. The fact is clearly described from the decreasing rate for the coefficients of acceleration (0.45 and 0.29). But, the shock is not significant enough if we calculate the overall welfare impact from the FTAs/EPAs that are in force. Table 4 summarizes the ECM result in scenario two.

Table 4. Equilibrium Errors

Dependent Variables / **Independent Variables**	***GDP (Japan)***	***GDP (China)***	***GDP (Korea)***
Equilibrium error for Export to Japan	*na*	*-0.45 ** *	*-0.88 *** *
Equilibrium error for Export to China	*-0.54 **	*na*	*-1.07 *** *
Equilibrium error for Export to Korea	*-0.57 **	*-0.29 **	*na*

Note: Statistical significance is indicated by *(10%), **(5%), and ***(1%)

Comparing the first and second scenario, the strategy to create FTA has created a regional difference. FTA creation has been helping the region to reach sustainability. Given this fact, it is fair to say that FTA creation is a dominant strategy for China, Japan and Korea.

4.4 Discussion

As it has been stated in section 4.2, China, Japan and Korea's strategy to create FTA with ASEAN member countries is the Nash equilibrium for this game. In this game, we have found that China, Japan and Korea strategy is interdependence to each other with China giving the most influence to others in making their move. But with the absence of Japan

and Korea, China's strategy will give a negative impact economically given her shallow and unclear FTA/RTA strategy in ASEAN. According to Nakagawa and Liang (2011), China has excluded sensitive sectors and issues that may be difficult to deal with in the short term such as intellectual property protection, dispute settlement mechanisms, special sectoral liberalization, environment, and labor standards. Moreover, they argue that China and ASEAN have placed a wide range of important industrial products (such as automobiles, appliances, chemical products, iron and steel, and textiles) as well as farm goods (such as rice and palm oil) on the sensitive track. China has negotiated more than half of its FTA agreements by placing geopolitical/security/strategic goals over economic considerations (Nakagawa and Liang, 2011).

China's attempt with China-ASEAN FTA (ACFTA) is widely seen as an example of the dominance on geopolitical considerations in its engagement in Southeast Asia region as stated by Nakagawa and Liang (2011). A worrying and uncomfortable region can only be a distraction from a focus on economic development. China also accepts very flexible plan, requested by its FTA partners, to reach FTA. As with China's FTA negotiation with ASEAN members, China agreed to negotiate trade in goods agreement (signed in 2004) separately from trade in services agreement (signed in 2007) to ease the political tensions in some of the ASEAN countries. .

The greater flexibilities demonstrated by China unilaterally also shows that reaching agreements with these countries will meet primarily its political and foreign policy objective and instead of reaching economic target such as GDP growth. In fact, Chinese government officials admitted that geopolitical considerations trump any economic benefit when China is negotiating economic issues with its neighboring countries (Nakagawa and Liang, 2011). This is quite understandable since the rivalry between ASEAN4 members and China has been prolonged for ages. Holst and Weiss (2004) point out China's emergence for creating short and medium term direct and indirect competition between ASEAN and China. They argue that ASEAN and China are experiencing intensified export competition in prominent third markets. This can lead to painful domestic structural adjustments within the ASEAN in the short run. Then again the mind set in viewing the economic opportunity or threat depends on whether China's economy is perceived as complementary or competitive vis-à-vis individual ASEAN

economies and on whether the latter economies are able to exploit their complementary opportunities and overcome the competitive threats.

In constituting East Asian regionalism, leadership plays a very important role. The Korea Herald once posed the crucial question for the future direction of Asian regionalism:" *Which country is capable of taking the lead? It boils down to either China or Japan"* (Korea Herald, 10 October 2002). Sino-Japanese antagonism and aspirations to leadership on both sides have, in consequence, been a major source of structural change in the region, resulting in a dynamic interplay between bilateral FTA and multilateral institutions. This paper argues that it is important for East Asia to give Japan an extensive role in designing East Asian wide FTA given the shallow impact of China's FTA the region. From the payoff matrix we can see that Japanese decision to create FTA, given Chinese and Korean decision, yields superior payoff not only for Japan but also for the East Asian region. Although we must admit that the possibility to have Japan as an ideal leader for East Asia is quite difficult, but it is worth trying given the potential effect for enhancing the regional welfare. Their joint strategy to create FTA will eventually bring the East Asian Region to the next level.

5. Concluding Remarks

The Nash equilibrium in this game happens when China, Korea and Japan are playing the same strategy which is to create FTA with the ASEAN member countries. Although the game is analyzed as backward looking, but what we have learned from it has created a benchmark towards the future FTA policy. In a sense of creating integration in East Asia, there is a need to set up more formal institutional mechanisms for trade. It is rational for such mutually dependent countries in the region to institutionalize de facto integration through the establishment of regional arrangements (Kawai, 2005). The growing significance of China, Japan and Korea market for ASEAN will then serve as the basis for a single East Asian Wide FTA. Eventually, China, Japan, and Korea's FTA will find its way to have a greater grip in East Asia (domino effect).

To wrap up, East Asian Regionalism (EAR) will enable the region to cope with the future challenges of globalization and remain internationally competitive. Moreover, Chia (2007) states that EAR

could help the less developed East Asian economies which would otherwise become marginalized as they lack the attraction of sizeable market and lack negotiating resources. As Bahrumshah (2007) et al argue, regional integration through RTAs is expected widens the markets of the participating member countries. Large and growing markets will create greater confidence for both domestic and foreign investors.

References

Agrawal, Gaurav and Mohd. Aamir Khan, (2011). 'Impact of FDI on GDP: A Comparative Study of China and India,' *International Journal of Business and Management*, Vol 6, No 10.

Asami, Tadahiro. (2002). 'Japan's Strong Leadership Urged to Promote Regional Economic Cooperation in East Asia' *International Finance Journal* No.1085.

Arellano, M. (1995) 'On the testing of correlated effects with panel data', *Journal of Econometrics*, Vol. 59, pp. 87--97.

Baharumshah, Ahmad Zubaidi, Kevin Odulukwe Onwuka, Muzafar Shah Habibullah (2007) 'Is a regional trade bloc a prelude to multilateral trade liberalization? Empirical evidence from the ASEAN-5 economies' *Journal of Asian Economics* Vol. 18 pp. 384–402.

Baldwin, Robert E. and Richard N Clarke. (1987) 'Game-Modeling Multilateral Trade Negotiations' *Journal of Policy Modeling* 9(2):257-284.

Capannelli, Giovanni. (2011). 'Institutions for Economic and Financial Integration in Asia: Trends and Prospects'. ADBI Working Paper 308. Tokyo: Asian Development Bank Institute

Capannelli, Giovanni., J-W. Lee, and Peter. Petri. (2010). 'Economic Interdependence in Asia: Developing Indicators for Regional Cooperation and Integration'. *Singapore Economic Review* 55(1): 125–161.

Chan, Sarah and Chun-Chien Kuo. (2005) 'Trilateral Trade Relations among China, Japan and South Korea:Challenges and Prospects of Regional Economic Integration', *Journal of East Asia,* Vol. 22, pp. 33-50.

Chia, Siow Yue. (2006) 'ASEAN-China Economic Competition and Free Trade Area', Asian Economic Papers, Vol. 4, pp. 109-147

----------. (2007) ,Challenges and Configurations of a Region-wide FTA in East Asia', FONDAD Conference.

Doraisami, Anita. (1996) Export Growth and Economic Growth: A Reexamination of Some Time-Series Evidence of the Malaysian Experience ', *Journal of Developing Areas*, Vol. 30, pp. 223-230.

Drysale, Peter. (2006). 'Regionalism in Asia and the Pacific and an Asian Economic Community'. Paper presented in a workshop in ICRIER, New Delhi.

Edwards, Sebastian, (1997). 'Openness, Productivity and Growth: What Do We Really Know?' *NBER Working Paper Series,* Working Paper 5978.

Ekanayake, E.M. (1999) 'Export and Economic Growth in Asian Developing Countries: Cointegration and Error-Correction Models', *Journal of Economic Development,* Vol. 24, pp. 43-56.

Engle, R.F. and C.W.J. Granger. (1987) 'Cointegration and Error Correction: Representation, Estimation and Testing', *Econometrica*, Vol. 55, pp. 251-76.

Robert C. Feenstra, (1995). 'Estimating the Effects of Trade Policy,' *NBER Working Papers* 5051, National Bureau of Economic Research, Inc

Frankel, Jeffrey A. and David Romer. (1999) 'Does Trade Cause Growth?, *The American Economic Review*, Vol. 89, pp. 379-399.

Gander, James P, (2008). 'Dynamic Economic Game Theory and Asian Free Trade Agreements' University of Utah, *Department of Economics Working Paper Series* Vol.18.

Grossman, Gene M. and Elhanan Helpman, (1991).'Trade, Knowledge Spillovers, and Growth' *NBER Working Papers*_3485, National Bureau of Economic Research, Inc.

Hansen, Henrik and John Rand, (2006). 'On the Causal Links Between FDI and Growth in Developing Countries,' *The World Economy*, Wiley Blackwell, vol. 29(1), pages 21-41, 01

Harrison, Ann. (1996) 'Openness and Growth: A Time Series, Cross Country Analysis for Developing Countries', *Journal of Development Economics*, Vol.48, pp. 419-447.

Harrison, Glenn W and E. E. Rustrom, (1987). 'Trade Wars and Trade Negotiations: A Computational Approach,' University of Western Ontario *Centre for the Study of International Economic Relations Working Paper* no. 8714C.

Harvie, Charles and Hyun Hoon Lee. (2002) 'New Regionalism in East Asia: How Does It Relate to the East Asian Economic Development Model', University of Wollongong Department of Economics, Working Paper Series.

Helpman, E., & Krugman, P. R. (1985) 'Market structure and foreign trade'. Cambridge: The MIT Press.

Holst, David Roland and John Weiss. (2004) 'ASEAN and China: Export Rival or Partners in Regional Growth?', Blackwell Publishing Ltd.

Kaufmann, Daniel, Aart Kraay and Massimo Mastruzzi. (2003) 'Governance Matters III: Governance Indicators for 1996-2002', World Bank Policy Research Department Working Paper.

Kawai, Masahiro, (2005) East Asian Economic Regionalism: Progress and Challenges, *Asian Economics*, Vol. 16, pp. 29-55.

Kawai, Masahiro and Ganeshan Wignaraja. (2007) 'Regionalism as an Engine of Multilateralism: A Case for a Single East Asian FTA', ADB Working Paper series on Regional Economic Integration no.14.

Kawai, Masahiro. (2007). 'Evolving Economic Architecture in East Asia'. Discussion Paper No. 84. Tokyo: ADB Institute.

Lucas, R. (1988). 'On the Mechanics of Economic Development,' Journal of Monetary Economics Vol. 2 pp. 3-42.

Nachrowi,Djalal. (2007) 'Ekonometrika Untuk Analisa Ekonomi dan Keuangan [Econometrics for Economic and financial analysis]', Faculty of Economics University of Indonesia.

Nakagawa, Junji and Wei Liang (2011). 'A Comparison of the FTA Strategies of Japan and China and

Their Implications for Multilateralism' RCCPB Working Paper Vol. 11.

Petri, Peter. (2006). 'Is Asia Becoming More Interdependent?' *Journal of Asian Economics* 17(3), 381–394.

Rodriguez, Francisco and Dani Rodrik. (2001) 'Trade Policy and Economic Growth: A Skeptic's Guide to the Cross National Evidence, in *NBER Macroeconomics Annual 2000*.

Soesastro, Hadi. (2006). Regional Integration in East Asia: Achievements and Future Prospects. *Asian Economic Policy Review* 1(2): 215–235.

Soesastro Hadi. (2009). 'East Asia, the G20 and global economic governance'. Available at: http://www.eastasiaforum.org/2009/03/08/east-asia-the-g20-and-globaleconomic-governance/

Stubbs, Richard. (2002) 'ASEAN PlusThree: emerging East Asian Regionalism?', *Asian Survey*, Vol. 42, pp. 440-455.

Tamura, Robert. (1995) 'Regional economies and market integration', *Journal of Economic Dynamics and Control*, Vol. 20, pp. 825-845.

Urata, Shujiro and Kozo Kiyota. (2003) 'The Impacts of an East Asia Free Trade Agreement on Foreign Trade in East Asia', *NBER Working Paper Series 10173,* National Bureau of Economic Research, Cambridge.

Watanabe, Yorizumi. (2008) 'Economic Partnership Agreement (EPA) of Japan and Economic Integration in Northeast Asia', Academic presentation, Graduate School of Media and Governance, Keio University.

Young, Alwyn. (1991). 'Learning by Doing and the Dynamic Effects of International Trade,' *NBER Working Papers* 3577, National Bureau of Economic Research, Inc

Yoshida, Tadahiro. (2004) 'East Asian Regionalism and Japan', *IDE APEC STUDY CENTER* Working Paper Series.

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Singapore' Exchange Rate Regime: A Garch Approach

Marco Mele[1]

Singapore is often cited for having successful exchange rate regimes. In fact it has been successful in maintaining low and stable rates of inflation and stability in its exchange rate. The basket, band and crawl features of the exchange rate system have served as an effective anchor of price stability, keeping inflation low and stable over the past 30 years. In addition, Singapore has complemented monetary policy with micron and macro-prudential measures to ensure overall price and financial stability in the economy. This study will demonstrate, through an econometric model in time series, if and how the Singapore *exchange rate policy* has changed in relation to the weight that four currency have within it. Specifically, utilizing Frankel's and Wei (2007) econometric model, we use a Garch approach because for most exchange rate time series, Garch model provide a sufficiently good fit.

1. Introduction

Monetary policy in Singapore has been characterized, since 1980, by price stability as a basis for sustainable economic growth. In this situation, therefore, thus falls the exchange rate regime that it present tree main features: a) the Singapore dollar is managed against a basket of currencies of major trading partners (in bases to weights) and depending on the extent of dependence with a particular country. So, the composition of the basket is revised every so often to take into account changes in Singapore's trade patterns; b) Monetary Authority of Singapore operates in a managed float regime for the his currency. The trade-weighted exchange rate is permissible to fluctuate within an hidden policy band, to a certain extent than kept to a fixed value. The band provides flexibility for the system to put up short-term fluctuations in the foreign exchange markets as well as some buffer in view of the

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country's equilibrium exchange rate, which cannot be known exactly. For this reason, Monetary Authority of Singapore' intervention operations generally works with anti-cyclical policies. Now, if the exchange rate moves outside the band, Monetary Authority will usually step in, through a buying or selling foreign exchange so as to guide the exchange rate back within the band; c) the exchange rate policy band is periodically reviewed to ensure that it remains consistent with the basic fundamentals of the macro-economic policy.

The decision to adopt an exchange rate regime type managed float is in accordance with many emerging markets (Calvo and Reinhart, 2002). This is due to eventually find mainly because these countries, such as Singapore, especially in the 70s and 80s, had a low international credibility. In addition, if we recall *trilemma*, a monetary policy open can only achieve two of the following three objectives: perfect capital mobility, fixed exchange rate regime and monetary policy autonomy. So, as Singapore is a world financial center, it has preferred the mobility of capital or to the detriment of the system of fixed exchange rates or the autonomy of monetary policy. In particular, the Monetary Authority of Singapore chose to use the exchange rate contrasting to the more conservative benchmark policy interest rate as its policy operating tool. But, managing the exchange rate has a high cost associated with the possible epileptic speculative. In this context, with the exception of the Asian financial crisis (1997), the Monetary Authority has successfully deterred speculators to attack the currency over the last three decades even though the major economists argue that it was a managed flexibility of the exchange rate system and its management have helped to Singapore during the Asian crisis. Yip (2005) underlined that Singapore's taking of market driven depreciations in the wake of and amid the deepening of the Asian financial crisis deterred currency speculators from engineering over-depreciation in the domestic currency. Therefore, the Asian financial crisis raised consciousness that exchange rates type *peg* and its attendant indemnity effect exacerbated boom-bust cycles linked with capital flows, thus contributing to the crisis.

In circumstance, the analysis of Singapore' the exchange rate regime seems very particular. The strength of the Singapore model is, in reality, very flexibility. In fact, a fixed exchange rate regime would imply that over a long run, the inflation rate of the economy in question has to

converge to that prevailing in the economies that it trades with. In the adjustment process, since the exchange rate cannot be changed, the entire burden of adjustment must then fall on the goods and the labor markets. While Singapore has more flexibility than most other countries, therefore, a fixed exchange rate regime is not a good idea especially when there are large shocks emanating from the rest of the world. In addition, instead, fully flexible exchange rates on the other hand will introduce volatility into the system, especially in a developing economy.

So, we can say that the Singapore' exchange rate regime that IMF defines *"Managed floating with no pre-determined path for the exchange rate"*, present a sort of *Exchange rate anchor*, but with high volatility that may even influence macroeconomic performance. This last statement is very important. In fact, although the objective of this paper is to estimate the currencies in which the dollar Singaporean engages more, the awareness of the volatility cannot be considered as a system subject to the volatility present limitations shared by the literature. In particular, there are two strands of macroeconomic theory, the first strand examines how the domestic economy responds to foreign and domestic real and monetary shocks under different exchange rate regimes, the second strand focuses on the issue of how exchange rate volatility under flexible exchange rate regimes affects international trade. Overall, the shock of the exchange rate regime on volatility will depend on the type of shocks beating the domestic economy, with the general principle being that flexible exchange rates provide better lagging against foreign sourced real shocks, and fixed exchange rates insulating against domestic sourced LM type shocks. Concerning to this point, it is also true that fixed exchange rates are thought to transport more credible monetary policy and lower inflation. To the extent that lower inflation reduces inflation variability then a fixed exchange rate regime will be preferable. For second question, there is also a very large literature examining the question of how the exchange rate regime affects international trade. The all-purpose argument is that exchange rates will be more variable under flexible than fixed exchange rates, and this volatility will be harmful to trade. Trade will be worse affected the more risk averse are firms, the fewer are the opportunities to hedge against exchange rate fluctuations, and the greater is the fraction of revenues and expenditures denominated in foreign currency.

In this regard, we can say that just by virtue of the above affirmed that Singapore clearly has strong defenses against what it deems excessive exchange rate volatility triggered by destabilizing capital flows. These include its strong fundamentals, the adoption of a CB system, and the non adherence to a fixed currency peg when the economic situation changes.

At present the economy and monetary choices that go to influence even those of the exchange, appear to be stabilized. Financial market development is thereby facilitated, and at the same time the risk of heightened currency speculation during turbulent periods is reduced, along with the associated macroeconomic instability.

2. Estimating Exchange Rate Regime

In the past few years, at the end of checking various exchange regimes, many studies have been conducted using different techniques of estimation, notably, those that concern countries that use the anchor for currency regime peg (the Central European Bank, for example, uses models based on Brownian motion geometry). Among these studies Frankel and Wei (1994) proposed an original technical regressive.

Taking a logarithmic equation of the type:

(1) $\ln homecurrency_{t+1} - \ln homecurrency_t = a+\Sigma w(j)\ln x(j,t,s)-\ln x(j,t)$

If the national value (home) dependent variable of the model is linked to a series of values $x_1, x_2, \ldots, x_n$ for the corresponding weight $w_1, w_2, \ldots, w_n$ it would be possible to estimate through a general OLS, the weight of each value of the considered basket peg.

Nevertheless, the impossibility of defining the effective value of each currency, especially in the absence of a rigid basket peg induces the model of consideration of a chart of numbers in presence of which it will present itself regressively:

(2) $\Delta \ln y_{home/k} = \alpha+\beta_1\Delta\ln e_{USD/k}+ \beta_2\Delta\ln e_{JPY/k}+\beta_3\Delta\ln e_{Euro/k}+\mu_t$

Returning to the method of ordinary minimal quadratic equations, it is possible to estimate the weight of each single value (measured by

coefficients) that multiply the logarithmic variations of the corresponding exchange rates using a numeraire k respecting two simple criteria of analysis: error standard next to zero and R-squared near to one.

Although, as noted J. Frankel (2009) the weight-inference technique is well-specified if the true regime is a stretched basket peg it may be less well specified if the true regime allows flexibility. For any currency it is probable that in practice the basket peg is not perfect. For this reason is also used a new estimation:

$$\Delta \ lnRMB_t = c + \sum w(j) \ \Delta lnX(j)_t + \delta \ \{\Delta emp_t\} + u_t$$

Where Δemp_t denotes the percentage change in exchange market pressure, that is, the increase in international demand for the RMB, which may show up either in the price of the RMB or the quantity of the RMB depending on the policies of the *Country (x)* monetary authorities (floating vs. fixed). So, $\Delta emp_t \equiv \Delta lnCurrency_t + \Delta Res_t / MB_t$.

In addition it is possible to analyze the system of exchange based on the type of econometric technique used. It's likely to estimate with generally OLS and so analyzing the value of R^2 and coefficient pendency. Another way, for example Mele (2010), estimate Frankel's regression with a regressive technique in a time series employing a Kalman's filter, in other world using a time series approach. It is still possible to analyze a regime change with time series econometric techniques in more advanced. A case would be estimate a GARCH model for a time series approach. In particular, if an autoregressive moving average model is assumed for the error variance, the model is a generalized autoregressive conditional heteroskedasticity model.

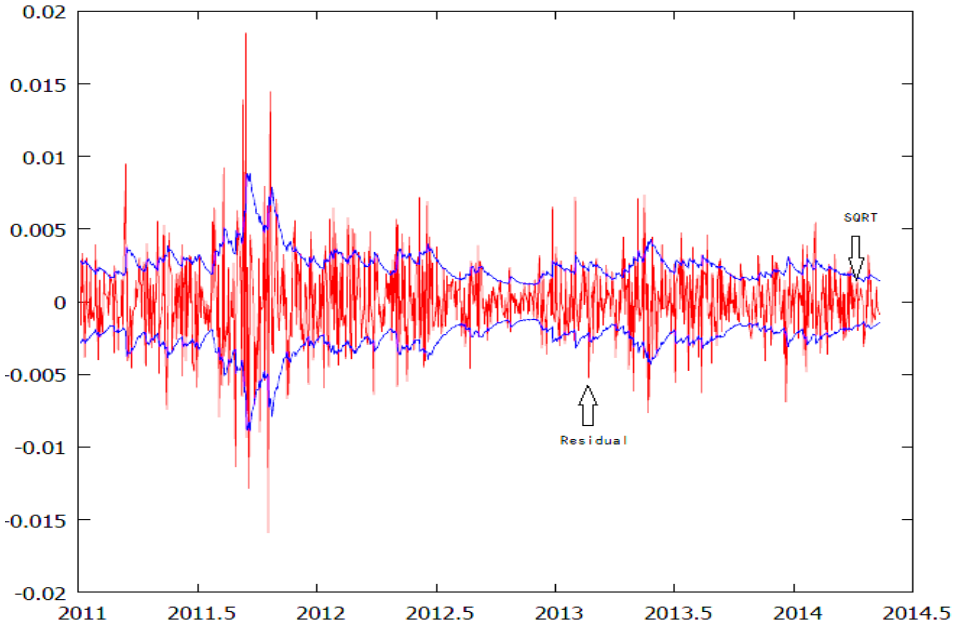
That is, if we look at the analysis that the exchange rate should be seen to represent a form leptokurtic, you will need to specify an equation that assumes a representative in residuals of the type GARCH process.

In fact it is not always possible to be able to minimize the excessive volatility through the use of logarithms or logarithmic first differences. Analysis of the time series on a graph, in fact, could highlight the many excesses of fluctuations, even if stabilized. In this situation, an analysis of ARMA type OLS or become distorted, especially in the residuals: the

regression line does not actually pass between all observations, even in the face of a very high value of R-squared.

We might find, for example, in a situation such as the graph below:

Figure 1 Excessive volatility. Residual presence



Source: our econometric processing with Gretl. Ver. 1.8.4 software

In a situation like the one shown above, which takes into account the exchange rate of a currency Asian (basket-peg) with daily data, we will face an econometric process:

$$\mathcal{E}_t\,[I_{t-1} \sim N(0,h_t)$$

$$h_t = \sigma + \sum^{p}_{i=1} \alpha_i\, \mathcal{E}^2_{i=1} + \sum^{q}_{i=1} \beta_i\, h_{i=1}$$

The variance in daily data depends on past news about volatility ($\mathcal{E}^2$) and past forecast variance (h_t). The inclusion of lagged conditional variances might capture some sort of adaptive learning mechanism. For most financial time series, Garch model provide a sufficiently good fit. This is also true for the others variable. Sufficient condition for well-defined variance and covariance only require $\alpha>0$; $\beta>0$; $\alpha+\beta<1$.

3. On Singapore' exchange rate regime

Frankel' model to estimate has been enriched by various economists that have expanded this approach. The implementations of the model involved the estimation of the numeraire consideration (not always the Swiss franc but also SDR), the use of time series models and the use of Brown' general equilibrium, or using the percentage change in exchange market pressure as $\Delta emp_t \equiv \Delta \ln Currency_t + \Delta Res_t / MB_t$.

Now, using Frankel–Wei method, we consider the following:

$$I_t^{fw} = \Delta_e + \Delta_r$$

where Δ_e is defined as the local currency per some independent numeraire here we use the Special Drawing Right (SDR) and Δ_r is as defined earlier. So, Frankel–Wei method as follows:

$$(3)\ \Delta e_t = \beta_0 + \beta_1 US_t + \beta_2 Yen_t + \beta_3 Euro_t + \beta_n Currency_t + \phi\, I_t^{fw} + \mu_t$$

The β coefficients in equation are often interpreted as implicit currency weights. The various currencies used estimating, as for example US dollar, euro and yen (all per the SDR) are chosen as they represent world currencies deemed to exert sufficient influence on the local currency such that it is worthy of consideration in our estimates. While it is tempting to interpret these coefficients as potential basket weights, it is probably more prudent for them to be interpreted as "degrees of influence".

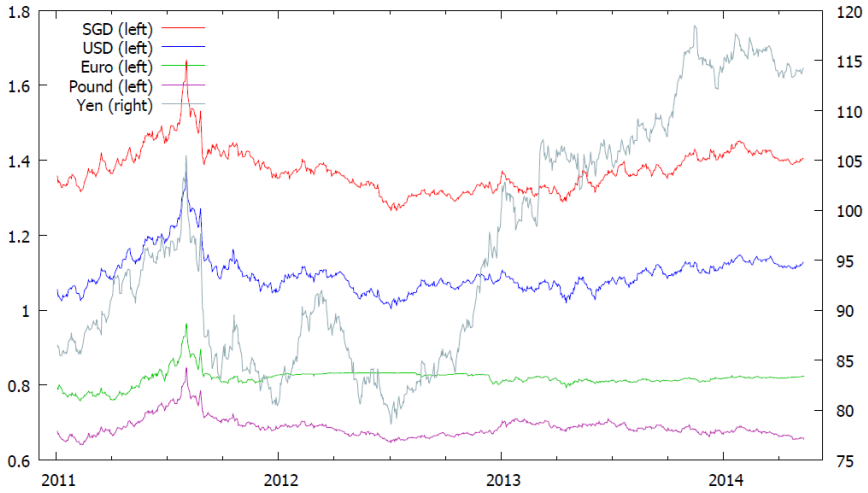
The reason for this is that it is very difficult to say whether a high and significant coefficient value implies a basket currency or just reflects market-driven correlations. Under equation (3) with ϕ which tends to 1, the exchange rate per local currency becomes more flexible as I_t^{fw} converges to the dependent variable and the β coefficients should be close to zero and/or statistically insignificant. If ϕ tends to 0, the exchange rate becomes more fixed as the situation where reserve movements overshadow exchange rate movements is reflective of a sustained exchange rate intervention and the extent of fixity to various major currencies is captured by the β coefficients.

We use daily data for the period 2011 January 1 to 2014 June 30 or some sub-periods there of depending on data availability. The our equation well be:

(4) $\Delta SGD_t = \beta_0 + \beta_1 US_t + \beta_2 Yen_t + \beta_3 Euro_t + \beta_n Pound_t + \phi\, I_t^{fw} + \mu_t$

Before to estimate, it is preferred to carry out the Dickey-Fuller test prefixed to 29 delays necessary to test if the historic series relative to the five currency explicative, to the dependent currency (SGD).

Figure 2: Progress of the SGD relative to four currency



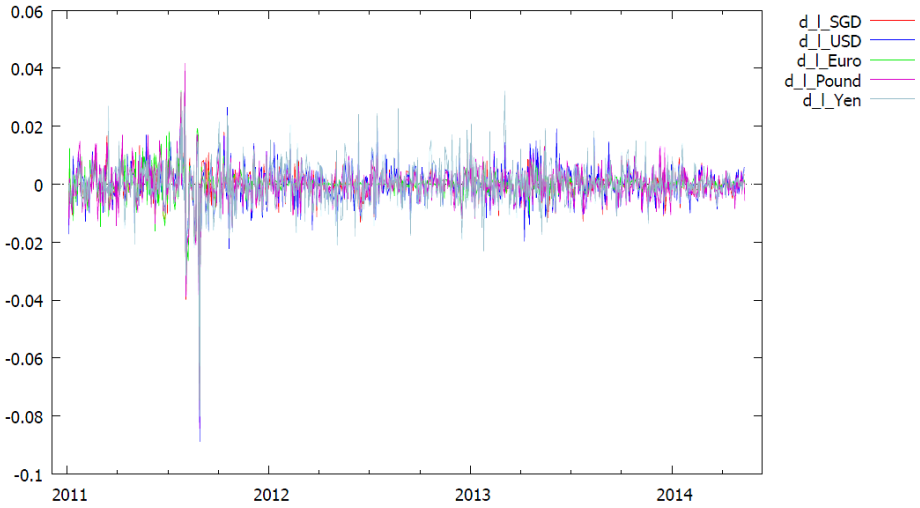
Source: our econometric processing with Gretl. Ver. 1.8.4 software on RBA data.

The results obtained confirm the necessity of a logarithmic differentiation of the variables whether we consider as the numeraire Special Drawing Right, like that suggested by Frankel (1996).

Nevertheless, although stationary, the outcome of the correlogram provides proof, instead, of the presence of self-correlation between the four explicative.

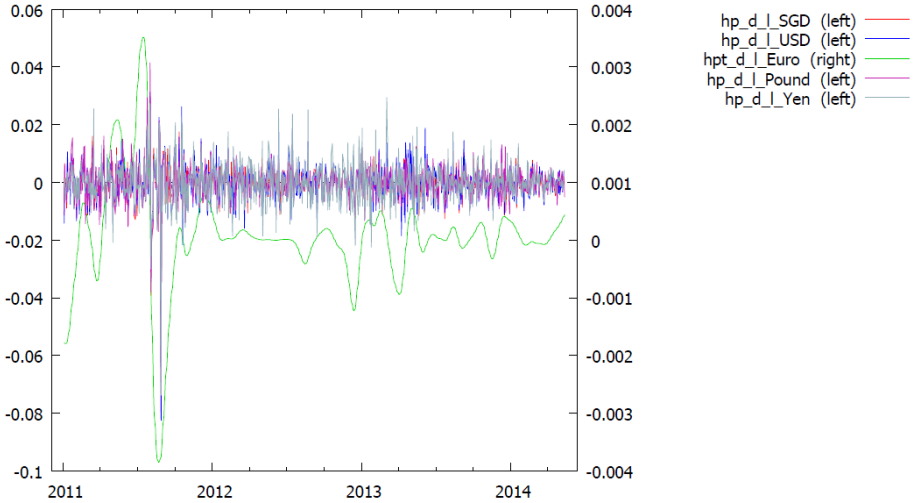
In addition, in order to better stabilize the process of volatility between the independent variables related to exchange rates, we introduced the H-P filter. In this case, better to be able to capture even the cyclical component relative to the pairs of the exchange rate.

Figure 3: Analyses of the stationary movements in prime logarithmic difference



Source: our econometric processing with Gretl. Ver. 1.8.4 software on RBA data.

Figure 4 Analyses of the stationary movements in prime logarithmic difference and H-P filter



Source: our econometric processing with Gretl. Ver. 1.8.4 software on RBA data.

A result of this type requires the application of a model different from the generic OLS (instead, it is used by various works which regard it), and more precisely, of an estimation in historic series of the type GARCH with the object of eliminating for each value, the influence of

the one preceding it and volatility process. Therefore, from our analyses that we have carried out, though still widely used, a methodology of regression spoiled by the error of self correlation.

4. Results

Function evaluations: 517
Evaluations of gradient: 222

Model : GARCH, using observations 2011-01-04:2014-05-12 (T = 875)
Dependent variable: hp_d_1_SGD
Standard errors based on Hessian

	coefficient	std. error	z	p-value
const	1.39159e-05	6.97032e-05	0.1996	0.8418
hp_d_1_USD	0.535387	0.0215566	24.84	3.63e-136 ***
hpt_d_1_Euro	0.0838992	0.108711	0.7718	0.4403
hp_d_1_Pound	0.286293	0.0219888	13.02	9.42e-039 ***
hp_d_1_Yen	0.0591650	0.0144305	4.100	4.13e-05 ***
alpha(0)	1.13060e-07	5.61708e-08	2.013	0.0441 **
alpha(1)	0.115511	0.0249626	4.627	3.70e-06 ***
beta(1)	0.874517	0.0248908	35.13	2.03e-270 ***

Mean dependent var 0.000000 S.D. dependent var 0.005961
Log-likelihood 4008.454 Akaike criterion -7998.907
Schwarz criterion -7955.939 Hannan-Quinn -7982.471

Analyzing the results about the model with t=875 it's possible to show as the informative criteria presents similar values, therefore, don't differentiate them self. The model, moreover, don't demonstrate common factors, confirming the reliability of the data obtained.

The values of R^2 adjusted for regression and that derived from the first OLS step is 80% (in appendix), indicating that the explanatory variables justify well the dependant variables; standard errors of regression showed values close to zero, with value of 0.005961.

The use of a GARCH model is proved to be absolutely fit and proper. In fact, if we observe the relative values alpha(0), alpha(1) e beta(1) they appear to be highly significant in the value of the p-value. Discussing now the results of the coefficients obtained from the model, it is immediately evident that the constant is not significant at any level of the p-value.

The currencies that are important in the commercial weight of Singapore and used by us as independent variables of the model, not all are significant. In particular, the model suggests that the weight of the euro turns out to be zero. The euro, therefore, does not affect the employee showing how the Singaporean dollar fluctuates without being affected by the euro.

The other three currencies considered, showing instead a value of the coefficient p-value with respect to the totally meaningful. A first consideration is that we can do the following: all three currencies, dollar, yen and pound, positively influence the dependent, or the Singaporean dollar. Values or the weight of each currency is rather different: the dollar confirms that the reference currency in the foreign exchange market for the type even-peg for Asian countries. In a nutshell it confirms the area of South East Asia as the dollar area. value tells us that each percentage point change in the weight of the dollar, the influence of dependent on 53.3%.

Second currency independent of the model, based on the weight of its coefficient, however, is the pound: it influences the Singaporean dollar at a value of 0.28.

Finally, we can say that the Japanese yen plays an important role in the exchange rate regime of the Singaporean dollar. Albeit marginally, you can clearly see from the results of the model that each percentage point change in the Singaporean dollar is due to the 5% to the change in the yen.

5. Conclusion

Singapore dollar originally was a exchange rate with a fixed link to a single currency. In particular, it was linked to Pound Sterling. After the dismantling of the Sterling Area in early 1970s, the Singapore Dollar

was linked to the U.S. Dollar, but only for a short period of time. From 1973 to 1985, Singapore pegged the value of Singapore Dollar against a fixed and undisclosed trade-weighted basket of currencies. Since 1985, with an aim to a more market-oriented regime, Singapore allowed its currency to float under the monitor of the Monetary Authority of Singapore which retains responsibility for exchange control matters in Singapore**.**

Now, Singapore' exchange rate regime may be classified as a Monitoring Band (IMF, 2012). With a primary goal to maintain public confidence, the currency in circulation is 100% backed by international assets for notes-issuance. In this contest, Monetary Authority of Singapore shows the Singapore dollar against an undisclosed basket of currencies of Singapore's major trading partners and competitors. The central parity is determined on the basis of countries that are the main sources of imported inflation and competition in export markets.

In this work we employ Garch approach to assess the time-varying weights of Singapore' exchange rate regime using daily data between January 2011 to June 2014 with volatility corrections. The model used has a high goodness highlighting how the data are used so perfectly adapted to the dependent variable.

Conscious of the fact that Singapore's economy appears to be most affected by the financial markets rather than real ones, we have chosen four reference currencies to try to understand what influenced the dependent variable. We thought that the currencies to be used for the Garch model, and then control the volatility, could be the most influence on the exchange rate regimes in Southeast Asia: dollar, yen, euro, pound. The results confirm our predictions: the dollar continues to be the reference currency most used; the euro is not this rather like significance in the model. Very interesting is the weight of the pound, confirming the link still exists between Singapore and the British currency. Finally, even the Japanese currency turns out to be significant in influencing the dependent.

References

Banerjee, A., R.L. Lumsdaine, and J.H. Stock (1992). Recursive and Sequential Tests of the Unit-Root and Trend-Break Hypotheses: Theory and International Evidence. *Journal of Business & Economic Statistics*, Vol. 10, No. 3, 271-287.

Cobham, D. (2007). Euro versus Dollar: Who Goes with Which?. *preliminary draft, Herriott-Watt University*, May.

Choo, L.H. (2000). The Performance of Exchange Rate Policies: The Case of Hong Kong and Singapore. unpublished.

Devereux, M. B. (2003). A tale of two currencies: The Asian crisis and the exchange rate regimes of Hong Kong and Singapore. *Review of International Economics* 11 (1): 38–54.

Eichengreen, B. (2006). China's Exchange Rate Regime: The Long and Short of It. *Paper for Conference on Chinese Money and Finance*; 2–3 February, Columbia University, New York.

Frankel, J. (1993). Is Japan Creating a Yen Bloc in East Asia and the Pacific? In: J. Frankel and M. Khaler (Eds.), *Regionalism and Rivalry: Japan and the US in Pacific Asia*, University of Chicago Press, Chicago.

Frankel, J. (2006). On the Yuan: The Choice Between Adjustment Under a Fixed Exchange Rate and Adjustment under a Flexible Rate. In G. Illing (Ed.), Understanding the Chinese Economy. *CESifo Economic Studies*, Munich. http://dx.doi.org/10.1111/j.1468-0327.2007.00185.x.

Frankel, J. and S. Wei (1994). Yen Bloc or Dollar Bloc? Exchange Rate Policies of the East Asian Economies. In: T. Ito and A. O. Krueger (Eds.), Macroeconomic Linkages: Savings, Exchange Rates and Capital Flows, University of Chicago Press, Chicago.
http://ideas.repec.org/h/nbr/nberch/8537.html

Frankel, J. and S. Wei (1995). Emerging Currency Blocs. In H. Genberg (Ed.), *The International Monetary System: its Institutions and its Future*, Springer, Berlin. http://www.nber.org/papers/w4335.

Frankel, J., S. Schmukler and L. Servén (2000). Verifiability and the Vanishing Intermediate Exchange Rate Regime. In S. Collins and D. Rodrik (Eds.), *Brookings Trade Forum 2000*, Brookings Institution, Washington, D.C. http://ideas.repec.org/p/nbr/nberwo/7901.html.

Frankel, J. and S. Wei (2007). Assessing China's Exchange Rate Regime. *Economic Policy 51*, 575–614.

Hawtrey, R. (1928). Currency and Credit. *Longmans Green*, New York.

Kochhar, K., A. Senhadji, J. Lee, and Y. Nishigaki. (2001). Singapore: Selected issues. *IMF Country Report* no. 01/177. Washington, DC: International Monetary Fund, October.

Kolm, S.C. (1977). Fondements de l'èconomie monètaire normative: segneuriage, liquiditè externe, impossibilitè de rèmunèrer les espèces. *Revue Economique*.

Krugman, P. (1991). Target zones and exchange rate dynamics. *Quarterly Journal of Economics*, *106*(3), 669–682. http://dx.doi.org/10.2307/2937922.

Lee, J. (2001). Evolution of the policy on non-internationalization of the Singapore dollar. In *Singapore: Selected issues*, ed. K. Kochhar, A. Senhadji, J.

Levy-Yeyati, E. and F. Sturzenegger (2003). To Float or to Trail: Evidence on the Impact of Exchange Rate Regimes on Growth. *American Economic Review*, *93*, 1173–93. http://dx.doi.org/10.1257/000282803769206250.

Marzovilla, O. and Mele, M. (2010). From Dollar Peg to Basket Peg: The Experience of Kuwait in View of the GCC Monetary Unification. *Global and Local Economic Review, 14(1).*

McCauley, R., and G. Jiang. (2004). Diversifying with Asian local currency bonds. *BIS Quarterly Review*. (September): 51–66.

Mele, M. (2010). A "*Time series*" approach on the Chinese Exchange Rate Regime. *Hrack Economic Research*, 23(2).

Ngiam, K. J., and L. Loh. (2002). Developing a viable corporate bond market: The Singapore experience. *Economics and Finance Series* no. 2, Singapore: Institute of Southeast Asian Studies, June.

Ogawa, E. (2006). The Chinese Yuan after the Chinese Exchange Rate System Reform. *China and World Economy*, 14, 39–57. http://dx.doi.org/10.1111/j.1749-124X.2006.00044.x.

Ohno, K. (1999). Exchange Rate Management in Developing Asia. *Working Paper No. 1*, Asian Development Bank Institute. http://www.adbi.org/research%20paper/1999/01/01/183.exchange.rate/.

Ong, L. H. (1998). Financial leverage of Singapore corporations, 1971–1997. *Statistics Singapore Newsletter.* April, pp. 9–14.

Peebles, G., and P. Wilson. (2002). Economic growth and development in Singapore. London: Edward Elgar.

Poitras, G. (2002). Short sales restrictions, dilution, and the pricing of rights issues on the Singapore Stock Exchange. *Pacific-Basin Finance Journal* 10 (2): 141–62.

Rzepkowski, B. (2000). The expectations of Hong Kong dollar devaluation and their determinants. *CEPII Working Paper* no. 2000-04. Paris.

Roosa, R. (1965). *Monetary Reform for the World Economy*. Harper and Row, New York.

Teh, K. P. (1988). Monetary policy in an open economy: Singapore. Lecture delivered at seventeenth SEANZA (South-East Asia, New Zealand, Australia) Central Banking Course. Sydney, Australia.

Triffin, R. (1960). *Gold and the Dollar Crisis*. Yale University Press, New Haven.

Yamazaki, K. (2006). Inside the Currency Basket. *Columbia University and Mitsubishi UFJ Trust and Banking*, December.

Zeileis, A. (2009). Exchange Rate Regime Analysis for the Chinese. *Department* of Statistics and Mathematics, WU Wirtschaftsuniversität Wien, Research Report Series.

Wong, S. J. (2004). Rising bond prices. December 10. http://www.fundsupermart .com.

Appendix

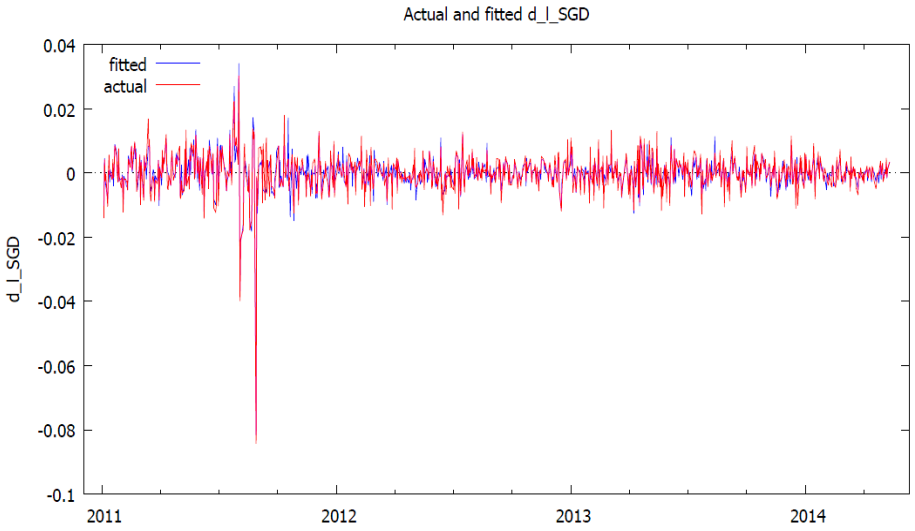
Model 1: OLS, using observations 2011-01-04:2014-05-12 (T = 875)

Dependent variable: d_l_SGD

HAC standard errors, bandwidth 7 (Bartlett kernel)

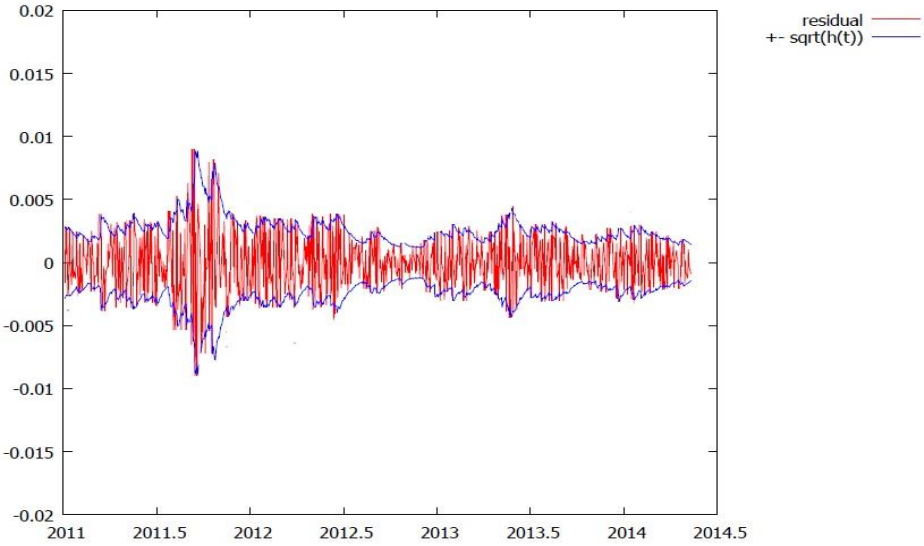
	coefficient	std. error	t-ratio	p-value	
const	-1.82208e-05	9.23898e-05	-0.1972	0.8437	
d_l_USD	0.426138	0.0393789	10.82	1.08e-025	***
d_l_Euro	0.289907	0.0288959	10.03	1.73e-022	***
d_l_Pound	0.231716	0.0374949	6.180	9.84e-010	***
d_l_Yen	0.0614303	0.0199401	3.081	0.0021	***

Mean dependent var	0.000040	S.D. dependent var	0.006138
Sum squared resid	0.006335	S.E. of regression	0.002698
R-squared	0.807618	Adjusted R-squared	0.806733
F(4, 870)	1020.198	P-value(F)	0.000000
Log-likelihood	3936.631	Akaike criterion	-7863.262
Schwarz criterion	-7839.391	Hannan-Quinn	-7854.131
rho	-0.037612	Durbin-Watson	2.074689



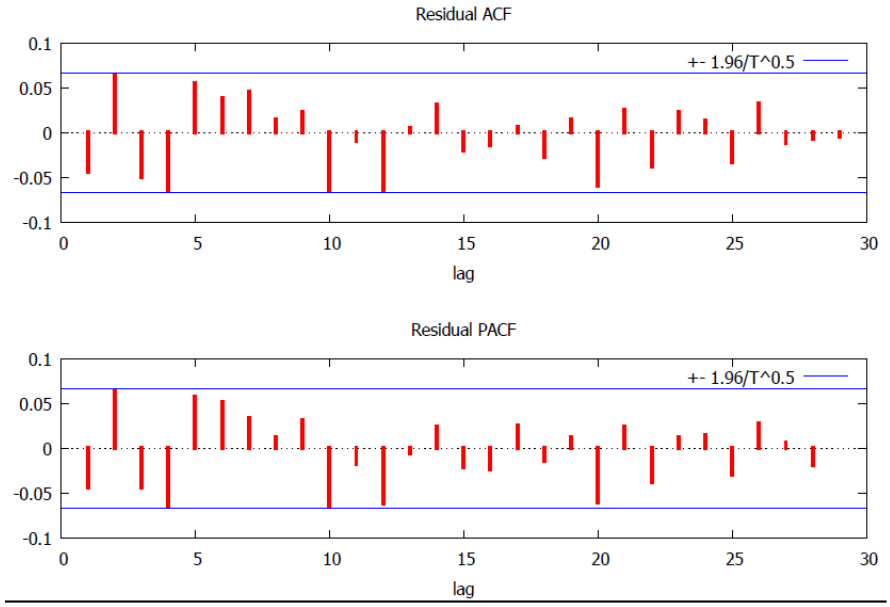
Source: our econometric processing with Gretl. Ver. 1.8.4 software on RBA data.

Residual Garch Model



Source: our econometric processing with Gretl. Ver. 1.8.4 software on RBA data.

Residual Correlogram Garch Model



Source: our econometric processing with Gretl. Ver. 1.8.4 software on RBA data.

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The Impact of Remittances on the Real Exchange Rate: Empirical Evidence from Ghana

Maxwell Tuuli [1]

This paper presents an empirical analysis of the impact of remittances on the real exchange rate in the Ghanaian economy using an error correction model approach. Disaggregating capital flows into other capital (CAP) and remittances, the paper found that increasing levels of all forms of capital leads to real exchange rate appreciation in the long run. However a Granger causality test fails to establish a short run causality between remittances and the Real Exchange Rate. The analysis further suggests that, in the long run, a change in the real exchange rate is generally related to movement in economic fundamentals.

1. Introduction

Capital inflows play a very significant role in the economies of many less developed countries. Major components of private capital inflows include foreign direct investment (FDI), official development assistance (ODA), worker's remittances, and portfolio investment. These flows have increased tremendously over the past decade and the composition and magnitude of the various types of capital flows have also undergone significant changes over the years.

The study of the dynamics of remittances, one of the components of capital flows, is gaining prominence in the economic literature and economic research. These studies address a wide variety of issues, ranging from its microeconomic impact on recipient households to its effect on major macroeconomic variables. More specifically, issues of research interest include: its role as a source of foreign exchange; welfare effects; and some concerns regarding its effect on inflation and the real exchange rate (RER). Bearing in mind the significant attention

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RER has gained over the last several decades as a policy variable, this paper seeks to carry out an in-depth analysis of the role remittances play in the real exchange rate dynamics in Ghana.

The size of remittances in the developing world is three times that of official development assistance and it is comparatively more stable than other financial inflows (Ratha, 2007). In 2010 for instance, the total amount of remittances received by developing countries was estimated to be $320.8 billion, an increase of more than 400% over the 2000 value (World Bank, 2011). The pattern of remittance flows is diverse but the regions where recipients of remittances (relative to total output) were greatest were South Asia, the Middle East and North Africa. There has been a consistent increase in the level of remittances to these parts of the world. Available data confirms that Ghana, also as a developing country, has had its fair share of the increase in the flow of remittances. Inflows of remittances to the Ghanaian economy have increased tremendously averaging about $54.5 million over the last decade compared to $20.3 million in the previous decade reaching about $135 million in the year 2010 (and rising). The level of remittance as a share of Ghana's GDP followed a similar trend. It increased from about 0.2% of GDP in 2000 to about 1.5% of GDP in the year 2010 (World Bank, 2011).

However, with the increasing flow of remittances, there are growing concerns about potential negative effects. Though it is generally expected that remittances should have a positive impact on the overall economy, very large volumes of remittances relative to the size of the economy could have detrimental effects such as high inflation, inefficient resource reallocation and/or exchange rate appreciation etc. Studies on Pakistan by Hamma (2009), with respect to the effect of remittance inflows on the exchange rate confirmed the experience of Dutch disease. High capital inflows led to the real appreciation of the domestic currency that made the export sector less competitive, adversely affecting the economy.

2. Literature Review

2.1 Remittances and Exchange Rate

Studies on remittances, especially in developing countries, have pointed to significant positive macroeconomic impact on these economies. There

is evidence suggesting that large flows of remittances to developing countries are sometimes associated with lower levels of poverty at the individual level and an increased pace of growth as well as better health and education indicators (Fajnzylber and Lopez, 2005).

Remittance flows to most developing countries are found to be countercyclical in the recipient economies as they serve as supplements to household income in periods of low economic activity (Ratha, 2007). Periods of general economic hardships arising from natural disasters or conflict usually witness high inflows of remittances that stabilize as economic conditions improve. Ratha (2007) documents evidence of high remittance flows to the Mexican economy during the financial crisis of 1995 and Indonesia and Thailand in 1998. The aftermath of 2010 earthquake in Haiti also witnessed a surge in remittances to partly reduce the financial strain that occurred as a result of the disaster[2]. This pattern of inflows can help smoothen aggregate demand and contribute to economic growth.

The developmental role of remittances is well recognised and there is an increasing volume of research in that regard. Not only is this recognised at the research level, the issue of remittances as a developmental tool, as well as its potential negative consequences, has engaged policy makers and the attention of major financial institutions such as the World Bank and IMF (see for instance IMF's *World Economic Outlook 2005* and the *World Bank's Global Economic Prospects 2006*). This has resulted in an increase in discussion and research in an attempt to maximise the potential benefits of remittances to developing countries.

In Ghana there is evidence that support the development and welfare effects of remittances. Remittances have been shown to improve individual welfare substantially and help minimize the negative economic shocks to recipient households (Quartey, 2006). Addison (2004) also documents the potential role remittances can play in the macroeconomic development of Ghana.

However, many developing countries that are high recipients of capital flows (where remittance is a major component) have to grapple with the impact of these flows on the real exchange rate and the international

[2] Author's own calculation with Data from WDI

competitiveness of their exports. Exchange rate stability is seen as a major developmental tool, especially in countries with highly volatile exchange rate, and has become a key policy issue (Gala, 2008). Most developing countries detail exchange rate target policies each fiscal year to maintain a stable currency and improve their competitiveness. In Ghana, this is reflected every year in the budget statement of the country.

With the developmental impact of a stable exchange rate in mind, much theoretical and empirical research has emerged with the major determinants of the real exchange rate and the factors that contribute to its volatility being of particular interest. The discussions that follow will give a rundown of some theoretical models and empirical studies that directly inform this study.

2.2 Theoretical Approaches to Exchange Rate

Many theories over the years have shaped today's empirical investigation of the dynamics of the real exchange rate. Some economists have used the Purchasing Power Parity (PPP) based approach in trying to model the long run RER dynamics but these theories typically fail to explain the persistent deviation of the RER from its long run PPP value both in developed and developing countries (Mussa, 1986).

There are, however, two broad strands of RER models in the literature (the fundamental equilibrium RER (FEER) and the behavioral equilibrium RER (BEER)) that appear to fit the evidence relatively well (Elbadawi and Soto, 2005). Models based on the FEER often specify the path of RER needed to achieve both internal and external balance. Thus, in these models the RER is specified as a function of optimum domestic output and sustained capital flows.

However, the FEER approach loses sight of other potentially important economic fundamentals such as the terms of trade (TOT), openness, trade policy, foreign aid and remittances that also affect the RER. The alternative approach (BEER), which originated with Clark and MacDonald (1999), uses a single equation reduced form behavioral model with emphasis on variables that affect the relative prices of traded to non-traded goods in the domestic and foreign markets. These

variables include medium to long term economic fundamentals such as the terms of trade, openness, government spending and capital inflows that are believed to exert a considerable influence on the RER (Elbadawi and Soto, 2005). This approach takes into account both external and internal factors that play a significant role in RER movement.

2.3 Empirical Studies on Capital Flows and Exchange Rates-General

Empirical studies on capital flows mostly drawing on the FEER and BEER approach are numerous; they range from the dynamics of capital movement from developed countries (to developing countries) in the form of Aid and Foreign Direct investment (FDI) to the development impact and growth implication of these flows.

Edwards (1989), in a bid to explain exchange rate volatility, built a theoretical model to capture the long run and short run fluctuations of exchange rate in developing countries. He presented a dynamic small open economy model that sought to explain the effect of both nominal and real variables on the RER. The model argued that equilibrium RER is determined by real variables and that only changes in these variables can affect the long equilibrium RER. His theoretical model was tested using 12 developing countries with data from 1962 to 1985. His results asserted that nominal variables affect the real exchange rate only in the short run while in the long run only real variables affect the RER. His findings are consistent with the theoretical presumptions of the BEER approach which asserts that in the long run only fundamentals such as the terms of trade (TOT), capital inflows, technological progress etc affect the real exchange rate (see for instance studies by Engel, Mark and West, 2007). His results also supported the view that excessively expansionary monetary policy can lead to RER appreciation.

More specifically, Ahmed (2009) confirmed the Dutch disease hypothesis in Pakistan by estimating a linear regression model that included the TOT, government spending, degree of openness, workers' remittances, FDI and foreign economic assistance as explanatory variables for movement in RER. The argument put forward for the inclusion of these variables is that the RER is a function of a set of exogenous and policy induced fundamentals (in line with BEER). His model included worker's remittances as a separate explanatory variable due to its importance in the Pakistani economy. He found that increases

in all the various forms of capital inflows led to a RER appreciation. His analysis raised important questions regarding the stationary nature of data and the need to resort to alternative approaches in cases where the data is observed to be non-stationary.

In terms of the impact of remittances (specifically) on the RER, studies by Lopez, Molina, and Bussolo (2007) on selected Latin American countries also suggested that high flows of remittances to these countries caused a significant appreciation of the RER. A similar study by Ameudo-Dorantes (2004) of Latin American countries obtained results consistent with the previous studies and noted that the appreciation of the RER in these countries, as a result of the increased level of remittances, reduced their competitiveness and may have led to a reallocation of resources to the non-tradable sector. Both studies derived their theoretical basis on the single equation reduced form behavioral model developed by Clark and MacDonald (1999).

Though most of the empirical studies available strongly support the idea that large flows of capital (and remittances) lead to RER appreciation, some studies are more equivocal in their conclusion. For instance, while studies by Lartey, Manelman, and Acosta (2008), Holzner (2006) and those mentioned above found strong evidence in support of Dutch disease in their empirical studies, Barajas (2010) and Fayads (2010) indicate that remittances tend to appreciate the RER but only under certain country specific economic circumstances. More specifically, Barajas concluded that only countries with more open capital accounts and low levels of trade are likely to experience RER appreciation associated with increased levels of remittances. The most striking revelation of Fayads's analysis, in relation to those previously mentioned, is that any empirical study on the RER and remittances must take into account the degree of openness of the country's capital account and its level of trade with the rest of the world.

2.4 Empirical Studies on Capital Flows and Exchange Rates-Ghana

Various studies in Ghana in the area of capital flows and RER also differ in their conclusion. Young (1992), for instance, pointed out in his studies that abundant foreign aid in the Ghanaian economy during the period of SAPs led to apparent RER appreciation (reflected by domestic inflation and continuous devaluation of the currency) and the crowding

out of the private sector due to government's increased demand for domestic goods and services. Young's analysis was a comprehensive study that observed the pattern of aid flow before and after SAPs and the economic indicators between the two periods to draw his conclusion. Studies by Opoku-Afari et al (2004) on Ghana also confirmed that, indeed, capital inflows to Ghanaian economy tend to cause an appreciation of the real exchange rate. They used the Vector Autoregressive approach to analyse the relationship between a set of variables that included the degree of openness, TOT, total factor productivity and aid as explanatory variables. This study is particularly important because of the exposition on the important economic variables that affect the RER in Ghana and is therefore used to inform the regression analysis to follow.

However, Sackey's (2001) empirical studies on the effect of foreign aid on the RER in Ghana found that, contrary to theoretical predictions, inflows of foreign aid to the Ghanaian economy actually depreciated the RER. This study was done using a co-integration approach and the key variables included in the model are, TOT, Aid, Government expenditure on non-tradable (measured by the share of government spending in GDP), Technological progress (proxied by the index of agricultural production), Government's expansionary monetary policy, parallel market premium and change in the nominal exchange rate. This analysis differs from that of Opoku-Afari et al in two ways; it does not include the effect of structural breaks and uses the bilateral nominal exchange rate to compute the RER instead of the nominal effective exchange rate used by Opoku-Afari et al.

3. The Ghanaian Economy: An Overview

The period immediately after Ghana's independence witnessed a surge in investment activities by the government mainly on improving the infrastructure of the country. With the availability of funds from the relatively high price of exports during this period (mainly cocoa), the country appeared poised for growth and development. However, high levels of corruption and numerous military interventions from 1966 through to the early 1980's coupled with drought and the low export prices of its main primary exports (cocoa and gold) resulted in the fading of the country's fortunes.

With the abysmal performance of the economy following this period it was not surprising that the country earnestly welcomed the IMF and World Bank sponsored structural adjustment, under the economic recovery program (ERP) of 1983, to secure funds and developmental aid in the hope of repositioning the country towards a trajectory of sustained growth and development. Since the implementation of the SAP the country has made significant strides in promoting development both economically and on the political front.

GDP growth rate has been steady over the past several decades. Growth averaged about 4.8% in the period 1987-1991. However, its growth rate has increased steadily since 1992 reaching an average of about 5% between 2002 and 2006 as indicated in the table below. In 2011, the country recorded an unprecedented growth rate of 11%. This growth rate witnessed in the country is likely the result of major policy initiatives undertaken by government to promote the private sector and improve the business environment that are beginning to yield positive results.

Table: 1: Average value of GDP, ODA and FDI

Period	**GDP Growth Rate (%)**	**ODA ($'000'000)** (Annual average)	**FDI ($'000'000)** (Annual average)
1987-1991	4.8	1,011.872	11.9
1992-1996	4.1	819.11	121.4
1997-2001	4.2	861.124	149.62
2002-2006	5.5	1,304.47	233.18

Source: Author's own calculation with data from WDI.

Ghana is highly dependent on foreign aid for most of its developmental projects and also for financing its budget. Average inflow of official development assistance (ODA) to the country in the period 1987-1991 was over $1 billion but fell below this value in the decade that followed. However, during the period 2002-2006 (i.e the period of debt reduction under HIPC) the flow of ODA picked up attaining an average value of over $1.3 billion. For foreign direct investment (FDI) the trend is slightly different. Average FDI in the country has been growing steadily since 1987 from about $11.9 million in the second half of 1980's to as much as $233.18 million annually since the year 2001. This trend is

expected to continue as the economy continuous to exhibit signs of prosperity attractive to foreign investors.

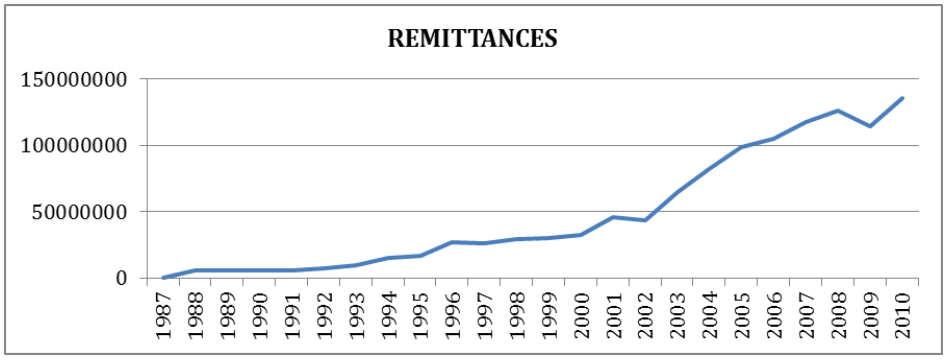
In terms of monetary policy, the Bank of Ghana is doing considerably well in pursuing sound monetary policies and this is manifested in the steady decline in inflation and the improved macroeconomic environment that has boosted investor confidence and attracted substantial amount of foreign direct investment into the country (Yvonne, 2010). Some economists have questioned the over restrictive inflation targeting policy pursued by the Bank of Ghana and recommend monetary policies that are geared towards promoting growth and employment along with maintaining moderate levels of inflation (Epstein and Heintz, 2006). This highlights the fact that the central bank still has an important role to play in the success of the economy.

3.1 Remittance Flows to Ghana

Ghana's receipt of remittances compared to other sub Saharan African countries such as Cameroon, Gambia and Liberia is quite substantial. Total volume of remittances to the country has been increasing since 1987. Remittances flow to the country in 1988 was about $6 million representing about 0.12% of total GDP. However, it rose steadily over the years and has exceeded $100 million annually since 2006. These flows only capture remittance flow to the country through official sources such as bank transfers and money transfer outlets. Some estimates have put remittance figures in Ghana close to $1 billion annually[3]. This increase in remittances over the years has played a significant role in improving the livelihood of many recipient households.

[3] See Addision (2004)

Figure 1: Remittance Inflows to Ghana



As the figure above indicates, remittances have been growing since 1987 and only in 2009 did we witness a significant dip from the previous year's value (i.e a decrease of about 9.2%). This can be attributed to the financial crisis that hit the world in 2008 and resulted in a reduction in private transfers. However as global financial conditions continue to improve, remittance inflow to the country has increased quite significantly from its 2009 value.

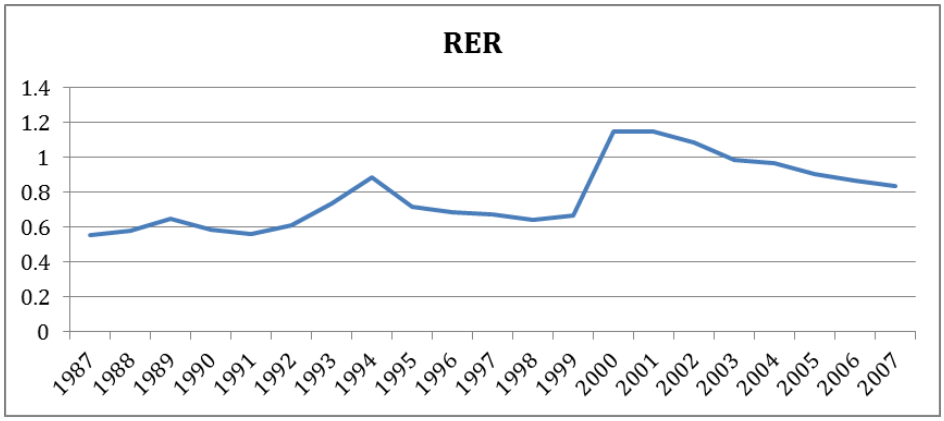
3.2 Real Exchange Rate (RER) Trend in Ghana

Theoretically, there are several ways of measuring the RER. One commonly used measure is the relative price of tradable to non-tradable goods. Another measure of the RER uses the ratio of a unit cost of labour in the foreign country to that in the home country expressed in a common denominator (using the nominal exchange rate) as a measure of the RER. However, these are usually difficult to estimate over time because of limited data availability. A more practical approach is to use the nominal exchange rate adjusted for the relative price differences between the relevant country and the rest of the world (Ahmed, 2009). Thus here we use the US wholesale price index (WPI) relative to the consumer price index (CPI) of Ghana as the measure of RER as indicated by the following

$$\text{RER}=\frac{ER*WPI}{CPI}$$ where *ER* is the nominal exchange rate.

In the formulation above an increase in the ratio represents RER depreciation whilst a decrease indicates an appreciation. We use the above equation to construct the RER for Ghana from 1987-2007.

Figure 2: Real Exchange Rate For Ghana



As Fig.2 above indicates, the RER (based on the above measure) was fairly stable from 1987 to 1991 after which it depreciated against the dollar and peaked in 1994. It again appreciated in 1995 and remained stable till 1999. It then depreciated by over 72% in the year 2000, the highest within the sample period. It has, however, steadily appreciated from 2001with little deviation from that trend.

4. Methodology and Data

4.1 Real Exchange Rate and Fundamentals

Following the earlier discussion on the theoretical approaches to RER, we use the BEER approach because of its wide usage and relative ease of applicability in empirical studies of the RER; especially in developing countries (See for instance Elbadawi and Soto (1997) and Amuedo-Dorantes and Pozo (2004)). According to this model there are several fundamentals that determine the movement of real exchange rate across countries. Opoku-Afari (2004) provides details of the important macroeconomic variables that determine the real exchange rate of Ghana. Here we give a brief description of these variables and how they affect the real exchange rate.

Terms of Trade (TOT): Measured as the relative price of exports to imports the terms of trade measures, in a specific manner, the effect of external demand and supply on the tradable sector of an economy. Movements in the TOT result in two effects (i.e the substitution and

income effect) and these have different impacts on the RER. The income effect of an improvement in the TOT is that more money is being spent on both tradable and non-tradable goods in the economy. This results in an increase in the price level in the non-tradable sector and lead to RER appreciation. The substitution effect is that more imports would be consumed to the detriment of domestic goods which causes a drop in demand of non-tradable goods resulting in a decline of their prices and RER depreciation. Thus, *a prior*, it is difficult to determine which of the two effects on the RER dominates the other.

Government Consumption (GC): Government expenditure is particularly important in countries where the ratio of government expenditure to GDP is quite large. The effect of government spending on the RER is captured through its effect on the prices of the non-tradable goods sector. Increased spending by the government would put upward pressure on the prices of non-tradable goods and result in RER appreciation. It is usually difficult to specifically distinguish between government spending on tradable and non-tradable goods but it is generally assumed that non-tradable goods dominate government consumption. Therefore, we use the ratio of government expenditure to GDP as a proxy in this analysis, similar with other studies (Edwards 1989).

Liberalization Index (LIB): The level of openness of an economy also has a significant effect on the movement of the RER. It usually measures the degree to which an economy engages in international transactions. Trade restrictions through policies such as quotas and tariffs usually result in an increase in the prices of both imports and non-tradable goods leading to an appreciation of the currency. A more liberalised economy benefits from international competitiveness and technological transfer which lead to lower prices in the non-tradable sector and result in RER depreciation. Owing to the unavailability of data specifically on trade restriction and international openness, one popular measure used in the literature (see Ahmed, 2009) as a proxy for the degree of liberalization is the ratio of imports plus exports to GDP.

Capital Flows: Theoretically, all forms of capital inflows are expected to result in RER appreciation. However, empirical estimates suggest that the impact of the various types of capital inflows on the RER depends on the degree of reversibility of that particular component which varies from one economy to the other. For the purpose of this study we

disaggregate the flows of capital into two main components; Other Capital flows (CAP) (i.e Official development Assistance (ODA) plus Foreign Direct Investment (FDI)) and Remittances (REMIT). In analysing the model we use the CAP to GDP ratio and the REMIT to GDP ratio since these correctly reflect the size of these flows to the country as the economy changes over time.

Using the above variables, noted to have a significant influence on the RER, we proceed to estimate the following regression equation directly in line with that specified by Ahmed (2009).

$$\boldsymbol{RER_t = f(TOT_t, REMIT_t, CAP_t, LIB_t, GC_t)}$$

It is expected that increases in all forms of capital inflows (ODA, FDI and REMIT) as well as Government expenditure would result in RER appreciation. Whilst it is expected that more liberalised trade would lead to the depreciation of the RER, an improvement in the terms of trade has an ambiguous effect on the RER for reasons mentioned earlier.

Tests of the data on the variables in the model specified above using the Augmented Dickey-Fuller test indicate that the levels of the data are non-stationary (see Table 2.) implying that the conventional method of ordinary least square cannot be used. This necessitates the use of the error correction model.

Table2: Unit root test for variables in the model

Variable	Dickey-Fuller	Dickey-Fuller(1st Difference)
RER	-1.45	-6.331
TOT	-2.511	-6.133
GC	-2.066	-4.199
LIB	-1.423	-4.915
REM	1.236	-5.327
CAP	-2.158	-6.571
Critical value 1%	-3.716	-3.723
Critical value 5%	-2.986	-2.989

* For each of the variables, the test statistic falls below both the 1% and 5% critical values of the Dickey-Fuller test thus the failure to reject the hypothesis of unit root. However, for the test in first difference the test statistics are all greater than the critical values. This indicates first difference stationarity of the variables.

4.2 Error Correction Model

Since it has been established in the analysis above that there is the presence of unit root in the data, the appropriate method of analysis to be used is the error correction approach. Thus we proceed by estimating the following error correction model.

$$\boldsymbol{\Delta Y_t = \alpha + \phi(Y_{t-1} - \curlyvee X_{t-1}) + B\Delta X_t + \varepsilon}$$

Where $\mathbf{Y_t}$, is our dependent variable and $\mathbf{X_t}$, the set of explanatory variables.

The idea behind the error correction approach is that, different macroeconomic variables may trend up and down overtime, however, a linear combination of a group of them may be found to drift together in a similar direction. This method provides two significant insights. It enables us to estimate the long run relationship among time series economic variables and helps us figure out short term disequilibrium among the variables.

To achieve the above we first use the method of cointegration to determine if there exist any long run relationship between the RER and the explanatory variables (in particular remittances) using data from 1980 to 2010. In fact, the error-correction equation above can only be estimated if such a cointegrating relationship exists. The next step would involve estimating the short run relationship among the variables in the error correction model specified above. This is done by introducing the lagged error term from the long run equation as an explanatory variable in a first difference equation. This approach helps us determine the short run behaviour of the variables as they move towards their equilibrium values.

The results obtained using the data can then be used to compare results from similar studies undertaken by Sackey (2001) and Opoku-Afari (2004). Where there exist differences we point out the underlying reasons that would likely account for that. Most importantly, the studies mentioned above did not take into account remittances as a separate independent variable and thus our comparison would only be with

respect to the direction of influence (not the magnitude) of the coefficients of the other variables included in these studies.

5. Analysis and Results

5.1. Cointegration

The method of cointegration to be used here is the Johansen Cointegration Test. This method is generally preferred because of the number of variables involved in this study, unlike the Engle-Granger approach which is preferred in cases involving two or three variables. Though this approach is sometimes complex, it is less restrictive because it allows for more than one cointegrating equation.

Thus we proceed to estimate the long run relationship of the model specified above using the Johansen test for cointegration. Below are the results from the Johansen test for cointegration

Table 3: Long Run Equation (Normalise on lnRER)

Variable	**Coefficient**	**Standard Error**
lnTOT	-2.7637	0.4598
lnGC	-1.4716	0.3197
lnCAP	-0.0943	0.0274
lnREM	-0.0080	0.1188
Trend	0.1983	0.0271

As expected from our analysis, all the variables are consistent in terms of their sign (impact) on the real exchange rate. In the case of the terms of trade, Ghana is a price taker in the international market and does not have control over the prices of its exports. The long run analysis implies that an improvement in the TOT is related to an appreciation of the RER in the Ghanaian economy which suggests that the income effect outweighs the substitution effect. The nominal coefficient of -2.76 on the TOT indicates that a change in the TOT exerts a significant influence on the RER in the long run compared to the other variables in the model. This finding is not only consistent with theory but it also confirms the results from a similar study done in Ghana by Opoku-Afari et al (2004). They found that in a model where long term capital flows are included, the terms of trade has an appreciating effect on the real

exchange rate in the long run. Sackey's 2006 analysis, however, found that an improvement in the TOT leads to RER depreciation. This is not surprising because his model did not include any form of long term capital flow as an explanatory variable. A possible explanation for this, which was alluded to by Opoku-Afari et al (2004) is that, when long term capital flows such ODA and FDI are not included in a model for RER determination, it introduces omitted variable bias that makes the substitution effect of an improvement in the TOT outweigh the income effect and lead to RER depreciation.

It is important to note that, even though the liberalisation index (level of economic openness) is an important economic variable in the determination of the RER, it was not included in the long run conintegration relationship. This is because, when included, the variable enters with the wrong sign and also results in non-stationary residuals (which indicate the absence of cointegration).

Government consumption (GC) has an appreciating effect on the RER, which is consistent with theory. It suggests that government spending generally tends to be biased towards the non-tradable sector which leads to increased prices in this sector and subsequently RER appreciation. Studies by Sackey (2006) also confirms this, which is not surprising because the governments of most developing countries tend to be very active in the economy purchasing mostly non-tradable goods such as labour and services and thus increases the prices in the non-tradable sector.

Capital inflows generally, according to theory, result in the appreciation of the RER of the domestic economy. Our analysis confirms that, indeed, capital inflows (both other capital and Remittances) into the Ghanaian economy lead to RER appreciation in the long run. This corroborates similar analysis undertaken by Opoku-Afari et al (2006) which shows that Dutch disease is present in the Ghanaian economy. Thus even though capital inflows (and recently remittances) play an important role in the development agenda of Ghana, the other side of the Ghanaian economy (exports) maybe taking a hard hit from RER appreciation resulting from the increasing capital inflows, thus necessitating attention. A surprising observation however, is the small magnitude of the coefficients on the CAP and REM variables (-0.0943 and -0.008 respectively) i.e small than that of GC and TOT.

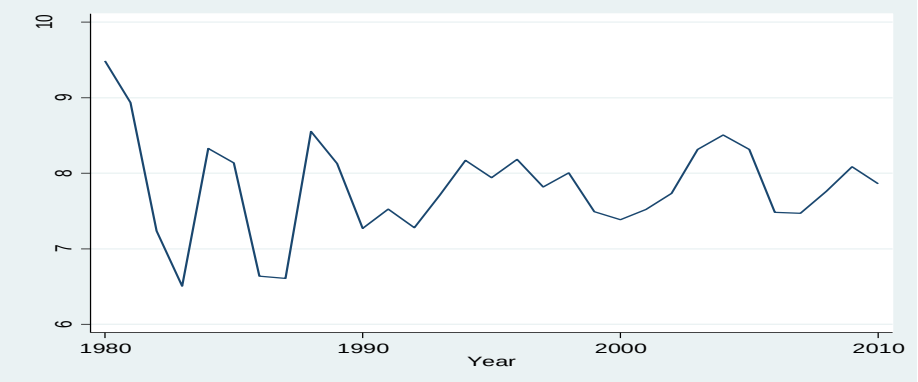
5.2 Short Run Equation

The short run dynamics of the RER may be different in some way from the long run relationship that exist between the RER and its fundamentals as established above because of the deviation in the short run from this equilibrium path due to the effect of transitory factors. In order to determine this short run relationship, we resort to the use of the error correction model. The idea is that even though short run relationship between the RER and its fundamentals may be different from its long run path there is always the tendency for it to move towards its long run path. Therefore, we proceed to estimate the following regression equation:

$$\boldsymbol{\Delta Y_t = \alpha + \phi \mathcal{E}_{t-1} + B \Delta X_t + \varepsilon}$$

Where $\mathcal{E}_{t-1}$ represent lagged values of the residuals from the long run equilibrium equation estimated earlier with the rest of the variables in first difference. To accurately estimate the short run relationship among the variables and further ascertain the existence of long run equilibrium, it is important the residuals from the cointegration equation be stationary. To determine this, we implement a graphical test and Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) tests on the residuals.

Graph 3: Plot of Residuals



*This graph plots the residuals from the cointegration relationship established in the previous section.

Table 4: Test of Residuals

Augmented Dickey-Fuller test on residuals	-4.782
Phillips-Perron Test on residuals	-5.149
ADF and PP 1% critical value	-3.716
ADF and PP 5% critical value	-2.986

In the diagram above, the absence of any systematic pattern in the residuals means that the residuals are stationary in level (i.e the plot of the residuals do not have a consistently rising or declining trend). This is further affirmed by both ADF and PP test on the residuals indicated in the table above. The 5% and 10% critical values for ADF and PP tests are such that we reject the null hypothesis that there exist unit root in the residuals, thus, buttressing the graphical analysis that there is indeed cointegration.

With stationary residuals confirmed by the above analysis, we proceed to estimate the error correction model indicated above. Below are the results from the estimation of the error correction model.

Table 5: Short Run Equation (Error Correction Model)

Dependent variable: lnRER	**Method: Least Squares (first difference)**	**Sample: 1980-2010**	**Number of Observation: 30**	
Variable	Coefficient	Standard Error	t-statistic	Prob(Tail)
l.Res	-.6275649	.1737318	-3.61	0.001
Cons	4.906793	1.369968	3.58	0.002
lnTOT	-2.957273	.7671627	-3.85	0.001
lnGC	-.8532484	.6615627	-1.29	0.209
lnREM	.6903433	.2792514	2.47	0.021
lnCAP	-.0316214	.0407198	-0.78	0.445
R-squared	= 0.5719			
Adj R-squared	= 0.4827			
Root MSE	= 0.51803			

The estimation results in the table above indicate that overall, 57% of the short run movement in the RER can be explained by the above specified model. Again the above results fits considerably well with theory. The coefficient on the error term is negative and below one, indicating that though RER may diverge from its equilibrium path in the short run it tends to automatically correct itself towards the long run equilibrium path (about 60% correction towards equilibrium in the first period). Two of the variables indicated above are not significant at the 5% significance level, i.e government spending on non-tradable goods and other capital inflows. Thus, even though GC and CAP influence the RER in the long run their effect is not established in the short run analysis possibly because it takes several lags before these variables eventually affect the RER. TOT is seen to have a negative effect on the RER in the short run indicating that the income effect, even in the short run, still dominates the substitution effect of an improvement in the terms of trade. Surprisingly, remittances in this model is captured as having a positive effect on the RER in the short run which runs contrary to its appreciating effect on the RER in the long run revealed earlier in the Johansen cointegration test. To establish the reason for this contradictory result we perform a Granger causality test to determine the direction of causality between the RER and remittances in the short run.

Table 6: Granger Causality Test

Null Hypothesis:	**lags**	**F-statistic**	**Probabilty**
REM does not Granger cause RER	2	0.09	0.9153
RER does not Granger cause REM	2	1.46	0.2524

The Granger causality test results noted in the table above failed to establish any causal relationship between the RER and REM. Thus, even at the 10% significance level we fail to reject both null hypothesis that REM does not Granger cause RER and neither does RER Granger cause REM. The probable reason for the inability of the Granger causality test to establish any short run causal relationship is that the short run dynamics may be occurring at a rather high frequency (monthly or quarterly). However, because the Granger test involves lagged annual data, the test lacks the ability to pickup this short term effect. It could also well be the case that, there is some other variable that influences both variables in the short run, hence the failure of the Granger test to establish a short run causation.

6. Conclusion

Migrants send money back home for the benefit of their families and in some cases to finance business projects left behind. Remittances serve as a source of livelihood for many families in Ghana. What is least thought about is that the increasing flows of remittances into the country, even though beneficial, may have negative consequences on the economy as a whole.

This paper employed an error correction model approach to empirically test the relationship between real exchange rate (RER) and remittances in the Ghanaian economy. In the analysis above, it has been established that remittance inflows to Ghana, like most other capital inflows, is coincidence with an appreciation of the RER. This has the potential of making the export sector less competitive and this negatively affects production in the sector thus leading to Dutch disease.

While the inflows of remittances to the Ghanaian economy were found to be related to an appreciation of the RER in the long run, the short run analysis showed that an increase in remittance flows was correlated with real exchange rate appreciation. However, a short run causal relationship between the real exchange rate and remittance inflows could not be established. The long run analysis results obtained in the study above are in tandem with previous studies by Opoku-Afari et al (2006) whose focus generally was on total capital flows as opposed to remittances specifically.

The paper further revealed that, terms of trade (TOT), government spending (GC) and capital inflows (CAP) in the long run, result in the appreciation of the RER in the Ghanaian economy. The short run analysis, however, failed to provide significant results for CAP and GC but still affirmed the long run prediction that an improvement in the terms of trade was related to an appreciation of the RER suggesting that the income effect outweighs the substitution effect. The paper further revealed that, TOT, GC and CAP in the long run, result in the appreciation of the RER in the Ghanaian economy.

The analysis raises several important issues: the need to clearly understand the economic importance of remittances in the Ghanaian economy and in particular, the need for a careful study of the

consequences on the export sector as a result of RER appreciation resulting from the increasing flows of remittances. The level of remittances to Ghana has increased quite considerably in the last decade and this presents new opportunities as well as challenges. Though the intentions of most migrant remittances may be altruistic, large flows of remittances may have unintended consequences on the whole economy.

References

Acosta, P., Calderon, C., Fajnzylber, P., & Lopez, H. (2008). What is the impact of international remittances on poverty and inequality in latin america? *World Development, 36*(1), 89-114.

Acosta, P. A., Lartey, E. K. K., & Mandelman, F. S. (2009). Remittances and the dutch disease. *Journal of International Economics, 79*(1), 102-116.

Acosta, P. A., Baerg, N. R., & Mandelman, F. S. (2009). Financial development, remittances, and real exchange rate appreciation. *Federal Reserve Bank of Atlanta Economic Review, 94*(1), 1-12.

Addison, E. K. Y. (2004). The macroeconomic impact of remittances. *Presentation by Dr EKY Addision, Director of Research, Bank of Ghanna, Conference on Migration and Development.*

Aggarwal, R., Demirgüç-Kunt, A., & Martinez Peria, M. (2006). Do workers' remittances promote financial development? *World Bank Policy Research Working Paper No. 3957.*

Ahmed, H. (2009). Capital flows and real exchange rate overvaluation-A chronic ailment: Evidence from pakistan. *Lahore Journal of Economics, 14*, 51-81.

Amuedo-Dorantes, C., & Pozo, S. (2004). Workers' remittances and the real exchange rate: A paradox of gifts. *World Development, 32*(8), 1407-1417.

Barajas, A. (2010). *Workers' remittances and the equilibrium real exchange rate: Theory and evidence* International Monetary Fund.

Bilson, J. F. O., Bilson, J. F., & Marston, R. C. (1988). *Exchange rate theory and practice* University of Chicago Press.

Clark, P. & MacDonald, R. (1999). Exchange rates and economic fundamentals: a methodological comparison of BEERs and FEERS. In Stein, J. and MacDonald, R. *Equilibrium Exchange Rates* (Kluwer: Boston), pp. 285-322.

Edwards, S. (1988). Real and monetary determinants of real exchange rate behaviour: theory and evidence from developing countries. *UCLA Working Paper No. 506*

Edwards, S. (1989). *Real exchange rates, devaluation, and adjustment: Exchange rate policy in developing countries*. Cambridge: MIT Press.

Elbadawi, A. I & Soto, R. (2005). Theory and empirics of real exchange rate in sub-saharan Africa and other developing countries. *World Bank, Mimeo, 2005.*

Elbadawi, A. I & Soto, R. (1997). Capital flows and long term equilibrium real exchange rates in Chile. *Revista de Analisis Economico.* 12(1), 35-62.

Engel C, Mark N.C, & West K. D. (2007). Exchange rate models are not as bad as you think. *NBER Working Paper No. 13318*

Epstein, G. & Heintz, J. (2006). *Monetary policy and financial sector reform for employment creation and poverty reduction in Ghana*. International Poverty Center, UNDP.

Fajnzylber, P., López, J. H., & World Bank. (2007). *Close to home: The development impact of remittances in latin america* the International Bank for Reconstruction and Development.

Fayad, G. (2010). Remittances and dutch disease: A dynamic heterogeneous panel analysis on the middle east and north africa region. *Centre for the Study of African Economies (CSAE).*

Gala, P. (2008). Real exchange rate levels and economic development: theoretical analysis and econometric evidence. *Cambridge Journal of Economics* 32 (2): 273-288.

Holzner, M. (2006). Real exchange rate distortion in southeast europe. *Vienna Institute for International Economics, Mimeo.*

Lopez, H., Bussolo, M., & Molina, L. (2007). Remittances and the real exchange rate. *World Bank Policy Research Working Paper no.4213,*

Mussa, M. (1986). Nominal exchange rate regimes and the behavior of the real exchange rate: evidence and implications. *Carnegie-Rochester conference series on public policy 25(1987). 117-214. North Holland.*

Opoku-Afari, M., Morrissey, O., Lloyd, T., & University of Nottingham. Centre for Research in Economic Development and International Trade. (2004). *Real exchange rate response to capital inflows: A dynamic analysis for ghana* Centre for Research in Economic Development and International Trade, University of Nottingham.

Quartey, P. (2006). *The impact of migrant remittances on household welfare in ghana* African economic research consortium (AERC).

Ratha, D. (2007). Leveraging remittances for development. *Policy Brief*, , 6-7.

Sackey, H. A. (2001). *External aid inflows and the real exchange rate in ghana* African Economic Research Consortium.

Stockman, A. C. (1980). A theory of exchange rate determination. *The Journal of Political Economy,* 673-698.

Younger, S. D. (1992). Aid and the dutch disease: Macroeconomic management when everybody loves you. *World Development, 20*(11), 1587-1597.

Yvonne, M. (2010). Economics, Ghana: Annual economic outlook. *The eve of oil production. Standard Bank, April 2010 report.*

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Exchange Rate Volatility and Market Efficiency Evidence from Pakistan

Munazza Jabeen[1] and Andleeb Ismail[2]

This paper empirically investigates the volatility dynamics of Pak Rupee exchange rates and its effects on market efficiency through using GARCH models. The monthly data on Pak Rupee exchange rates in the terms of major currencies (US Dollar, British Pound, Canadian Dollar and Japanese Yen) are taken from April, 1982 to June, 2012. The results show that Pak Rupee exchange rates depict high persistence and volatility clustering across GARCH models. There are no evidences of asymmetry and risk premium in Pak Rupee exchange rates except PKR-USD. Moreover, results indicate inefficiency of Pakistan exchange market which implies that the past information is not quickly incorporated by the current volatility.

1. Introduction

The exchange rate is one of the important economic indicators which play a crucial role to determine the degree of competitiveness among economies because it has a strong impact on economic developments, foreign direct investment flows, international trade and capital mobility. It also affects firm profitability, price stability, and financial stability of a country (Benita and Lauterbach, 2007)**.** It plays an important role in currency related derivative pricing and international capital budgeting and key input to investment, portfolio design and risk management.

Further, for stable economic conditions there is need of existence of an efficient foreign exchange market. According to Fama (1970), an efficient foreign exchange market is the one if exchange rates reflect all available relevant information. The exchange rates immediately absorb

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new information so that there exist no opportunities for investors to earn excess profits. There is efficient allocation of the resources as decisions are made on the basics of observed exchange rates by economic agents.

Exchange rate volatility in developing countries like Pakistan is very pervasive. In Pakistan, an extensive increase in the exchange rate volatility is seen in the recent years. This results in uncertainty and risk that adversely affect foreign exchange market agents as well as market efficiency in Pakistan. Market efficiency has sufficient condition that exchange rates fluctuate randomly or without any identifiable pattern i-e they follow a random walk. If foreign exchange market is efficient, abnormal profits cannot be earned from trading rules based on past returns. Therefore, exchange rate returns are unpredictable, and any technical analysis or statistical technique to predict future pattern of exchange rate returns based on past returns is impossible. Therefore, exchange rate volatility and market efficiency are important issues in Pakistan.

The conventional market efficiency tests e.g serial correlation test, unit root test, variance ratio test and runs test assume linear structure in the exchange rates returns generation process and are not able to capture non-linear behavior in exchange rate return series. Therefore, GARCH models are used to estimate exchange rates volatility and for testing market efficiency. These models are able to capture characteristics of exchange rate returns that include fat tails, peakedness (leptokurtosis), skewness and volatility clustering.

This paper empirically investigates the volatility dynamics of Pak Rupee exchange rates and its effects on market efficiency. In this paper, GARCH models are used and monthly data on Pak Rupee exchange rates in the terms of major currencies (US Dollar, British Pound, Canadian Dollar and Japanese Yen) are taken from April, 1982 to June, 2012 for a total of 363 monthly observations are used.

The structure of paper is as follows: Section II shows the literature review. Section III presents the methodology. Section IV presents empirical analysis. Section V provides conclusion.

2. Literature Review

A considerable amount of research is focused on modelling volatility in foreign exchange markets. ARCH model proposed by Engle (1982) is designed to incorporate conditional variance in order to model the financial volatility. For this purpose, conditional variance is modelled as function of past square error terms. GARCH model proposed by Bollerslev (1986) is introduced which consider conditional variance depends not only on past square error term but also on its past conditional variance.

The use of ARCH/GARCH models and its extensions and modifications in modelling and forecasting foreign exchange market volatility is now very common in finance and economics, such as French *et at.* (1987), Lau *et at.* (1990), Franses andVan Dijk (1996) and Choo *et al*. (1999). On the other hand, the ARCH model was first applied in modeling the currency exchange rate by Hsieh (1988). He has found that GARCH models can explain a large part of the nonlinearities for exchange rates and do well at removing conditional heteroscedasticity. Since then, applications of these models to currency exchange rates have increased tremendously, such as Hsieh (1989b), Bollerslev, (1990), Pesaran and Robinson (1993), Copeland and Wang (1994), Takezawa (1995), Episcopos and Davies (1995), Hopper (1997), Cheung and Wong (1997), Laopodis (1997), Brooks and Burke (1998), Lobo and Tuite (1998) and Duan and Jaso (1999).

Recent studies like West and Cho (1995), Chong *et al*.(2002), Balaban (2004) Antonakakis (2007) have studied GARCH models to estimate exchange rate volatility and compared the forecasting performance of GARCH models. The forecasting performances are evaluated by using ME, MAE, MSE and MAPE measures. These studies have suggested that symmetric GARCH models are relatively good in forecasting exchange rate volatility. While Longmore and Robinson (2004), Kar and Sarkar (2006), Yoon and Lee (2008) and Olowe(2009), have applied GARCH models to estimate exchange rate volatility and have found existence of asymmetry effect and leverage effect. They have concluded

the asymmetric GARCH models are the best models in capturing volatility. Zakaria (2012) have concluded that GARCH models are adequately model exchange rate volatility. Siddiqui (2009a & b) and Kamal and Ghani (2012) have investigated the daily Pak Rupee exchange rates volatility using symmetric and asymmetric GARCH models.

The efficiency of foreign exchange markets has investigated by various studies. Most of the studies have tested the market efficiency based on Fama's (1970) classification system. Hakio (1981) has tested the efficiency market hypothesis on five exchange rates against US dollar and found rejection of efficiency market hypothesis. Fama (1984) has also tested the efficiency market hypothesis on nine exchange rates against US dollar and found rejection of efficiency market hypothesis. Similar results were found by Domowitz and Hakio (1985) and Hodrick and Srivastava (1986). The rejection of efficiency market hypothesis has attributed to various factors, like the measurement of technical trading rules, the existence of risk premiums in forward rates, experimental irregularities in regression tests, negative correlation between the expected future spot rates and forward risk premia, and the lack of use of suitable econometric procedures.

Wickrema singhe (2004), Chakrabarti (2005) and Nath (2006) have employed unit root tests to investigate market efficiency for Sri Lanka and Indian exchange markets. Their results support the market efficiency hypothesis. Ahmed, *et al*. (2005) and Hideki (2006) have applied serial correlation tests and run test to investigate the market efficiency for the South Asian foreign exchange markets and the Hong Kong FX market. They found rejection of the market efficiency hypothesis. Kimani (2007) has applied the unit root tests to the Kenya Shilling per US Dollar. They found rejection of the market efficiency hypothesis. Rose, *et al.* (2008) has analyzed the market efficiency of the foreign exchange market of Kenya and found it to be inefficient. They attributed their rejection of the hypothesis to significant patterns in the exchange rates, trend stationarity and autocorrelation in foreign

exchange returns. Noman and Ahmed (2008) have applied various unit root tests and the variance ratio to test the market efficiency of seven SAARC countries; namely, Pakistan, India, Bangladesh, Sri Lanka, Bhutan, Nepal and Maldives. The results of their study supported the market efficiency. Attiya (2012) has examined market efficiency of four South Asian foreign exchange markets namely, Pakistan, India, Sri Lanka and Bangladesh; by using unit root tests. Results shown all four foreign exchange markets are consistent with the efficient market hypothesis. All these studies have used the same conventional market efficiency tests e.g serial correlation test, unit root test, variance ratio test which assume linear structure in the exchange rates returns generation process and are not able to capture non-linear behavior in exchange rate return series. Therefore, this study employs GARCH models to estimate exchange rates volatility and to test market efficiency.

3. Methodology

GARCH Models

In this paper, Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models are employed for modelling exchange rate volatility and for testing market efficiency. These models are able to capture the exchange rates dynamics which include fat tails, peakedness (leptokurtosis), skewness, volatility clustering, asymmetric and leverage effects.

Generalized Autoregressive Conditional heteroskedasticity (GARCH) model was proposed by Bollerslev (1986). The GARCH Model considers conditional variance depends not only on the squared error term past values but also on its conditional variance past values. The ARMA (m,n) -GARCH (p,q) is specified as

$$r_t = c + \sum_{i=1}^{m} \delta_i r_{t-i} + \sum_{j=1}^{n} \varphi_j \varepsilon_{t-j} + \varepsilon_t$$

$$h_t = \omega_0 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-j} \quad (1)$$

$$\varepsilon_t = z_t \sqrt{ht}$$

$$\varepsilon_t \sim N(0, h_t) \text{ and } z_t \sim \text{iid } N(0, 1)$$

In the mean equation (1) , r_t is the exchange rate return and ε_t is residual, z_t, is a standardized error by conditional variance and normal iid random variable. Where $\omega_0 > 0$, $\alpha_i \geq 0$ and $\beta_j \geq 0$ ensure that the conditional variance is always non-negative

The GARCH model is extended to GARCH-M model by Engle, Lilien and Robins in 1987 in which conditional variance is added into conditional mean equation. The risk premium is generated by conditional volatility as part of expected returns. The ARMA (m,n)-GARCH-M (p,q) model is specified as follows:

$$r_t = c + \sum_{i=1}^{m} \delta_i r_{t-i} + \sum_{j=1}^{n} \varphi_j \varepsilon_{t-j} + \lambda ht + \varepsilon_t h_t = \omega_0 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-j} \quad (2)$$

The coefficient λ in mean equation (2) measures the risk premium indicating the relationship between exchange rate returns and their volatilities.

Furthermore, Glosten, Jagannathan and Runkle (1993) introduced GJR-GARCH model to allow asymmetric effects. The ARMA (m,n)- GJR-GARCH (p,q) model is specified as

$$r_t = c + \sum_{i=1}^{m} \delta_i r_{t-i} + \sum_{j=1}^{n} \varphi_j \varepsilon_{t-j} + \varepsilon_t$$

$$h_t = \omega_0 + \sum_{i=1}^{q} (\alpha_i \varepsilon_{t-i}^2 + \gamma_i \varepsilon_{t-i}^2 S_{t-i}) + \sum_{j=1}^{p} \beta_j h_{t-j} \quad (3)$$

Where S_t (dummy variable) = 1 if $\gamma_i < 0$, and 0 if $\gamma_i > 0$. In the model, good news ($\varepsilon_{t-1} > 0$), and bad news ($\varepsilon_{t-1} < 0$), acts differentially on the conditional variance. If $\gamma_i > 0$, bad news increases volatility and leverage effect exists. If $\gamma_i = 0$, the news impact is symmetric i.e. past bad news

(negative shocks) impacts similarly on current volatility as good news (positive shocks).

In the analysis GARCH (1,1)-M, GARCH (2,1)-M and GJR-GARCH(1,1)-M are employed for volatility modelling of the four Pak-Rupee exchange rate series. Various ARMA (m,n) model specifications for mean equation are used with the conditional variance equation simultaneously. The covariance matrix of the estimates (outer-product of gradients) is computed with the Maximum Likelihood Estimation (MLE) method. Further, normal distribution is used for conditional distribution of the error term.

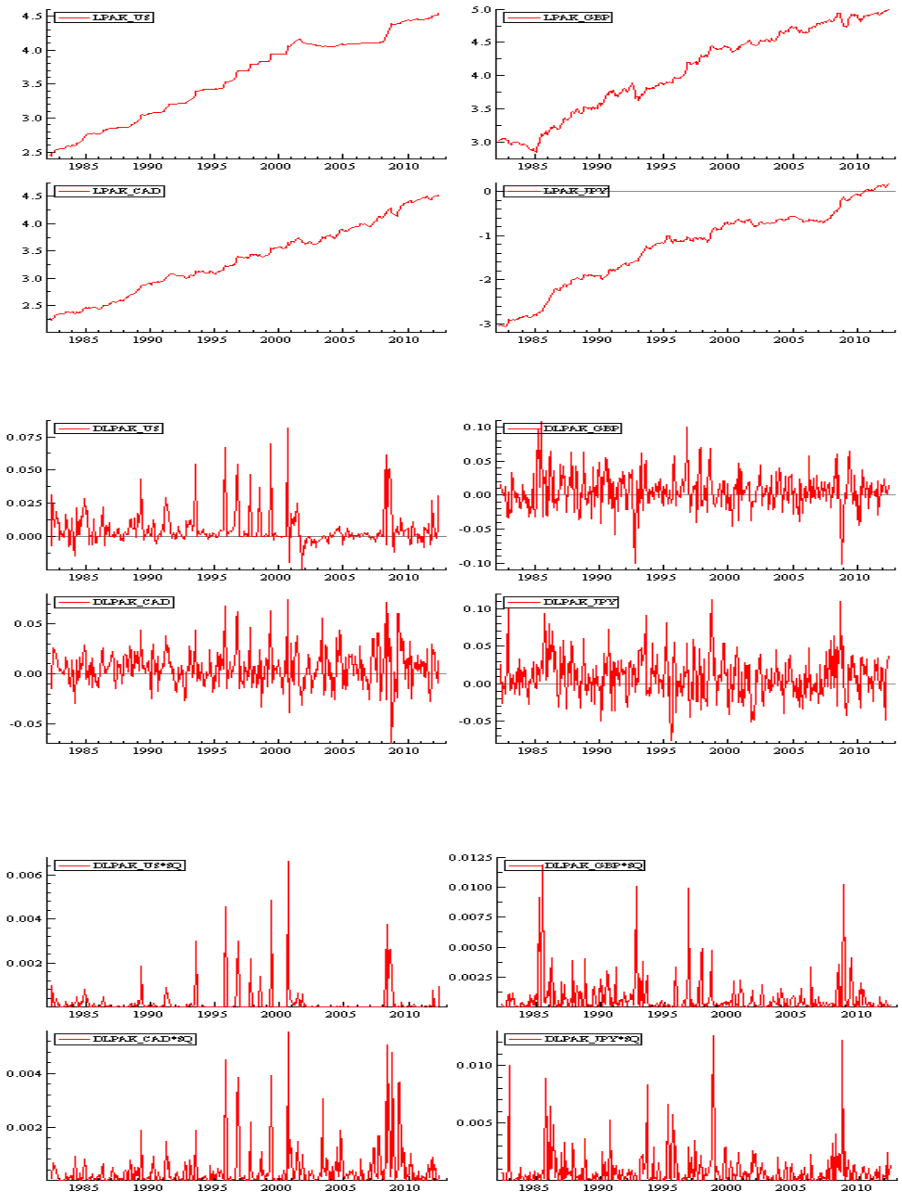
4. Empirical Analysis

In our empirical analysis, the monthly data from April, 1982 to June, 2012 for a total of 363 monthly observations are used. The data is obtained from International Financial Statistics (IFS), Annual State Bank Reports. Bilateral Pak Rupee nominal exchange rates in the term of major currencies (US dollar, British pound sterling, Canadian dollar and Japanese yen) are examined. The monthly average data of these exchange rates are used and expressed in Pak Rupees for one unit of foreign currency. The monthly return series are constructed as logarithmic first difference of monthly Pak Rupee exchange rates of successive months [$r_t = \ln (E_t/E_{t-1})$]. Because exchange rate volatility is not directly observable, monthly squared return series is used as proxy of realized volatility.

The plots of the monthly exchange rates in logarithmic level and exchange rate returns and squared returns are given in Figure 1. The plots of the monthly exchange rates reveal a general upward trend over the sample period. The plots of the monthly exchange rate returns as logarithmic changes in exchange rates indicate no definite pattern in the exchange rate returns and they revert quickly to their means. It also reveals that the variances change over time and volatility tends to cluster. The exchange rate returns are complying with the mean reverting and volatility clustering stylized facts. The squared returns are

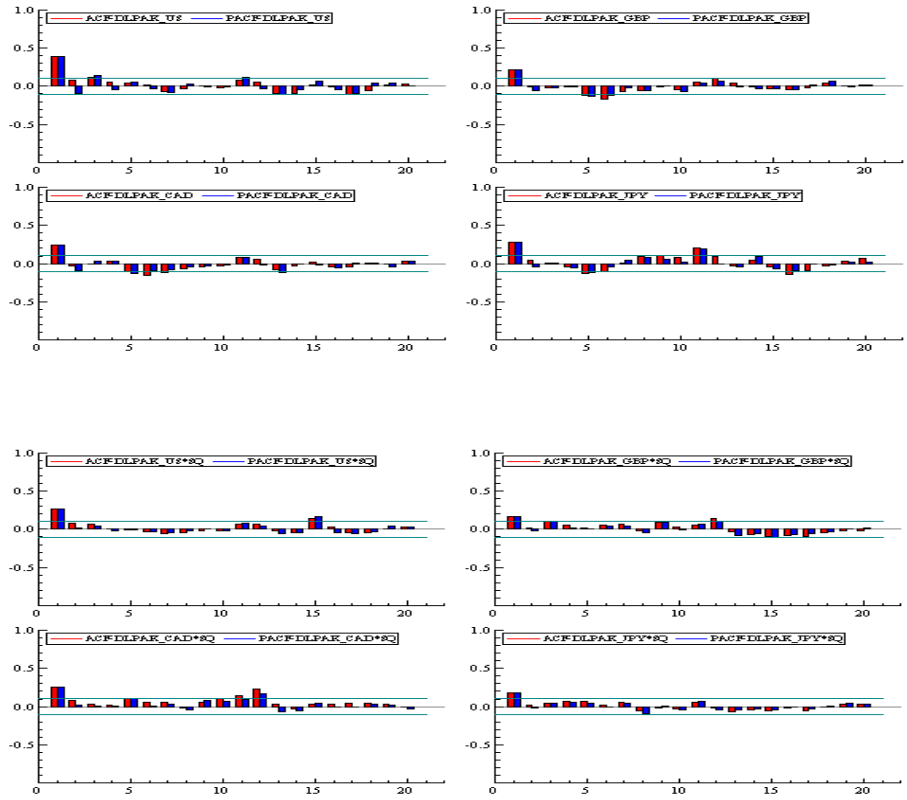
taken for the proxy of volatility. In Figure 1 plots of squared exchange rate returns are indicating variation in volatility.

Figure 1: Monthly Pak Rupee Exchange Rates , Returns and Squared Returns



In Figure 2, the plots of autocorrelation functions for monthly exchange rate returns and squared returns are given which show that autocorrelations are not persistent and die out very fast. In particular, they are insignificant after 1 lag exhibiting short memory process.

Figure 2: Autocorrelations and Partial Autocorrelations of Monthly Pak Rupee Exchange Rate Returns and Squared Returns



The Table 1 reports summary statistics for the monthly exchange rate returns series. The mean of monthly exchange returns are slightly positive as the exchange rates increase slightly overtime. The value of skewness is positive statistically significant in PKR-USD, PKR-GBP, PKR-CAD and PKR-JPY exchange rate returns which implies that depreciation are more probable in these exchange rates. The excess

kurtosis is statistically significant and positive for each of Pak Rupee exchange rates returns which indicate the monthly exchange rate returns are heavy tailed and have leptokurtic distribution. The Jarque-Bera test statistics are positive and statistically significant for each of Pak Rupee exchange rates returns showing non-normality in each of Pak Rupee exchange rates returns distributions.

In order to test the stationarity of time series Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test is employed. The KPSS test is used with constant term and with constant and trend terms. The results in table 1 show stationarity of all the variables in first difference form.

In order to test conditional heteroskedasticiy, Lagrange Multiplier test and the Ljung-Box test are employed on exchange rate return series (PKR_USD, PKR_GBP, PKR_AUD, PKR_CAD, PKR_JPY) from April, 1982 to June, 2012. The Table 1 represents the Ljung-Box–Pierce Q-statistics and Q^2-statistics of exchange rate return series and ARCH LM test. The Ljung-Box–Pierce Q-statistics Q(10) are highly significant, showing there is serial correlation in residuals and square residuals and $Q^2(10)$ statistics shows evidence of ARCH effect. The significant Ljung-Box–Pierce Q-statistics Q(10) also shows foreign exchange market information inefficiency as investors can earn excess profits by using historical information from purchasing and selling foreign currencies. The LM test shows strong evidence that the square residuals exhibit an ARCH effect. These results support for the estimation of a conditional heteroscedasticity model for Pak Rupee exchange rate returns.

Table 1: Summary Statistics and Diagnostic Checks of Monthly Pak Rupee Exchange Returns

	Monthly Pak Rupee Exchange Returns			
	PKR-USD	**PKR-GBP**	**PKR-CAD**	**PKR-JPY**
Mean	0.0057689	0.0054297	0.0062427	0.0088838
Max	0.081364	0.1087	0.07463	0.11199
Min	-0.02412	-0.10127	-0.069189	-0.07589
Std.Dev.	0.012787	0.026399	0.018705	0.02819
Skewness	2.5608	0.14890	0.52231	0.50135
Excess Kurtosis	8.6990	2.0515	1.7930	0.92556
J-B test statistic	1537.0**	64.819**	64.952**	28.086**
Observations	363	363	363	363
KPSS test statistic (with constant)	0.202707 (1)	0.088708 (1)	0.0549032 (1)	0.289753 (1)
KPSS test statistic (with constant and trend)	0.0922526 (1)	0.0529174 (1)	0.0359339 (1)	0.0773787 (1)
LM-ARCH 1-2	13.899 [0.0000]**	5.2107 [0.0059]**	11.856 [0.0000]**	6.0987 [0.0025]**
LM-ARCH 1-5	5.6488 [0.0001]**	2.8025 [0.0169]*	5.5792 [0.0001]**	2.8601 [0.0151]*
LM-ARCH 1-10	2.8750 [0.0019]**	1.8952 [0.0448]*	3.1914 [0.0006]**	2.0780 [0.0256]*
LB- Q(10)	67.9733 [0.0000000]**	36.0902 [0.0000812]**	41.9169 [0.0000078]**	49.1270 [0.0000004]**
LB- $Q(10)^2$	32.9390 [0.0002789]**	21.1475 [0.0200883]*	37.4668 [0.0000470]**	18.9717 [0.0406231]*

Note: *p* – values are in parentheses, ** indicates significant at 1% and * significant at 5%.

The evidences of non-stationarity, non- normal distribution and significant volatility clustering of exchange rate returns series imply the use of non-linear models to model volatility. Hence, GARCH models are estimated. The table 2, 3 & 4 presents estimated GARCH-M (1,1) , GARCH -M(2,1) and GJR- GARCH –M (1,1) results for PKR-USD, PKR-GBP, PKR-CAD and PKR-JPY exchange rates returns series.

For exchange rate returns ARMA (1, 0) specification is chosen to incorporate the serial correlation in returns series as supported by ACF and PACF plots in GARCH-M (1,1) and GJR- GARCH –M (1,1) models

for all exchange rates returns series as presented in table 2 & 4. The significant ARMA (1, 0) indicates that returns series shows prediction of exchange rates movements based on past information and suggests of market inefficiency.

The estimated parameters of GARCH-M (1,1) and GJR- GARCH-M (1,1) for Pak Rupee exchange rates series show ω is significant in PKR-USD and PKR-GBP exchange rates, α_1 is significant in all exchange rates except PKR-JPY exchange rates and β_1 is significant in all exchange rates except PKR-USD exchange rates in GJR- GARCH-M (1,1). The significance of α_1 shows the presence of volatility clustering. The insignificant α_1 indicates that the exchange rates do not react to past shocks and suggests that ARCH effects are not overwhelmingly strong. The significance of β_1 shows strong GARCH effect. The significance of both α_1 and β_1 indicates that lagged squared disturbance and lagged conditional variance have an impact on the conditional variance, indicating indicating that news about volatility from the previous periods have an explanatory power on current volatility. The positivity constraint ($\alpha_1 + \beta_1 \geq 0$) for the GARCH–M (1,1) is observed in all exchange rate series. The sum of estimated $\alpha_1 + \beta_1 < 1$which satisfy the stationarity constraint ($\alpha_1 + \beta_1 < 1$) in all exchange rate series. The estimated volatility persistence ($\alpha_1 + \beta_{1)}$ is very high and implies the shocks to volatility are very high. These results are in line with Siddiqui (2009a) and Kamal and Ghani (2012). The regularity condition ($\alpha_1 + \beta_1 + \gamma_1 / 2 < 1$) for GJR-GARCH (1,1)-M is satisfied as the sum of estimated $\alpha_1 + \beta_1 + \gamma_1 / 2 < 1$ in all exchange rate series. The estimated parameter γ_1 which captures the asymmetric effects is insignificant and negative in PKR-GBP, PKR-CAD and PKR-JPY exchange rates. This implies no leverage and asymmetric effects while the asymmetric effect is significant in PKR-USD exchange rates. Siddiqui (2009a) found asymmetric effects in PKR-GBP and PKR-CAD exchange rates and symmetric effects in and PKR-USD and PKR-JPY exchange rates. While Kamal and Ghani (2012) found asymmetric effect and leverage effect in PKR-USD exchange rates. The λ is positive and significant for PAK-USD exchange rates which reveals the principle of 'the higher the risk the higher the returns'. The significance of λ in

PKR-USD exchange rates is consistent with the findings of Siddiqui (2009a). The λ is insignificant for other three Pak Rupee exchange rates and is negative for PAK-CAD exchange rates. The insignificance of λ suggests that higher risk, proxied by the conditional variance, will not necessarily lead to higher returns. The insignificance of λ in PKR-GBP exchange rates is in line with Siddiqui (2009a). The negative sign of λ indicates different reaction of returns on arrival of "bad" and "good news" (Glosten, Jagannathan & Runkle ,1993)

In order to test how quickly the past information is incorporated by the current volatility, the lags of GARCH terms are added in the variance equation. In GARCH –M (2,1) model ARMA (1, 0) for PKR-USD and PKR-JPY exchange rates returns series, ARMA (2, 0) for PKR-GBP exchange rates returns series and ARMA (3, 0) PKR-CAD exchange rates returns series are chosen which shows again market inefficiency.

The table 3 presents estimated GARCH-M (2,1) results for PKR-USD, PKR-GBP, PKR-CAD and PKR-JPY exchange rates returns series. The estimated parameters of GARCH-M (2,1) shows ω is significant in PKR-USD and PKR-GBP exchange rates, α_1 is significant in all exchange rates except PKR-JPY exchange rates, β_2 of GARCH – M (2,1) for Pak Rupee exchange rates series is significant in all exchange rates except PAK-JPY exchange rates while β_1 is insignificant in all exchange rates. This indicates inefficiency of Pakistan exchange market which implies that exchange rates are not likely to quickly incorporate past information.

The diagnostic tests of GARCH-M (1,1) , GARCH -M(2,1) and GJR-GARCH –M (1,1) of point out that Jarque-Bera statistics still shows that the standardized residuals are not normally distributed. Moverover, the LM-ARCH test shows no ARCH effects. The Q(10) statistic for the standardized residuals indicates no sign of serial autocorrelation in exchange rates. The Q^2 (10) statistic for squared standardized residuals indicates no sign of serial autocorrelation in exchange rates.

Table 2: GARCH -M (1,1)

Parameter	**Monthly Pak Rupee Exchange Returns**			
	PKR-USD	**PKR-GBP**	**PKR– CAD**	**PKR– JPY**
Mean Equation				
c (constant)	-0.003808 (0.2165)	0.000237 (0.9774)	0.006928 (0.2707)	0.008120 (0.7194)
δ_1 (AR(1))	0.421254 (0.0000)**	0.208152 (0.0020)**	0.282354 (0.0000)**	0.270099 (0.0000)**
λ	0.870320 (0.0056)**	0.172844 (0.6254)	-0.030937 (0.9328)	0.012150 (0.9886)
Variance Equation				
ω(constant)	0.072372 (0.0000)**	1.431567 (0.0088)**	0.135858 (0.0863)	1.577539 (0.2972)
α_1ARCH-Co	0.160371 (0.0000)**	0.237402 (0.0013)**	0.079375 (0.0004)**	0.086226 (0.1931)
β_1 GARCH-Co	0.820077 (0.0000)**	0.568352 (0.0000)**	0.882227 (0.0000)**	0.697205 (0.0080)**
$\alpha + \beta$	0.98045	0.80575	0.96160	0.78343
AIC	-6.164424	-4.501606	-5.232332	-4.369739
SIC	-6.099252	-4.436434	-5.167160	-4.304567
Log likelihood	1106.350	809. 537	939.971	785.998
Skewness	2.9814	0.073009	0.53470	0.46125
Excess Kurtosis	15.160	0.74378	1.4998	0.35369
Jarque-Bera	3947.3	8.5460	50.471	14.520
LM-ARCH 1-2	1.0177 [0.3625]	0.19118 [0.8261]	0.93459 [0.3937]	0.36332 [0.6956]
LM-ARCH 1-5	0.59581 [0.7032]	0.24873 [0.9403]	0.72169 [0.6075]	0.49899 [0.7770]
LM-ARCH 1-10	0.37974 [0.9551]	0.25460 [0.9899]	0.86045 [0.5708]	0.96842 [0.4708]
LB- Q(10)	13.0575 [0.1600233]	10.5111 [0.3107165]	21.9460 [0.2869496]	10.7828 [0.2908900]
LB- $Q(10)^2$	4.54355 [0.8050609]	2.58071 [0.9578612]	9.81076 [0.2785604]	7.54176 [0.4794607]
RBD(10)	3.97382 [0.9485205]	3.01007 [0.9811860]	10.2805 [0.4162418]	3.51647 [0.9665360]

Note: *p* – values are in parentheses, ** indicates significant at 1% and * significant at 5%.

Table 3: GARCH -M (2,1)

Parameter	**Monthly Pak Rupee Exchange Returns**			
	PKR-USD	**PKR-GBP**	**PKR– CAD**	**PKR– JPY**
Mean Equation				
c (constant)	-0.003223 (0.3062)	-0.000770 (0.9194)	0.006074 (0.2447)	0.004294 (0.8292)
δ_1 (AR(1))	0.406241 (0.0000)**	0.235999 (0.0009)**	0.335256 (0.0000)**	0.261936 (0.0000)**
δ_2 (AR(2))		-0.084585 (0.1345)	-0.161915 (0.0019)**	
δ_3 (AR(3))			0.090120 (0.1707)	
λ	0.804070 (0.0089)**	0.241899 (0.4492	0.008124 (0.9792)	0.157479 (0.8339)
Variance Equation				
ω(constant)	0.105537 (0.0000)**	1.522508 (0.0413)**	0.129545 (0.1007)	2.052631 (0.2628)
α_1ARCH-Co	0.233150 (0.0000)**	0.245666 (0.0005)**	0.122508 (0.0001)**	0.115767 (0.1345)
β_1 GARCH-Co	0.136021 (0.1882)	0.147089 (0.3054)	0.185370 (0.4544)	0.267570 (0.5192)
β_2 GARCH-Co	0.591000 (0.0000)**	0.391821 (0.0145)*	0.659151 (0.0071)*	0.334892 (0.4452)
$\alpha + \beta$	0.96017	0.78458	0.96703	0.71823
AIC	-6.211715	-4.497830	-5.250709	-4.365343
SIC	-6.135681	-4.410934	-5.152951	-4.289309
Log likelihood	1115.791	810.863	946.252	786.214
Skewness	2.9499	0.12016	0.50317	0.45691
Excess Kurtosis	15.072	0.77764	1.3619	0.32929
Jarque-Bera	3896.7	9.8543	42.653	14.034
LM-ARCH 1-2	0.57528 [0.5631]	0.10020 [0.9047]	1.2030 [0.3015]	0.15382 [0.8575]
LM-ARCH 1-5	0.40808 [0.8431]	0.16662 [0.9747]	0.66921 [0.6471]	0.53733 [0.7480]
LM-ARCH 1-10	0.28458 [0.9844]	0.14435 [0.9991]	0.82332 [0.6064]	0.99931 [0.4437]
LB- Q(10)	12.9857 [0.1632528]	9.22833 [0.3234019]	6.40569 [0.4932558]	10.5659 [0.3066376]
LB- $Q(10)^2$	3.34206 [0.8516605]	1.73319 [0.9731235]	9.45517 [0.2216065]	7.52694 [0.3761465]
RBD(10)	2.89085 [0.9838773]	1.50185 [0.9989296]	14.9496 [0.1339106]	5.51858 [0.8539600]

Note: *p* – values are in parentheses, ** indicates significant at 1% and * significant at 5%.

Table 4: GJR- GARCH -M (1, 1)

Parameter	**Monthly Pak Rupee Exchange Returns**			
	PKR-USD	**PKR-GBP**	**PKR– CAD**	**PKR– JPY**
Mean Equation				
c (constant)	-0.000105 (0.9654)	0.000089 (0.9917)	0.008364 (0.2380)	0.008916 (0.6839)
δ_1 (AR(1))	0.357140 (0.0001)**	0.211838 (0.0012)**	0.301141 (0.0000)**	0.269864 (0.0001)**
λ	0.520617 (0.0145)*	0.208981 (0.5666)	-0.091121 (0.8277)	-0.001008 (0.9990)
Variance Equation				
ω(constant)	0.749745 (0.0000)**	1.546178 (0.0014)**	0.215280 (0.0294)*	1.626480 (0.1514)
α_1ARCH-Co	0.847332 (0.0000)**	0.363213 (0.0042)**	0.122650 (0.0022)**	0.134502 (0.1041)
β_1 GARCH-Co	0.004645 (0.9465)	0.529628 (0.0000)**	0.859950 (0.0000)**	0.695070 (0.0006)**
γ GJR-Co	-0.667435 (0.0014)**	-0.197307 (0.1239)	-0.100230 (0.1307)	-0.115913 (0.2124)
$\alpha + \beta + \gamma/2$	0.51826	0.794187	0.932485.	0.771615
AIC	-6.301553	-4.502403	-5.232449	-4.370896
SIC	-6.236381	-4.426369	-5.156415	-4.294862
Log likelihood	1133.681	810.679	940.992	787.205
Skewness	3.3883	0.013151	0.60496	0.40999
Excess Kurtosis	21.528	0.71637	1.5684	0.23482
Jarque-Bera	7576.9	7.6439	58.366	10.821
LM-ARCH 1-2	0.064738 [0.9373]	0.093040 [0.9112]	0.46086 [0.6311]	0.35522 [0.7013]
LM-ARCH 1-5	0.10504 [0.9911]	0.15918 [0.9771]	0.45061 [0.8128]	0.37813 [0.8637]
LM-ARCH 1-10	0.13580 [0.9993]	0.20086 [0.9961]	0.73094 [0.6952]	0.80139 [0.6275]
LB- Q(10)	10.0565 [0.3459268]	11.5052 [0.2426634]	12.8425 [0.1698657]	11.1489 [0.2656410]
LB- $Q(10)^2$	1.44951 [0.9935149]	1.90964 [0.9836577]	8.26587 [0.4079392]	6.48450 [0.5931271]
RBD(10)	1.55913 [0.9987391]	2.18570 [0.9947085]	8.54255 [0.5759957]	8.02237 [0.6266520]

Note: Note: *p* – values are in parentheses, ** indicates significant at 1% and * significant at 5%.

Stability

To check the stability of GARCH models Nyblom Test for parameter stability is applied. The Nyblom test for individual and joint parameter stability suggests there is no any statistically significant parameter instability in parameters of GARCH Models in all exchange rates.

Table 5: Nyblom Test for Parameter Stability

Parameters	GARCH (1,1)-M				GJR- GARCH (1,1)-M			
	PAK-USD	**PAK-GBP**	**PAK-CAD**	**PAK-JPY**	**PAK-USD**	**PAK-GBP**	**PAK-CAD**	**PAK-JPY**
Cst(M)	0.06910	0.05878	0.02654	0.24253	0.21595	0.07331	0.03843	0.24546
AR(1)	0.08925	0.04670	0.09920	0.06597	0.26958	0.03879	0.08668	0.08461
Cst(V)	0.07521	0.15662	0.46925	0.14364	0.09839	0.14760	0.55066	0.13712
ARCH(Alpha1)	0.06034	0.16134	0.24625	0.07581	0.11389	0.14768	0.30868	0.11987
GARCH(Beta1)	0.07781	0.21905	0.26194	0.11570	0.08753	0.18916	0.34080	0.11366
GJR(Gamma1)					0.14345	0.12185	0.25859	0.11977
ARCH-in-mean(std)	0.04430	0.04145	0.02339	0.22621	0.19207	0.05296	0.04304	0.24094
Joint Lc	1.9056	0.618407	1.756	1.02586	1.77489	0.636982	1.74597	1.02739
For individual statistics 1% and 5% critical values = 0.75 and 0.47 GARCH(1,1) For joint statistics 1% and 5 % critical values = 2.12 and 1.68 GJR- GARCH(1,1) For joint statistics 1% and 5 % critical values = 2.35 and 1.90								

5. Conclusion

This paper empirically investigates the volatility dynamics of Pak Rupee exchange rates and its effects on market efficiency through using GARCH models. The results show that Pak Rupee exchange rates are characterized by different dynamics of conditional volatility. These exchange rates depict high persistence in conditional volatility across GARCH models. There are no evidences of asymmetry and risk premium in Pak Rupee exchange rates except PKR-USD. Further, both GARCH models i-e GARCH –M (1,1) and GJR-GARCH-M(1,1), are

adequate in capturing the volatility dynamics in exchange rates evidenced by diagnostic tests and shows individual and joint parameter stability evidenced by Nyblom test. Therefore, GARCH models are appropriate in modelling Pak Rupee exchange rate volatility.

Moreover, results indicate inefficiency of Pakistan exchange market which implies that the past information is not quickly incorporated by the current volatility. The investors can earn excess profits by using historical information from purchasing and selling foreign currencies. The government authorities can reduce exchange rate volatility by influencing exchange rates.

References

Antonakakis, N. and Darb, J (2009). Forecasting Volatility in Developing Countries Nominal Exchange Returns. MPRA Paper from University Library of Munich, Germany.

Ahmed, K., Ashraf, S. and Ahmed, S. (2005). Efficiency of Foreign Exchange Markets: Evidence from South Asian Countries . *Indian Journal of Economics,* 88, 3, 1–33.

Baillie, R., Bollerslev, T. and Mikkelsen, H. (1996). Fractionally Integrated Generalized Autoregressive Conditional Heteroskedasticity. *Journal of Econometrics,* 74, 3-30.

Baillie, R. and Bollerslev, T. (1989). Common Stochastic Trends in a System of Exchange Rates. *Journal of Finance,* 44, 167-181.

Balaban, E., (2004). Comparative Forecasting Performance of Symmetric and Asymmetric Conditional Volatility Models of an Exchange Rate. *Economics Letters,* 83, 99-105

Benita, G. and Lauterbach, B. (2007). Policy Factors and Exchange-Rate Volatility: Panel Data versus a Specific Country Analysis. *International Research Journal of Finance and Economics*, 7, 7-23.

Black, F. (1976). Studies of Stock Price Volatility Changes. *Proceedings of the American Statistical Association*, Business and Economic Statistics Section, 177-181.

Bollerslev, T. (1986). Generalized Autoregressive Conditional Heteroskedasticity. *Journal of Econometrics,* 31, 3, 307-327.

Bollerslev, T. (1987). A Conditional Heteroskedastic Time Series Model for Speculative Prices And Rates Of Return", *Review of Economics and Statistics*, 69, 542-547.

Bollerslev, T. (1990). Modelling the Coherence in Short-Run Nominal Exchange Rates: A multivariate generalized ARCH model. *The Review of Economics and Statistics,* 498-504.

Bollerslev, T. and Mikkelsen, O. (1996). Modeling and Pricing Long Memory in Stock Market Volatility. *Journal of Econometrics,* 73, 151-184.

Brooks, C. and Burke, S. (1998). Forecasting Exchange Rate Volatility using Conditional Variance Models selected by Information Criteria. *Economics Letters,* 61, 273-278.

Chakrabarti, R. (2005). Foreign Exchange Markets in India. *Indian School of Business Working Paper Series*

Cheung, Y. and Wong, C. (1997). The Performance of Trading Rules on Four Asian Currency Exchange Rates. *Multinational Finance Journal,* 1, 1, 1-22.

Chong, Chun and Ahmad (2002). Modelling the Volatility of Currency Exchange Rate Using GARCH Model. *Pertanika J. Soc. Sci. & Hum,* 10, 2 , 85-95

Choo, W., Ahmad, M. and Abdullah M. (1999). Performance Of GARCH Models in Forecasting Stock Market Volatility. *Journal of Forecasting,* 18: 333-343.

Copeland, L. and Wang, P. (1994). Estimating Daily Seasonality In Foreign Exchange Rate Changes. *Journal of Forecasting,* 13, 6, 519-528.

Diebold, F. (1988). Empirical Modeling of Exchange Rate Dynamics. New York: Springer-Verlag.

Diebold, F. and Nerlove, M. (1989). The Dynamics of Exchange Rate Volatility: A Multivariate Latent Variable Factor ARCH Model. *Journal of Applied Econometrics,* 4, 1, 1-21.

Domowitz, I. and Hakio , S. (1985). Conditional Variance and the Risk Premium in the Foreign Exchange Market. *Journal of International Economics* 19, 47–66.

Duan, J. and Jaso, Z. (1999). Pricing foreign currency and cross-currency options under GARCH. *The Journal of Derivatives.* (Fall).

Engle, R. (1982). Autoregressive Conditional Heteroskedasticity with Estimates of U.K. Inflation. *Econommetrica*, 50, 4, 987-1007.

Engle, R. and Bollerslev, T. (1986). Modelling the Persistence of Conditional Variances. *Econometric Reviews,* 5, 1, 1-50.

Engle R. (1990). Discussion on Schwert (1990). *Review of Financial Studies*, 3,193-106

Engle, R., Lilien, D. and Robins. R. (1987). Estimating Time Varying Risk Premia in the Term Structure: The ARCH-M Model. *Econometrica,* 55, 391– 407.

Engle, R. and Ng, V. (1993). Measuring and Testing the Impact of News on Volatility. *Journal of Finance,* 48, 5, 1749-1778.

Episcopes, A. and Davies, J. (1995). Predicting Returns on Canadian Exchange Rates with Artificial Neural Networks And Egarch-M Models", *Neural Computing and opplications.*

Fama, E. (1965). The Behaviour of Stock Price. *Journal of Business*, 37, 34-105.

Fama, E. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *Journal of Finance*, 25, 2, 387-417.

Fama, E. and Roll, R. (1971). Parameter Estimates for Symmetric Stable Distributions. *Journal of the American Statistical Association*, 66, 334, 331-38.

Fidrmuc, J. and Horvath, R. (2007). Volatility of Exchange Rates in Selected New EU Members: Evidence from Daily Data. *CESifo Working Paper* No.2107.

Franses, P. and Van Dijk, D. (2000). Non-Linear Time Series Models in Empirical Finance", Cambridge, UK: Cambridge University Press.

Frjedman, D. and Vandersteel, S.(1982). Short-Run Fluctuations in Foreign Exchange Rates : Evidence from the Data 1973 – 1979. *Journal of International Eonomics* ,13, 171-186.

French, K., Schwert , G. and Stambaugh, R. (1987). Expected Stock Returns and Volatility. *Journal of Financial Economics*, 19, 3-30.

Glosten L., Jagannathan R. and Runkle D. (1993). Relationship between the Expected Value and Volatility of the Nominal Excess Returns on Stocks. *Journal of Finance,* 48, 1779-802.

Hakio, C. (1981). Expectations and the Forward Exchange Rate. *International Economic Review* 22, 663–678

Hideki, I. (2006). An Empirical Test of the Efficiency Hypothesis on the Renminbi NDF in Hong Kong Market. (Kobe University Discussion Papers, No. 196).

Hodrick, R. J. and S. Srivastava (1986). The Covariance of Risk Premiums and Expected Future Spot Exchange Rates. *Journal of International Money and Finance* 5, 5–21.

Hopper, G. (1997). What determines the Exchange Rate: Economics Factors or Market Sentiment? *Business Review*, Federal Reserve Bank of Philadelphia, 17-29.

Hsieh, D. (1988). The Statistical Properties of Daily Foreign Exchange Rates: 1974-1983. *Journal of International Economics,* 24, 129-145.

Hsieh, D. (1989a). Modeling Heteroskedasticity in Daily Foreign-Exchange Rates. *Journal of Business and Economic Statistics 7*, 307-317.

Hsieh, D. (1989b). Testing for Non-Linear Dependence in Daily Foreign Exchange Rates. *Journal of Business,* 62, 339-368.

Kamal, Y., Haq, H., Ghani, U., and Khan, M. (2012). Modelling the Exchange Rate Volatility, using Generalized Autoregressive Conditionally Heteroscedastic (GARCH) Type Models: Evidence from Pakistan. *African Journal of Business Management*, *6*, 8, 2830-2838.

Kar and Sarkar (2006). Mean and Volatility Dynamics of Indian Rupee/US Dollar Exchange Rate Series: An Empirical Investigation. *Journal of Asia-Pacific Financial Markets,* 13, 1, 41-69.

Kimani, S. (2007). Efficiency of Foreign Exchange Market in Kenya: The Rational Expectation Approach. Unpublished MBA dissertation, University of Nairobi.

Laopodis, N. (1997). U.S. Dollar Asymmetry and Exchange Rate Volatility. *Journal of Applied Business Research* , 13, 2, 1-8.

Lau, A., Lau H. and Wingender J. (1990). The Distribution of Stock Returns: New Evidence against the Stable Model. *Journal of Business and Economic Statistics, 8,* 217-223.

Lobo, B. and Tuite, D. (1998). Exchange Rate Volatility: Does Politics Matter? *Journal of Macroeconomics,* 20, 2, 351-365.

Longmore , R. and Robinson, W. (2004). Modelling and Forecasting Exchange Rate Dynamics: An Application of Asymmetric Volatility Models. Bank of Jamaica. Working Paper WP2004/03.

Mandelbrot, B. (1997). The Variation of Certain Speculative Prices. in Malliaris, A. G. e. (Ed), Futures Markets, 2.

Medhora, R. (1990). The Effect of Exchange Rate Variability on Trade: The Case of the West African Monetary Union's Imports World Development. 18, 2, 313-24.

Mandelbrot, B. (1963a). New Methods in Statistical Economics. *Journal of Political Economy,* 71, 421-440.

Mandelbrot, B. (1963b). The variation of certain speculative prices. *Journal of Business* 26, 394-419.

Mandelbrot, B. (1967). The variation of some other speculative prices. *Journal of Business,* 40, 393-413.

Nath, G. (2006). Market Efficiency and Volatility in Indian FX Market. *The IUP Journal of Applied Finance* 24:1, 13–25.

Noman, A., and Ahmed, U. (2008). Efficiency of the Foreign Exchange Markets in South Asian Countries. (AIUB Bus Econ Working Paper Series, 2008–18

Nelson D. (1991).Conditional heteroskedasticity in Asset Returns: a New Approach. *Econometrica*, 59, 347-70.

Olowe (2009). Modelling Naira/Dollar Exchange Rate Volatility: Application of GARCH and Assymetric Models. *International Review of Business Research Papers*, 5, 3, 377- 398.

Pesaran, B. and Robinson, G. (1993). The European Exchange Rate Mechanism and the Volatility of the Sterling-Deutschmark Exchange Rate. *Economic Journal*, 103, 1418-1431.

Rose, N., Kisaka, E., Ganesh, P. and Gituro, W. (2008) .An Analysis of the Efficiency the Foreign Exchange Market in Kenya. *Economics Bulletin* 14,2,1–13.

Siddiqui (2009a). Modelling Pak Rupee Volatility against Five Major Currencies in the Perspective of Different Exchange Rate Regimes. *European Journal of Economics, Finance and Administrative Sciences*, 17, 81-96.

Siddiqui (2009b), Statistical Irrelevance of Kibor to the Volatility of Pakistani Exchange Rate Market: A Case of Five Major Currencies. *Middle Eastern Finance and Economics*, 4, 65-81.

Takezawa, N. (1995).A Note on Intraday Foreign Exchange Volatility and the Informational Role of Quote Arrivals. *Economics Letters* 48, 399-404.

West, D. and Cho, D. (1995). The Predictive Ability of Several Models of Exchange Rate Volatility. *Journal of Econometrics*, 69, 367-391.

Wickremasinghe, G. (2004). Efficiency of Foreign Exchange Markets: A Developing Country Perspective. (ABERU Discussion Paper 3)

Yoon, S. and Lee, S. (2008). The Volatility and Asymmetry of Won/Dollar Exchange Rate." *Journal of Social Sciences*, 4, 1, 7-9.

Zahid, F., Ramzan, S., and Ramzan, S. (2012). Modeling and Forecasting Exchange Rate Dynamics in Pakistan using Arch Family of Models. *Electronic Journal of Applied Statistical Analysis*, 5, 1, 15-29

Zakaria, S. (2012). Modelling Exchange Rate Volatility using GARCH Models: Empirical Evidence from Arab Countries. *International Journal of Economics and Finance*, 4, 3, 216-226.

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Relationship between Remittances, Exports, Foreign Direct Investments and Growth in South Asia: A Panel Cointegration and Causality Analysis

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The relationship among remittances, Foreign Direct Investments (FDI), exports and economic growth is known to have important role in economic literature for countries suffering from technological distress and unemployment problems. This paper explores the long and short run relationship between remittances, exports, foreign direct investment and economic growth using data of South Asian countries. The study covers the period from 1988 to 2011. Stationarity of the variables have been examined through both first and second generation panel unit root tests to cater for cross-section dependence. After confirmation of panel cointegration, long term coefficients have been estimated by Fully Modified OLS (FMOLS) and Dynamic Ordinary Least Square (DOLS) models. Pooled Mean Group (PMG) methodology is applied to examine the cause and effect relation among the associated variables. Results suggest presence of cointegration among the tested variables. FMOLS and DOLS estimation analysis reveal positive impact of capital, remittances, exports, and FDI on economic growth whereas a negative impact of labor on growth is observed. The causality analysis confirms the presence of long term equilibrium relation among economic growth, labor, capital, remittances, exports, and foreign direct. In short run, exports Granger cause growth and FDI Granger cause exports. Feedback causality is also confirmed between remittances and capital in the South Asian countries.

1. Introduction

Every economy strives to achieve the higher level of economic growth. There are many macroeconomic factors that contribute towards the

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economic growth of a country and they have also received much attention in the literature. Workers' remittances, exports expansion, and FDI are few among others. Workers' remittances and net FDI inflows emerged as important components for the purpose of external financing for developing countries (World Bank, 2009). FDI as a net inflow of investment presents a way to acquire management interest in an enterprise of any economy. This management interest is usually of lasting nature (voting stocks of 10 percent or more). FDI stimulates economic growth primarily through work force and knowledge/technological transfer effect as growing number of literature proves the positive impact of FDI on the economic growth of the host countries. For instance, see Rao and Hassan (2011), Cooray (2012), Azam et al., (2013), Imai et al., (2014), Hassan et al., (2014), Shakar and Aslam (2015).

The second largest source of foreign funding is remittance. Remittances of foreign employed workers or migrants are the current transfers as these migrants have intentions to remain employed for more than one year and are considered residents of the that economy (WDI, 2014). The remittances-growth literature is divided into two schools of thought. One school of thought supports the positive impact of remittances on the economic growth i.e. Catrinescu et al., (2009), Marwan et al., (2013), Azam et al., (2013), Kumar and Stauvermann (2014), etc. However the other school of thought argues that remittances either have a negative influence on the economic growth of a host country or there is no relationship. Rao and Hassan (2011) selected a sample of 40 countries having remittances to GDP ratio of one percent or more and found that remittances did not have any significant direct impact on growth of these countries. Moreover, Rao and Takirua (2010) found the negative impact of remittances on growth for Kiribati. The negative effects are attributed to the Dutch Disease effect and decrease in the quality of governance being carried out in the host country.

This study focuses on exploring the impact of workers' remittances and FDI along with exports and the two basic conditioning variables, capital (K) and labor (L), on the economic growth of South Asian countries. Export is one of the major determinants of the economic growth. Literature provides mixed/ambiguous result on its impact on economic growth. Some studies support that exports lead to higher economic growth; for example, Rao and Takirua (2010), Marwan et al. (2013),

Ullah et al. (2009), Aditya and Acharyya (2012). Others do not support the export-led growth hypothesis (see, for example, Mah (2005) and Pazim (2009)). Bilquees and Mukhtar (2012) argue that exports instability has a potential impact on economic growth in case of Pakistan. The present study empirically analyze the relationship between economic growth, FDI, workers' remittances and exports using Solow model (1956) and its extended version for South Asian countries. It is relatively unexplored area for the South Asian countries including Bangladesh, India, Pakistan, Sri Lanka and Nepal. This paper uses the extension of Solow model used by Mankiw *et al.* (1992) in which the Cobb–Douglas production function as a basic neoclassical model is amplified with the help of the shift variables. Summaries of the previous empirical work conducted on international and country specific level is provided in Table 1.

Table 1: Summaries of main International, Country Specific and Asian Studies

Year	**Country/ Sample**	**Period**	**Methodology**	**Cointegration/ Causality Results**
International (Panel)				
Driffield and Jones (2013)	Entire sample of developing countries available at WDI	1984-2007	Dynamic GMM	FDI and RE have +ve impact on EG.
Tekin (2012)	18 least developed countries	1970-2009	Panel data SUR (seemingly unrelated regression) systems proposed by Konya (2006)	EX impact GDP (few countries) GDP impacts EX (few countries) FDI impacts GDP FDI has no impact on real EX (few countries)
Rao and Hassan (2011)	40 Countries. (Having remittances to GDP ratio of 1% and above.)	1960-2007	System GMM	FDI has +ve impact on EG.
Azman-Saini *et al.* (2010)	85 countries	1976-2004	GMM	FDI itself has no impact on output growth but through economic Freedom.

Year	Country/ Sample	Period	Methodology	Cointegration/ Causality Results
International (Panel) Cont'd				
Catrinescu (2009)	162 countries. (Remittances' model) 102 countries (Institution model)	1970-2003 1991-2003	AH, GMM	RE have +ve impact on GDP in presence of sound institutional environment.
Adams (2009)	Sub-Sahara African countries	1990-2003	OLS, FEM	FDI has +ve impact on EG. (only in OLS)
Le (2009)	67 countries	1970-2000	OLS, GMM	TO positively impacts EG through institutions. RE not a stable source of capital and thus may hamper EG
Fayissa & Nsiah (2008)	37 African countries	1980-2004	FEM, REM	RE boosts EG in countries where financial systems are less developed.
Herzer *et al.* (2008)	28 Developing countries	1970-2003	Engle-Granger, ECM, Johanson approach, Gregory-hansen approach	No LR and SR between FDI and EG.
Hansen & Rand (2006)	31 developing countries	1970-2000	GC (VAR framework) MGE (Mean group estimator)	FDI has +ve impact on EG.
Borensztein *et al.* (1998)	69 developing countries	1970-1990	System equations	FDI have a positive impact on growth

Year	Country/ Sample	Period	Methodology	Cointegration/ Causality Results
Country Specific Studies				
Kumar & Stauvermann (2014)	Lithuania	1980-2012	ARDL, TY-GC	RE have +ve LR and SR with GDP RE → GDP Capital per worker ↔ output per worker.
Marwan *et al.* (2013)	Sudan	1977-2010	Johansen Cointegration technique, TY-GC	RE, EX, TO have +ve LR with GDP RE, EX, TO ─ ─ GDPPC
Rao and Takirua (2010)	Kiribati	1970-2005	Hendry's general to specific approach (GETS), Johansen's maximum-likelihood VECM	EX has +ve SR with GDPPC RE has –ve LR with GDPPC
Asian Studies				
Imai *et al*. (2014)	24 Asian countries	1980-2009	GMM	FDI and RE have +ve impact on EG.
Azam *et al.* (2013)	5 South and South East Asian countries	1985-2011	FEM, REM	FDI and RE have +ve impact on EG. Corruption has negative impact on EG.
Cooray (2012)	6 South Asian Countries	1970-2008	GMM	RE, FDI and EX have +ve impact on EG.
Siddique *et al.* (2012)	Bangladesh, India, Sri-Lanka	1977-2006	GC (VAR framework)	RE impact EG (Bangladesh) RE has no impact on EG (India) RE ↔ EG (Sri-Lanka)
Hsiao & Hsiao (2006)	Newly developed Asian countries	1986-2004	Johansen Cointegration, FEM, REM, TY-GC	FDI impacts EG indirectly through EX.

Notes:←, and → indicate unidirectional, ↔ bidirectional and no causality, respectively.
Abbreviations are defined as follows: AH= Anderson–Hsiao estimator; ARDL=autoregressive distributed lagged; RE= Remittances; ECM=error correction model; EX=export; EG=Economic growth; FEM=Fixed effect model; FDI= Foreign Direct Investment; GDP=Real gross domestic product; GDPPC=GDP per capita; GMM=generalized method of moments; GC=granger causality; LR= long run relation; OLS= ordinary least square method; REM=random effect model; SR= short run relation. TY= Toda-Yamamoto; TO=trade openness; VAR= vector autoregressive model; VECM=vector error correction model.

There are three types of empirical limitations that are worth considering in the light of the past studies. First, there are few studies focusing on the causal relationship among export, remittances, FDI and economic growth in the South Asian countries. Second, the literature indicates the presence of cross section dependence in a panel setting due to unobserved common factors, macro-economic and regional linkages, externalities and unaccounted residual interdependence. Besides its importance, no study has discussed the implications of cross sectional dependence. Similarly, the issues of heterogeneous co-integrated panels are un-dealt. To deal with the problems associated with co-integration tests in small sample sizes and lower power of unit root tests, methods introducing new panel data techniques within panel settings are preferred over the traditional and usual time series techniques. Along with using the time dimension, addition of cross sectional dimensions play an important role in increasing the power of these tests regarding the non-stationary time series. According to Baltagi and Kao (2000), the purpose of the application of non-stationary panel data aims to combine the both worlds, one being the dealing with non-stationary time series and the other being the power and increased data from cross section. To sum up, there is very limited literature on the relationship between remittances, exports, FDI, and economic growth in South Asia; however, the available empirical work either provides mixed results or there is no consensus on the direction of causality between the selected variables.

2. The Model

Mankiw et al., (1992) extension of basic Solow growth model (1956) where the neoclassical Cobb-Douglas production function has been augmented with shift variables is used in this empirical study. Thus, the basic production function with constant returns and Hicks- neutral technical progress, following Rao and Takirua (2006) is:

$$y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \qquad [1]$$

Where, A_t present technology, K denotes capital, L is labor, and t is time. The Solow growth model assumes the technological evolution as:

$$A_t = A_0 e^{g^T} \qquad [2]$$

Where, the initial knowledge stock is denoted by A_0. It is further assumed that:

$$A_t = f(R_t, X_t, F_t) \quad [3]$$

Where, R is remittance, X is exports, and F is foreign direct investment. The Rearrangement of equation (1) and (3) results:

$$y_t = (R_t, X_t, F_t) K_t^{\alpha} L_t^{1-\alpha} \quad [4]$$

3. Data, Methodology and Discussion

3.1. Data

We have taken five South East Asian countries including Bangladesh, Pakistan, India, Nepal and Srilanka. Panel data of annual frequency is used where, Growth (G) is measured by GDP per capita (constant US$) and real Gross fixed capital formation (K) is a proxy for capital. Following Kumar (2011), labor (L) is proxied by using average employment rate as a percentage of annual population ages >15, workers' remittance (R) inflows percentage of GDP (%), Exports (X) of goods and services as a percentage of GDP, and inflows of FDI also as a percentage of GDP is used from 1988-2011. Data source is the World Development Indicators of World Bank. We have made selection of the countries and time period according to the availability of secondary data.

Table 2: Variables and Symbols

S. No.	Variables Used	Variable Symbol
1.	GDP per capita (constant US$)	*G*
2.	Gross fixed capital formation (% of GDP)	*K*
3.	Employment to population ratio, ages 15-24, total (%) (modeled ILO estimate)	*L*
4.	Workers' remittances (% of GDP)	*R*
5.	Exports of goods and services (% of GDP)	*X*
6.	Foreign direct investment (FDI), net inflows (% of GDP)	*F*

Table 3 presents descriptive statistics for the sample covering period 1988 to 2011. Exports as a percentage of GDP (18.12%) are higher than both remittances (5.68%) and foreign direct investment (0.83&). However, exports also show higher variability (8.13%) when compared with remittances (4.90%) and FDI (0.764). On the other hand, Remittances to South Asian countries are five times higher than the FDI.

Table 3: Descriptive Statistics of Variables (1988–2013)

	G	K	L	R	X	F
Mean	618.157	21.799	48.479	5.679	18.129	0.832
Std. Dev.	347.340	4.424	16.389	4.906	8.135	0.764
Maximum	1724.826	32.918	79.500	23.220	39.015	3.668
Minimum	228.575	12.514	24.100	0.730	5.747	-0.098

The relationship between economic growth, capital, labor, remittances, exports, and foreign direct investment is analyzed in a three stage process in this paper. Initially, an assessment on the order of integration is made for the variables. Then, two panel cointegration tests are applied to analyze the presence of a long-run relationship among the variables. Then, the long-run coefficients are estimated using FMOLS and DOLS models. Finally, Pooled Mean Group (PMG) approach developed by Pesaran et al. (1999) is used to establish the long-run and short-run relationship between the variables. Same is used to ascertain the direction of causality among economic growth, capital, labor, remittances, exports, and foreign direct investment in South Asian countries.

3.2. Panel Unit Root Tests

The selection of appropriate cointegration technique depends on the order of integration of all variables. Considering the relative advantage i.e. less restrictive and more powerful over previous tests developed by Breitung (2000), Levin and Lin (1993), and Levin et al. (2002), Im et al. (2003, hereinafter IPS) panel unit root test is used. These former tests do not deal with heterogeneity of the autoregressive coefficient. IPS test first applies the Augmented Dickey Fuller (ADF) test to each series thus it allows individual series to have its own short-run dynamics. Then the

arithmetical mean of all individual countries' ADF statistics is used as the overall t-test statistics. This dynamic panel framework may resolve the serial correlation problems of Levin and Lin's. The panel unit root equation for IPS is as under:

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{p} \emptyset_{ij} \Delta y_{i,t-j} + \varepsilon_{i,t}\,; \qquad i = 1,2, N; t = 1,2, \ldots . T, \quad [5]$$

Where y_{it} represents the variables under analysis in our Augmented Solow Model (ASM), α_i denotes individual fixed effect, and to make residual uncorrelated overtime, ρ is added in above equation. The null hypothesis is that $\rho_i = 0$ for all i while the alternative hypothesis is that $\rho_i < 0$ for some $i = 1, \ldots , N_1$, and $\rho_i = 0$ for $i = N_1 + 1, \ldots , N$. After the ADF regression, the model also includes various augmented lags for individual country with infinite samples. The terms E(t_i) and var(t_i) are then replaced with the corresponding group averages of the tabulated values of E(t_i, P_i) and var(t_i, P_i), respectively. The IPS statistic which is an average of individual Augmented Dickey–Fuller (ADF) statistic can be written as under:

$$\bar{t} = \frac{1}{N} \sum_{i=1}^{N} t_{iT}\ (P_i), \quad [6]$$

Where, t_{iT} presents the country specific ADF t-statistic obtained from the country "*i*" ADF regression. The t-statistic is normally distributed under H_0 and Im et al. (2003) have provided the critical values for specified values of N and T. The results of IPS (2003) shows the panel unit root tests with and without trend in table 4. All of the included variables are non-stationary at level and therefore made stationary at first difference with 1 percent significance level.

The panel unit root tests can be divided into two groups based on their nature to cater for cross sectional dependence. First generation unit root test e.g. IPS-2003, assumes that the cross sections in the panel data are independent. On the other hand, second generation panel data unit root

tests allows to cater more general forms of cross sectional dependency which are not limited to common time effects (Pesaran 2007).

Table 4: Results of IPS-2003 panel unit root test.

Variables	Level		1st difference	
	Constant	Constant with trend	Constant	Constant with trend
G	4.433	1.039	-2.890***	-2.182**
K	-0.853	-0.683	-6.462***	-5.032***
L	2.050	0.874	-7.347***	-6.063***
R	2.071	-0.229	-6.589***	-5.480***
X	1.419	-0.707	-7.134***	-5.706***
F	-1.657	-2.091	-8.764***	-6.337****

Note: ***' ** indicates the rejection of null hypothesis of non-stationary at the 1% and 5% level of significance, respectively.

To test the cross sectional dependence, we have calculated the cross sectional dependence (CD) statistics through the application of simple test of Pesaran (2004). First, the individual OLS residuals are obtained through standard ADF regressions. Then average values of the pair-wise correlation coefficients are calculated. The null hypothesis of cross-sectional independence is finally tested where the two-tailed normal distribution is assumed to be asymptotically distributed. The literature indicates that there are some unobserved externalities, unaccounted residual interdependence, common factors and macroeconomic linkages that give rise to cross section dependence within a panel. The Rejection of the null hypothesis irrespective of the lags (up to five) in ADF auxiliary regression at 5 percent significance level indicates the presence of cross sectional dependence in our panel. The high cross sectional correlation exits among the selected countries of South Asia and thereby we can conclude that this may have resulted due to similar regulation present in fields like economy, trade, tourism, administration, finance, customs and legislation along with the increasing level of financial integration.

Table 5: Results of cross-sectional dependence test.

Test	Statistics
Pesaran's test of cross sectional independence	2.188**

Note: ** indicates rejection of null hypothesis of cross sectional independence at the 5% level of significance.

Recently the question of correlation and dependence has been addressed by some new panel unit root statistics given the presence of macro-economic dynamics and linkages within the variables. These tests are commonly known as second generation panel unit root tests and the most common of which is the CIPS (Cross Sectionally Augmented Test IPS test). Pesaran (2007) developed a panel unit root test that assumes dependence between the cross sections. The test estimates the OLS method for the ith cross-section in the panel by considering the following Cross-Sectional ADF (CADF) regression. The resulting mathematical equation is presented below.

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + c_i \bar{y}_{i,t-1} + \sum_{j=0}^{k} d_{t-j} \Delta \bar{y}_{t-j} + \varepsilon_{i,t} + \sum_{j=1}^{k} \delta_{ij} \Delta y_{i,t-j} + \varepsilon_{i,t}, \quad [7]$$

In the above expression, $\bar{y}_{i,t-1} = (1/N) \sum_{i=1}^{N} y_{i,t-1}$ and $t_i(N,T)$ represents t-statistic of ρ_i that is used for the computation of individual Augmented Dickey Fuller statistic. Following CIPS statistic was proposed by Pesaran based on individual CADF average statistic.

$$CIPS = \left(\frac{1}{N}\right) \sum_{i=1}^{N} t_i\,(N,T), \quad [8]$$

Pesaran (2007) has tabulated the critical values for CIPS for various deterministic terms. The expression given below presents the panel unit root test with and without the presence of trend. For all of the included variables, null hypothesis cannot be rejected at level and therefore

implying the non-stationarity of all these variables at one and five percent significance level. We can conclude that all of the included series are stationary at first difference and non-stationary at level even if the cross sectional dependence is present or not.

Table 6: Results of Pesaran-2007 CIPS panel unit root test.

Variables	Level		1st difference	
	Constant	Constant with trend	Constant	Constant with trend
G	-1.734	-1.588	-2.402**	-3.047**
K	-1.594	-1.659	-3.046***	-3.023**
L	-1.046	-1.493	-2.304**	-2.622**
R	-1.416	-2.821	-3.302***	-3.360***
X	-0.112	-2.236	-2.832***	-2.743**
F	-2.277	-2.405	-3.622***	-3.543***

Note: ***' ** Rejection of null hypothesis of non-stationary at the 1% and 5% level of significance, respectively.

3.3. Co-integration Tests on Panel Data

We have applied Pedroni's (1994) co-integration test after the identification of lag orders. This heterogeneous panel co-integration test like IPS test allows the cross sectional interdependence along with the individual effects of different nature. Following equation represents the Pedroni's co-integration test:

$$G_{it} = \eta_i + \delta_i t + \beta_{1i}\mathrm{K}_{i,t-1} + \beta_{2i}\mathrm{L}_{i,t-1} + \beta_{3i}\mathrm{R}_{i,t-1} + \beta_{4i}\mathrm{X}_{i,t-1} + \beta_{5i}\mathrm{F}_{i,t-1} + \varepsilon_{it}, \quad [9]$$

Where $t = 1, \ldots\ldots, T$ shows the time period and $i = 1, \ldots\ldots, N$ shows the number of countries. η_i and δ_i are the effects of country and time fixed effects. ε_{it} represents the residual that are estimated showing deviations from long term relation. The estimated residuals are represented in the following equation.

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + \mu_{it}, \quad [10]$$

To test co-integration on panel data, seven different statistics were proposed by Pedroni out of which four have pooling basis commonly referred to as "within" dimension whereas the last three are based on "between" dimensions.

Panel v-statistics:

$$X_v \equiv T^2 N^{3/2} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{k}^{-2}{}_{11,i} \, \hat{\mu}^2{}_{it-1} \right)^{-1}$$

Panel ρ-statistics:

$$X_p \equiv T\sqrt{N} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{k}^{-2}{}_{11,i} \, \hat{\mu}^2{}_{it-1} \right)^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{k}^{-2}{}_{11,i} \left(\hat{\mu}_{it-1} \Delta \hat{\mu}_{it} - \hat{\lambda}_{it} \right)$$

Panel t-statistics (non-parametric):

$$X_t \equiv \left(\hat{\sigma}^2 \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{k}^{-2}{}_{11,i} \, \hat{\mu}^2{}_{it-1} \right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{k}^{-2}{}_{11,i} \left(\hat{\mu}_{it-1} \Delta \hat{\mu}_{it} - \hat{\lambda}_{it} \right)$$

Panel t-statistics (parametric):

$$X^*{}_t \equiv \left(\widehat{S_{N,T}}^{*2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{k}^{-2}{}_{11,i} \, \hat{\mu}^2{}_{it-1} \right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{k}^{-2}{}_{11,i} \left(\hat{\mu}_{it-1} \Delta \widehat{\mu^*}_{it} \right)$$

Group ρ -statistics:

$$\tilde{X}_p \equiv T N^{-1/2} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{\mu}^2{}_{it-1} \right)^{-1} \sum_{t=1}^{T} \left(\hat{\mu}_{it-1} \Delta \hat{\mu}_{it} - \hat{\lambda}_{it} \right)$$

Group t-statistics (non-parametric):

$$\tilde{X}_t \equiv N^{-1/2} \sum_{i=1}^{N} \left(\hat{\sigma}_i^2 \sum_{t=1}^{T} \hat{\mu}^2{}_{it-1} \right)^{-1/2} \sum_{t=1}^{T} \left(\hat{\mu}_{it-1} \Delta \hat{\mu}_{it} - \hat{\lambda}_{it} \right)$$

Group t-statistics (parametric):

$$\tilde{X}^*_t \equiv N^{-1/2} \sum_{i=1}^{N} (\tilde{S}^{*2} \hat{\mu}^{2*}_{it-1})^{-1/2} \sum_{i=1}^{N} (\hat{\mu}^*_{it-1} \Delta \hat{\mu}^*_{it})$$

Where $\hat{\lambda}_i = 1/2(\hat{\sigma}_i^2 - \hat{S}_i^2)$ and $\tilde{S}^{*2}_{N,T} = 1/2(1/N \sum_{i=1}^{N} \hat{S}^{*2})$.

Null hypothesis of no co-integration is focused by both of the tests. However, the alternative hypothesis specification makes distinction between them. For tests based on "within", alternative hypothesis is given by $\rho_i = \rho < 1$ for all values of i. As far as the last three hypothesis are concerned that are based on "between" dimension, $\rho_i < 1$, represents the alternative hypothesis for each value of i. For each of the seven statistics, finite sample distribution was tabulated by Pedroni through Monte Carlo simulations. The value calculated through the statistical tests must be smaller than the critical value so that null hypothesis for the absence of co-integration can be rejected. As all the included variables are integrated at order 1, we will check the presence of long run relations among these variables. Table given below shows us the result of Pedroni (1999) among all the included variables. In most of the cases, the null hypothesis of no co-integration can be rejected based on within dimensions and between dimensions tests. Therefore, growth, capital, labor, remittances, exports and FDI are cointegrated in our selected sample of South Asian countries for the period 1988-2013.

Table 7: Results of Pedroni-1999 panel cointegration tests.

	Statistics of panel tests				**Statistics of group tests**		
	V statistics	**Rho statistics**	**pp statistics**	**Adf statistics**	**Rho statistics**	**pp statistics**	**Adf statistics**
Statistics	1.259	1.507	-2.441*	-4.419*	1.738	-2.558*	-1.606***
p-value	0.103	0.934	0.007	0.000	0.959	0.005	0.054

The common factor restriction assumption and failure to take into account the possible cross-country dependence are considered the limitation of Pedroni (1999) co-integration test. The common factor hypothesis assumes that the short-run parameters of the variables in first difference and the long-run parameters of the variables in levels are equal. Thus a failure in satisfying this restriction may cause a significant power loss in a residual-based cointegration tests. Hence, the panel

cointegration test proposed by Westerlund (2007), in addition to the Pedroni (1999) tests, is used to examine the long-run relationship between economic growth, capital, labor, remittances, exports, and foreign direct investment in South Asian countries. The test proposed by Westerlund (2007) tests not only avoids the common factor restriction problem but it also tests the presence of cointegration under the null hypothesis with the inference that in a conditional error-correction model, the error-correction term is equal to zero. Therefore, when the null hypothesis of no error-correction is rejected, it is inferred that long run relationship exists between the variables under consideration. Following error-correction model is assumed in this case:

$$\Delta Y_{it} = \delta_i' d_t + \alpha_i (Y_{it-1} - \beta_i' X_{it-1}) + \sum_{j=1}^{p_i} \alpha_{ij} \Delta Y_{it-j}) + \sum_{j=0}^{p_i} \alpha_{ij} \Delta X_{it-j} + \varepsilon_{it}, \quad [11]$$

Where Y_{it} shows the remittances inflows, d_t represents the deterministic components, and X_{it} gives a set of exogenous variables. We can rewrite equation (7) in the given below form:

$$\Delta Y_{it} = \delta_i' d_t + \alpha_i Y_{it-1} - \lambda_i' X_{it-1} + \sum_{j=1}^{p_i} \alpha_{ij} \Delta Y_{it-j}) + \sum_{j=0}^{p_i} \alpha_{ij} \Delta X_{it-j} + \varepsilon_{it}, \quad [12]$$

Where $\lambda_i' = -\alpha_i \beta_i'$ .The speed is determined by the parameter α_i at which the system $Y_{it-1} - \beta_i' X_{it-1}$ reverts back to the equilibrium after experiencing the sudden shock. The value of $\alpha_i < 0$ suggests that the model is error-correcting, which implies that Y_{it} and X_{it} have cointegrating relationship. Value of $\alpha_i = 0$, suggests the absence of error correction and thereby lack of co-integration. H_o for all the included sample countries in the panel dataset is H_0: $\alpha_i = 0$, for all $i = 1, \ldots, N$ whereas H_1: $\alpha_i \neq 0$ for $i = 1, \ldots, N_1$ and $\alpha_i = 0$ for $i = N_1 + 1, \ldots, N$. H_o allows α_i having differentiation across the units in cross-sectional settings. To test the panel co-integration based on least square parameters of α_i and the associated t ratio, Westerlund (2007) presented four type of statistics. Two out of four are panel tests presenting alternative hypothesis of cointegration presence among the

whole panel, the remaining two presents mean group tests against the above mentioned alternative hypothesis thereby proving the presence of co-integration for at least one cross-section unit. Two out of four tests are panel in nature with alternative hypothesis suggesting integration among the whole panel($H_1: \alpha_i = \alpha < 0$). Remaining two tests are group mean tests against the alternative hypothesis that the co-integration for at least one unit in cross-section setting ($H_1: \alpha_i < 0$ for at least one *i*). The null hypothesis of cointegration absence is tested by the panel statistic P_t and P_a against the simultaneous alternative of panel co-integration. The null hypothesis of no cointegration against the alternative hypothesis of atleast one element of panel cointegration, is tested by the group mean statistic statistics G_t and G_a. One property of Westerlund (2007) is that it provides p-values quite robust against cross sectional dependencies through boot strapping thereby allowing for various forms of heterogeneity. The results are presented in table 7 given below. Null hypothesis of no cointegration is rejected under 1% level of significance except for the Ga test statistics. Null hypothesis stating no-cointegration is rejected in three out of four cases with the significance level of 1 percent when using bootstrapped calculated p-values (making allowance for cross-sectional dependence). Boot strapped p-values indicate the presence of strong cointegrating relation among economic growth, capital, labor, remittances, exports, and foreign direct investment.

Table 8: Results of Westerlund-2007 panel cointegration test.

Statistic	**Value**	***p*-value**	**Robust *p*-value**
G_t	-6.291	0.000	0.000
G_a	-0.215	1.000	0.300
P_t	-17.479	0.000	0.000
P_a	-0.828	0.979	0.000

Notes: The width for Bartlett-kernel window is 2. Akaike Information Criterion (AIC) with a maximum lag/lead length of 2 is used for optimal lag/lead length selection. Bootstrapped p-values robust against cross-sectional dependencies are obtained by setting the bootstrap value to 200.

3.4. Long/short Run Parametric Estimation through Panel Error Correction Model

Coefficient estimation either for short or the long term parameter of the panel error correction model is not provided by Westerlund (2007) and Pedroni (1999) although they allow us to check the presence of cointegration among the economic variables. Fully Modified OLS (FMOLS), simple OLS, Pooled Mean Group (PMG) and Dynamic OLS (DOLS) can be used if the cointegration is present in a panel framework. The properties of OLS estimator are analyzed by Chen et al (1999) with the suggestion of using DOLS and FMOLS estimators in cointegrated panel regression. This paper addresses the estimation of three parameters of PVAR describing linkage among the included economic variables i.e. economic growth, labor, exports, capital, remittances ad foreign direct investment: PMG for both the long and short run parameters whereas DOLS and FMOLS in case of long run parameters.

3.4.1. Fully Modified OLS (FMOLS) Estimation

As the OLS estimator is an inconsistent and biased estimator during its application on the cointegrated panels, we have utilized the group mean panel fully modified OLS estimator (FMOLS) by Pedroni (1999, 2001) is made. This estimator helps in the generation of consistent estimates of parameters β along with the control on correlation and regressors endogeneity. The expression given below presents the FMOLS equation.

$$\beta_i^* = (X_i' X_i)^{-1}\left(X_i' y_i^* - T\delta\right), \quad [13]$$

In the above presented equation, endogenous variable in transformed form is presented by y* whereas δ represents the parameter for adjustment of autocorrelation. T shows the number of time periods taken. Tables 8 display the results of FMOLS at individual as well as panel level. The capital coefficient is positive and significant in India, Sri Lanka and Bangladesh whereas negative and significant in Pakistan and Nepal. The +/- coefficient of capital suggests that increase (decrease) in capital leads to increase (decrease) in economic growth in South Asian countries. Labor coefficient is positive and significant in

Pakistan, Sri Lanka and Bangladesh whereas negative and significant in India and Nepal. Remittance is negative and significance in Pakistan however, insignificant in India. In Bangladesh, Sri Lanka and Nepal, remittance has a positive impact on growth. Exports are positive and significant in India, Bangladesh and Nepal. FDI has a positive impact on growth in Pakistan, Sri Lanka and Nepal and otherwise in India and Bangladesh. The results of FMOLS at group level show that all coefficients are statistically significant and positive except labor. Results of FMOLS indicate that 1% increase in remittances, exports and FDI as a percentage of GDP increases GDP per capita by about 6%, 14% and 23%, respectively in the South Asian countries.

Table 9: Results of Long term Co-efficient Estimates by FMOLS

	K	L	R	X	F	Adj. R-sq.
Pakistan	-18.771*** (-5.443)	31.666*** (6.513)	-10.986* (-1.839)	-4.110 (-0.956)	22.785** (2.430)	0.892
India	8.829*** (2.870)	-36.107*** (-14.564)	-9.339 (-0.941)	17.033*** (5.806)	-40.358*** (-3.611)	0.992
Srilanka	12.724*** (3.108)	12.772*** (2.867)	191.018*** (16.120)	-26.638*** (-11.958)	41.051** (2.184)	0.975
Bangladish	11.436** (2.245)	9.317** (2.495)	23.822*** (8.479)	7.393** (2.608)	-27.151* (-1.979)	0.970
Nepal	-4.529*** (-2.044)	-0.587** (-2.806)	6.757*** (13.947)	4.302*** (6.332)	32.451** (2.620)	0.933
Panel	**23.138*** (32.804)**	**-6.079*** (-31.316)**	**6.673*** (9.368)**	**14.282*** (28.876)**	**23.06*** (22.043)**	**0.624**

Note: ***' **' * indicates 1%, 5% and 10% level of significance, respectively.

Both OLS and FMOLS estimators' exhibit a small sample bias, however, the estimators by DOLS seems to outperform the preceding models (Kao and Chiang, 2000). Kao and Chiang (2000) have discussed the advantages of DOLS estimators. To avoid such biasness in our analysis, we have further applied the DOLS estimator to gauge the long-run relation.

3.4.2. Dynamic OLS (DOLS) Estimation

To achieve an unbiased and endogeneity corrected estimates of the long-run parameters, parametric adjustment are made to the errors. This adjustment is done by including both past and future values of first

differenced *I*(1) regressors. Following equation is used to obtain the Dynamic OLS estimators:

$$Y_{it} = \alpha_i + X_{it}^{'}\beta + \sum_{j=-q_1}^{j=q_2} C_{ij}\,\Delta X_{it+j} + v_{it}, \qquad [14]$$

Where X = [K, L, R, X, F], C_{ij} represents the lead or lag coefficient of explanatory variables at first difference. The equation given below presents the estimated coefficient of DOLS:

$$\hat{\beta}_{DOLS} = \sum_{i=1}^{N}\Big(\sum_{t=1}^{T} z_{it}z_{it}^{'}\Big)^{-1}\left(\sum_{t=1}^{T} z_{ij}\,\hat{y}_{it}^{+}\right), \qquad [15]$$

Where z_{it}= [X_{it}- $\bar{X}_i$, $\Delta X_{i,t-q}, \ldots\ldots \Delta X_{i,t+q}$] is vector of regressors, and $\hat{y}_{it}^{+}$ ($\hat{y}_{it}^{+}$= $y_{it} - \bar{y}_i$) is the GDPPC variable. Table 10 shows the results of DOLS at individual as well as panel level. The capital coefficient is positive and significant in India, Sri Lanka and Bangladesh whereas negative and significant in Pakistan. Labor coefficient is positive and significant in Pakistan and Sri Lanka whereas negative and significant in India and Nepal. In Bangladesh, Sri Lanka and Nepal, remittance has a positive impact on growth. Exports are positive and significant in India, Bangladesh and Nepal. FDI has a positive impact on growth in Pakistan and Nepal whereas negative in India. The results of FMOLS for panel show that FDI has a high positive impact on GDP per capital at 1% significance in the South Asian countries.

Table 10: Results of Long term Co-efficient Estimate by DOLS

	K	L	R	X	F	Adj. R-sq.
Pakistan	-18.898*** (-4.293)	29.512*** (5.183)	-10.544 (-1.500)	-6.583 (-1.234)	21.828* (1.819)	0.903
India	9.306** (2.306)	-35.598*** (-10.911)	-7.614 (-0.601)	16.011*** (4.150)	-38.775** (-2.668)	0.991
Srilanka	11.970** (2.679)	13.626*** (2.843)	190.290*** (14.758)	-26.113*** (-10.780)	33.862 (1.663)	0.977125
Bangladish	8.959 (1.098)	8.702 (1.544)	21.780*** (4.931)	8.697* (1.874)	-20.929 (-0.928)	0.972
Nepal	-3.389768 (-1.285)	-0.556* (-2.007)	6.463*** (11.911)	3.698*** (4.845)	27.875* (1.823)	0.940572
Panel	**13.767*** (5.721)**	**-7.575*** (-4.330)**	**-4.030376 (-0.653)**	**-0.279303 (-0.066)**	**33.69*** (3.666)**	**0.921194**

Note: ***' **' * indicates 1%, 5% and 10% level of significance, respectively.

3.4.3. The Pooled Mean Group (PMG) Estimator and the Test for Causality

Final step in the implementation of an alternative methodology consists of the PMG approach proposed by Pesaran et al. (1999) to estimate the long and short run parameters of PECM (Panel Error Correction Model) along with the test to check causality among all the included macro-economic variables. The role of PMG is like an intermediate estimator as it involves both averaging and pooling. PMG test has a preference over the DOLS model as it allows the specification of short term dynamics so that it can differ among the countries whereas the coefficients in long term have constraints to remain same, an assumption that will be tested in this investigation. The strong assumption of the underlying PMG test consists of having restriction on long run coefficients to have similar values in different countries needs to be discussed in detail as the empirical data does not support it. One reason for the difference of our result from the previous studies is due to the incorporation of above methodology as they have not included it and therefore they all behave in a similar manner in the long run. If this is the case, then we shall not have an idea of the amount of weight that needs to be assigned on the new results of panel estimation, as these will

merely be estimation and modeling artifact used here and therefore not be able to provide beneficial information. As our variables have cointegration among them, the granger causality test is performed through the estimation of PMG estimator. Equation (9) is used to as a long run model to obtain residuals. The following model is estimated in define the lag residuals as the error correction term.

$$\Delta G_{it} = \beta_{1j} + \sum_{k=1}^{p} \beta_{11ik}\,\Delta G_{it-k} + \sum_{k=1}^{p} \beta_{12ik}\,\Delta K_{it-k} + \sum_{k=1}^{p} \beta_{13ik}\,\Delta L_{it-k} + \sum_{k=1}^{p} \beta_{14ik}\,\Delta R_{it-k} + \sum_{k=1}^{p} \beta_{15ik}\,\Delta X_{it-k} + \sum_{k=1}^{p} \beta_{16ik}\,\Delta F_{it-k} + \lambda_{1i}\varepsilon_{it-1} + v_{1it} \quad [16a]$$

$$\Delta K_{it} = \beta_{1j} + \sum_{k=1}^{p} \beta_{11ik}\,\Delta G_{it-k} + \sum_{k=1}^{p} \beta_{12ik}\,\Delta K_{it-k} + \sum_{k=1}^{p} \beta_{13ik}\,\Delta L_{it-k} + \sum_{k=1}^{p} \beta_{14ik}\,\Delta R_{it-k} + \sum_{k=1}^{p} \beta_{15ik}\,\Delta X_{it-k} + \sum_{k=1}^{p} \beta_{16ik}\,\Delta F_{it-k} + \lambda_{1i}\varepsilon_{it-1} + v_{1it} \quad [16b]$$

$$\Delta L_{it} = \beta_{1j} + \sum_{k=1}^{p} \beta_{11ik}\,\Delta G_{it-k} + \sum_{k=1}^{p} \beta_{12ik}\,\Delta K_{it-k} + \sum_{k=1}^{p} \beta_{13ik}\,\Delta L_{it-k} + \sum_{k=1}^{p} \beta_{14ik}\,\Delta R_{it-k} + \sum_{k=1}^{p} \beta_{15ik}\,\Delta X_{it-k} + \sum_{k=1}^{p} \beta_{16ik}\,\Delta F_{it-k} + \lambda_{1i}\varepsilon_{it-1} + v_{1it} \quad [16c]$$

$$\Delta R_{it} = \beta_{1j} + \sum_{k=1}^{p} \beta_{11ik}\,\Delta G_{it-k} + \sum_{k=1}^{p} \beta_{12ik}\,\Delta K_{it-k} + \sum_{k=1}^{p} \beta_{13ik}\,\Delta L_{it-k} + \sum_{k=1}^{p} \beta_{14ik}\,\Delta R_{it-k} + \sum_{k=1}^{p} \beta_{15ik}\,\Delta X_{it-k} + \sum_{k=1}^{p} \beta_{16ik}\,\Delta F_{it-k} + \lambda_{1i}\varepsilon_{it-1} + v_{1it} \quad [16d]$$

$$\Delta X_{it} = \beta_{1j} + \sum_{k=1}^{p} \beta_{11ik}\,\Delta G_{it-k} + \sum_{k=1}^{p} \beta_{12ik}\,\Delta K_{it-k} + \sum_{k=1}^{p} \beta_{13ik}\,\Delta L_{it-k} + \sum_{k=1}^{p} \beta_{14ik}\,\Delta R_{it-k} + \sum_{k=1}^{p} \beta_{15ik}\,\Delta X_{it-k} + \sum_{k=1}^{p} \beta_{16ik}\,\Delta F_{it-k} + \lambda_{1i}\varepsilon_{it-1} + v_{1it} \quad [16e]$$

$$\Delta F_{it} = \beta_{1j} + \sum_{k=1}^{p} \beta_{11ik}\,\Delta G_{it-k} + \sum_{k=1}^{p} \beta_{12ik}\,\Delta K_{it-k} + \sum_{k=1}^{p} \beta_{13ik}\,\Delta L_{it-k} + \sum_{k=1}^{p} \beta_{14ik}\,\Delta R_{it-k} + \sum_{k=1}^{p} \beta_{15ik}\,\Delta X_{it-k} + \sum_{k=1}^{p} \beta_{16ik}\,\Delta F_{it-k} + \lambda_{1i}\varepsilon_{it-1} + v_{1it} \quad [16f]$$

The Δ represents operator at first difference whereas p represents the lag length at optimal level as per Schwarz Bayesian Criterion. We have selected six lags for this purpose and considered these as the optimal lag length as per Schwarz Bayesian Criterion in the VAR system. The problem of endogeneity can be minimized by selecting the value of explanatory variable lags from k=1 rather than k=0. We can check the long and short run causality through the specification presented in equation (16). For instance, in the per capita gross domestic product in equation 16(a), causality in short term is tested among capital, labor, remittance, exports and FDI to GDP per capita based on H_0; $\beta_{12ik} = 0\ \forall ik$, H_0; $\beta_{13ik} = 0\ \forall ik$, H_0; $\beta_{14ik} = 0\ \forall ik$, H_0; $\beta_{16ik} = 0\ \forall ik$, and

H_0; $\beta_{12ik} = 0\ \forall ik$. In general, referring to Eqs. (16a)–(12f), statistical significance value of the partial F-statistic having association with the variables on the right hand side determines the short run causality. We can check for the long term causality by having an examination of the t value on coefficient λ of ECT ε_{it-1} to confirm the significance level.

Table 11 reports the results of short-run and long-run Granger causality tests. With respect to Eq.(16a), the coefficient of lagged error-correction term is negative and significant at 5% level but with a relatively low speed of adjustment to long-run equilibrium. Negative error correction term confirms the existence of the long run Granger causality running from capital, labor, remittances, exports, and FDI to economic growth. With respect to short-run causality tests, there is evidence of Granger causality running from exports to economic growth. From Eq.(16b), error correction term is negative and significant at 1% which suggests that capital responds to long-run equilibrium and confirms the long-run causality running growth, labor, remittances, exports and FDI. Over a short period of time, there is evidence of Granger causality running from remittances to capital. The significant and negative error correction term in Eq. (16c) confirms the presence of long-run causality running from energy growth, capital, remittances, exports and FDI to labor. In Eq.(16d), the long-run equilibrium relation is insignificant however in and short-run indicates that Granger causality runs from capital to remittances. The existence of long run equilibrium relation at relatively higher speed is evident in Eq. (16e, 16f) between all the variables. However, Eq. (16e) shows that causality runs from FDI to exports. Results indicate unidirectional causality from exports to growth and from FDI to exports. Results also provide evidence of feedback relationship between remittances and capital. These results suggest that remittances, exports and FDI play a vital role in the economic growth and capital in South Asia. Effective utilization of inflows through remittances and FDI, enhancing the exports are necessary to reap optimal fruits of economic growth.

Table 11: Results of PMG Panel Causality Test

Dependent Variables	**Independent Variables (Sources of Causality)**						
	ΔG_{it}	ΔK_{it}	ΔL_{it}	ΔR_{it}	ΔX_{it}	ΔF_{it}	ECT_{t-1}
	Short run						Long run
Eq. (16a) ΔG_{it}	-	1.529 (0.87)	-.914 (-0.49)	.684 (0.30)	1.634* (1.76)	-2.715 (-0.48)	-.0443** [-1.93]
Eq. (16b) ΔK_{it}	.011 (1.14)	-	.101 (0.51)	-.887** (-1.94)	-.010 (-0.13)	.020 (0.03)	-.467*** [-2.82]
Eq. (16c) ΔL_{it}	.067 (0.97)	-.268 (-1.61)	-	-.588 (-0.72)	.043 (0.99)	-1.070 (-1.45)	-.535** [-2.48]
Eq. (16d) ΔR_{it}	-.033 (-1.06)	-.191*** (-3.47)	.017 (0.20)	-	-.024 (-0.55)	-.639 (-0.76)	-.189 [-1.14]
Eq. (16e) ΔX_{it}	.019 (0.82)	-.008 (-0.07)	-.081 (-0.62)	.292 (0.64)	-	.550** (1.89)	-.547*** [-2.57]
Eq. (16f) ΔF_{it}	.001 (0.21)	.044 (1.31)	-.033 (-0.90)	.050 (0.47)	.010 (0.39)	-	-.879*** [-3.91]

Notes: ***' ** indicates significance at the 1% and 5%, respectively. () and [] represent sum of the lagged coefficients for the respective short-run changes and t-statistics.

4. Conclusion and Policy Implications

This paper explores the relationship between economic growth, capital, labor, remittances, exports, and foreign direct investment using data of 5 South Asian countries over the period 1988–2013. In doing so, we have applied panel unit root tests to examine the integrating properties of the variables. To examine cointegration between variables, we have applied Pedroni cointegration and Westerlund panel cointegration approaches. The PMG Granger causality proposed by Pesaran et. al is applied to examine the direction of causality between variables in the South Asian countries.

Empirical results indicate that all variables are integrated at I(1) confirmed by panel unit root tests and the same inference is drawn about cointegration between economic growth, capital, labor, remittances, exports, and foreign direct investment. The FMOLS and DOLS estimation analysis reveals a positive impact of capital, remittances, exports and FDI on economic growth whereas an inverse relationship between labor and growth is observed. The causality analysis confirms the existence of long run equilibrium relationship between economic

growth, capital, labor, remittances, exports, and foreign direct investment. In short run, exports Granger cause growth and FDI Granger cause exports. Feedback causality is also confirmed between remittances and capital in the South Asian countries.

The empirical findings of this paper have important implications for the policymakers of South Asia. The region should undertake the educational and financial reforms as this will help to create an environment which is more favorable for the spillover effects as this spillover will improve the social returns for both domestic and foreign investments. This paper presents very important results for developing countries to have an understanding that the formulation of capital, increase in exports and the attraction of remittances and FDI is important to promote economic growth. Future research can utilize the sector level data on these variables to dig deep the implications for economic growth. The availability of data is the biggest hurdle in doing so at present.

References

Adams, S. (2009). Foreign Direct investment, domestic investment, and economic growth in Sub-Saharan Africa. *Journal of Policy Modeling, 31*(6), 939-949.

Aditya, A., & Acharyya, R. (2013). Export diversification, composition, and economic growth: Evidence from cross-country analysis. *The Journal of International Trade & Economic Development, 22*(7), 959-992.

Azam, M., & Hassan, S. Khairuzzaman, (2013). Corruption, Workers Remittances, Fdi and Economic Growth in Five South and South East Asian Countries: A Panel Data Approach, *Middle-East Journal of Scientific Research,15*(2), 184-190.

Azman-Saini, W. N. W., Baharumshah, A. Z., & Law, S. H. (2010). Foreign direct investment, economic freedom and economic growth: International evidence. *Economic Modelling, 27*(5), 1079-1089.

Baltagi, B. H., & Kao, C. (2001). *Nonstationary panels, cointegration in panels and dynamic panels: A survey* (Vol. 15, pp. 7-51). Emerald Group Publishing Limited.

Bilquees, F., & Mukhtar, T. (2012). Export Instability, Income Terms of Trade Instability and Growth: Evidence from Pakistan. *Journal of Economic Cooperation and Development*, *33*(1), 59-78.

Borensztein, E., De Gregorio, J., & Lee, J. W. (1998). How does foreign direct investment affect economic growth?. *Journal of international Economics, 45*(1), 115-135.

Breitung, J., (2000). The local power of some unit root tests for panel data. *Advances in Econometrics, 15*, 161–177.

Catrinescu, N., Leon-Ledesma, M., Piracha, M., & Quillin, B. (2009). Remittances, institutions, and economic growth. *World Development, 37*(1), 81-92.

Chen, B., McCoskey, S., Kao, C., (1999). Estimation and inference of a cointegrated regression in panel data: a Monte Carlo study. *American Journal of Mathematical and Management Sciences, 19*, 75–114.

Cooray, A. (2012). The impact of migrant remittances on economic growth: evidence from South Asia. *Review of International Economics, 20*(5), 985-998.

Driffield, N., & Jones, C. (2013). Impact of FDI, ODA and migrant remittances on economic growth in developing countries: A systems approach. *European Journal of Development Research, 25*(2), 173-196.

Fayissa, B., & Nsiah, C. (2010). The impact of remittances on economic growth and development in Africa. *American Economist, 55*(2), 92.

Hansen, H., & Rand, J. (2006). On the causal links between FDI and growth in developing countries. *The World Economy, 29*(1), 21-41.

Hassan, S., Bakar, N. A., & Abdullah, H. (2014). Analysis of FDI Inflows into China from ASEAN-5 Countries: A Panel Cointegration Approach. *Journal of Economic Cooperation & Development, 35*(3), 1-28.

Herzer, D., Klasen, S., & Nowak-Lehmann D, F. (2008). In search of FDI-led growth in developing countries: The way forward. *Economic Modelling, 25*(5), 793-810.

Hsiao, F. S., & Hsiao, M. C. W. (2006). FDI, exports, and GDP in East and Southeast Asia—Panel data versus time-series causality analyses. *Journal of Asian Economics, 17*(6), 1082-1106.

Im, K.S., Lee, J., Tieslau, M., (2005). Panel LM unit-root tests with level shifts. *Oxford Bulletin of Economics and Statistics, 67*(3), 393–419.

Imai, K. S., Gaiha, R., Ali, A., & Kaicker, N. (2014). Remittances, growth and poverty: New evidence from Asian countries. *Journal of Policy Modeling, 36*(3), 524-538.

Kao, C., Chiang, M.H., (2000). On the estimation and inference of a cointegrated regression in panel data. In: Baltagi, B. (Ed.), Nonstationary Panels, Panel Cointegration, and Dynamic Panels. *Advances in Econometrics, 15.* , JAI Press, Amsterdam, 161–178.

Kumar, R. (2011). Role of Trade, Aid, Remittances and Financial Development in Pakistan. MPRA Paper No. 38871. Online at http://mpra.ub.uni-muenchen.de/38871/

Kumar, R. R., & Stauvermann, P. J. (2014). Exploring the Effects of Remittances on Lithuanian Economic Growth. *Engineering Economics, 25*(3), 250-260.

Le, T. (2009). Trade, remittances, institutions, and economic growth. *International Economic Journal, 23*(3), 391-408.

Levin, A., Lin, C.F., (1993). *Unit Root Tests in Panel Data: New Results*. Discussion paper. Department of Economics, UC-San Diego.

Levin, A., Lin, C.F., Chu, C., (2002). Unit root tests in panel data: asymptotic and finite sample properties. *Journal of Econometrics, 108*, 1–24.

Mah, J. S. (2005). Export expansion, economic growth and causality in China. *Applied Economics Letters, 12*(2), 105-107.

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). *A contribution to the empirics of economic growth* (No. w3541). National Bureau of Economic Research.

Marwan, N. F., Kadir, N. A. A., Hussin, A., Zaini, A. A., Ab Rashid, M. E., & Helmi, Z. A. G. (2013). Export, Aid, Remittance and Growth: Evidence from Sudan. *Procedia Economics and Finance, 7*, 3-10.

Pazim, K. H. (2009). *Panel data analysis of "Export-led" Growth Hypothesis in BIMP-EAGA Countries*. University Library of Munich, Germany.

Pedroni, P., (2004). Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis: new results. *Econometric Theory, 20*, 597–627.

Pedroni, P. (2001). Fully modified OLS for heterogeneous cointegrated panels. *Advances in econometrics, 15*, 93-130.

Pedroni, P., (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics, 61*, 653–670.

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association, 94*(446), 621-634.

Pesaran, M. H., (2004). *General Diagnostic Tests for Cross Section Dependence in Panels.* Cambridge Working Papers in Economics no. 435. University of Cambridge.

Pesaran, M. H., (2007). A simple panel unit root test in presence of cross section dependence. *Journal of Applied Econometrics, 22*, 265–312.

Rao, B. B., & Hassan, G. M. (2011). A panel data analysis of the growth effects of remittances. *Economic modelling, 28*(1), 701-709.

Rao, B. B., & Takirua, T. (2006). *The effects of exports, aid and remittances on output: The case of Kiribati*. University Library of Munich. (MPRA paper no 1548).

Sakar, S. A., & Aslam, M., (2013). Foreign Direct Investment, Human Capital and Economic Growth in Malaysia. *Journal of Economic Cooperation & Development, 36*(1), 103-132.

Shirazi, N. S., & KHAN, A. U. (2009). Role of Pakistan Poverty Alleviation fund's Micro Credit In Poverty Alleviation: A Case of Pakistan. *Pakistan Economic and Social Review*, 215-228.

Siddique, A., Selvanathan, E. A., & Selvanathan, S. (2012). Remittances and economic growth: empirical evidence from Bangladesh, India and Sri Lanka. *Journal of Development Studies, 48*(8), 1045-1062.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The quarterly journal of economics*, 65-94.

Tekin, R. B. (2012). Economic growth, exports and foreign direct investment in Least Developed Countries: A panel Granger causality analysis. *Economic Modelling, 29*(3), 868-878.

Westerlund, J., (2007). Testing for error correction in panel data. *Oxford Bulletin of Economics and Statistics, 69*(6), 709–748.

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The Determinants of Trade and Trade Direction of Arab Maghreb Union

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The Arab Maghreb Union (AMU) comprising Algeria, Libya, Mauritania, Morocco, and Tunisia have established a framework to enhance regional cooperation on trade facilitation. Today, the AMU countries have increased their trade integration into the world economy. Despite the effort of trade openness in the AMU, the economic growth, intra-trade and inter-trade are still lagging behind other developing countries in the Middle East, Asia, and Latin America. The paper examines the determinants of intra-regional trade in the AMU countries. Using a data set of 1989-2009; the standard gravity model is used to measure the pattern and trend of bilateral trade. The results from gravity model indicate that there are strong positive and negative relationship between trade and GDP, population, distance, foreign currency reserves (FOC) and real exchange rate (RER) among AMU countries. AMU has helped to improve trade flows in its member trading. Evidently this study shows that the gravity model is still a useful instrument in analyzing the implications of international economic integration. In a way, this study established that regional economic integration is plausible and beneficial.

1. Introduction

The Arab Maghreb Union comprising Algeria, Libya, Mauritania, Morocco, and Tunisia have established a framework to enhance regional cooperation on issues of common interest, focusing initially on trade facilitation. Over the last decade, the Arab Maghreb Union countries

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have increased their trade integration into the world economy, including in the context of the Association Agreements between the European Union and Arab Maghreb countries. However, there is a debate that, whether the Arab Maghreb countries achieve the goals of this regional cooperation or not. In addition, there were an opposite views that, the Arab Maghreb countries were affected by this regional integration.

According to Brenton et al. (2006) the Maghreb countries have experienced lackluster growth rates during the last decade. Tunisia was the best performer with growth at 4.8 per cent, but even this was only average for developing countries; the other two countries grew substantially less at 3.2 per cent. While Maghreb exports of goods and services have grown at global averages in the last decade, they have not fully realized the growth potential associated with their location advantages of close proximity to the European Union (EU). Their exports have grown at less than half the rate of Turkey, Poland and Hungary in the last decade. However, according to the statistics of the Arab monetary fund and Arabian press release in 2000 indicated that member states of the Arab Maghreb Union suffered from economic dependency in the form commerce, food, technology and finance (Brenton et al., 2006).

Maghreb countries' trade with the Arab world and with the rest of the world is relatively small. Despite the establishment of the Arab Maghreb Union over two decades ago, the bulk of the Maghreb's trade is with Europe. The level of intra-Maghreb trade is lower than that of many of the world's trading blocs. In 2007, intra-Maghreb trade represented less than 2 per cent of the sub region's combined gross domestic product (GDP) and less than 3 per cent of the sub region's total trade. Some of the reasons for this low performance include high barriers to trade, logistical bottlenecks, lack of production base diversification, and political considerations (World Bank, 2001).

Table 1: Trade in the Arab Maghreb Union (% of GDP)

	1990-1999		2000-2008	
	Exports	**Imports**	**Exports**	**Imports**
Algeria	26	24	42	23
Libya	29	25	57	28
Mauritania	37	48	40	68
Morocco	26	31	32	37
Tunisia	43	47	49	52

Source: World Bank, GDF and WDI data, April 2010

By referring to Table 1, overall exports accounted for between 57 per cent to 32 per cent of GDP and import for between 67 per cent to 28 per cent in the Arab Maghreb Union during the period 2000–2008. This represents a slightly increase from trade levels in the 1990s, with Libya showing the greatest increase. Mauritania and Tunisia are the most open economies in the sub region, with average trade volumes exceeding GDP during 2000–2008. Trade among the countries of the Maghreb was less than 3 per cent of the regions's total trade in 2008. The low levels of trade within the Maghreb persit despite the existence of overlapping institutional frameworks for regional integration, such as the Arab Maghreb Union. World Bank (2006) estimated the loss due to weak trade integration as equal to two to three per cent of the annual Gross Domestic Product of The Maghreb. Thus, this paper examines determinants of intra-regional trade in the Arab Maghreb Union (AMU) countries.

2. Literature Review

Only a few empirical studies have examined whether regional economic integrations had trade creation effects or trade diversion effects. At cross-country level, Endoh (1999) found that the European Economic Community (EEC) had a trade creation effect, the Latin American free Trade Association (LAFTA) to have had a trade diversion effect, and the Council of Mutual Economic Assistance (CMEA) to have had a relatively stronger trade creation effect than the trade diversion effect. Aitken (1973) as cited in Musila (2004) found that the EEC to have no significant trade creation effects. Pelzman (1977) also as quoted by Musila (2004) finds the CMEA to have a trade creation effect. At individual country level, Endoh (1999) found the EEC and LAFTA to

have had no statistically significant effect on Japanese trade but found the CMEA to have had greatly reduced trade with Japan (i.e. trade diversion). Pelzman (1977) found the CMEA to have had a trade diversion effect in the case of Czechoslovakia and East Germany (Musila, 2004).

In examining the effect of regional integration on bilateral trade, Ghosh and Yamarik (2004) and Siliverstovs and Schumacher (2006) found that the North American Free Trade Agreement (NAFTA) had led to reduction in trade among its members. Preferential trade agreements (PTAs) involving Asian countries have also received a lot of attention in the literature. Those studies have mainly focused on the trade impact of the Association of South East Asian Nation Free Trade Agreement (AFTA), the South Asian Association for Regional Cooperation Preferential Trade Agreement (SAPTA) and the Asia-Pacific Economic Cooperation (APEC). Lee and Park (2002) have argued that ASEAN+3 (China, Japan and Korea) is emerging as a promising regional integration more than other PTAs in the East Asia Region. Rahman (2005), Lee and Park (2005), and Pusterla (2007) have all concluded that AFTA has enhanced trade among members. Similar results have been found for SAPTA.

Musila (2004) uses the gravity model to examine the impact of the Common Market for Eastern and Southern Africa (COMESA) on the flow of Kenya's exports. The empirical results of this study suggest that COMESA has the effect of trade creation. No evidence for trade diversion was found. The results also show that nominal GDP of importing countries, distance, adjacency, and common official language have a statistically significant impact on the flow of Kenya's exports. Micco et al. (2003), Hassan (2001), and Walsh (2006) have used the gravity model to examine the effect of EEC/EU and EFTA on bilateral trade. They concluded that the PTAs have fostered trade among members and between members and non-members. However, evidence of trade diversion for the EEC/EU agreement has been found by Westerlund and Wilhelmsson (2006) and Kien and Hashimoto (2005). Study by Breuss and Egger (1999) has also showed that the formation of NAFTA has led to increase in intra-PTA trade.

Martinez-Zarzoso, Inwald and Nowak-Lehman (2003) applies the gravity trade model to assess Mercosur-European Union trade, and trade

potential following the agreements reached recently between both trade blocks. The study found out that the fixed effect model should be preferred to the random effects gravity model. A number of variables, namely, infrastructure, income differences and exchange rates added to the standard gravity equation, are found to be important determinants of bilateral trade flows. Furthermore, Martinez-Zarzoso and Nowak-Lemann (2004) study also helps us to understand the effects of geographic and economic distance. According to Hirsch and Hashai (2000) geographical distance refers to miles or kilometers between capitals of trading countries. Since local products are cheaper than products transported over long distances, it is expected that geographical distance hinder trade. The second type, economic distance refers to absolute differences in the per capita income of the trading countries. These differences are expected to play a crucial role in explaining trade between the Arab Maghreb Union and other major trading blocs.

3. Methodology

Several methods have been used to analyze the intra-regional trade effects of regional economic integration. A frequently used approach, however, is the gravity equation (see Endoh, 1999). According to Yamazawa (1970) cited in Darku (2009), the trade intensity model concentrates on the structure of departures of actual trade flows from trade flows estimated in gravity models. He proved that in a simplified gravity model where bilateral trade is solely determined by the GDPs of country i and j, the index (export or import intensity index) is always equal to unity. An index greater than unity reflects the importance of various factors such as distance, favorable trade agreements, and strong complementarities of comparative advantages in determining trade flows. Hence, the dynamics in these intensities must be consistent with the predictions of the gravity model that captures these factors.

An export intensity index measures the extent to which the proportion of a country ***i***'s export to another country ***j*** differs from the proportion of exports from the rest of the world to country *j*. The index is given as:

$$\mathrm{EX}_{ij} = \left[\frac{\mathrm{X}_{ij}}{\mathrm{X}_{i}}\right] / \left[\frac{\mathrm{X}_{wi} - \mathrm{X}_{ij}}{\mathrm{X}_{w} - \mathrm{X}_{i}}\right] \quad (1)$$

where EX_{ij} is the exports intensity index of country ***i*** with trading partner ***j***, $X_{ij}$is the exports of country ***i*** to trading partner ***j***, X_i is the total exports of country ***i***, $X_{wj}$is the total exports to country ***j***, and X_w is the total world exports. The index measures the extent to which country j is over or under-represented as country i's export market. The index will take a value of unity if the proportion of country ***i***'s exports to country j is the same as the proportion of the rest of the world's exports to country ***j***. If the value exceeds unity, country ***j*** is said to be over-represented as country ***i***'s exports market. A value less than unity imply relative under-representation.

Similar to the analysis of exports, an import intensity index measures the extent of AMU member country's import dependence on its trading partners. This index is given as:

$$\mathrm{IM}_{ij} = \left[\frac{\mathrm{M}_{ij}}{\mathrm{M}_i}\right] / \left[\frac{\mathrm{M}_{wi} - \mathrm{M}_{ij}}{\mathrm{M}_w - \mathrm{M}_i}\right] \quad (2)$$

Where IM_{ij} is the imports intensity index of country I with trading partner j, M_{ij} is the imports of country *i*to trading partner *j*, M*i* is the total imports of country i, M_{wj} is the total world imports from country *j*, and M*w* is the total world imports. The index is equal to one if an AMU member country's import from a particular country as a proportion of its total imports is the same as the proportion of the rest of the world's imports from that country. If an AMU member country is over-dependent on a particular country for its import, then the ratio will be greater than one. On the other hand, if the ratio is less than one, then an AMU member is under-dependent on that country.

To augment the standard gravity equation with country specific dummies instead of the traditional approach, this study includes regional trading block dummies. The variables included in the standard gravity equation are income of both the importing and exporting countries, and distance. Income of the importing country represents the purchasing power or its absorption capacity, while the income for the exporting country represents the country's production and supply capacity. Distance is used as a proxy for transportation cost.

Equation (3) is extended from Equation (1) and Equation (2). In order to examine the gravity model of AMU (first objective) and between AMU, the empirical model is as follows:

$$lnY_{ijt} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnPOP_{it} + \beta_4 lnPOP_{jt} + \beta_5 lnDINS_{ij} + \beta_6 lnFCR_{ij} + \beta_7 lnRER_{ij} + \beta_8 lnOPEN_{ij} + \beta_9 AGMT_{ij} + \beta_{10} LAN_{ij} + u_{ijt} \quad (3)$$

where lnY_{ijt} is the trade variable between country *i* (AMU) and country *j* at time *t*; $lnGDP_{it}$ is a measure of income of country *i*at time *t*;$lnGDP_{jt}$ is a measure of income of country *j* at time *t*; $lnPOP_{it}$ and $lnPOP_{jt}$ are local and target populations, respectively at time *t*; $lnDINS_{ij}$ is the distance between countries ***i*** and *j;* $lnFCR_{ij}$ is the target country's foreign currency reserves at time *t*; $lnRER_{ij}$ is the real exchange rate between the two countries at the time *t*. $lnOPEN_{ij}$is the most basic measure of trade intensity is the so-called ''trade openness'' that is the ratio of exports plus imports to GDP. $LAN_{ij}$is a dummy variable for trading partners sharing a common language. Ability to communicate in a common language is predicted to reduce the costs of trade. We use measure for English as a common language.$AGMT_{ij}$is a dummy variable which evaluate the effects of preferential trading agreements. *ßi* (i = 1,2,..,7) are parameters of the equation, and u_{ijt} is a white noise disturbance term. All variables are in logs so the estimated coefficients are interpreted as elasticities.

The data set consists of a panel of observations for five Arab Maghreb Union (AMU) countries, namely Algeria, Libya, Mauritania, Morocco and Tunisia for the period 1989-2009. For the empirical application, we follow the broad specification and data sets of Egger and Pfaffermayr (2003).

4. Analysis

The estimation results for Equation 3 are presented in Table 2 to Table 6 including the five Arab Maghreb Union (AMU) countries namely Algeria, Libya, Mauritania, Morocco and Tunisia. These tables present the intra-trade among the AMU countries which is each country will

take place as a anchor country, while the others as a partner trading. Each table shows the results of the pooled model are in the second column, while those of fixed effects and random effects models are in the third and fourth columns. The main problem of the pooled model is that it does not allow heterogeneity of countries. It does not estimate country specific effects and assumes that all countries are homogenous. It is a restricted model (Eita, 2008).

Fixed effects model introduces heterogeneity by estimating country specific effects. It is an unrestricted model as it allows the intercept and other parameters to vary across trading partners. The F-test statistic was performed to test whether countries are able to pool and the results indicate that the null hypothesis of equality of individual effects is rejected. This means that a model with individual effects must be selected.

Like the fixed effects, the random effects model also acknowledges heterogeneity in the cross-section. However, it differs from the fixed effects model in the sense that the effects are generated by a specific distribution. Although it assumes that there is heterogeneity in the cross-section, it does not model each effect explicitly. This prevents the loss of degrees of freedom which happens in fixed effects model. The LM test was performed and the null hypothesis of equality of the individual effects is rejected in favour of random effect specification.

The Hausman statistic is used to test the null hypothesis that the regressors and individual effects are not correlated in order to distinguish between fixed effects model and random effects model. Failure to reject the null hypothesis implies that the random effects model will be preferred. If the null hypothesis is rejected, the fixed effects model will be appropriate. The Hausman test statistic shows that the null hypothesis is rejected and this indicates that country specific effects are correlated with regressors. This suggests that the fixed effects model is appropriate, and the random effects estimates are not consistent. Since the fixed effects model is the appropriate one, interpretation of the results will focus on the fixed effects model (Eita, 2008).

Table 2 shows the intra-trade between Algeria and the others AMU countries namely Libya, Mauritania, Morocco, and Tunisia. The

Hausman specification test statistic shows that the null hypothesis failed to reject and indicated that there was no systematic difference between fixed and random models, whereby confirmed that the random effects estimator was efficient in our empirical framework for intra-trade between Algeria and among others AMU countries.

The results show that an increase in the foreign GDP ($lnGDP_{it}$) causes an increase in Algeria's trade. The coefficient for this variable is positive by 1.049 in random effects model and statistically significant at 1 per cent level as expected and in line with the previous literature on trade (see, for example, Cheng and Wall, 2002, and Serlenga and Shin, 2004). It suggests that the demand-side "pull" effects of foreign output dominate the supply-side effects of domestic output. On the overall this indicates that an increase in foreign GDP causes Algeria trade to increase. On the other hand, domestic GDP is not statistically significant, that means we found the domestic GDP not causes Algeria trade to increase.

The population coefficients of foreign country ($lnPOP_{it}$) and domestic population ($lnPOP_{jt}$) are positive sign coefficient by 1.511 and 34.245 in random effects model, and strongly significant at 1 per cent level. These positive sign indicates that the country size is directly related to trade. These results are consistent with Martines-zarzoso (2003) who was studied on Gravity Model: An Application to Trade between Regional Blocs found that from the year 1991 onwards, the sign is positive which point towards the growing importance of the role played by scale economies and market-size effects in international trade models.

Table 2: Algeria – Dependent variable: $\boldsymbol{lnY_{ijt}}$ (Trade)

Variables	Pooled Model	Fixed Effects Model	Random Effects Model
$Constant$	-882.277***(-4.89)	-222.782**(-2.07)	-581.277***(-4.21)
$lnGDP_{it}$	2.049*** (3.58)	0.514***(2.94)	1.049***(4.80)
$lnGDP_{jt}$	-0.557(0.36)	-0.009(-0.11)	-0.054 (-0.36)
$lnPOP_{it}$	2.561***(3.86)	69.341**(2.19)	1.551**(2.86)
$lnPOP_{jt}$	44.845***(4.52)	76.799** (2.30)	34.245***(4.02)
$lnDINS_{ij}$	-2.955***(-7.67)		-1.715***(-7.44)
$lnFCR_{ij}$	0.661***(3.91)	0.085(0.69)	0.601**(2.93)
$lnRER_{ij}$	0.986 (0.55)	0.393(0.88)	0.186(0.25)
$lnOPENNESS_{ij}$	0.233*** (7.33)	0.026***(4.71)	0.0438*** (11.03)
$AGMT_{ij}$	-2.453***(7.54)	-0.633 (-1.40)	-2.083***(-8.76)
LAN_{ij}	0.124*(1.90)	0.165 (0.37)	0.124(0.25)
F Test		10.46***[0.000]	
LM Test			1.47[0.226]
Hausman Test		5.34[0.253]	
Time Fixed Effect		1.04[0.236]	
R-squared	0.852	0.732	0.932
Number of Observation	84	84	84

Notes: *** indicates significant at 1%, ** indicates significant at 5%, and * indicates significant at 10%; t-statistics are in parentheses ( ) and p-value are in [ ].

$lnPOP_{it} lnPOP_{jt}$

The distance variable ($lnDINS_{ij}$) is intended as a proxy for transportation cost. The distance variable in the random effects model and pooled model has the right sign in the sense that increased trade is negatively correlated with distance. The coefficient is -1.715 and statistically significant at 1 per cent level. It indicates that this variable may hide the fact that the transaction costs of trading in Algeria in respect of distance are far higher than the others AMU countries.

The real exchange rate($lnRER_{ij}$) has positive coefficient but an insignificant coefficient, implying that it does not have an impact on trades.

The foreign currency reserves ($lnFCR_{ij}$) is typically positive coefficient; 0.601 in random effects model and statistically significant at 1 per cent. This result is consistent with previous evidence (Harris and Matyas, 2001, Egger and Pfaffermayr, 2003, and Serlenga and Shin, 2004).

The study takes a particular interest in how both exporters and importer respond to trade openness. As expected, trade and Openness ($lnOPENNESS_{ij}$) are correlated significantly and positively with each other. The coefficient is 0.0438 in random effects model and statistically significant at 1 per cent level. Given the strong and positive relationship between trade intensity ratios and growth, the existence of a significant correlation between trade and Openness indicates that Openness is fairly effective for increasing trade.

The interpretation of the coefficients on the integration dummy variables is also relevant for our analysis. The regression results in Table 4.1 are consistent with the predictions of theoretical studies, rather than the conventional view on the issue. The random effects model column shows report that a significant and negative relationship between trade and agreement($AGMT_{ij}$) among Algeria and the others AMU countries. The coefficient of the agreement($AGMT_{ij}$) are -2.083 in random effects model. Since the model is log-linear, the impact of AGMT on bilateral trade can be computed in percentage terms as 100 x [exp(β_{AGMT}) − 1.00] or 100 x [0.12455 – 1.00] = -87.54%. This indicates that with the AGMT agreement, the percentage reduction of trade between Algeria and other four AMU countries is 87.54%. On the other hand, Libya, Mauritania and Tunisia demonstrate trade expansion by signing the PAFTA.

Table 2 also shows that the fixed effects model doesn't have any significant effect between trade and agreement. The estimated coefficient of lagged English language (LAN_{ij}), is not significant in random effects model.

The Goodness of fit reflected by the R-square, as well as the total number of observations are given in the final rows. The overall goodness of fit of four estimation of the gravity model can be concluded that the specified models explain the variety in trade flows to a sufficient extends. Time fixed effects are needed if the independent variables for all are equal to 0, if they are, then no time fixed effects are needed. In

Table 2, we fail to reject the null that all years coefficients are jointly equal to zero which is 3.17. Therefore time fixed effects are not needed in this model.

Table 3 illustrates the intra-trade between Libya and the others AMU countries namely Algeria, Mauritania, Morocco, and Tunisia. The Hausman specification test statistic shows that the null hypothesis fail to reject and indicate that there was no systematic difference between fixed and random models, thereby confirmed that the random effects estimator was efficient in our empirical framework for intra-trade between Libya and among others AMU countries.

Table 3: Libya – Dependent variable: Trade

Variables	**Pooled Model**	**Fixed Effects Model**	**Random Effects Model**
$Constant$	-32.753 (-1.46)	94.9611 (0.72)	-35.953 (-1.06)
$lnGDP_{it}$	0.823** (2.64)	-0.203(-0.87)	0.8553*** (2.96)
$lnGDP_{jt}$	0.2911* (1.86)	0.115 (0.67)	0.3903* (1.64)
$lnPOP_{it}$	1.389*** (5.34)	8.010 (0.92)	1.659*** (4.49)
$lnPOP_{jt}$	4.441*** (2.96)	1.700 (0.98)	5.341** (2.41)
$lnDINS_{ij}$	-1.132*** (-6.25)		-1.892*** (-7.38)
$lnFCR_{ij}$	0.437 *** (5.00)	0.3487* (1.70)	0.338*** (5.25)
$lnRER_{ij}$	2.100*** (3.61)	1.509** (2.24)	2.430*** (3.31)
$lnOPENNESS_{ij}$	9.226*** (20.06)	9.585*** (37.67)	9.616*** (39.49)
$AGMT_{ij}$	0.233*** (5.32)	0.370** (2.72)	0.313** (2.58)
LAN_{ij}	-0.139 (-1.12)	-0.168 (-0.80)	-0.249 (-1.46)
F Test		1.82 [0.1512]	
LM Test			2.10 [0.1474]
Hausman Test		5.46 [0.7924]	
Time Fixed Effect		1.43 [0.2433]	
R-squared	0.9938	0.8737	0.9634
Number of Observation	84	84	84

Notes: *** indicates significant at 1%, ** indicates significant at 5%, and * indicates significant at 10%; t-statistics are in parentheses ( ) and p-value are in [ ].

The results show that an increase in the foreign GDP ($lnGDP_{it}$) and domestic GDP ($lnGDP_{jt}$) causes an increase in Libya's trade. The coefficient for both variables are positive by 0.8553 and 0.3903 in random effects model and statistically significant at 1 per cent and 10 per cent level, as expected and in line with the previous literature on trade. Overall, this indicates that an increase in foreign GDP and domestic GDP causes Libya trade to increase. The results also show that foreign GDP and domestic GDP are an insignificant in the fixed effect. The results are in line with those found in other gravity model studies suggesting that the results are consistent. These results also show that foreign GDP in Libya have the same impact in Algeria to the trades through the intra-trade between Algeria and others AMU countries as well as Libya and others AMU countries.

The population coefficients of foreign country ($lnPOP_{it}$) and domestic population ($lnPOP_{jt}$) are positive sign coefficient by 1.659 and 5.341 in random effects model and strongly significant at 1 per cent level. Population as gravitational variables is expected to have a positive sign. This reflects that countries with large GDP have more goods to trade and greater demand for good to import and export. These results also show that population of foreign country and domestic population in Libya have the same impact in Algeria to the trades through the intra-trade between Algeria as well as Libya and others AMU countries.

The distance variable ($lnDINS_{ij}$) in the random effects model has the right sign in the sense that increased trade is negatively correlated with distance. The coefficient is -1.892 and statistically significant at 1 per cent level. It is indicate that this variable may hide the fact that the transaction costs of trading in Libya in respect of distance are far higher than other AMU countries. This result consistent with Alam et al. (2009) stated that geographical distance has significant impact on imports of Bangladesh which means transport costs and other transaction costs, such as, the probability of surviving intact of perishable goods etc. still have significant impacts on its import. The result of the distance in Libya also had the same impact in Algeria in term of a resistance factor and has a negative impact on volume of intra-trade.

Libya's real exchange rate ($lnRER_{ij}$) has positive coefficient by 2.430 and statistically significant at 1 per cent level, implying that it have an

impact on trades. The foreign currency reserves ($lnFCR_{ij}$) are typically positive coefficient by 0.338 in and statistically significant at 1 per cent level. This result is consistent with previous evidence. The results show that the real exchange rate and the foreign currency reserves are akin to a price variable in the trade demand schedule.

As expected, trade and Openness ($lnOPEN_{ij}$) are correlated significantly and positively with each other. The coefficient of the openness is 9.616 and statistically significant at 1 per cent level. Given the strong and positive relationship between trade intensity ratios and growth, the existence of a significant correlation between trade and Openness indicates that Openness is fairly effective for increasing trade.

The interpretation of the coefficients on the integration dummy variables is also relevant for our analysis. The regression results in Table 3 are consistent with the predictions of theoretical studies, rather than the conventional view on the issue. Reports on the random effects model column show a significant and positive relationship between trade and agreement ($AGMT_{ij}$) among Libya and the others AMU countries. The coefficient is 0.313 and statistically significant at 1 per cent level. Since the model is log-linear, the impact of AGMT on bilateral trade can be computed in percentage terms as 100 x [exp(β_{AGMT}) − 1.00] or 100 x [1.36752 – 1.00] = 36.75%. This indicates that with the AGMT agreement, the percentage expansion of trade between Algeria and other four AMU countries is 36.75%. On the other hand, Libya, Mauritania and Tunisia demonstrate trade reduction by signing the PAFTA. The estimated coefficient of lagged English language (LAN_{ij}) is not significant. The Goodness of fit reflected by the R-square, as well as the total number of observations is given in the final rows. The overall goodness of fit of four estimation of the gravity model can be concluded that the specified models explain the variety in trade flows to a sufficient extends. Time fixed effects are needed if the independent variables for all are equal to 0, if they are then no time fixed effects are needed. In Table 3 we fail to reject the null that all years coefficients are jointly equal to zero which is 1.43. Therefore time fixed effects are not needed in this model.

Table 4 shows the intra-trade between Mauritania and the others AMU countries namely Algeria, Libya, Morocco, and Tunisia. The Hausman

test statistic shows that the null hypothesis is rejected and this indicates that the country specific effects are correlated with regressors. This suggests that the random effects model is appropriate, and the fixed effects estimates are not consistent. That means the random effects model is the appropriate one for trade of exports between countries.

Table 4: Mauritania – Dependent variable: Trade

Variables	**Pooled Model**	**Fixed Effects Model**	**Random Effects Model**
$Constant$	-690.563** (-2.12)	-551.172* (-2.01)	-690.563** (-2.36)
$lnGDP_{it}$	3.538* (1.76)	3.554** (6.90)	3.432*** (7.42)
$lnGDP_{jt}$	9.971*** (6.58)	9.962*** (9.68)	9.715*** (11.10)
$lnPOP_{it}$	1.036** (2.35)	2.479* (1.93)	1.067** (2.63)
$lnPOP_{jt}$	37.607* (1.93)	37.587* (1.93)	38.034** (2.08)
$lnDINS_{ij}$	-61.125** (-2.22)		-59.551*** (-3.21)
$lnFCR_{ij}$	1.199** (2.16)	1.162** (2.45)	1.210** (2.69)
$lnRER_{ij}$	1.425 (1.27)	1.567 (0.99)	1.644 (1.18)
$lnOPENNESS_{ij}$	11.169*** (28.73)	11.172*** (66.30)	11.143*** (71.49)
$AGMT_{ij}$	2.846*** (3.48)	2.806* (1.84)	3.465*** (5.16)
LAN_{ij}	0.794 (0.62)	0.392 (0.19)	0.794 (0.66)
F Test		0.05 [0.9861]	
LM Test			2.10 [0.1477]
Hausman Test		0.14 [0.9325]	
Time Fixed Effect		0.56 [0.6462]	
R-squared	0.9229	0.9815	0.9939
Number of Observation	84	84	84

Notes: *** indicates significant at 1%, ** indicates significant at 5%, and * indicates significant at 10%; t-statistics are in parentheses ( ) and p-value are in [ ].

The results show that an increase in the foreign GDP ($lnGDP_{it}$) and domestic GDP ($lnGDP_{jt}$) causes an increase in Mauritania's trade. The coefficient for both variables are positive by 3.432 and 9.715 and statistically significant at 1 per cent level, as expected and in line with the previous literature on trade and also the results in Algeria and Libya. Overall this indicates that an increase in foreign GDP causes Mauritania trade to increase.

The domestic population ($lnPOP_{jt}$) is positive sign coefficient by 38.034 and strongly significant at 5 per cent level. Population as gravitational variables is expected to have a positive sign. This reflects that countries with large GDP have more goods to trade and greater demand for good to import and export. On the other hand, the population coefficients of foreign country ($lnPOP_{it}$) have positive coefficient but not significant at any level (1.067). This means no impact on trades. In relation to the foreign and domestic population variables, we should point out that their role in the Gravity setting is generally considered to be ambiguous (Oguledo and MacPhee, 1994).

The distance variable ($lnDINS_{ij}$) in the random effects model has the right sign in the sense that increased trade is negatively correlated with distance. The coefficients are -59.551 and statistically significant at 1 per cent level. It indicates that this variable may hide the fact that the transaction costs of trading in Mauritania in respect of distance are far higher than the others AMU countries.

Mauritania's real exchange rate ($lnRER_{ij}$) have positive coefficient (1.644) but statistically an insignificant, implying that it have no impact on trades. The foreign currency reserves ($lnFCR_{ij}$) is typically positive coefficient by 1.210 and statistically significant at 5 per cent level. This result is consistent with previous evidence (Harris and Matyas, 2001, Egger and Pfaffermayr, 2003, and Serlenga and Shin, 2004). We can conclude that the reason could well be that these simply represent the accumulation of trade flows combined with past exchange rate and the foreign currency reserves policies, rendering their effect on contemporaneous trade flows somewhat ambiguous. Trade and Openness ($lnOPENNESS_{ij}$) are correlated significantly and positively with each other. The coefficients are 11.143 and statistically significant at 1 per cent level. Given the strong and positive relationship between trade intensity ratios and growth, the existence of a significant correlation between trade and Openness indicates that Openness is fairly effective for increasing trade.

Table 4 also show that the random effects model column report show a negative relationship between trade and agreement ($AGMT_{ij}$) among Mauritania and other AMU countries. The coefficient is 3.465 and statistically significant at 1 per cent level. Since the model is log-linear,

the impact of AGMT on bilateral trade can be computed in percentage terms as 100 x [exp(β_{AGMT}) − 1.00] or 100 x [31.974 – 1.00] = 3,097.64%. This indicates that with the AGMT agreement, the percentage expansion of trade between Algeria and other four AMU countries is 3,097.64%. On the other hand, Libya, Mauritania and Tunisia demonstrate trade reduction by signing the PAFTA. The estimated coefficient of lagged English language (LAN_{ij}) is not significant.

The Goodness of fit reflected by the R-square, as well as the total number of observations is given in the final rows. The overall goodness of fit of four estimation of the gravity model concluded the specified models explain the variety in trade flows to a sufficient extends. Time fixed effects are needed if the independent variables for all are equal to 0, if they are then no time fixed effects are needed. In Table 4.3, we fail to reject the null that all years coefficients are jointly equal to zero which is 0.56. Therefore time fixed effects are not needed in this model.

Table 5 shows the intra-trade between Morocco and the others AMU countries namely Algeria, Libya, Mauritania, and Tunisia. The Hausman specification test statistic shows that the null hypothesis fail to reject and indicated that there was no systematic difference between fixed and random models, thereby confirmed that the random effects estimator was efficient in our empirical framework for intra-trade between Morocco and among others AMU countries.

Table 5: Morocco – Dependent variable: Trade

Variables	Pooled Model	Fixed Effects Model	Random Effects Model
$Constant$	-188.875 (1.56)	-154.840 (-1.23)	-168.875 (-1.26)
$lnGDP_{it}$	0.334** (2.21)	0.221 (1.39)	0.309** (2.01)
$lnGDP_{jt}$	2.152*** (3.80)	3.354*** (3.87)	3.041*** (3.41)
$lnPOP_{it}$	0.786* (1.78)	-1.292 (-0.71)	0.988 (1.63)
$lnPOP_{jt}$	4.112 (0.89)	7.781 (1.01)	5.492 (0.70)
$lnDINS_{ij}$	-1.885** (-2.06)		-2.985* (-1.96)
$lnFCR_{ij}$	0.482** (2.67)	0.420** (2.47)	0.402** (2.31)
$lnRER_{ij}$	2.837*** (4.93)	3.078*** (5.42)	2.837*** (4.93)
$lnOPENNESS_{ij}$	11.169*** (28.73)	11.172*** (66.30)	6.162*** (22.58)
$AGMT_{ij}$	-2.846*** (-3.48)	-2.806* (-1.84)	-0.055 (-0.80)
LAN_{ij}	-0.794 (-0.62)	-0.392 (-0.19)	2.10 (0.1477)
F Test		0.05 [0.9861]	
LM Test			2.10 [0.1477]
Hausman Test		0.23 [0.9735]	
Time Fixed Effect		0.59 [0.6352]	
R-squared	0.9229	0.9845	0.9613
Number of Observation	84	84	84

Notes: *** indicates significant at 1%, ** indicates significant at 5%, and * indicates significant at 10%; t-statistics are in parentheses ( ) and p-value are in [ ].

The results show that an increase in the foreign GDP ($lnGDP_{it}$) and domestic GDP ($lnGDP_{jt}$) causes an increase in Morocco's trade. The coefficient for both variables are positive by 0.309 and 3.041 and statistically significant at 1 per cent and 5 per cent level, as expected and in line with the previous literature on trade. Overall this indicates that an increase in foreign GDP causes Morocco trade to increase. The results are in line with those found in other gravity model studies suggesting that the results are consistent.

The population coefficients of foreign country ($lnPOP_{it}$) and domestic population ($lnPOP_{jt}$) are positive sign coefficient by 0.988 and 5.492

but strongly an insignificant at any level. This reflects that there is no impact on trade. The distance variable ($lnDINS_{ij}$) in the random effects model has the right sign in the sense that increased trade is negatively correlated with distance. The coefficients are -2.985 and statistically significant at 10 per cent level. It indicates that this variable may hide the fact that the transaction costs of trading in Morocco in respect of distance are far higher than the others AMU countries.

Morocco's real exchange rate ($lnRER_{ij}$) have positive coefficient by 2.837 and statistically significant at 1 per cent level, implying that it have an impact on trades. The foreign currency reserves ($lnFCR_{ij}$) is typically positive coefficient (0.402), and statistically significant at 5 per cent level. This result is consistent with previous evidence and the intra-trade between Libya and other AMU countries. The results show that the real exchange rate and the foreign currency reserves are akin to the price variable in the trade demand schedule.

Trade and Openness ($lnOPENNESS_{ij}$) are correlated significantly and positively with each other. The coefficients are 6.162 and statistically significant at 1 per cent level. Given the strong and positive relationship between trade intensity ratios and growth, the existence of a significant correlation between trade and Openness indicates that Openness is fairly effective for increasing trade.However, agreement ($AGMT_{ij}$) and English language (LAN_{ij})are not significant.

The Goodness of fit reflected by the R-square, as well as the total number of observations is given in the final rows. The overall goodness of fit of four estimation of the gravity model concluded the specified models explain the variety in trade flows to a sufficient extends. Time fixed effects are needed if the independent variables for all are equal to 0, if they are, then no time fixed effects are needed. In Table 5, we fail to reject the null that all years coefficients are jointly equal to zero which is 0.59. Therefore time fixed effects are not needed in this model.

Table 6 shows the intra-trade between Tunisia and the others AMU countries namely Algeria, Libya, Mauritania, and Morocco. The Hausman specification test statistic shows that the null hypothesis fail to reject and indicate that there are no systematic difference between fixed and random models, thereby confirmed that the fixed effects estimator

was efficient in our empirical framework for intra-trade between Tunisia and among others AMU countries.

The results show an increase in the foreign GDP ($lnGDP_{it}$) and the domestic GDP ($lnGDP_{jt}$) causes an increase in Tunisia's trade. The coefficients for these variables are positive by 0.808 and 1.056 and statistically significant at 1 per cent level, respectively, as expected and in line with the previous literature on trade. Overall this indicates that an increase in foreign GDP causes Tunisia trade to increase.

The population coefficients of foreign country ($lnPOP_{it}$) and domestic population ($lnPOP_{jt}$) are positive and have a positive sign coefficient by 2.843 and 5.076 and strongly significant at 1 per cent level, respectively. Population as gravitational variables is expected to have a positive sign. This reflects that countries with large GDP have more goods to trade and greater demand for good to import and export.

Tunisia's real exchange rate ($lnRER_{ij}$) have negative coefficient by -0.028 in but statistically not significant, implying that it have not an impact on trades. The foreign currency reserves ($lnFCR_{ij}$) are typically positive coefficient (1.383) and statistically significant at 1 per cent level. This result is consistent with previous evidence and the intra-trade between Tunisia and the others of AMU countries. The results show that the foreign currency reserves are akin to a price variable in the trade demand schedule.

Table 6: Tunisia – Dependent variable: Trade

Variables	Pooled Model	Fixed Effects Model	Random Effects Model
$Constant$	87.082*** (3.10)	-10.883 (-0.38)	87.621*** (4.50)
$lnGDP_{it}$	0.707*** (11.55)	0.808*** (12.57)	0.700*** (9.41)
$lnGDP_{jt}$	0.414*** (4.79)	1.056*** (4.43)	0.365*** (8.28)
$lnPOP_{it}$	7.551*** (32.42)	2.843** (2.77)	7.545*** (45.49)
$lnPOP_{jt}$	6.796*** (3.30)	5.076*** (4.31)	6.756*** (5.19)
$lnDINS_{ij}$	-0.482** (-2.32)		-0.475*** (-3.35)
$lnFCR_{ij}$	0.197*** (3.89)	1.383** (2.47)	0.197*** (6.15)
$lnRER_{ij}$	0.420** (1.79)	-0.028 (-0.11)	0.303 (1.16)
$lnOPENNESS_{ij}$	7.874*** (102.97)	7.880*** (116.38)	7.866*** (96.99)
$AGMT_{ij}$	1.307** (2.05)	0.031 (0.11)	1.320*** (5.16)
LAN_{ij}	0.380* (1.89)	-0.002 (-0.10)	0.380 (1.02)
F Test		11.75*** [0.0000]	
LM Test			1.99 [0.1585]
Hausman Test		35.32***[0.0001]	
Time Fixed Effect		15.58*** [0.0000]	
R-squared	0.9736	0.6565	0.9956
Number of Observation	84	84	84

Notes: *** indicates significant at 1%, ** indicates significant at 5%, and * indicates significant at 10%; t-statistics are in parentheses ( ) and p-value are in [ ].

In Table 6, trade and Openness ($lnOPEN_{ij}$) are correlated significantly and positively with each other. The coefficients are 7.880 and statistically significant at 1 per cent level. Given the strong and positive relationship between trade intensity ratios and growth, the existence of a significant correlation between trade and Openness indicates that Openness is fairly effective for increasing trade. The estimated coefficient of agreement ($AGMT_{ij}$) and English language (LAN_{ij}) are not significant in fixed effects model.

The Goodness of fit reflected by the R-square, as well as the total number of observations is given in the final rows. The overall goodness

of fit of four estimation of the gravity model concluded the specified models explain the variety in trade flows to a sufficient extends. Time fixed effects are needed if the independent variables for all are equal to 0, if they are, then no time fixed effects are needed. In Table 6, we reject the null that all years coefficients are jointly equal to zero which is 15.58. Therefore time fixed effects is needed in this model.

5. Conclusion

This paper attempts to identify the important of intra-trade among AMU countries namely Algeria, Libya, Mauritania, Morocco, and Tunisia. The results from the traditional approach of the gravity model, indicate that there are significant relationships between trade and GDP, population, distance, foreign currency reserves (FOC) and real exchange rate (RER) among the AMU countries. These results answered the first objective which is to examine the impact of regional integration on trade among the Maghreb countries. Overall we can conclude that the AMU has had mix relationships of intra-regional trade in the member countries. This study also shows that AMU's non-traditional trading partners are relatively more open to AMU's member states trade. On the hand, the dummy variables for trading agreement and English language have mix results. As shown by the study, the existence of a significant correlation between trade flows and openness shows that openness are fairly effective for increasing trade.

Several policy implications emerged from the analysis. First, identifying that trade direction, this is intra-trade and inter-trade. The intra-trade among AMU is below the expected level, this study clearly identifies that GDP, population, distance, Foreign currency reserve (FOC), and Real Exchange Rate (RER) measures to promote trade relationships and which look like remove barriers to trade is justified. Importantly, there is evidence that the deviation from the expected level of trade is increasing among AMU especially among Mauritania, Morocco, and Tunisia, further highlighting the need for appropriate policies in population and Real Exchange Rate (RER).

The real exchange rate is best thought of as a facilitating condition as keeping it at competitive levels and can be critical for jump-starting growth. From our study, we found that the real exchange rate gave mixed results of significant level. Algeria, Mauritania, and Tunisia have

a positive and negative impact, but not significant into trade among the other AMU countries, while only Libya and Morocco have positive and significant impact into the trade. From a policy perspective, it is important to consider where resources are most effectively used to promote trade. Furthermore, it is also important to consider the appropriate policy tools as these may well differ between countries. As the global exchange rate system is in a state of flux, it is important for AMU countries to work towards some kind of convergence with respect to exchange rate policies in the immediate term. There has to be a clear understanding among the foreign exchange authorities of the kind of interventions that will have to be made in the near term. This will facilitate increased intra-regional trade transactions. We found that the language is not significant to the Arab Maghreb Union trade more to countries where the official language is English, which suggests that sharing the same language promotes volumes of trade.

References

Alam, M. M., Uddin, M.G. S. and Taufique, K. M. R. (2009). Import inflows of bangladesh: the gravity model approach, *International Journal of Economics and Finance,* 1(1), 131-140.

Bergstrand, J.H. (1985). The gravity equation in international trade: some microeconomic foundations and empirical evidence. *Review of Economics and Statistics*, 67, 474-80.

Brenton, P., Baroncelli, E. and Malouche1, M. (2006).Trade and investment integration of the Maghreb, Middle East and North Africa.*Working Paper Series* No. 44, The World Bank.

Breuss, F. and Egger, P. (1999). How reliable are estimations of East-West trade potentials based on cross-section gravity analyses? *Empirica*, 26 (2), 81-95.

Darku, A. B. (2009), The gravity model and the test for the regional integration effect: the case of Tanzania, *The Journal of Developing Areas*, 43(1), 25-44.

Egger, P. (2000).A note on the proper econometric specification of the gravity Equation.*Economics Letters,* 66, 25-31.

Egger, P., and M. Pfaffermayr (2003). The Proper Econometric Specification of the Gravity Model: A Three-Way Model with Bilateral Interaction Effects. *Empirical Economics*, 28, 571-580.

Eita, J. H. (2008). Determinants of Namibian Exports: A gravity model approach. retrieved from http://www.africametrics.org/documents/conference08/day1/session2/eita.pdf

Endoh, M. (1999). Trade creation and trade diversion in the EEC, the LAFTA and the CMEA: 1960-1994, *Applied Economics*, 31, 207-21.

Ghosh, S., and Yamarik S. (2004).Are regional trading arrangements trade creating? an application of extreme bounds analysis. *Journal of International Economics*, 63, 369-395.

Hannik, D.M &Owusu, J.H. (1998) Has ECOWAS promoted trade among its members? *Journal of African Economics*, 7, 363-383.

Hassan, M. (2001). Is SAARC a viable economic block? Evidence from gravity model.*Journal of Asian Economics*, 12, 263-290.

Harris, M. and Matyas, L. (2001).Modelling Export Flows In The APEC Region: Static And Dynamic Gravity Model Approach, *Asia Pacific Journal Of Economics And Business*, 5, 97-118.

Kien, N. and Hashimoto, Y. (2005). Economic analysis of ASEAN Free Trade Area: By a Country Panel Data. Discussion Papers in Economics and Business, No. 12.

Lee, J., and Park, I. (2005). Free trade areas in East Asia: discriminatory or non-discriminatory? *The World Economy*, 28, 21-48.

Martinez-Zarzoso, I. and Nowak-Lehman, F.D. (2003). Augmented gravity model: An empirical application to Mercosur-European Union trade flows. *Journal of Applied Economics*, 6(2), 291-316.

Martinez-Zarzoso, I. and Nowak, F.D. (2004), Economic and geographic distance: explaining MERCOSUR sectoral exports to the EU, *Open Economies Reviews*, 15, 291-314.

Martinez-Zarzoso, I. (2008). Gravity model: an application to trade between regional blocs, *Atlantic Economic Journal*. 31(2), 174-187,

Mayer, T. &Zignago,S. (2005). *Market Access in Global and Regional TradeWorking Papers 2005-02*, CEPII research center.

Musila, J. W. (2004). The common market for Eastern and Southern Africa and Kenya's export trade, *International Journal of Social Economics*, 31(1/2), 67 – 77.

Oguledo, V. I. (1996). Gravity model estimation of trade flows effects of the ECOWAS. *The Negro Educational Review*, 47, 170-189.

Pusterla, F. (2007). Regional integration agreements: impact, geography and efficiency. *IDB-SOE Working Paper*, 2007, No. 1.

Rahman, M. (2005). The determinants of Bangladesh's trade: evidence from the generalised gravity model. School of Economics and Political Science, University of Sidney, *Working Paper*, No. 3.

Siliverstovs, B. and Schumacher, D. (2006).*To log or not to log, or how to estimate a gravity model?*Unpublished, DIW Berlin.

Tinbergen, J. (1962). *Shaping the World Economy*, the Twentieth Century Fund, and New York, NY.

Walsh, K. (2006). Trade in services: does gravity hold? a gravity model approach to estimating barriers to services trade, IIIS *Discussion Paper* 183.

Westerlund, J. and Wilhelmsson, F. (2006).*Estimating the Gravity Model without Gravity Using Panel Data*.Unpublished, Departments of Economics, Lund University.

World Bank (2001).*Algeria in Brief*.World Bank web site.

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Economics, Law Enforcement and Crime Connection [A Longitudinal Data Approach]

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Current study empirically investigates the effect of various socio-economic and law enforcement variables on crime rate by using cross-sectional time series data set of 35 districts of Punjab. An Interaction term of police strength with economic activity and divisional analysis on the basis of more or less crime dense districts has empirically proved that magnitude of deterrence effect of increasing police strength in a community depends upon its allocation regarding some specific characteristics of that area. An increase in Population growth and increase in Untraced Criminal cases by crime prevention authorities have a significant positive impact on crime rate of a society. While an increase in Economic Activity and Education level have a significant negative impact on crime rate. Initial findings have been obtained by applying fixed effect modal which are quite consistent with Log-linear, Least Square Dummy variable, Interaction term and Divisional analysis models that can be taken as robustness of our empirical findings. Furthermore, an empirical finding has revealed a strong positive relationship of increase in Police strength on crime rate of Lahore division which is indicating of low efficiency of police department in respective years. Current study stands distinct regarding policy purposes as it indicates a clear idea about allocation and performance of police in various divisions of Punjab along with identifying the socio-economic and demographic determinants of crime.

1. Introduction

There is a growing concern about higher crime rate in different areas of Pakistan which is a threatening situation regarding economic and political scenario of Pakistan. It needs a reasonable attention of all

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concerning authorities to take feasible actions related to minimize the illicit behavior of the natives of the country. Becker (1968) in his influential work has called criminals and law enforcement agencies as rational one which is a motivation for economists to identify various economic reasons behind high crime rate of some society.

Economics of Crime is a newly emerging discipline in Pakistan and few available studies comprises of time series data of country level seems less sufficient to explain the deep insights of nature of activity (crime). According to best of our knowledge most of the studies in this discipline has less concentrated on isolation of various socio-economic, demographic and law enforcement variables at districts and divisional level, therefore, understating or overstating their effect on crime rate[4]. All available studies ignored the possible heterogeneity among different districts and divisions of Pakistan as these studies only focused country level time series analysis [Jabbar, M. S., & Mohsin, H. M. (2014); Kennedy et al (2008)]. So space is available in literature to extend the crime and economics analysis on districts and divisions level in Pakistan.

Furthermore, direction[5] (sign) of police strength in most of the empirical studies of Economics of Crime, Law and Economics and Criminology creates ambiguity either increase in police strength has deterrence effect on crime rate or not. This study highlighted that deterrence effect of police strength on crime rate is conditional upon its decision of allocation by crime prevention authorities based on some specific characteristics of different areas or according to nature or severity of crime. For this purpose study focused on using a balance panel data set for the year (2008-2012) of thirty five (35) districts of Punjab [Pakistan] keeping in mind the regional disparity and use of suitable econometric technique to get more reliable empirical findings.

[4] There is no available study on panel data study of districts and divisional level in literature of Crime and Economics of Pakistan.

[5] Erdal Gumus (2002) defended his positive sign by arguing that, Government announces new vacancies in police department in those areas where there is high crime rate that leads to a positive sign between police strength and crime rate. While in context of Pakistan Jabbar, M. S., & Mohsin, H. M. (2013; 2014) have empirically explored negative sign between these two variables and state increase in police strength has a deterrent effect on crime rate as it enhance the probability of arrest that may increase the cost of crime.

Study has used an interaction term with respect to economic activity and has introduced regional dummy models to test either empirical findings of current study supports the above stated hypothesis or not?

It is of note that current study is using law enforcement variables along with socio-economic variables to avoid expected omitted variable bias in economic equation of crime. Moreover care has also been taken regarding use of some more reliable econometric technique to get empirical findings of this study.

Letter half of study is arranged as follow; Section 2 portrays literature review related to our work. Section 3 explains some economic theory of crime model that are used for empirical estimations. Section 4 portrays empirical results along with interpretation and discussion on empirical findings. Section 5 concludes our paper and some policy implications of current study have been suggested on the basis of our results.

2. Literature Review

History of illegitimate activities started with the history of human beings and it remained a subject of interest in every society. However economists re-concentrated on crime and economics discipline with modern ideas and techniques after Becker (1968) who concentrated on modeling the criminal behavior to show rationality of criminals also an optimal level of law enforcement by crime prevention authorities. He preferred private law enforcement to public law enforcement by arguing that it may lead to have a less burden on tax payers. He led the theoretical foundations of modern school of thought of crime and economics' discipline and after that Fleisher (1966), Tullock (1967), Rottenberg (1968), Stiggler (1974), Landes and Posners (1974) have also done seminal work in this discipline [Issac Ehlrich (1996)]. Now a bulk amount of literature comprises of time series, cross-sectional and panel data approaches is available to identify socio-economic factors which may declare a very reason of different magnitude of crime rate in different societies. A comprehensive literature supports to claim that if panel data set is available then it can control unobservable country specific characteristics that may be correlated with deterrent variable like Justice [Altindag D.T (2011) ; Entorf and Spengler (2000)].
At national level literature of crime and economics, few studies are available. Gillani et al. (2011) empirically investigated the effect of

unemployment, Inflation and poverty on crime rate in Pakistan by using a time series data 1975-2007. They applied Johenson cointegration approach to conclude that unemployment rate, poverty and inflation are granger cause of crime in Pakistan.

Jalil et al. (2010) has attempted to explore the link between urbanization and crime rate of Pakistan by using a time series date set for the year 1964-2008. He also used Johenson cointegration approach to report that lack of planning regarding to the expansion of urban areas increases crime rate while literacy rate and unemployment has a significant and negative impact on crime rate of the country.

The recent contribution in this newly emerging discipline at country level has been made by Jabbar and Mohsin (2014; 2013) in which they highlighted the measuring error problem in crime data and lack of deterrent variables in the economic modal of crime at country level literature. They emphasized the regional disparity in socio-economic and demographic variables of Pakistan so that not to overstate or understate the role of economics behind the illicit behavior. Using time series data set of Punjab from the year 1978-2013, they applied Johenson cointegration approach and showed that police strength, high conviction rate and education have significant negative impact on murder crime rate while the impact of unemployment on violent crime is ambiguous.

A common characteristic of above empirical investigations is that they have used time series data set with a limited number of observations while immense literature of said discipline has emphasized econometrics technique other than time series to claim more reliability of their empirical findings. For example, Entorf and Spengler (2000) emphasize to analyze the impact of demographic changes, unemployment and income inequality on crime rate at aggregate and disaggregate level in Germany. They tested the deterrence hypothesis by using static and dynamic economic techniques. They have found that socio-economic and demographic factors have strong influence on crime. Their empirical findings supported the theory of Ehrlich (1973) which states that absolute income of a country works as an opportunity for illegal activities. A high crime rate was found in high dens areas and young population found to be positively related to most of the categories of crime. While relationship between unemployment and crime remained ambiguous.

Similarly Altindag D.T (2011) has investigated the impact of unemployment on crime rate and found that an overall unemployment rate may be unable to identify people on the margin of committing a crime. Thus he decomposed the overall unemployment rate into labor force shares of the unemployed with primary education and high education. He used country specific panel data set of Europe and considered earthquakes, industrial accidents and the exchange rate movements as instruments for the unemployment rate. He concluded that 2SLS point estimates are larger than OLS estimates and only the unemployment of individuals with low education has a significant impact on crime rate.

So current study intends to fill this gap in country level literature of said discipline and we have used a panel data technique to identify various determinants of crime rate in districts and divisions of Punjab.

3. Theoretical Background of Economic Model of Crime

In social sciences, criminal behavior has been discussed by different theories however economists consider criminals as economic agents by stating that they participate in criminal sector to enhance their expected utility. They believe in rationality and argue that the choice of committing criminal activity depends upon its net-payoff (π_i). According to them participation in criminal sector (P_i) is decreasing function of expected cost (C_i) and an increasing function of gain (G_i) of some criminal activity. Simply it can be manipulated as under;

$$P_i = f(C_i, G_i) \quad (1)$$

$$C_i = f(dc_i, w_i, pa_i, fn_i) \quad (2)$$

$$G_i = f(L_i) \quad (3)$$

Where, C_i is total cost faced in committing a crime while dc_i has been labeled as direct cost faced by a criminal in term of time spend in planning and committing of a crime, efforts of self-defense[6]. Moreover in equation (2) w_i stands for foregone illegitimate labor market wages in case of arrest, accused, being convicted or condemned in case of

[6] Efforts made to avoid penalties, arrest, imprisonments or monetary fines etc.

some criminal activity. Furthermore pa_i stands for probability of arrest or conviction and fn_i represents the fines or other penalties in term of imprisonment. Finally in equation (3), G_i is gross gain and L_i is something gained (loot) as a result of criminal activity. Thus net pay off π_i can be defined as the difference of gross gain and total cost i.e.

$$\pi_i = G_i - C_i \quad (4)$$

Or

$$\pi_i = L_i - dc_i - w_i - pa_i\ fn_i \quad (5)$$

It can be claimed that a criminal activity takes place if and only if; $\pi_i > 0$

It is important to note that expected gain has been supposed as economic incentives because nature of activity under discussion is more responsive to socio-economic and law enforcement situations in some society [Becsi (1999)]. The above mentioned discussion is core of economic model of crime which has been used in this study and it has been stated as under;

Crime = f (Police Strength, untraced criminal cases, Population Growth rate, Economic Activity, Education)

Above stated economic equation of crime consists of socio-economic, demographic and law enforcement variables which are quite similar to the logic prescribed in most of the theoretical frameworks of discipline of Crime and Economics. There are two law enforcement variables labeled as Police Strength and Untraced criminal cases which are expected to be negatively correlated with crime rate. Police Strength is defined as number of Police stations available to per thousand people while the Untraced Criminal cases variable is defined as a ratio of untraced crime to total registered crimes in a district or division. Again it is quite logical that an increase into the number of untraced crime by the side of police department depicts their inefficiency in context of crime detection and crime prevention. It can result in boosting criminal behavior of the natives of that area because a lower clearance rate or increase in number of untraced crimes synonymously means a lower expected cost of committing some illegal activity.

Secondly, a demographic variable in form of population growth rate is likely to be positively correlated with crime rate of some district and thirdly there is a variable labeled as Economic Activity to represent the economic situation of districts. It is defined as a ratio of number of factories in a district to the total number of factories in a province. Intuitively, increase in number of factories in some district can be considered as a symbol of prosperity and urbanization of that district. It is worth noting that we have used Economic Activity instead of unemployment rate as it is considered as one of the most controversial variable in stating its true effect on crime rate [Chiricos (1988)]. Finally, a variable included in our modal is socio-economic in nature and has been labeled as education that can affect the decision of committing some crime.

3.1. The Empirical Procedure

In a country like Pakistan crime rate may be affected numerous unobserved characteristics which vary from district to district. These factors include family background, neighborhood effects, social contacts, geographic boundaries and political influence etc. These factors are not easy to observe but we cannot negate their strong influence on crime rate of some area. Since a longitudinal data take into account the effect of these implicit factors thus a fixed effect model seems more appropriate to get empirical results of current study. We have specified the following empirical equation to have our empirical findings;

$$C_{it} = c_i + \alpha X_{it} + u_{it} \quad (6)$$

$$C_{it} = c_i + \alpha_1 UT_{it} + \alpha_2 PS_{it} + \alpha_3 EA_{it} + \alpha_4 Ed_{it} + \alpha_5 Pop_{it} + u_{it} \quad (7)$$

$$t = 2008 \quad 2012 \; ; \qquad i = 1, 2 \qquad 32$$

Where C_{it} is total registered crime per thousand people in district i in time t. C_{it} is a function of deterrent, socio-economic, demographic and economic variables. We have measured the effect of untraced criminal cases (UT_{it}) on crime rate of some district and data related to it has been taken from Annual Crime Reports of DIG Crime Punjab.

Police stations available to per thousand people in a district have been used to measure the effect of increase in police strength (PS_{it}) on crime rate. While economic activity has been denoted by EA_{it} which represents the state of economic prosperity of that district as defined and discussed above in theoretical framework of this study. Socio-economic and demographic effects have been captured by literacy rate Ed_{it} and population growth by Pop_{it} respectively.

This study has used secondary data which has taken from different government publications. Data related to socio-economic and demographic variables has been taken from annual publications of Punjab Development Statistics (2008-2012). While the data related to deterrent variable defined as PS_{it} has been taken from Annual Administration Reports of DIG Establishment Punjab and data related to untraced criminal cases (UT_{it}) has been taken from Annual Administration Reports of DIG Crime Punjab. Our panel data set consists of five years as it is maximum available data due to limited numbers of annual publications starting from 2008 to 2012. We have incorporated 35 districts of Punjab (Pakistan) which give our data more diversification.

Idiosyncratic disturbances u_{it} in above mentioned empirical equations (6) & (7) are independent and identically distributed which changes both across time and districts while c_i is individual effect which captures unobserved factors that affect crime rate in each district of Punjab (Pakistan).

In fixed effect approach, individual effect can either be captured by dummy variable model or within transformation method but least square dummy variable model faces incidental parameter problem when there are too many groups in the panel (Baltagi 2001) and within group effect model removes incidental parameter problem as it does not require dummy variables. So we are using the following model to compute our parameters.

$$TC_{it} - \overline{TC}_{i\blacksquare} = \alpha(X_{it} - \bar{X}_{i\blacksquare}) + (u_{it} - \bar{u}_{i\blacksquare}) \qquad (8)$$

$\overline{TC}_{i\blacksquare}$, is total mean of district i$\bar{X}_{i\blacksquare}$ is mean of explanatory variables of district i. Another method used to remove the individual is first

differencing method but the difference lies between two estimates when time period is greater than 2. If there are only two time periods then two estimators are same (Wooldridge, 2002).

Slope dummies have introduced in the regression to check the relationship of police strength and total crime in each division of Punjab (Pakistan). It will enable us to claim either the coefficient of police strength differs across divisions or not. Moreover, an interaction term in economic model of crime has also introduced to see how the relationship between police strength and total crime rate changes when there is a high or low economic activity.

$$C^*_{it} = c_i + \alpha_1 UT^*_{it} + \alpha_2 PS^*_{it} + \alpha_3 EA^*_{it} + \alpha_4 Ed^*_{it} + \alpha_5 Pop^*_{it} + \alpha_6 PS^*_{it} * EA^*_{it} + u_{it} \quad (9)$$

UT^*_{it}, PS^*_{it} , EA^*_{it} , Ed^*_{it}, Pop^*_{it} are untraced criminal cases, police strength, economic activity, education and population growth respectively.

3.2. Descriptive Statistics and Graphical Analysis

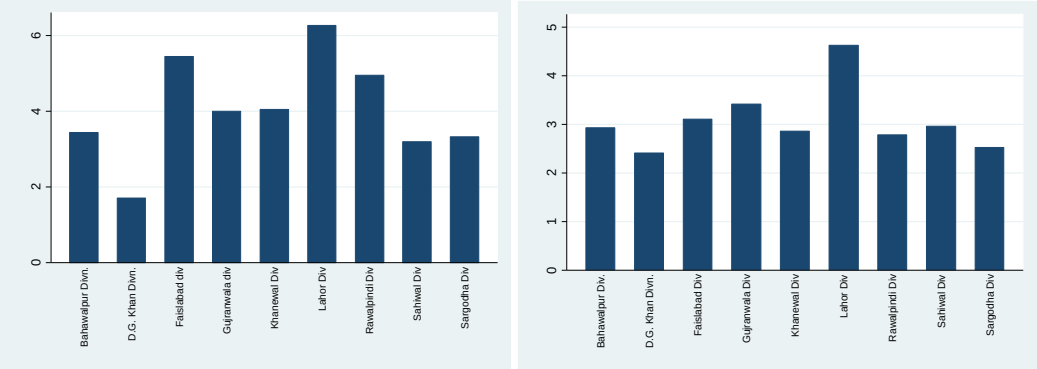
Table 1 shows values of mean, standard deviations and range of the variables used in econometric model. It reveals that on average there are 3.15 total registered crimes per thousand people in each district of Punjab with standard deviation of 1.11. There are 4.06 untraced criminal cases per thousand people in each districts of Punjab with a standard deviation of 2.75. In table 1, almost all variables are indicating a low standard deviation which shows less variability of data set.

Table 1: Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
TC	175	3.10	1.11	1.21	8.47
UT	175	4.06	2.75	.2	14.3
PS	175	.007	.001	.003	.01
Pop	175	1.58	.28	1.09569	2.22
Ed	175	56.85	11.67	27	80
EA	175	.09	.06	.0114329	.32

Graphical analysis of total crime per thousand people revealed that Lahore division has highest untraced criminal cases while D.G khan and Sargodha division are among the lowest side of crime. Performance of police is very weak in Lahore and Faisalabad divisions as there is greater number of untraced criminal cases in these divisions and Punjab police relatively performed well in D.G Khan, Sargodha and Sahiwal divisions as there are lower number of registered and untraced criminal cases.

Figure 1: Police is performing well in those divisions where there are lower untraced crime rate



4. Results and Discussion

After applying the group effect test which has indicated that intercepts differ across the districts. Thus pooled regression is not appropriate in current scenario. Hausman test directed us to estimate the regression model by using fixed effect model as regressors are correlated with individual effect. Regression results in table 2, column (1), are indicating that economic, socio economic, demographic and deterrent variables have significant impact on the total crime rate in one or another way.

Table 2: Empirical Estimations by Fixed effect Modal

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	TC	**TC**	**Log TC**	**Log TC**	**TC (LSDV)**	**TC (Less dens districts)**	**TC (High dens districts)**
Police Strength	181.2974*	238.474**	24.3806*	33.5525**	171.3231*	282.0303**	87.8152
	(78.6538)	(83.8437)	(11.8745)	(12.6451)	(77.8039)	(105.1671)	(62.5390)
Untraced criminal cases	0.1004**	0.0955**	0.0127*	0.0119*	0.0831*	0.1630***	0.1536**
	(0.0365)	(0.0355)	(0.0055)	(0.0054)	(0.0349)	(0.0470)	(0.0488)
Population Growth	4.1014***	4.2040***	0.5972***	0.6137***	4.1782***	6.7975***	6.1807***
	(0.9811)	(0.9772)	(0.1481)	(0.1474)	(0.9805)	(1.6611)	(1.7198)
Education	-0.0437**	-0.0431**	-0.0068**	-0.0067**	-0.0476**	0.0124	-0.0176
	(0.0155)	(0.0153)	(0.0023)	(0.0023)	(0.0150)	(0.0251)	(0.0231)
Economic activity	-4.4749*		-0.7099**		-0.7495**	-7.5611**	-5.2988*
	(1.7771)		(0.2683)		(0.2862)	(2.4186)	(2.3367)
Police Strength* Economic Activity		-644.352**		-102.908**			
		(228.9125)		(34.5239)			
_cons	-2.2722	-2.8589	-0.2600	-0.3546	-3.2294		
	(1.8852)	(1.9124)	(0.2846)	(0.2884)	(2.0075)		
N	175	175	175	175	175	80	80
R2	0.863	0.864	0.794	0.797	0.863	0.882	0.871

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Our foremost empirical finding is related to the deterrent variable, police strength, which indicates positive and significant relationship of police strength with the total registered criminal cases in districts of Punjab [Pakistan]. This empirical result is similar to Becsi (1999), Gumus (2004) and Buonnano et al (2008). These researchers instinctively justify their results by stating that Government announces new vacancies in police department when a high crime rate is observed in society which causes a positive relationship between these two variables. On the other hand Jabbar and Mohsin (2014), Sjoquist (2012), Baltagi (2006), Vollaard (2005), Kelaher and Sarafidis (2011) have found a negative relationship between police strength and crime rate. They have justified it with economic rationale that increase in police strength enhance the probability of arrest which may increase the expected cost of committing some criminal activity. So empirical literature gives mixed result regarding the relationship between police strength and total crime

rate and this conflict motivates to have a debate on the direction (sign) and magnitude of deterrence effect of police strength on the crime rate.

Magnitude of deterrence effect of increasing police strength in some area is conditional upon the decision of allocation of police strength. So we have introduced an interaction term of police strength and economic activities in our empirical model. Additional we have divisionally analyzed our empirical estimations on the basis of more crime dense and less crime dense districts and compared the coefficient of police strength in both regions.

Our empirical findings in column 2 &3 of table 1 enable us to claim that increase in police strength has a deterrent effect in those areas where economic activities are higher and vice versa. Since increase in economic activity depicts more industrialization or urbanization and crime is often considered as urban phenomenon that may leads crime prevention authorities to deter crime in urban areas first.

Secondly, divisional analysis on the basis of more crime dense and less crime dense districts in column 6 & 7 of table 2 clearly indicates that performance of Punjab police is relatively better in more crime dense districts of Punjab as crime prevention authorities concentrate more on those areas where there is a high crime rate. The above discussion aids us to conclude that deterrence effect of police in various districts and divisions of Punjab is also conditional upon the decision of its allocation. In other words, police allocation is geographically focused and authority is following hot spot policy rather community policy in Punjab.

The above mentioned fact become further clear when we incorporate slope dummies with police strength variable in our empirically model to analyze the relationship between these two variables. Empirical findings obtained in this regard are given below in table 3 which can be divided into three categories named as deterrent effect, strong positive impact and weak positive impact. Deterrent effect occurs in two divisions namely D.G Khan, Gujranwala and Sargodha Division and it is noteworthy that these divisions have a lower number of untraced criminal cases which also indicates relatively better performance of crime prevention authorities in these divisions.

On the other hand an increase in Police Strength has strong positive impact on crime rate in Lahore division. This indicates poor performance of police in this division due to strong political influence and a higher population density can. Since Lahore is capital of the province and a hub of most of the political activities and crime detection authorities may be more conscious about protection of political incentives rather than community policing. In Sahiwal and Rawalpindi divisions police strength has weak positive impact on total crime which shows relatively better performance of police as compare to Lahore Division.

Second foremost empirical finding of this study indicates that if there is increase in number of untraced criminal cases then it will have a significant positive impact on crime rate. It can be stated as inefficiency of police department in tracing criminal cases, thus leads to higher crime rate. Intuitively if police department has poor crime detection ability and a lot of registered crime remained untraced then it may leads to have a lower expected cost of committing crime that definitely will cause a high crime rate.

Thirdly, increase in population growth rate has a significant positive impact on the total crime rate which is quite rational and similar with the empirical findings of Jabbar and Mohsin (2013;2014), Regoeczi (2003), Keith Harries (2006), Buonnano et al (2008) and Erdal Gumus (2008). It seems reasonable to argue that in a dense populated area may lead to lower probability of arrest and reduces the cost of crime. As a result there will be a higher crime rate.

Table 3: Empirical Estimations with Slope Dummy Modal

	(1)	(2)	(3)	(4)	(5)	(6)
	TC	**TC**	**TC**	**TC**	**TC**	**TC**
Police Strength	217.0439**	201.9303**	109.0303	196.9998*	236.7010**	177.0199*
	(81.0307)	(77.2613)	(76.7764)	(83.9050)	(79.5647)	(78.7766)
Clearance Rate	0.0797*	0.0872*	0.0918**	0.0852*	0.0922**	0.0817*
	(0.0346)	(0.0342)	(0.0336)	(0.0350)	(0.0342)	(0.0351)
Pop growth	4.1102***	4.2294***	4.4098***	4.2291***	4.4618***	4.0945***
	(0.9727)	(0.9618)	(0.9439)	(0.9837)	(0.9628)	(0.9962)
Education	-0.0455**	-0.0583***	-0.0450**	-0.0472**	-0.0437**	-0.0478**
	(0.0149)	(0.0153)	(0.0144)	(0.0150)	(0.0147)	(0.0150)
Economic activity	-0.7481**	-0.8317**	-0.7427**	-0.7557**	-0.7373**	-0.7459*
	(0.2837)	(0.2826)	(0.2748)	(0.2866)	(0.2795)	(0.2871)
D.G. Khan Div.	-475.5793					
	(258.5017)					
Gujranwala Div.		-1261.11*				
		(499.895)				
Lahore Div.			256.0451***			
			(72.6936)			
Rawalpindi Div.				-187.1993		
				(227.3149)		
Sahiwal Div.					-204.7709**	
					(74.1441)	
Sargodha Div.						-253.0059
						(485.4327)
_cons	-3.2732	-1.3537	-3.6052	-3.4385	-4.3794*	-2.9323
	(1.9655)	(2.0932)	(1.9058)	(1.9914)	(1.9742)	(2.1150)
N	175	175	175	175	175	175
R2	0.866	0.869	0.875	0.864	0.870	0.863

The socio-economic variable in shape of literacy rate yields negative and significant relationship on total crime rate. Usher (1997), Lance Lochner (2007; 2001), Jalil (2010) and Jabbar and Mohsin (2013; 2014)

have also concluded same negative association of education and lucrative criminal opportunities. The economic rationale behind this negative relationship lies in the line of cost and benefit analysis that a criminal makes before committing some illicit activity. Since attaining education requires some monetary and time investment which increases the expectation about legitimate earnings and expected cost of crime in term of time, imprisonment or penalties becomes higher for a well-educated person [Lochner (2004) and Usher (1997)]. Moreover, schooling alters the way of thinking, changes the preference for risk taking and affects the social network (Lecher, 2007).

It is of worth note that empirical findings of current study do not change[7] when we estimate the regression equation by using least square dummy variable method (intercept dummies are not shown in this table) or in log linear arrangement. This tests the robustness of our empirical results[8]. Finally R-square in all regression models is greater than 0.78 which is quite convincing.

5. Conclusion and Policy Recommendations

This study has empirically analyzed the impact of law enforcement, economic, socio economic variables on total crime in 35 districts of Punjab [Pakistan] by using the fixed effect model which takes into account aggregation bias explicitly.

The Study has explored the relationship between police strength and total crime rate in a more comprehensive way by introducing an interaction term and regional slope dummies in the model as there are conflicting views on this issue in crime literature. Our initial results supported those arguments which suggest that high crime rates induces the government to increase the police strength in order to combat crimes, but results of our interaction term model suggested that government allocates police personnel on the basis of economic activity as police strength has deterrence effect in those districts where economic activities are higher and vice versa. Moreover, sample was divided into parts depending on high crime dense and low dense districts, results

[7] See column 3 for log linear estimations and column 5 for least square dummy variable

[8] See table 2

supported our argument and indicated that coefficient of police strength variable has weak positive impact in high crime dense areas.

Slope dummy variables have also introduced in economic model of crime to see how the relationship between police strength and total crime changes in different division and its results showed that relationship differs across division. Police strength have weak positive impact on total crime in Sahiwal and Rawalpindi divisions while deterrent effect occurs in those divisions (D.G Khan, Gujranwala and Sargodha Division) where untraced cases are low. It is of policy concern to note that Lahore division, which is considered as a hub of economic and political activities, has highest positive coefficient which shows the inefficiency of police department in this division. So there is need to review the police allocation and performance in this division.

Untraced cases has positive and significant impact on total crime rate as low untraced cases enhances the chances of getting caught and increase the cost of committing crime. Population growth has positive impact on the total crime since high density mitigates the probability of arrest. Literacy rate and economic activity plays a positive role in reducing total crime rate as our empirically results of all model showed that literacy rate and economic activity has negative impact on total crime rate. Robustness of results is checked by applying Least Square dummy variable model and log linear model and results remained the same.

References

Altindag, Duha T. (2012). Crime and unemployment: Evidence from Europe. International Review of Law and Economics, 32(1), 145-157.

Baltagi, Badi H. (2006). Estimating an economic model of crime using panel data from North Carolina. Journal of Applied Econometrics, 21(4), 543-547.

Becsi, Z. (1999). Economics and Crime in the States. Economic Review, (Q1), 38-56.

Becker Gary, S. (1968). Crime and punishment: An economic approach. Journal of Political Economy, 76(2), 169-217.

Becker, Gary Stanley, Landes, William M, & Landes, William M. (1974). Essays in the Economics of Crime and Punishment: National Bureau of Economic Research New York.

Buonanno, Paolo, & Montolio, Daniel. (2008). Identifying the socio-economic and demographic determinants of crime across Spanish provinces. International Review of Law and Economics, 28(2), 89-97.

Chiricos, Theodore G. (1987). Rates of crime and unemployment: An analysis of aggregate research evidence. Social problems, 187-212.

Ehrlich, Isaac. (1973). Participation in illegitimate activities: A theoretical and empirical investigation. The Journal of Political Economy, 521-565.

Ehrlich, I., (1996), "Crime, Punishment, and the Market for Offenses", Journal of Economic Perspectives, 10 (1), pp. 43-67.

Entorf, Horst, & Spengler, Hannes. (2000). Socioeconomic and demographic factors of crime in Germany: evidence from panel data of the German states. International review of law and economics, 20(1), 75-106.

Fleisher, B. M. (1966). The economics of delinquency. Quadrangle Books.

Gillani, Syed Yasir Mahmood, Rehman, Hafeez Ur, & Gill, Abid Rasheed. (2009). Unemployment, poverty, inflation and crime nexus: cointegration and causality analysis of Pakistan. Pakistan Economic and Social Review, 79-98.

Gumus, Erdal. (2003). Crime in urban areas: An empirical investigation.

Jabbar, M. S., & Mohsin, H. M. (2014). Does Police Strength and Conviction Help to Deter Violent.

Jabar M.S, Mohsin H.M. (2013), "Economics of Property Crime Rate in Punjab", Pakistan Development Review, Volume 52, Number 3 (2013)

Jalil, H. H., & IQBAL, M. (2010). Urbanisation and Crime: A Case Study of Pakistan. Pakistan Development Review, 49(4).

Kelaher, Richard, & Sarafidis, Vasilis. (2011). Crime and Punishment Revisited.

Landes, W. M., & Posner, R. (1974). The private enforcement of law.

Levitt, Steven D, & Lochner, Lance. (2001). The determinants of juvenile crime Risky behavior among youths: An economic analysis (pp. 327-374): University of Chicago Press.

Lochner, Lance. (2007). Education and crime. University of Western Ontario, 5, 8.

Lochner, L., &Moretti, E. (2001). The effect of education on crime: Evidence from prison inmates, arrests, and self-reports (No. w8605). National Bureau of Economic Research.

Punjab Development Statistics. (2007-2012). Government of Punjab Lahore: Bureau of Statistics.

Regoeczi, Wendy C. (2003). When context matters: a multilevel analysis of household and neighbourhood crowding on aggression and withdrawal. Journal of Environmental Psychology, 23(4), 457-470.

Rottenberg, S. (1968). The clandestine distribution of heroin, its discovery and suppression. The Journal of Political Economy, 78-90.

Tullock, Gordon, " The Welfare Cost of Tariffs, Monopolies, and Theft," Economic Inquiry, June 1967, 5, 224-32.01

Stigler, George, " The Optimum Enforcement of Laws," Journal of Political Economy, 1970, 78:3, 526-36.

Tullock, G. (1967). The welfare costs of tariffs, monopolies, and theft. Economic Inquiry, 5(3), 224-232.S

Usher, Dan. (1997). Education as a Deterrent to Crime. Canadian Journal of Economics, 367-384.

Vollaard, Ben. (2006). Police effectiveness: measurement and incentives.

Usher, Dan. (1997). Education as a Deterrent to Crime. Canadian Journal of Economics, 367-384.

Vollaard, Ben. (2006). Police effectiveness: measurement and incentives.

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