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The Determinants of Pakistan's Trade Balance: An ARDL Cointegration Approach

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Abstract

This article is an attempt to examine the short and long-run relationship between the trade balance, income, money supply, and real exchange rate in the case of Pakistan's economy. Income and money variables are included in the model in order to examine the monetary and absorption approaches to the balance of payments, while the real exchange rate is used to evaluate the conventional approach of elasticities (Marshall Lerner condition). The bounds testing approach to cointegration and error correction models, developed within an autoregressive distributed lag (ARDL) framework is applied to annual data for the period 1970 to 2005 in order to investigate whether a long-run equilibrium relationship exists between the trade balance and its determinants. Additionally, variance decompositions (VDCs) and impulse response functions (IRFs) are used to draw further inferences. The result of the bounds test indicates that there is a stable long-run relationship between the trade balance and income, money supply, and exchange rate variables. The estimated results show that exchange rate depreciation is positively related to the trade balance in the long and short run, consistent with the Marshall Lerner condition. The results provide strong evidence that money supply and income play a strong role in determining the behavior of the trade balance. The exchange rate regime can help improve the trade balance but will have a weaker influence than growth and monetary policy.

Keywords: Trade balance, ARDL, exchange rate, money supply, Pakistan.

JEL Classification: F10, F12, C15, C22.

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1. Introduction

A change in exchange rate policy to improve external competitiveness has now become the focal point of any adjustment effort. It is believed that a nominal devaluation will result in expenditure switching, increased production of tradable goods and services, higher exports and an improvement of the country's external accounts. Traditional stabilization packages and especially their devaluation component have come under attack in recent studies. It has been argued that devaluation can be counterproductive because exports and imports are relatively insensitive to price and exchange rate changes, especially in developing countries. If the price elasticities of imports and exports are sufficiently low, the trade balance expressed in domestic currency may worsen. Grubel (1976) has argued that a country's persistent payment imbalances can be due only to faulty monetary policy and cannot be corrected by either devaluation (exchange rate policy) or the use of fiscal policy. Similarly, Miles (1979) shows that devaluation does not improve the trade balance but improves the balance of payments. This result implies that the improvement comes through the capital account. He therefore concludes that the devaluation mechanism involves only a portfolio stock adjustment and is essentially monetary in nature.

Furthermore, there is a time lag before the trade balance improves following a currency depreciation. The short- and long-run effects on the trade balance of currency depreciation are different. Initially, the trade balance deteriorates after depreciation and then starts to improve until it reaches its long-run equilibrium. The time path that the trade balance follows generates a J-curve.

However, despite popular belief that depreciation can improve the trade balance, empirical work tends to suggest mixed results. Among 30 countries studied, Rose (1990) finds that the impact of devaluation on the trade balance is insignificant for 28 countries, while one country shows a negative impact. He concludes that devaluation does not necessarily lead to an increase in the trade balance. If valid, the issue of whether or not the trade balance will improve after devaluation becomes more important. These results have important policy implications. If exchange rate (devaluations) do not improve the trade balance, then the various stabilization packages that include some exchange rate realignment cannot be justified.

As a developing country, In Pakistan imports exceed exports due to which the country faces a large trade deficit every year. Similarly, it reported a balance of trade deficit equivalent to USD1278.4 million in

April 2010. Since 1982, the Pakistan rupee has been characterized by a managed float; the rupee was pegged to a basket of currencies with the US dollar being the main anchor currency. In 1998, to alleviate the financial crisis in Pakistan, the authorities adopted a multiple exchange rate system, which comprised an official rate (pegged to the US dollar), a floating interbank rate (FIBR), and a composite rate (combining the official and FIBR rates). With the economy recovering from the crisis in 1999, the three exchange rates were unified and pegged to the US dollar within a certain band. This band was removed in 2000. Since July 2000, Pakistan has maintained a floating rate, although central bank intervention continues, and therefore the issues of real depreciation to correct the trade balance remain controversial.

The main objective of the study is to examine the validity of the argument that exchange rate devaluation improves the trade balance. In addition, it attempts to test the short- and long-run empirical relevance of the absorption and monetarist approaches by incorporating the variables of income and money supply in the model. Variance decomposition and impulse response analyses are carried out to observe the direction, magnitude, and persistence of the trade balance in relation to variations in policy variables such as the real exchange rate, income, and money supply. Pakistan provides an ideal opportunity to examine this issue as in recent years its trade balance has deteriorated considerably. It also pursued a fixed exchange rate policy until January 1982. Since then, Pakistan has pursued a managed floating exchange rate policy to maintain external competitiveness. The subject matter concerns the various channels through which the trade balance can be improved.

The remainder of this paper is organized as follows. Sections 2 and 3 discuss briefly the relevant literature and various theories of the balance of payments from three different views, namely the elasticity, absorption, and monetary approaches. Section 4 presents the econometric methodology and data. Section 5 discusses the empirical results, and Section VI provides the main conclusions and policy implications.

2. Literature Review

Defining the exchange rate policy is one of the most important issues in the response of the trade balance to the real exchange rate (RER). The impacts of currency depreciation on a country's trade balance have been extensively examined in the empirical literature in the context of the Marshall Lerner condition and the J-curve theory. According to the former, currency devaluation improves the trade balance only if the sum of the

absolute values of import and export demand price elasticities exceeds unity. However, due to lag dynamics, the structure can worsen in the short run because of the inelastic demand for imports and exports in the immediate aftermath of an exchange rate change. Recently, numerous papers have tested the Marshall Lerner condition and J-curve. Bahmani-Oskooee and Niroomand (1999) have tested the Marshall Lerner condition for 30 developed and developing countries for the period 1960-1992. Gomes and Paz (2005) and Tsen (2006) find the existence of a long-run relationship between the trade balance, RER, foreign and domestic income for Brazil and Malaysia during 1965-2002. Bahamani-Oskooee and Ratha (2004) provide a good survey on the Marshal Lerner condition and J-curve, showing inconclusive results for this issue.

Rose (1991) has examined the empirical relationship between the real effective exchange rate and trade balance for five major OECD countries. He finds that the exchange rate is a statistically insignificant determinant of the balance of trade. Similarly, Rose and Yellen (1989) do not find any significant relationship between the RER and balance of payments. They examine bilateral trade flows between the US and other OECD countries using quarterly data. Most studies relating the exchange rate to the trade balance have found weak statistical evidence of such a relationship, i.e., Greenwood (1984), Mahdavi and Sohrabian (1993), Rahman and Mustafa (1996), and Rahman et al. (1997). Himarios (1989) and Bahmani-Oskooee (2001) have found weak statistical evidence connecting exchange rate changes and the trade balance. Mahmud et al. (2004) suggest that, although the Marshal Lerner condition holds during fixed exchange rate periods, it is less likely to do so in flexible exchange rate periods. Furthermore, Singh (2002) finds that the RER and domestic income explain a significant influence while foreign income shows an insignificant impact on the trade balance in India. Singh's study also demonstrates a very significant effect (+2.33) of the RER and domestic income (-1.87) on the Indian trade balance.

Tavlas (2003) has reviewed issues surrounding the exchange rate, particularly types of exchange rate regimes. Mussa (2002) and Edwards (2002) provide synoptic reviews and analysis of the RER. They point out that exchange rate misalignment issues are very important in the exchange rate regime literature. In other words, the fundamental fluctuations of macroeconomic policies lead to the disequilibrium of the RER; if the nominal exchange rate remains fixed, the result is misalignment between the RER and the new equilibrium rate. Furthermore, various studies have explored and tried to identify effective exchange rate regimes in a world increasingly characterized by high capital flow mobility. Goldstein (1992) proposes that countries choose

from among a broad spectrum of exchange rate arrangements and says that exchange rate commitments should be tailored to the characteristics and circumstances of individual countries.

A wide range of papers have tested the monetary and absorption approaches to balance of payments. Lardy (1996), Zhang, et al. (1999), and Liu, et al. (2001) have shown that foreign-invested firms have contributed significantly to China's impressive export expansion and economic growth. Using panel data at the provincial level from 1986 to 1997, Tse (1997) has shown that inward FDI has a positive effect on provincial manufacturing export performance. However, Sun (2001) argues that the role of FDI changes across regions in China. FDI has a positive and significant impact on exports from the coastal region to the central region and positive but statistically insignificant impact on export performance in the western region.

A study on ASEAN-5 countries by Kim-sen Liew et al. (2003) has shown that the trade balance in these countries is affected by real money rather than by the nominal exchange rate; it concludes that the role of exchange rate changes in trade balances has been exaggerated. However, very few attempts have been made to incorporate other views on the balance of trade/balance of payments analysis or to test these other views empirically. Duasa (2007) examines the short- and long-run relationships between trade balance, RERs, income, and money supply in the case of Malaysia. He includes income and money variables in his model in order to examine monetary and absorption approaches to the balance of payments beside the conventional elasticity approach, using exchange rates. Using the ARDL cointegration approach, he finds a positive but statistically insignificant relationship between the trade balance and exchange rate. The money supply and domestic income have a strong negative and positive impact on the trade balance (consistent with the monetary approach and absorption approach, respectively). The findings also suggest that the Marshall Lerner condition does not hold in the long run for Malaysia and that, policy wise, the Malaysian trade balance/balance of payments should be viewed from the absorption and monetary approaches.

3. Theoretical Framework

There are a number of theoretically distinct approaches to predicting the outcome of policy changes on the balance of payments. The elasticity approach describes the effects of changes in the exchange rate. This view is rooted in a static and partial equilibrium approach to the balance of

payments that is well known as the elasticity approach[1] (Bickerdike, 1920; Robinson, 1947; Metzler, 1948). It states that, starting from a balanced trade situation, devaluation will improve the balance of payments if the sum of the price elasticities (a measure of how much demand changes in response to a price change) of domestic and foreign demand for imports is larger than 1. Devaluation always improves the balance of payments if this condition is satisfied—although it is not a necessary condition of such improvement. The essence of this view is the substitution effects in consumption and production induced by the relative price (domestic versus foreign) changes caused by a devaluation. In particular, the Marshall Lerner condition states that, for a positive effect of devaluation on the trade balance, and implicitly for a stable exchange market, the absolute values of the sum of the demand elasticities for exports and imports must exceed unity. Assuming that the Marshall Lerner condition is met, when the exchange rate is above the equilibrium there is excess supply of foreign exchange and when the exchange rate is below the equilibrium there is excess demand for foreign exchange.

The absorption approach[2] to the balance of payments emerged at the beginning of 1950s when authors such as Harberger (1950), Meade (1951), and Alexander (1952, 1959) shifted the focus of economic analysis to the balance of payments. This approach is in some respects an alternative to the elasticity approach. It states that a country's trade balance will improve if its output of goods and services increases by more than its absorption—the expenditure by domestic residents of goods and services. This approach takes a more macroeconomic view of the balance-of-payments question and looks at production and expenditure for the economy as a whole. It argues that currency devaluation will be successful only if the gap between domestic output and expenditure widens. The theory has been criticized, however, from a number of directions: first, for ignoring the inflationary effects of devaluation; second, for being inappropriate if the economy is at full employment, in which case output cannot increase; third, for completely ignoring monetary factors; and fourth, for dealing with the balance of trade without taking account of capital movements.

A different approach, the monetarist approach[3] (Polak, 1957; Hahn, 1959; Pearce, 1961; Prais, 1961; Mundell, 1968, 1971) of the balance of payments emerged at the end of 1950s. This approach emphasizes the interaction between the demand and supply of money to determine the

[1] See Appendix 1 for further detail.
[2] See Appendix 2 for further detail.
[3] See Appendix 3 for further detail.

overall balance of payments position of the economy. Since, for any economy, the monetary base equals the sum of the domestic value of international reserves and the domestic asset holdings of monetary authorities, a change in international reserves is reflected in the change in the money supply. In very simple terms, if people demand more money than that being supplied by the central bank, then the excess demand for money will be satisfied by inflows of money from abroad. In this case, the trade balance will improve. On the other hand, if the central bank is supplying more money than is demanded, the excess supply of money is eliminated by outflows of money to other countries and this will worsen the trade balance.

The three different views presented above demonstrate that a country's balance of payments will be affected by changes in the domestic income level, money supply, and exchange rate. With regard to these different views, the present study develops a model that incorporates simultaneously all three approaches and uses it to analyze Pakistan's trade balance.[4] The reason for incorporating all three approaches in a single equation model is to verify their empirical relevance and validity and minimize the residual unexplained variation in the trade balance model.

4. Methodology and Data

The variable in this study, the trade balance, is measured as the ratio of export value (X) to import value (M). The ratio of X to M (i.e., X/M) or its inverse has been widely used in many empirical investigations of trade balance-exchange rate relationship, such as Bahmani-Oskooee and Brooks (1999), Lal and Lowinger (2001), and Onafowora (2003). This ratio is preferable because it is not sensitive to the unit of measurement and can be interpreted as the nominal or real trade balance (Bahmani-Oskooee, 1991). Gross domestic product (GDP) is used as a proxy for income and M3 for money supply. All variables are expressed in natural logarithms in order to estimate their elasticities.

The traditional approach to determining long run and short run relationships among variables has been to use the standard Johanson Cointegration and VECM framework, but this approach suffers from serious flaws as discussed by Pesaran et al. (2001). We adopt the autoregressive distributed lag (ARDL) framework popularized by Pesaran and Shin (1995, 1999), Pesaran, et al. (1996), and Pesaran (1997) to establish the direction of causation between variables. The ARDL method yields consistent and robust results both for the long-run and short-run relationship between

[4] This type of model has been estimated for the Malaysian trade balance by Duasa (2007).

trade balance and various policy variables. This approach does not involve pretesting variables, which means that the test for the existence of relationships between variables is applicable irrespective of whether the underlying regressors are purely *I(0)*, purely *I(1)*, or a mixture of both.

In order to obtain robust results, we utilize the ARDL approach to establish the existence of long-run and short-run relationships. ARDL is extremely useful because it allows us to describe the existence of an equilibrium/relationship in terms of long-run and short-run dynamics without losing long-run information. The ARDL approach consists of estimating the following equation.

$$\Delta \ln(TB)_t = \alpha_0 + \sum_{i=1}^{n} \beta_i \Delta \ln(TB)_{t-i} + \sum_{i=0}^{n} \delta_i \Delta \ln(GDP)_{t-i} + \sum_{i=0}^{n} \eta_i \Delta \ln(M3)_{t-i}$$
$$+ \sum_{i=0}^{n} \psi_i \Delta \ln(EX)_{t-i} + \lambda_1 \ln(TB)_{t-1} + \lambda_2 \ln(GDP)_{t-1} + \lambda_3 \ln(M3)_{t-1}$$
$$+ \lambda_4 \ln(EX)_{t-1} + \varepsilon_t \qquad (1)$$

The first part of the equation with β_i , δ_i , η_i and ψ_i represents the short-run dynamics of the model whereas the parameters λ_1, λ_2 , λ_3 and λ_4 represents the long-run relationship. The null hypothesis of the model is

H_0: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = 0$ (there is no long-run relationship)

H_1: $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq 0$

We start by conducting a bounds test for the null hypothesis of no cointegration. The calculated F-statistic is compared with the critical value tabulated by Pesaran (1997) and Pesaran et al. (2001). If the test statistics exceeds the upper critical value, the null hypothesis of a no long-run relationship can be rejected regardless of whether the under lying order of integration of the variables is 0 or1. Similarly, if the test statistic falls below a lower critical value, the null hypothesis is not rejected. However, if the test statistic falls between these two bounds, the result is inconclusive. When the order of integration of the variables is known and all the variables are *I(1)*, the decision is made based on the upper bound. Similarly, if all the variables are *I(0)*, then the decision is made based on the lower bound.

The ARDL methods estimates $(p+1)^k$ number of regressions in order to obtain the optimal lag length for each variable, where p is the maximum number of lags to be used and k is the number of variables in the equation.

In the second step, if there is evidence of a long-run relationship (cointegration) among the variables, the following long-run model (Equation 2) is estimated,

$$\ln(TB)_t = \alpha_1 + \sum_{i=1}^{n} \beta_i \ln(TB)_{t-i} + \sum_{i=0}^{n} \delta_i \ln(GDP)_{t-i} + \sum_{i=0}^{n} \psi_i \ln(M3)_{t-i} + \sum_{i=0}^{n} \eta_i \ln(EX)_{t-i} + \varepsilon_i \quad (2)$$

If we find evidence of a long-run relationship, we then estimate the error correction model (ECM), which indicates the speed of adjustment back to long-run equilibrium after a short-run disturbance. The standard ECM involves estimating the following equation.

$$\Delta \ln(TB)_t = \gamma_1 + \delta_1(ECM)_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta \ln(TB)_{t-i} + \sum_{i=0}^{n} \beta_i \Delta \ln(GDP)_{t-i} + \sum_{i=0}^{n} \eta_i \Delta \ln(M3)_{t-i} + \sum_{i=0}^{n} \psi_i \Delta \ln(EX)_{t-i} + \varepsilon_i \quad (3)$$

To ascertain the goodness of fit of the ARDL model, diagnostic and stability tests are conducted. The diagnostic test examines the serial correlation, functional form, normality, and hetroscedasticity associated with the model. The structural stability test is conducted by employing the cumulative residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ).

Furthermore, we simulate VDCs and IRFs for further inferences. VDCs and IRFs serve as tools for evaluating the dynamic interactions and strength of causal relations among variables in the system. The VDC indicates the percentages of a variable's forecast error variance attributable to its own innovations and innovations in other variables. Thus, from the VDC, we can measure the relative importance of the RER, income, and money fluctuations in accounting for fluctuations in the trade balance variable. Moreover, the IRF traces the directional responses of a variable to a one-standard deviation shock to another variable. This means that we can observe the direction, magnitude, and persistence of trade balance to variations in the RER, income, and money supply.

The variables in this study, trade balance (TB) and income (GDP), are taken from World Development Indicators. Data on money supply (M3) is taken from various issues of the Pakistan Economic Survey, while data on the real exchange rate (EX) are collected from the International Financial Statistics database. The data are annual and spans the time period 1970 to 2005.

5. Empirical Results

Before testing the cointegration relationship, a test of order of integration for each variable using the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests are conducted. Even though the ARDL framework does not require the pre-testing of variables, the unit root test could help in determining whether or not the ARDL model should be used. The results in Table-1 and 2 are the unit root test results of the Augmented Dickey-Fuller and Phillip Perron tests, respectively, showing that there is a mixture of *I(1)* and *I(0)* of underlying regressors and that, therefore, we can proceed with ARDL testing.

Trade balance (TB), gross domestic product (GDP) and money supply (M3) are integrated to the order of one *I(1)*, while the real exchange rate (EX) is integrated to the order of zero *I(0)*.

Table-1: Unit-Root Estimation (ADF Test)

Variables	Lag 1	Lag 2	Lag 3
TB	-3.101	-3.101	-3.101
ΔTB	-5.243*	-3.677**	-3.677**
GDP	-1.089	-1.089	-1.089
ΔGDP	-4.565*	-3.701**	-4.565*
M3	-2.645	-2.645	-2.645
ΔM3	-5.028*	-5.028*	-5.028*
EX	-3.221***	-3.221***	-3.221***
ΔEX	-7.072*	-7.072*	-8.461*

Notes: *, **, *** represents significant at 1%, 5% and 10%.

Table-2: Unit-Root Estimation (Philips Perron Test)

Variables	Lag 1	Lag 2	Lag 3
TB	-3.155	-3.120	-3.179
ΔTB	-6.186*	-6.240*	-6.258*
GDP	-2.383	-2.445	-2.453
ΔGDP	-5.032*	-5.014*	-4.992*
M3	-0.996	-1.116	-1.227
ΔM3	-4.507*	-4.523*	-4.544*
EX	-3.186	-3.275***	-3.345***
ΔEX	-7.006*	-6.996*	-7.000*

Notes: *, **, *** represents significant at 1%, 5% and 10%.

Now we turn to the ARDL approach to determining long-run relationships as mentioned in Table-4. The main assumption of ARDL is that the variables in model are cointegrated to the order of *I(0)* or *I(1)* or both. This lends support to the implementation of bounds testing, which is a three-step procedure. In the first step, we select a lag order on the basis of the Schwarz-Bayesian criteria (SBC) because the computation of F-statistics for cointegration is very sensitive to lag length. The lag length that minimizes SBC is 1. The calculated *F*-statistic (*F*-statistic = 4.233) is higher than the upper bound critical value at a 5% level of significance (3.67), using a restricted intercept and no trend as reported by Pesaran et al. (2001). This implies that the null hypothesis of no cointegration is rejected at 5% and that, therefore, there is a cointegrating relationship among the variables.

The empirical results of the long-run model obtained by normalizing the trade balance are presented in Table-3 (ARDL(0,0,1,0) selected based on the SBC and Table-4 (ARDL(1,0,1,0) selected based on the Akaike information criterion [AIC]).

Table-3: Estimated Long Run Coefficients using the ARDL Approach

ARDL (0,0,1,0) based on Schwarz Bayesian Criterion			
Dependent Variable: (TB)			
Variables	**Coefficient**	**t-Values**	**Prob-Values**
Constant	-7.706	-5.932	[0.000]
GDP_t	1.562	4.118	[0.000]
$M3_t$	-0.367	-3.267	[0.003]
$M3_{t-1}$	-0.889	-3.042	[0.005]
EX_t	0.560	3.385	[0.002]
R^2 = 0.901		F-Statistics (4, 29) = 65.923[0.000]	
Adjusted-R^2= 0.887		Durbin-Watson Stat =1.683	

Table-4: Estimated Long Run Coefficients using the ARDL Approach

ARDL (1,0,1,0) based on Akaike Information Criterion Dependent Variable: (TB)			
Variables	**Coefficient**	**t-Values**	**Prob-Values**
Constant	-6.132	-3.710	[0.001]
TB_{t-1}	0.252	1.819	[0.040]
GDP_t	1.302	3.187	[0.004]
$M3_t$	-0.242	-2.198	[0.036]
$M3_{t-1}$	-0.691	-2.198	[0.036]
EX_t	0.445	2.488	[0.019]
R^2 = 0.908		F-Statistics (5, 28) = 55.576[0.000]	
Adjusted-R^2= 0.892		Durbin-Watson Stat =2.007	

The results indicate that the domestic income level as measured by GDP is an important determinant of trade balance. Every 1% increase in real income yields an average 1.56% improvement in the trade balance (SBC selection criterion results) and a 1.30% improvement under the AIC selection criterion results. Similarly, the sign of the money supply variable is consistent with the monetary approach to trade balance. The theory indicates that a rise in domestic income increases the demand for money and will therefore increase exports and improve the trade balance. Also, a fall in domestic money supply improves the trade balance since foreigners send their money domestically for more goods and services. The impact of the exchange rate on the trade balance is positive and statistically significant. It suggests that the Marshall-Lerner condition holds in the long run in the case of Pakistan. The devaluation/depreciation of domestic currency by 1% on average improves the trade balance by 0.56% and 0.44% in the long run as suggested by the SBC selection criterion and AIC selection criterion respectively. It indicates that the sum of elasticities of exports and imports exceeds unity in the long run and that devaluation/depreciation improves the trade balance.

Table-5: Error Correction Representation for the selected ARDL-Model

ARDL (1,0,1,0) based on Akaike Information Criterion			
Dependent Variable: $\Delta(TB)_t$			
Variables	**Coefficients**	**t-Values**	***Prob*-Values**
Constant	-6.132	-3.740	[0.001]
ΔTB_{t-1}	0.251	1.819	[0.040]
ΔGDP_t	1.302	3.187	[0.003]
$\Delta M3_t$	-0.789	-2.978	[0.004]
$\Delta M3_{t-1}$	0.242	0.821	[0.418]
ΔEX_t	0.445	2.488	[0.019]
ECM_{t-1}	-0.749	-4.529	[0.000]
R-Squared = 0.449		Akaike Info Criterion = 16.446	
Adjusted R^2 = 0.351		Schwarz Criterion = 11.867	
Durbin-Watson Stat = 2.007		F-Statistic (4, 29) = 5.713[0.002]	

The results of the ECM for trade balance are presented in Table-5. Most of the coefficients in the short run are significant, except for the lag difference of money supply. The positive sign of the coefficient of income variable does not support the Keynesian view that income increases will encourage citizens to buy more imported goods and thus worsens the trade balance. However, this impact could only be observed in the short run. Money supply has a negative and statistically significant impact on the trade balance and the magnitude of the impact is much higher than that of the long-run impact, indicating that the impact of change in money supply is much stronger in the short run. However, the impact of the exchange rate on the trade balance is almost the same in the long run and short run. Furthermore, the exchange rate has a positive and highly significant effect on the balance of trade. This implies that the Marshall-Lerner condition holds even in the short run.

We apply a number of diagnostic tests to the ECM, finding no evidence of serial correlation, heteroskedasticity and ARCH (Autoregressive Conditional Heteroskedasticity) effect in the disturbances. The model also passes the Jarque-Bera normality test which suggests that the errors are normally distributed.

The significance of an error correction term (ECT) shows causality in at least one direction. The lagged error term (ECM_{t-1}) in our results is negative and highly significant. The coefficient of -0.74884 indicates a high rate of convergence to equilibrium, which implies that deviation from the long-term equilibrium is corrected by 74.88% over each year. The lag length of the short-run model is selected on basis of the AIC.

From an estimated VAR, we compute VDCs and IRFs, which serve as tools for evaluating the dynamic interactions and strength of causal relations among variables in the system. In simulating VDCs and IRFs, it should be noted that VAR innovations may be contemporaneously correlated. This means that a shock in one variable may work through the contemporaneous correlation with innovations in other variables. The responses of a variable to innovations in another variable of interest cannot be adequately represented since isolated shocks to individual variables cannot be identified due to contemporaneous correlation (Lutkepohl, 1991). Therefore, we use Cholesky factorization which orthogonalizes the innovations as suggested by Sims (1980) to solve this identification problem. The strategy requires a prespecified causal ordering of the variables. The results from VDC and IRFs may be sensitive to the variables' ordering unless the error terms' contemporaneous correlations are low. The ordering of variables suggested by Sims (1980) starts with the most exogenous variable in the system and ends with the most endogenous variable.

To see whether the ordering could be a problem, the contemporaneous correlations of VAR error terms are checked and displayed in Table-6. The results show that there are high correlations between trade balance and the RER, between RERs and M3, and between GDP and M3. Other correlations are mostly less than 0.2. Based on this, we can arrange the variables according to the following order: M3, GDP, EX, and TB.

VDC is an alternative method to IRFs for examining the effects of shocks on dependent variables. It shows how much of the forecast error variance for any variable in a system is explained by innovations to each explanatory variable over a series of time horizons. Usually, own series shocks explain most of the error variance, although the shock will also affect other variables in the system. From Table-6, the VDC substantiates the significant role played by GDP, M3, and EX in accounting for fluctuations in the Pakistani TB. At the one-year horizon, the fraction of Pakistan's trade balance forecast error variance attributable to variations in income, money supply, and RER are 41.64%, 12.2%, and 1.28%, respectively. The explanatory power of all variables increases further at the 4-year horizon, but the percentage of trade balance forecast variance explained by

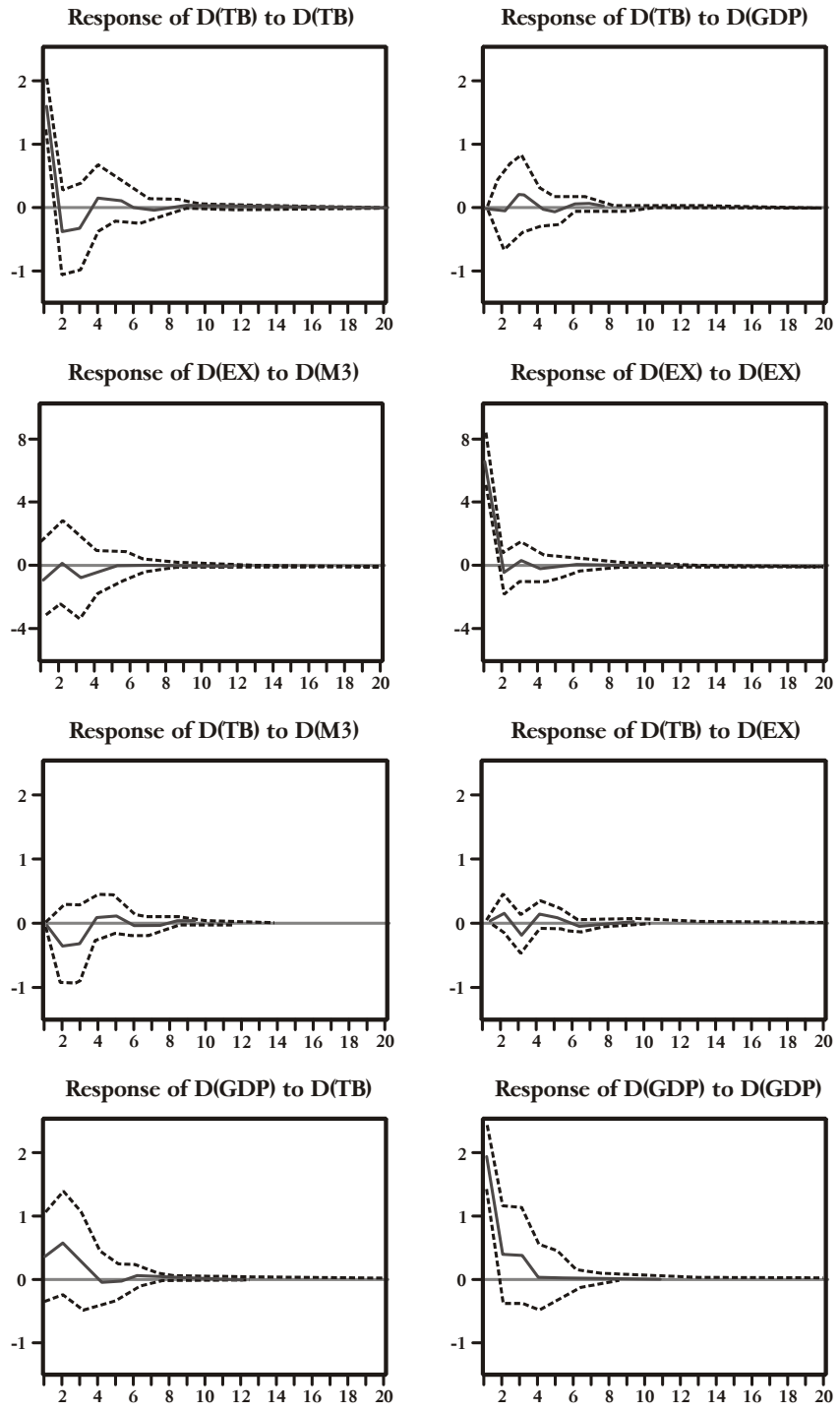
innovations in EX is smaller than explained by innovations in other variables. However, the portion of trade balance variations explained by all explanatory variables increases continuously over longer horizons, for which the percentage of forecast variances in the trade balance is largely explained by innovations in GDP among other explanatory variables as it maintains higher percentages than the others.

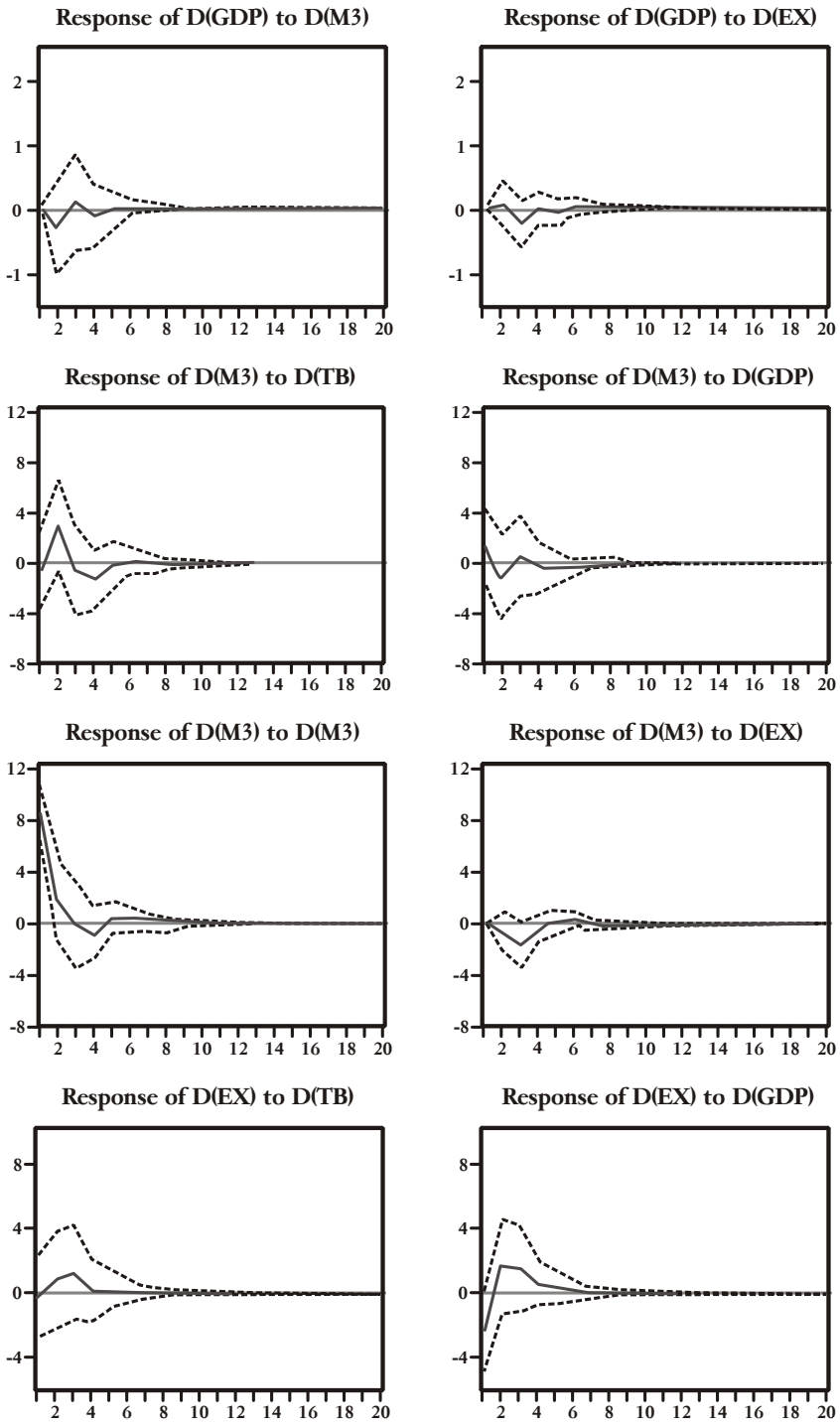
Looking along the main diagonal, the results reveal that the own shock is relatively high for GDP and TB, at 96.24% and 49.82%, respectively. This implies the exogeneity of GDP and TB in VDCs, as after the first year after the shock, the variance appears to be less explained by innovations in other explanatory variables. On the other hand, the results shows that the percentage of variance explained by own shocks for M3 and EX are similar to 24.89% and 26.91%, respectively.

Table-6

% of Forecast Variances Explained by Innovation in				
Horizon	**TB**	**GDP**	***M3***	***EX***
(a) Variance Decomposition of TB				
1	66.459	41.64903	12.201	1.281
4	49.817	38.023	11.932	1.061
9	49.817	38.023	11.932	1.061
15	49.817	38.023	11.932	1.061
24	49.817	38.023	11.932	1.061
(b) Variance Decomposition of GDP				
1	2.023	97.976	6.829	0.938
4	3.227	96.242	7.073	0.941
9	3.224	96.242	7.073	0.941
15	3.224	96.242	7.073	0.941
24	3.224	96.242	7.073	0.941
(c) Variance Decomposition of M3				
1	6.263	71.508	25.488	0.578
4	5.994	66.459	24.891	0.617
9	5.722	66.459	24.891	0.617
15	5.722	66.459	24.891	0.617
24	5.722	66.459	24.891	0.617
(d) Variance Decomposition of EX				
1	0.874	14.286	3.018	29.450
4	4.153	8.546	2.948	26.906
9	4.153	8.546	2.948	26.906
15	4.153	8.546	2.948	26.906
24	4.153	8.546	2.948	26.906

Figure 1: Impulse Response Functions
Response to Cholesky One S.D. Innovations ±2 S.E




Response of D(GDP) to D(M3)
Response of D(GDP) to D(EX)
Response of D(M3) to D(TB)
Response of D(M3) to D(GDP)
Response of D(M3) to D(M3)
Response of D(M3) to D(EX)
Response of D(EX) to D(TB)
Response of D(EX) to D(GDP)

6. Conclusion

This study reviews and tests the three major alternative theories of balance of payments adjustments. These theories are the elasticities and absorption approaches (associated with Keynesian theory), and the monetary approach. In the elasticities and absorption approaches, the focus is on the trade balance with unemployed resources. In the monetary approach, on the other hand, the focus is on the balance of payments with full employment. The monetary approach emphasizes the role of demand for and supply of money in the economy. Thus, the present study is an attempt to assess the three major approaches simultaneously in a dynamic model for the Pakistani balance of trade.

The method used is a bounds testing approach to cointegration, developed within an ARDL framework to investigate the existence of a long-run equilibrium relationship between trade balance, income, money supply and exchange rates. The results provide strong evidence that money supply and income play a stronger role in determining the long run as well as short run behavior of the trade balance in Pakistan as compared to the exchange rate, since money supply and income level have a much stronger impact on trade balance. The policy implication is that difficulties in the trade balance should be corrected through policies for income or growth as well as money supply. Although the exchange rate regime can improve the trade balance, it has a weaker influence than monetary policy.

Appendix-1

Elasticities Approach to the Balance of Trade

The effect of exchange rates on international trade will depend on the elasticities of demand and supply for goods and services.

Elasticity of Demand: e_d = (% change in quantity) / (% change in price)

Total revenue = PQ, as P changes total revenue will depend on elasticities

$e_d > 1$, elastic, PQ and P move in opposite directions, and BOP will improve.

< 1 , inelastic, PQ and P move in same directions, BOP will become worsen.

$= 1$, unit elastic, PQ unaffected by P, BOP will remain unaffected.

Appendix-2

Absorption Approach to the Balance of Trade

Trade balance is difference between what the economy produces and what it spends (absorbs)

If Y = C+I+G+(X-M)

then (X-M) = Y-(C+I+G)

A surplus country produces more than it absorbs and deficit country produces less than its absorption.

A devaluation of the domestic currency when there is unemployment may stimulate production and increase the trade surplus or reduce the deficit. Devaluation with full employment will create inflation as foreigners increase demand for domestic goods but no more can be produced in the short run.

Appendix-3

Monetary Approach to the Balance of Payments

Balance of payments flows have implications for money supplies.

1. With fixed exchange rates, money will flow between countries and prices will change to maintain equilibrium.

Draw the line in the balance of payments so only official monetary transactions are below the line and we have the impact of the balance of payments on international reserves.

2. International reserves are part of base money-the base for expansion of the money supply.

A Simple MABP Model:

$$L = kPY \qquad (A1)$$

where L is money demand, k is fraction of national income held as money, P is the price level and Y is real GDP.

$$M = R + D \qquad (A2)$$

where M is money supply, R is international reserves and D is domestic credit.

$$P = EP^F \qquad (A3)$$

where P is domestic price level, E is exchange rate and P^F is foreign price level.

Putting equation (3) in equation (1) and equating to equation (2) as at equilibrium money demand will be equal to money supply.

$$L = M$$

$$L = kEP^FY$$

$$kEP^FY = R + D \qquad (A4)$$

In percentage changes form equation (4) can be written as

$$\hat{E} + \hat{P}^F + \hat{Y} = \hat{R} + \hat{D} \qquad (A5)$$

Under the fixed exchange rate equation (4) can be:

$$\hat{R} = \hat{P}^{F} + \hat{Y} - \hat{D} \qquad \text{(A6)}$$

And with managed float exchange rate:

$$\hat{R} - \hat{E} = \hat{P}^{F} + \hat{Y} - \hat{D} \qquad \text{(A7)}$$

- Monetary policy causes reserve outflows or BOP deficits.
- A country will eventually run out of reserves to support such a deficit and a devaluation of the exchange rate will occur.
- Can cure a BOP deficit by restrictive monetary policy rather than exchange rate change-devaluation is a substitute for reducing money growth.
- Higher domestic income is associated with improvement in the BOP.

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Unilateral Liberalization versus Regional Integration: The Case of ECO Member Countries

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Abstract

Using an international dataset on bilateral trade for 137 countries in 2005, we estimate a gravity model to address the question of whether intra-Economic Cooperation Organization (ECO) trade is too low and whether the scale of trade at present is accounted for by regional integration or unilateral liberalization. The results of the gravity model confirm that intra-regional trade is lower than predicted by the gravity equation. The results also validates the theory that the present level of trade is attributed to regional agreements rather than unilateral liberalization, suggesting greater scope for regional cooperation among ECO member countries.

Keywords: Bilateral trade, economic cooperation organization, regionalism.

JEL Classification: N70, P45.

1. Introduction

Several theories of regionalism emerged in the 1990s as a response to the sudden upsurge of regionalism in the world in the second half of the 1980s and early 1990s. Some focused on the welfare effects of regionalism, while others tried to pin down the political economy rationale for such moves. In general, the success of the European Union (EU), the oldest regional scheme and the relation between the US and the EU, have spurred these theoretical developments. Studies of actual cases of integration, however, are far fewer.

In particular, the spread of regionalism among small countries and the possible motivation for these countries to enter into South-South regional integration agreements (RIAs) in the 1990s have received very little attention. Yet this kind of regionalism is booming once again and, as opposed to the frustrating experience of South-South regionalism in the 1970s, seems to be succeeding.

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What has pushed these countries to try the regional route once again? The purpose of this paper is to explore the motivation for recent regionalism among Economic Cooperation Organization (ECO) member countries. There has been a radical change in the foreign trade policy of ECO countries. Having restricted trade policies during the postwar period, the region turned toward more open regimes. What made regionalism in the ECO region suddenly so attractive was the evolution of regionalism in the North. There has been a significant revival of regionalism in that part of the world. Regional preferential trade agreements of different kinds have been established. As a result of such agreements, intra-regional trade has rapidly increased. The success of the EU and Association of Southeast Asian Nations (ASEAN) in promoting international trade and stimulating economic development has also encouraged other countries to form economic groups.

Seen in this perspective, Pakistan, Turkey, and Iran laid the foundations of Regional Cooperation for Development (RCD) in 1964. Under the RCD, member countries cooperated in the fields of trade, communications, banking, industry, political and cultural affairs, railways, and transportation. The organization was renamed the Economic Cooperation Organization or ECO in 1985. Seven new members, namely Afghanistan, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan joined the regional bloc in May 1992.

Traditionally, almost all of the ten member countries of the ECO have been trading with each other for centuries. In order to institutionalize their traditional relations, member states took the initiative to establish the RCD in 1964 and ECO in 1985.

Pakistan is characterized by a policy of closer and growing relations with all countries in general and neighboring ones in particular. In light of the above mentioned policy, the country has been striving to strengthen trade ties with ECO countries. Unfortunately, their share in intraregional trade has remained negligible, despite the fact that the member countries of ECO are linked with each other geographically.

The available information presents a dismal picture of the current state of intraregional trade in the ECO region. Member countries still rely heavily on industrial economies for their exports and imports. Mutual trade in the region has become stagnant over time. The share of intraregional trade in the world trade of countries in the region remained more or less constant at around 6.0% in 2005. Intraregional trade continues to remain a marginal part of the ECO.

Keeping in view the background of ECO countries in terms of the status of their interrelated low share of trade, there is a need to ask why trade among ECO countries is so low and whether it can rise? The rest of the paper has been developed to respond to this question and to identify the magnitude of mutual trade. It can be said that there exists untapped/unexplored potential in the region, which needs to be harnessed through collaborative plans and actions to achieve the target of higher intraregional trade.

2. Empirical Analysis

2.1. Theoretical Background of the Model

The gravity model has been used widely used in the empirical literature to explain bilateral trade between countries. The first important attempt to provide a theoretical basis for gravity models was the work of Anderson (1979), which did so in the context of a model where goods were differentiated by country of origin and where consumers have preferences defined over all the differentiated products.

Deardorff (1998) shows that a gravity model can arise from a traditional factor-proportions explanation of trade and derived a gravity-type relationship from it. Anderson and Wincoop (2003) develop a model of monopolistic competition in differentiated products and Helpman, et al. (2004) developed a theoretical model of international trade in differentiated goods with firm heterogeneity.[1]

The important contribution of Anderson and Wincoop's (2003) paper has been to highlight that controlling for relative trade costs is crucial for a well-specified gravity model. Their theoretical results show that bilateral trade is determined by *relative* trade costs, that is, the propensity of country *i* to import from country *j* is determined by country *i*'s trade cost toward *j* relative to its overall "resistance" to imports (weighted average trade costs) and to the average "resistance" facing exporters to country *j,* and not simply by the absolute trade costs between country *i* and *j*.

In terms of the empirical gravity model, this implies that, after controlling for country size and bilateral distance, trade will be higher between country pairs that are far from the rest of the world than between country pairs that are close to the rest of the world.

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[1] This model is built along the lines of Melitz (2003) where firms face fixed and variable costs of exporting. Firms vary by productivity, and only the more productive firms will find it profitable to export.

McCallum (1995) concludes that whatever the reasons may be and whatever the future may hold, the fact that even the relatively innocuous Canada-US border continues to have a decisive effect on continental trade patterns suggests that national borders in general continue to matter.

Another recent study that applies the gravity model to RIAs is Frankel (1996). He estimates a gravity model using a sample of 63 countries for various years between 1965 and 1992. In its basic form, Frankel's model includes dummies for adjacency, common language, and the traditional bloc dummies. His general conclusion is that the new wave of regionalism has resulted in a significant concentration of trade within different blocs all over the world. Even after holding constant for such natural determinants of bilateral trade such as size and distance, intraregional concentrations of trade continue to appear in various parts of the world.[2]

2.2. Gravity Model

Gravity models are econometric models of trade that have acquired their name from their similarity to Newton's theory of gravity. Newton's Law states that the force of gravity between two bodies is positively related to the mass of the attracting bodies and inversely related to the square of their distance. The gravity model of trade predicts that the volume of trade between any two countries will be positively related to the size of their economies (usually measured by gross domestic product [GDP]) and inversely related to the trade costs between them.[3]

The model in its most basic form says that trade between country *i* and country *j* is proportional to the product of GDP_i and GDP_j and inversely related to the distance between them. Other explanatory variables that are often added are other measures of size, namely, population and land areas and dummy variables like common borders, common language and common membership in regional trading arrangements.

2.3. Estimation of the Reference Model

The gravity equation used in the analysis is as follows:

$$\begin{aligned} Ln(T_{ij}) = {} & \beta_0 + \beta_1 Ln(GDP_i) + \beta_2 Ln(GDP_j) + \beta_3 Ln(PCI_i) + \beta_4 Ln(PCI_j) \\ & + \beta_5 Ln(DIST_{ij}) + \beta_6 (ADJ_{ij}) + \beta_7 (LANG_{ij}) + \beta_8 (ECO) + \epsilon_{ij} \end{aligned}$$

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[2] Frankel (1996) p. 113.
[3] Roberta Piermartini and Robert Teh (2006).

where T_{ij} is the trade between country *i* and country *j*, GDP_i is the gross domestic product of country *i*, GDP_j is the gross domestic product of country *j*, PCI_i is the per capita income of country *i*, PCI_j is the per capita income of country *j*, $DIST_{ij}$ is the distance between country *i* and country *j*, and ADJ is the dummy variable for common borders. ADJ takes a value of 1 if two countries have a common border and 0 otherwise. $LANG_{ij}$ is the dummy variable for a common language which takes a value of 1 if two countries have a common language and zero otherwise. ECO is the dummy variable for countries belonging to the ECO bloc. It is 1 when both countries *i* and *j* are part of the agreement and 0 otherwise.

As trade is expected to increase with the size of the domestic economy (GDP), level of development (PCI), and common border (ADJ), and declines with distance (DIST), β_1, β_2, β_3, β_4 and β_6 should be positive, and β_5 negative.

We expect trade to be positively affected by economic size (GDP) and negatively related to distance (DIST). The coefficients on per capita income (PCI) could be positive or negative[4]. Since trade is expected to increase with the size of the domestic economy (GDP), the expected sign on β_1 is positive.

GDP per capita indicates the stage of development of the countries:[5] countries with a higher income per capita may be expected to trade more than poorer countries. Distance, in turn, may be seen as a general proxy for the costs of trade behind which lie a variety of factors. Since a large part of these costs are made up by transport costs, various studies have gone through very detailed and complex measures of shipping distances.[6]

To the extent that neighboring countries can be expected to share many cultural traits, and that information from across the border is typically more readily available, a dummy for common borders or adjacency is normally also included in the gravity equation. Finally, and for the same reasons, having a common language should also be included.

Once all the above factors are considered, it is possible to assess whether or not a formal trade agreement is effective in concentrating trade among its members. To this end, dummy variables of bloc membership are

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[4] The impact of per capita income on trade is not straightforward. On one hand, the Linder hypothesis says that intra-industry trade increases when countries have similar per capita incomes. On the other hand, the comparative advantage theory, which is premised on different factor endowments, predicts a decline in inter-industry trade when countries have a similar income.

[5] See Brada and Mendez (1985) and Frankel (1996).

[6] For a review of these, see Frankel (1996).

added to the basic equation. If bilateral trade exceeds (or lies below) the 'normal' levels of trade (normality being defined as the sample's average bilateral trade flows) the bloc variables will be significantly different from zero.

The model was estimated using weighted least squares (WLS). The technique was used to take into account the presence of hetroskedasticity which arises when the variance of the error terms is not constant over all observations. In its presence, OLS estimators are unbiased and consistent but not efficient estimators of the true variance of the estimated parameters. Since one knows a priori that hetroskedasticity, if present, will be related to the size of the countries, the appropriate correction for it is the use of the WLS technique, using as weights a measure of the size of the countries. This is the procedure followed here, using as weights the logarithm of the exporter's GDP.

2.4. Data

The gravity equation was estimated for the year 2005. The export values for 137 countries were taken from the UN COMTRADE database. The data for GDP and PC GDP was obtained from the World Bank's (2005) World Development Indicators. The data related to the distance between capital cities and countries sharing borders and common languages was obtained from the French Centre for Exploratory Studies and International Information (Le CEPII, Centre d'Etudes Prospectives et d'Informations Internationales).

2.5. The Dependent Variable

There are two possibilities for measuring the size of a trade flow: at the point of export or at the point of import. Apart from the well-known differences in valuation—exports are valued at free-on-board prices, and imports usually at cost-insurance-freight prices—and apart from minor differences due to time-lags between the recording of exports by the exporting country and the recording of the same flow as an import by the importing country, these two measurements should produce the same results. This analysis uses mostly export data, most of which has been obtained from the UN COMTRADE database.

2.6. Estimation Results

The results of the model show that the three standard gravity variables (GDP, GDP per capita, and distance) are highly significant statistically at a 5% level of significance. The same is the case with adjacency

and language variables which are also significant statistically at a 5% level of significance. All variables carry their expected signs.

Table-1: Gravity Model Estimation
Dependent Variable is Total Exports: Method of Estimation Weighted Least Squares, Weight is the Log (GDP_i)

Explanatory Variable	Coefficient	t-Statistic
GDP_i	1.095	102.13
GDP_j	0.775	89.892
PCI_i	0.076	5.67
PCI_j	0.076	6.225
$DIST_{ij}$	-1.268	-56.505
Adjacency	1.062	9.183
Language	0.915	18.89
ECO	1.132	4.34
Constant	-27.934	-82.808
R^2	0.627	
Adjusted R^2	0.627	-
Std Error	2.1542	
Heteroskedasticity	520.928	
DW	1.754	-
No. of Observations	16,265	-

Table-1 presents the empirical results of the gravity model. The model's overall fit is good and compares favorably with other studies. As expected, trade increases with both domestic and foreign GDP and with per capita income, and falls with distance. Significant coefficients for GDP confirm that international trade is strongly affected by the trading partners' incomes. The estimated coefficient on the log of the exporting country GDP at 1.1 indicates that, when GDP increases by 1%, trade increases by 1.1%. In case of the importing country, the coefficient is 0.78, indicating that, when GDP increases by 1%, trade increases by 0.78%. The GDP per capita coefficient is also significant statistically, indicating that richer countries do in fact trade more than poor ones. The results of GDP and per capita GDP are

more or less the same when compared with the findings from other studies. For example, Clarete, Edmonds, and Seddon (2002), with a sample of 83 countries report exactly the same coefficients (1.1 for the GDP of the exporting country and 0.8 for the importing country's GDP). Frankel (1996), with a sample of 63 countries finds a coefficient for GNP of 0.93 in the year 1992. His findings for per capita GNP during the same periods are reported to be 0.13.

The coefficient on the log of distance is about -1.27, indicating that when distance between two countries is 1% higher, trade between them falls by 1.27%. The value of the distance coefficient is large, reflecting that transportation and communication among most member countries are generally more costly and act as a significant barrier to trade.

In the case of adjacency, the results are slightly higher when compared with previous studies. The value of the dummy for adjacency is 1.062. This means that in 2005, two bordering countries were trading 189% [exp(1.062) = 2.89] more than two nonadjacent countries. The adjacency dummy being significant indicates that the extent of trade flows between countries is ceteris paribus higher if these countries share a border. As regards the dummy variable for common language, with a coefficient of 0.92, it also has a heavy impact on trade.

Finally, if there were nothing to the notion of trade blocs, then the five basic variables in the gravity equation—size, per capita income, bilateral distance, common borders, and common languages—would account for most of the variation in bilateral trade flows, leaving little to attribute to a dummy variable indicating whether two countries are members of the same regional grouping. Variations in intraregional trade would be due solely to the proximity of countries and their rates of economic growth.

In our estimations the dummy variable is represented when both members of the country pair are among the ECO bloc. The estimated coefficient of ECO is significant statistically. The coefficient estimate is 1.1, indicating that in the year 2005, two members of ECO countries trade 210% more among themselves, after holding constant for GDP, proximity, and the other gravity variables.

2.7. Pakistan Potential Trade with ECO Countries

In order to predict Pakistan's potential trade with member states of the bloc, we compare the trade volumes estimated by the model with that

of the actual trade volumes of the member countries by using the parameter estimates produced by the gravity equation.

The following equation is used to analyze the results of Pakistan's predicted exports.

$$Ln(X_{ij}) = -27.93 + 1.1Ln(GDP_i) + 0.86Ln(GDP_j) + 0.08\ Ln(PCI_i) + 0.08\ Ln(PCI_j) - 1.27Ln(DIST_{ij}) + 1.06(ADJ_{ij}) + 0.92(LANG_{ij}) + 1.13(ECO)$$

The data for member countries GDP, PCI, and DIST etc., are used to estimate "normal" trade flows, which gives us an indication of the predicted trade volumes that prevail between member states of the regional bloc.

Table-2: Pakistan's Predicted Trade with the Reference Group (000, US$)

Partner Country	Actual Exports	Predicted Exports	Actual: Predicted Ratio
Afghanistan	222,316.7	228,463.7	0.973094
Azerbaijan	1,811.428	8,813.905	0.205519
Iran, Islamic Rep	41,775.36	395,510.2	0.105624
Kazakhstan	11,291.11	91,980.18	0.122756
Kyrgyz Republic	1,128.448	12,934.89	0.087241
Tajikistan	618.282	17,072.92	0.036214
Turkey	110,097.9	98,044.97	1.122933
Turkmenistan	2,094.967	15,134.69	0.138421
Uzbekistan	7,570.992	74,867.81	0.101125

As can be seen from Table-2, Pakistan's actual exports to ECO member countries were below the levels predicted by the model in each but one of the cases examined. The exception is found for Pakistan's exports to Turkey, where the actual level is 12% higher than the predicted value. At the other extreme, in the case of Tajikistan, exports are only 3% of the predicted value and there is a 97% potential for Pakistan's exports to the country. Afghanistan, being the second largest market for Pakistan's exports after Turkey and having a common border with Pakistan broadly matches the predicted value. The country received 97% of the exports predicted by the model. In case of Iran, exports are only 10% that of the predicted level, despite the fact that the country shares a border with Pakistan. Among the

Central Asian countries, Azerbaijan is a major market for Pakistan's exports, and meets 20% of the predicted exports.

The results clearly indicate that there is considerable scope for an increase in Pakistan's exports to ECO member countries.

2.8. ECO Bloc Dummy

The results of the coefficient of the ECO bloc dummy are in line with the previous study by Clarete, Edmonds, and Seddon (2002). With a sample of 83 countries, the study "Asian regionalism and its effects on trade" reports a value of 1.7 for the ECO dummy coefficient. The value of the bloc dummy coefficient is lower in our study, one reason for which could be the large number (137) of countries included in our dataset. According to their findings, ECO countries tend to trade more intensely among themselves at the expense of trade with the rest of the world. Estimates showed that intra-bloc trade in the ECO region was higher at a statistically significant level in 1995 and 2000 than would be expected if the countries were not members of the ECO.

To add to the findings of Clarete, Edmonds, and Seddon (2002), our results were further analyzed to answer the question posed at the beginning of the paper, i.e. whether the existing level of trade is attributed to a regional agreement or whether it is due to the policy of unilateral liberalization among these countries. In the case of the ECO countries at different speeds and with different intensities, most of these countries went through significant changes in their policy orientations while simultaneously undertaking the formation or the renewal of different trade agreements. The explicit inclusion of the national policy variables that was attempted here (inclusion of the bloc openness dummy to the model in Table 3) and the comparison of the directions of trade after and before the signature of the agreements allows for a better understanding of the actual impact of these arrangements.

In the same way, to see each country's national policy effect separately, 10 country dummies were added to the model. The bloc effect can then be read as the extra impact on intraregional trade over the national policies effect. This technique allows for differences in national policies among member countries of the bloc. The results controlling for national policies are shown in Table-4.

2.9. Bloc Openness Dummy

A comparison as to what happens to intra-bloc trade before and after any treaties have been signed involves both effects, and the estimated bloc coefficients therefore may be assigning to regional negotiations what in fact should be related to national policy. This would result in an overstatement of the bloc effect. In order to solve this problem a dummy variable for the general level of openness of the ECO bloc was added to our model.

This dummy takes the value of 1 when at least one country of the pair in question is a member of the group. The bloc effect can then be read as the extra impact on intraregional trade over the national policies effects. To a greater extent, this is similar to what Frankel (1996) does with his dummies for bloc openness. Table-2 shows the results controlling for national policy. The ECO openness dummy coefficient's value is negative and statistically significant. At the same time with the inclusion of the ECO openness dummy, the level of the coefficient of the ECO bloc dummy increases further. The above two results clearly indicate that a large part of intraregional trade growth in the ECO region should be attributed to regional agreements rather than to unilateral liberalization.

Table-3: Gravity Model Estimation with National Policy Dummy Dependent Variable is Total Exports: Method of Estimation Weighted Least Squares Weight is the Log (GDP)

Variable	Expected Sign	Coefficient	t-Statistic
GDP_i	+	1.098	102.531
GDP_j	+	0.778	90.412
PCI_i	+	0.062	4.631
PCIj	+	0.064	5.22
$DIST_{ij}$	_	-1.277	-58.375
Adjacency	+	1.0681	9.334
Language	+	0.871	18.112
ECO		1.32	4.983
ECO Openness		-0.267	-4.57
Constant		-27.75	-82.479
Adjusted R^2		0.64	
No. of Observations		16269	

2.10. Country Openness Dummy

Similarly, to look at each country's national policy effect separately, 10 country dummies were added to the model. The dummies take the value of 1 whenever a particular country becomes part of a pair. The bloc effect can then be read as the extra impact on intraregional trade over the national policies effect. This method is different from the one above (the ECO openness dummy), which restricts all national policies to be the same, while the method followed here allows for differences among countries. Table-3 shows the results controlling for national policies.

Table-4: Gravity Model Estimation with National Policy Dummies Dependent Variable is Total Exports: Method of Estimation Weighted Least Squares Weight is the Log (GDP)

Variable	Expected Sign	Coefficient	t-statistic
GDP_i	+	1.097	101.75
GDP_j	+	0.778	90.24
PCI_i	+	0.062	4.62
PCI_j	+	0.062	5.07
$DIST_{ij}$	–	-1.276	-58.38
Adjacency	+	1.07	9.36
Language	+	0.861	17.85
ECO		1.54	5.43
AFG		-1.0	-5.68
AZR		0.05	0.29
IRN		-0.78	-5.37
KAZ		0.06	0.36
KYG		-0.19	-0.94
PAK		0.09	0.67
TAJ		0.05	0.23
TKM		-0.05	-2.34
TUR		0.11	0.82
UZB		-0.85	-4.68
Constant		-27.72	-81.75
Adjusted R^2		0.64	
No. of Observations		16,260	

The results in Table 3 shows that, out of the ten countries, the coefficient on the openness dummy for four countries, namely, Afghanistan, Iran, Uzbekistan and Turkmenistan is negative and statistically significant, indicating that these countries are not open to world markets. Among these four countries Afghanistan seems to be the most restrictive country of the group, having a coefficient of -1.0 and a t-statistic of -5.68. Iran follows Afghanistan with a dummy coefficient of -0.78 showing that the country is not open to world markets. The same is the case with Uzbekistan and Turkmenistan. The value of the coefficient on their dummies is reported as -0.85 and -0.05, respectively. On the other hand, for the six remaining countries, the model reports values that are not statistically significant.

Moreover, with the inclusion of individual country dummies in the model, the results suggests that intraregional cooperation in the ECO is stronger than originally estimated (Table 1), where the ECO bloc dummy increases from 1.13 to 1.54. It indicates that the growth in trade among these countries is not at the cost of intraregional trade in the ECO region. It further explains the fact that the rise in trade in these countries is not attributed to unilateral liberalization but rather to regional agreements among the countries.

3. Conclusions

The debate on the causes of regionalism and its implications for the world trading system is a long and unsettled one. Theoretical explanations abound, but actual studies are far fewer. The contribution of this paper is its empirical approach to regionalism in the ECO region, a region with a long story of regional integration agreements, many of which failed and some of which seem to be succeeding—success being defined as the arrangement's ability to promote intraregional trade among its member countries.

The political economy of the ECO member countries is changing radically. Export-oriented groups have started to dominate the political scene of ECO countries. The duty free entrance of Mediterranean products in Europe and of Mexican products in the US market has jeopardized the competitive position of the countries' exports in these markets. The revival of regionalism in this part of the world is because of the need of these export-oriented groups to at least maintain the status quo in their main export markets. Too small to negotiate trade concessions with the EU or the US, ECO member countries are left with the option of regionalism. With export-oriented groups counterbalancing protectionist pressure

groups, this time there is strong hope for the success of regionalism in the ECO region.

Although generalizations cannot easily be drawn from this empirical approach, the results obtained in this paper give some interesting insights into the expected reactions of small countries to changes in larger countries. The results obtained from the gravity model predict that the ECO bloc has the potential to boost intraregional trade among its member countries. To what extent has the sub-regional agreement in the ECO region succeeded in concentrating trade among their members? No worthwhile empirical studies exist except the study by Clarete, Edmonds, and Seddon (2002). Their findings are in line with the result of the present study. Their estimates show that intra-bloc trade in the ECO region was higher at a statistically significant level than would be expected if the countries were not members of the ECO.

The findings of the paper show that trade between ECO member countries are is far lower than its inherent potential. The results were further analyzed to address the question as to whether the existing trade could be attributed to regional agreement or whether it was on account of unilateral liberalization among these countries. In the case of the ECO countries, most of these countries went through significant changes in their policies while simultaneously undertaking the formation or the renewal of different trade agreements. The explicit inclusion of the national policy variables that was attempted here, and the comparison of the directions of trade after and before the signature of trade agreements allows for a better understanding of the actual impact of these arrangements. In this light, the effect of the ECO bloc looks impressive.

What these results show is that the main determinant in the change of ECO countries' trade flows in the past has been the process of regionalism and not unilateral liberalization. The main achievement of this economic integration seems to have been to redress a pattern of trade in the case of most of the member countries that was heavily distorted by protectionist policies adopted by countries in the past. It strengthens the case for further trade liberalization in the ECO region, possibly in the context of greater regional integration. Greater regional integration, in a way that is compatible with multilateral liberalization, could contribute to growth not only by increasing trade and allowing regional producers to benefit from economies of scale, but also by encouraging foreign direct investment and the deepening of capital markets.

Where is it heading to? The main winner of the new ECO trade orientation would be intra-ECO trade. Reduced in the past by protectionist trade policies throughout the region, intra-ECO trade will increase as these countries turn toward more open trade regimes. In this regard, the initiatives in regional integration is a step towards that end: in 2003, the ECO member countries signed the ECO Trade Agreement (ECOTA) under which tariffs will be reduced for participating members to a maximum of 15% as the highest tariff slab in eight years.

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External Shocks in a Small Open Economy: A CGE - Microsimulation Analysis

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Abstract

This paper studies the impact of changes in the external balance of Pakistan. We explain why the economic growth achieved during the past decade was highly dependent on improvements in the external balance. Between 2001 and 2007, Pakistan benefited from an increase in remittances, foreign assistance from bilateral and multilateral sources, and a relatively stable exchange rate. After 2007, this performance came under pressure from external price shocks. The rise in the import prices of petroleum, raw materials and other manufactured goods has the potential to reduce the country's growth performance, impacting the competitiveness of the economy and threatening the gains achieved during past years. We integrate a computable general equilibrium (CGE) model with a microsimulation model to study the effects of changes in foreign savings and import prices faced by Pakistan. An increase in foreign savings leads to an increase in imports and a decrease in exports. The main sectors facing a decline in exports are textiles, leather, cement, and livestock. In this simulation food and oil prices decline and the factors of production that gain are agricultural wage labor and nonagricultural unskilled wage labor. The increase in import prices of petroleum or industrial raw material leads to a reduction in exports. In this simulation the crop sector is negatively impacted and returns to land and profits to farm owners increase, showing a change in favor of agricultural asset owners, while poverty and inequality increase.

Keywords: Microsimulation, computable general equilibrium, poverty, inequality, balance of payments, Pakistan.

JEL Classification: D58, C81, C82, H22, D58, C51, I32.

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1. Introduction

The external account impacts economic growth through aid, trade, and foreign investment. The major issues affecting Pakistani balance of payments are the expensive structure of foreign savings and terms of trade shocks. Foreign savings are known to play an important role in the infrastructure and social sector needs of developing countries (see Husain 2007). There are two forms of foreign savings: debt and nondebt. The nondebt sources of foreign savings are usually less of a concern if compared with short- and medium-term debt instruments. According to conventional economic thinking, developing economies should not rely solely on national savings, but should put in place mechanisms to bring in foreign direct and portfolio investment (see Reisen and Soto 2001).

Short-term debt under weak macroeconomic fundamentals is expensive and has been responsible in the past for plunging several developing countries into a debt trap (see Voyvoda and Yeldan 2005). A persistent current account deficit also puts adverse pressure on national budgetary targets, bringing about the phenomenon commonly known as 'twin deficits' (see Aristovnik 2008).

The general equilibrium dynamics of aid and grants are explained in Anderson et al. (2003), who bifurcate the effects of aid into (a) the diversion of resources, and (b) real currency appreciation. Project-based aid diverts resources away from ongoing and existing production activities. Even where projects are funded entirely by foreign capital, human capital is taken away from existing activities. Most development projects are publically administered, and this implies that resources may be inefficiently allocated as the private sector now faces increased costs of production due to increases in labor wages and the price of raw materials. This effect seems plausible and can be observed in several developing economies.

The inflow of foreign capital can cause the exchange rate to appreciate, which in turn increases real wages and imports. This has implications for exports and future economic growth. Recent literature shows that several Asian economies have defended their (competitive) exchange rates in order to promote growth. This debate is highlighted in Bresser-Pereira and Gala (2008).

In the wake of trade liberalization, the import volumes of developing countries have generally increased. There is evidence that after liberalization, there has been an increase in economic growth at the cost of a rising trade deficit (see Pacheco-López and Thirlwall, 2007).The manner in which import prices impact local prices has been studied in the literature

using primarily two methodologies, (a) the pass-through approach, and (b) the Armington elasticity approach. Studies focusing on the pass-through of exchange rates and import prices to domestic inflation reveal that import price shocks have a much larger impact on domestic inflation in comparison to exchange rate shocks (see McCarthy 2007). An accommodative monetary policy combined with exchange rate changes may however trigger the inflation-depreciation spiral (see Ito and Sato 2008). The Armington approach is commonly used in CGE models where the elasticity of substitution is assumed for the import and domestic production of a good. This paper also uses this approach. See Warr (2005) for the relationship between the pass-through and Armington approach.

Studies focusing on the rise in international oil prices find a reduction in welfare and economic growth (see Zaouali, 2007 and Schintke, et al. 2000). In a general equilibrium framework, energy prices faced by households and producers can have varying distributional impacts. Countries that have a deregulated energy sector through price reforms provide interesting insights. In Indonesia's case, Yusuf and Resosudarmo (2008) show how differentiated prices for domestic and commercial fuel can make the overall reform process (deregulation) progressive. Several countries including Pakistan have tried until recently not to pass on the impact of rising energy prices by subsidizing the overall price (see Baclajanschi, et al. 2007).

During the 1990s, Pakistan struggled with its debt servicing due to the misappropriation of funds, poor fiscal efforts, and a continuously depreciating exchange rate. The recovery from the twin deficits after 2001 allowed Pakistan to retire its expensive short-term debt, and until 2007 it only had medium- to long-term debt commitments under multilateral and bilateral arrangements. Like any other low- and middle-income country, Pakistan is a price-taker and its current account is exposed to shocks in global export and import prices. This issue is of critical importance because of the lack of diversification in the overall export structure of Pakistan. The structure of imports also plays an important role in sustaining the long-run development of a country. What is important is that a country imports more capital goods than consumption goods. Due to the growth in large-scale manufacturing (seen during this decade) the import of machinery and other inputs has increased to unprecedented levels. However oil price shocks have remained a continuous threat to the overall terms of trade. More recently, local food shortages have led Pakistan to importing food (mainly wheat) at high rates.

Our reason for studying these external account changes in a CGE framework is motivated by the literature on trade reforms in particular and global economic liberalization in general. A CGE model is an economy-wide

framework that shows how a specific change in the economy impacts other sectors, markets, or institutions. These models are widely used for analysis pertaining to taxation, trade liberalization, environment, natural resource policy, and regional development. The data used for the construction of CGE models is commonly known as a social accounting matrix (SAM). Examples of CGE models developed for Pakistan include McCarthy and Taylor (1980), Labus (1988), Vos (1998), Naqvi (1998), Siddiqui and Kemal (2002), Ahmed and O'Donoghue (2010).

Since the seminal work by Orcutt (1957), micro-simulation models have been widely used to study the micro-level impacts of socioeconomic policies. These models use household budget data and allow the explicit incorporation of tax and benefit-related rules and regulations. Micro-simulation models are made behavioral through the incorporation of an expenditure system, and wage and occupational choice functions.

The integration of CGE models with microsimulation models has allowed us to obtain the micro-impacts of macroeconomic changes by making use of heterogeneity in household-level surveys (see Davies 2004). Gunter, Cohen and Lofgren (2005) present a review on analyzing macro-poverty linkages (see also Robinson and Lofgren 2005, Kraev and Akolgo 2005). Ben Hammouda and Osakwe (2008) look at the trade-focused CGE models in Africa. Cockburn, et al. (2008) summarize general equilibrium lessons on the trade-poverty nexus in African and Asian countries.

In this paper we look at the welfare impact of changes in foreign savings and world import prices. For the latter, we are particularly interested in the import price of petroleum and industrial raw material. The next section describes recent trends in Pakistan's socioeconomy with special reference to the external balance during the high growth period from 2001 to 2007. Section 3 will describe our model framework, data, parameterization, related measurement issues, and the design of simulations. Section 4 explains the impact of changes in foreign savings and Section 5 explains the import price effects. Section 6 then concludes the article and provides a summary of our main findings.

2. Growth, Trade, and Welfare in Pakistan

Since 1960, Pakistan's economy has grown at an average rate of 5.6 percent. The 1960s exhibited the highest annual average growth rate of 6.8 percent derived from an increase in manufacturing (9.9 percent) and agriculture (5.1 percent). During this period, Pakistan received substantial aid from bilateral and multilateral development partners. Public sector

expenditure was focused on public works and the setting up of necessary infrastructure for future growth requirements.

Table-1 Growth, Trade, and Welfare: Historic Overview

	1960s	1970s	1980s	1990s	2000-07
	Annual Average				
	Real Growth Rates (%)				
GDP	6.8	4.8	6.5	4.6	5.4
Agriculture	5.1	2.4	5.4	4.4	3.4
Manufacturing	9.9	5.5	8.2	4.8	8.6
Commodity Producing Sector	6.8	3.9	6.5	4.6	4.9
Services Sector	6.7	6.3	6.7	4.6	5.8
	As % of GDP				
Total Investment	-	17.1	18.7	18.3	18.6
Fixed Investment	-	15.9	17.0	16.6	17.1
Public Investment	-	10.3	9.2	7.5	4.8
Private Investment	-	5.6	7.8	9.1	12.3
National Savings	-	11.2	14.8	13.8	17.9
Foreign Savings	-	5.8	3.9	4.5	0.8
Domestic Savings	-	7.4	7.7	14.0	16.8
Total Revenue	13.1	16.8	17.3	17.1	14.1
Tax Revenue	-	-	13.8	13.4	10.7
Total Expenditure	11.6	21.5	24.9	24.1	18.1
Current Expenditure	-	-	17.6	19.4	14.9
Development Expenditure	-	-	7.3	4.7	3.3
Overall Deficit	2.1	5.3	7.1	6.9	4.0
Exports (fob)	-	-	9.8	13.0	12.5
Imports (fob)	-	-	18.7	17.4	15.4
Trade Deficit	-	-	8.9	4.4	2.9
	Annual Average				
Gini Coefficient*	0.39	0.38	0.37	0.39	0.34
Poverty Headcount**	42.4	38.6	20.9	27.3	26.9
Unemployed %***	-	2.2	3.5	5.6	7.1

Source: Economic Survey of Pakistan 2007-08. Some figures for 1960s and 1970s are missing on account of the separation of East Pakistan (now Bangladesh).

* Gini estimates from Anwar 2005, For 2005-07 estimates from the Economic Survey.
**Until 1999 from Haq & Bhatti 2001. After that from Economic Survey 2007-08.
***Labour Force Survey.

However Table-1 indicates that this impressive growth performance could not be sustained in the longer term. During the 1970s, the government tried to implement a model of nationalization that aimed at bringing productive resources (in identified sectors) under the control of the government. This resulted in a mismanaged endeavor where most established entrepreneurs left the country along with their moveable assets. The average growth rate during the decade fell to 4.8 percent; the agriculture and manufacturing growth rate fell to 2.4 percent and 5.5 percent, respectively. The nationalization experience however kept the unemployment level below 3 percent during the 1970s. To some extent, this resulted in a marginal decline in inequality. The poverty headcount ratio declined from an average of 42.4 percent in the 1960s to 38.6 percent during the 1970s, showing a decline of almost 9 percent. During the 1970s, the total investment-to-GDP ratio fell to its lowest, averaging around 17 percent. The public investment-to-GDP ratio stood at 10.3 percent while the private investment-to-GDP ratio was 5.6 percent. The savings requirement for the economy was augmented largely through a current account deficit that averaged 5.8 percent of GDP during the decade.

During the 1978-1988 period, there was a partial move to restore the elements of private property and the free market, but the operational control of the government existed largely through a detailed licensing framework. The real GDP growth rate during the 1980s averaged around 6.5 percent with agriculture and manufacturing growing at 5.4 and 8.2 percent, respectively. Both total investment and national savings as a ratio to GDP showed reasonable improvement, with an average of 18.7 and 14.8, percent respectively. The 1980s posed challenges for Pakistan in the wake of a record influx of Afghan refugees into Pakistan. The new geographical challenges substantially increased government expenditure on defense, public administration, and related activities. Ultimately, the increased budgetary expenditure resulted in an increase in the average fiscal deficit from 2.1 percent during the 1960s to 7.1 percent during the 1980s. There was added pressure in the form of a high trade deficit of around 9 percent of GDP. This was attributed to the rise in imports (18.7 percent of GDP) and low levels of exports (9.8 percent of GDP).

The post-1988 period, was marked by frequent changes in operational strategy, which in most instances resulted in economic policy reversals. However, the competing parties both promoted free market policies such as deregulation, liberalization, and privatization. Measures were adopted in order to attract foreign investment. Overseas Pakistanis were encouraged to invest under special incentives.

Given the frequent changes of government and general political and economic instability during the 1990s, real GDP growth averaged 4.6 percent

with the agriculture and manufacturing sectors contributing 4.4 percent and 4.8 percent, respectively. Overall investment and national savings as a percentage of GDP were 18.3 and 13.8 percent, respectively and showed a decrease from the levels witnessed during the 1980s. The fiscal deficit remained high at 7 percent of GDP, partially due to a reduction in the tax-to-GDP ratio, which fell from around 14 percent in the 1980s to 13.4 percent in the 1990s. The current expenditure of the government as a percentage of GDP also increased from 17.6 percent in the 1980s to 19.4 percent in the 1990s. This deterioration in fiscal position in turn brought down development spending on infrastructure as well as in social sectors such as education and health. As a percentage of GDP, development expenditure decreased from an average of 7.3 percent in the 1980s to 4.7 percent in the 1990s.

The process of trade liberalization, which initially included a reduction in tariff rates, was initiated in the 1990s. Overall trade performance improved in comparison to the 1980s. The export-to-GDP ratio increased to 13 percent while imports as a percentage of GDP exhibited a decline and averaged 17.4 percent. The trade deficit came down to 4.4 percent of GDP. After 1999 economic policies resulted in declining foreign exchange reserves, stalled investment activity, and the mounting debt of public sector corporations. During the next two years Pakistan tried to secure short-term stabilization funds at an expensive interest rate term structure.

In the post 2001 milieu, Pakistan experienced medium-term economic gains and GDP growth was soon restored. The manufacturing sector took a leading role and grew at an average of 8.6 percent between 2000 and 2007. The investment-to-GDP ratio was restored to its 1980s level, averaging 18.6 percent, only this time financed by relatively higher national savings (17.9 percent of GDP). Rising workers' remittances touched record levels. The average growth in remittances during this period was almost 29 percent per annum. The current account deficit as a percentage of GDP was 0.8 percent. The average trade deficit as a percentage of GDP was 3 percentage points lower than the level observed in both previous decades.

Table-2: Structure of Trade

	1970s	1980s	1990s	2000-07
	Annual Average			
% Share in Imports				
Capital Goods	35.6	33.6	35.8	31.8
Consumer Goods	21.1	15.5	15.2	11.1
Raw Material for Capital Goods	8.1	6.6	6.0	6.6
Raw Material for Consumer Goods	34.6	44.4	43.0	50.5
% Share in Exports				
Primary Commodities	39.7	33.1	14.6	11.3
Semi-Manufactured Goods	20.9	15.9	21.7	12.4
Manufactured Goods	39.6	51	63.7	76.4

Source: Economic Survey of Pakistan 2007-08.

Table-2 exhibits the structure of imports and exports. The share of capital goods in overall imports has remained more or less constant since the 1970s, averaging between 31 and 36 percent, while the share of consumer goods has declined from 21 percent in the 1970s to 11 percent during 2000-07. The import of raw material for the production of capital goods has been on the decline while the share of raw material for consumer goods increased and averaged around 51 percent during 2000-07. On the export side the share of primary commodities decreased substantially from 40 percent in the 1970s to 11 percent during 2000-07. The encouraging aspect is that the share of manufactured goods increased to 76.4 percent, indicating a movement toward achieving value addition in the export structure.

Table-3: Growth in Imports

	1970s	1980s	1990s	2000-07
	Annual Average Growth (%)			
Chemicals*	19.2	36.9	16.8	17.3
Medicines	30.8	18.9	15.1	9.6
Dyes/Colors	5.1	16.8	17.0	11.0
Chemical Fertilizers	82.6	16.0	27.3	13.9
Electrical Goods	12.8	12.1	9.1	25.1
Machinery	15.4	20.7	14.1	24.2
Transport Equipment	27.1	15.9	16.6	29.1
Paper/Board	22.4	18.9	8.6	18.8
Tea	22.9	15.6	16.6	2.5
Art-Silk Yarn	206.9	9.8	1.5	29.2
Iron/Steel	17.5	11.7	11.6	24.3
Non-Ferrous Metals	60.5	21.4	11.0	25.8
Petroleum	12.1	17.6	16.2	31.1
Edible Oils	45.5	17.0	21.2	8.7
Grains	66.8	46.9	24.5	25.5
Other Imports	15.1	14.5	16.6	22.2

Source: Economic Survey of Pakistan.

*The data for group-wise imports is from 1976 under Statistical Supplement to the Economic Survey 2006.

Table-3 shows the decade-wise percentage growth in imports. In comparison to the 1970s, there is a shift away from necessary items toward those used in the production process. Growth in the import of food items such as edible oils, grains, and tea is declining over time. There is an increase in the import of capital goods and industrial inputs such as electric goods, machinery, transport equipment, iron/steel, and petroleum.

Since the early 1990s, governments have continuously reduced tariff rates to facilitate the cheap import of raw material and to pass on the effects of free trade onto consumers. The maximum tariff was brought down to 25 percent in 2003 from 92 percent in 1993. During the same period, the number of tariff slabs was reduced from 13 to 4. The role of excise duties in the overall taxation structure has been minimized.

3. Model, Data, and Simulations

CGE-Microsimulation Model

The CGE model follows the framework in Lofgren, et al. (2001) and Dervis, et al. (1982). The model is tailored for the commonly observed specifications of a developing country. Some of the important features of low- and middle-income countries included in this model are: (a) household consumption of nonmarketed commodities, (b) the explicit treatment of transaction costs for marketed commodities, and (c) a separation of production activities and commodities (which allows an activity to produce multiple commodities and any commodity can be produced by multiple activities). The detailed model equations are given in Annex B.

The production and consumption decisions are modeled using nonlinear optimality conditions, i.e., production and consumption decisions are based on the maximization of profits and utility, respectively (subject to the underlying budget constraints). Production technology at the top of the nest uses a CES specification. The value addition has been treated as a CES function of primary inputs while the overall intermediate input is a Leontief function of disaggregated intermediate inputs. Fixed yield coefficients determine whether an activity produces one or multiple commodities. The aggregate revenue from an activity is then a function of the level of activity, yield, and the producer prices of commodities. The factor market follows the microeconomic assumption of employing factors until the point where the marginal revenue product of a particular factor becomes equal to its wage. Factor wages are variable across activities in order to realistically portray cases where: (a) markets are segmented, (b) factors are mobile, and (c) both the abovementioned possibilities exist. The activity-specific wage is calculated by multiplying the wage by a distortion value. The distortion value will be different across activities.

The overall domestic output from all activities is allocated between domestic turnover and exports. In this case, the assumption of imperfect transformability between exports and domestically sold goods is established using a CET function. Similarly, on the import side, a CES function is used to model imperfect sustainability (also referred to as the Armington assumption).

Households receive (a) income from factors via enterprises, and (b) transfers from other institutions such as the government and the rest of the world. A household's income is exhausted by (a) consumption, (b) savings, (c) paying income tax, and (d) transfer payments to other institutions. Household consume two types of commodities that include marketed

commodities which are accounted at their market price (which includes indirect taxes and transactions costs) and home-produced commodities accounted at producer prices. A linear expenditure system (LES) demand function is used to allocate consumption across commodities.

The income received by enterprises is allocated among savings, payment of corporate (direct) taxes, and transfers. The government receives taxes at fixed ad valorem rates and has a fixed consumption level. Those taxes that are charged on a specific basis enter the model after conversion to ad valorem equivalents. However, transfer payments made by the government to households and enterprises are indexed to the CPI. The residual from the government's income and consumption is treated as savings. Given that the government savings are flexible, direct tax rates are fixed in order to bring about government sector closure in the model. The payments made by the *rest of the world* to domestic institutions (government, households, and enterprises) and factors are treated as fixed. The exchange rate is flexible. The CPI is regarded as a numeraire. The model has investment-driven savings where capital formation is fixed and there is uniform change in the marginal propensity to save for selected institutions. Land and labor are fully employed and allowed mobility across sectors. Capital is also fully employed, however it is activity-specific, i.e., there is no mobility across sectors.

For the micro-simulation model we estimate earnings equations and an occupational choice model following the convention in Alatas and Bourguignon (2005). Earnings equations were estimated for various categories, namely[1]: (a) labor on a large farm, (b) labor on a medium farm in Sindh, (c) labor on a medium farm in Punjab, (d) labor on a medium farm in the rest of Pakistan, (e) labor on a small farm in Sindh, (f) labor on a small farm in Punjab, (g) labor on a small farm in the rest of Pakistan, (h) wage employment in agriculture, (i) nonagricultural unskilled wage earner, and (j) nonagricultural skilled wage earner.

We obtained predicted earnings from the above earnings functions and used them (among other characteristic variables)[2] as independent variables in maximum likelihood multinomial logit regressions, thus allowing individual occupational choice to be influenced by returns on other activities and regions. This possibility translates from the macro-model where we explained earlier that CGE model closure for the labor market allows mobility of labor across activities.

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[1] In most cases a two-step Heckman procedure was adopted. However for the profit function, an instrumental variables regression was estimated.

[2] Other variables include: age, age squared, province, marital status, number of persons in the household, and type of dwelling.

Linking macro- and micro-models has recently gained a lot of attention in the literature. The three channels that affect income distribution are: (a) changes in factor returns, (b) changes in prices, and (c) changes in capital gains (see Bourguignon et al. 1991). The micro-macro models in this paper were linked in a top-down fashion as shown in Bourguignon, Robilliard and Robinson (2003), which also provides details on how consistency is achieved between the SAM and household data. These data consistency requirements are an essential aspect of this top-down exercise, which allows us to link factor returns, prices, and employment in the CGE model with the corresponding household level variables in the micro-data. This approach has been used in Bussolo and Lay (2006), Herault (2005), Coady and Harris (2004), and Vos and De Jong (2003).

Data and Measurement Issues

The data for our CGE model has been derived from an existing SAM for 2002 documented in Dorosh, Niazi, and Nazli (2004)[3]. This SAM has been furnished by five different data sources. First, we use the input-output table that provides information mainly on activities and commodity accounts. Second, the national accounts data is used to compile information on value addition in fifteen sectors. Third, the Pakistan Integrated Household Survey is used to disaggregate consumption. Fourth, the Pakistan Rural Household Survey 2001 conducted by the Pakistan Institute of Development Economics is used to disaggregate household incomes. Finally, the Pakistan Economic Survey 2001-02, published by the Ministry of Finance provides sector-wise and commodity-wise data on production, prices, and trade.

On the activities side, the matrix includes payments and receipts for 12 agricultural sectors, 16 industrial sectors, and 6 services sectors. Similar sectoral detail follows in the commodity accounts, which makes the mapping between activities and commodities easier. Factor accounts include labor, land, and capital, with labor disaggregated into 10 different categories. This categorical disaggregation is based on the criteria of farm size, agriculture/non-agriculture wage, and unskilled/skilled labor. Land, again, is disaggregated according to farm size (in different provinces). Capital is categorized into livestock, other agriculture, and informal and formal

[3] Ideally, a more recent SAM should have been used. However, given the delay at the Federal Bureau of Statistics in finalizing the latest input-output table, we were forced to use the data for 2002. As we are working with relative changes in a CGE model, the underlying relationships between production sectors and institutions remain relevant in the medium term. The structural changes in developing countries are not rapid therefore we may consider these SAM estimates reliable. All results should be interpreted in terms of 2001/02 prices.

capital. Household accounts are distributed into rural and urban with rural households being further classified into 17 categories based on farm size and rural poor/rural non-poor. Urban households have been classified into poor and non-poor. Other institutions in the SAM include enterprises, the government, and the rest of the world account.

In terms of factor shares in income, 39 percent of household income comes from labor, 21 percent from informal capital, 9 percent from agricultural capital, 6 percent each from land and transfers, and the remaining 19 percent from other sources. The share of rural and urban households in overall income is 44.8 and 55.2 percent, respectively.

The main data source for the microsimulation model is the Pakistan Integrated Household Survey 2001/02 which includes income and expenditure details for 16,400 households. The average monthly income in the benchmark data is Rs. 7,168 per month, with quintiles 1 and 5 earning Rs. 4,391 and Rs. 11,360, respectively. Incomes falling under self-employment account for the major portion (41.3%) followed by wages and salaries (33.5%). Average expenditure is Rs. 6,714 with quintiles 1 and 5 spending Rs. 4,004 and Rs. 10,334, respectively. Food and beverages occupy a 48.3 percent share in overall spending, although the share of food declines by 17.2 percent when one moves from the lowest to highest quintiles.

The selection of free parameters/elasticities poses a potential problem. Some studies that provide trade, production, and consumption elasticities for the Pakistan economy include Deaton (1997), Kemal (1979), and Dorosh et al. (2002). However, in cases where econometrically estimated elasticities for Pakistan are not available, we have selected our values keeping in line with studies conducted for comparable developing economies. The trade and production elasticities are given in Annex-A.

The structure of value addition is such that livestock (cattle and dairy) contributes 10.3 percent; major crops, fruits and vegetables contribute around 12 percent; textiles 3.6 percent; energy 3.4 percent; construction 3.6 percent; transport 12 percent; housing 4.8 percent; and wholesale and retail trade 15 percent toward overall value addition. The total share of the agricultural sector in exports is around 4 percent, while industry stands at 79 percent with the leading subsectors being textile, lint, and yarn. The services sector contributes 17 percent to exports, mainly in the transport and communication subsectors. The total share of the agricultural sector in imports is around 3 percent while industry's share is 92 percent. The services sector contributes 5 percent to imports, mainly in private services subsectors.

Simulation Design

In the post-2001 milieu, the current account deficit of Pakistan was transformed into a surplus in one of the shortest periods in economic history. This was largely due to factors such as an increase in remittances, unilateral transfers, and export receipts. However, the current account deficit (and the composition of this deficit) has once again become a problem for the domestic economy. This is attributable to an increase in import prices which in turn has increased the domestic cost of production and therefore hampers export competitiveness. Pakistan allowed a subsidy in the wake of rising oil and food prices, but this can only be a short term measure given the substantial size of this transfer payment which, if maintained in the medium- to long-term, might increase the budgetary deficit and thereby bringing about another spiral of inflation.

In our experiments, we study the impacts of two current account shocks that have had opposite impacts on the economy (at least in broad macroeconomic terms). First, there is the inflow of foreign savings, required by developing countries to augment domestic savings and hence finance their infrastructure and social sector requirements. Since 2002, the increased inflow of capital led to an appreciation in the value of domestic currency which favored imports. In our model, we will increase overall foreign savings by 50 percent and determine their impact at the macro and micro level. Second, there are the changes in import prices that in turn impact prices faced by local producers and consumers, thereby altering welfare levels in the economy. The imported goods that are integrated into the production process not only influence growth and competitiveness, but also impact productivity in the form of spillover benefits. Coe, Helpman and Hoffmaister (1997) estimate that if the import share of machinery and equipment to GDP increases by 1 percent, total factor productivity increases by 0.3 percent.

An outline of our policy experiments is as follows:

Simulations	Description
Sim-1	50 percent increase in foreign savings
Sim-2	10 percent increase in the import price of petroleum
Sim-3	10 percent increase in the import price of industrial raw material

Closure rules remain the same for all simulations. For the factor market, we assume labor to be fully employed and mobile across activities. The same closure is retained for land. Capital is fully employed and activity-

specific. We have investment-driven savings where the marginal propensity to save is allowed to change for selected institutions. Government savings are flexible and the direct tax rate is fixed. The CPI is treated as a numeraire (i.e., fixed) and the index of domestic producer prices is flexible. The exchange rate is also flexible.

We have sequenced our results below such that in every simulation, macroeconomic results (providing aggregate demand, investment, and consumption) are followed by changes in prices and wages. We then see the impact of the changed price structure on the disaggregated value addition (in all activities given in the SAM), import demand and export supply. In our case, given the assumption of full employment, macroeconomic changes do not impact the employment levels (however inter-sectoral changes in labor demand are allowed). We continue our analysis and see how changed production patterns impact household consumption expenditure and overall welfare. Finally, we see the impact of simulations on poverty and inequality.

4. Results-I: Increase in Foreign Savings

Our macroeconomic results for the abovementioned experiments are given in Table-4. In Sim-1, a 50 percent increase in foreign savings leads to an increase in real private consumption by 2.8 percent. Given the larger amount of foreign exchange available, imports increase by 3.7 percent while exports decline by 6.5 percent. The decline in exports indicates deterioration in the trade balance. We observe that the trade deficit as a percentage of nominal GDP increases by 1.8 percent. In nominal terms, the foreign savings-to-GDP ratio increases by 2 percent while the investment- and private savings-to-GDP ratios decline by 0.3 and 2.4 percent, respectively.

These results, if seen in the light of economic theory, suggest that foreign savings can significantly alter the real exchange rate, which in turn causes the trade balance to change. This also implies that the production of domestically consumed goods will be altered. This happens in our results because absorption, which is defined as total domestic spending on a good calculated at the prices paid by domestic demanders, increases by 2.2 percent in real terms. This increase, to some extent, is made possible through the domestic (non-tradable) price index, which is decreasing.

The impact of simulations on value added and output price is given in Table-5. Value-added prices decline mostly for tradable goods. The sectors showing the highest decline are: leather (10 percent), cotton lint/yarn (7.1 percent), and manufacturing (6.9 percent). The prices of several large sectors show an increase, such as livestock, wheat milling,

housing, and private services. These are mostly non-tradable sectors. The direction of change is similar in the case of output prices, but the magnitude of these changes is much smaller, given the inclusion of other factors in output prices. Such a change seems pro-poor given that the prices of food and oil show a decline. However, the price of housing increases by 6.9 percent in the case of value added price and 5.5 percent in the case of output price. The decreased prices of cotton and textiles also indicate increasing export competitiveness, although we know from the macroeconomic results above, that overall exports did not increase because of an exchange rate appreciation.

The returns to labor with farm holdings and returns to land decline (Table-6). The return to capital does not change given our closure assumptions. Those who gain under this change are agricultural wage labor and nonagricultural unskilled wage labor, whose wages increase by 1.5 percent and 0.5 percent, respectively. It is broadly recognized that agricultural wage workers are regarded as the poorest of the rural poor (ILO, 1996). Overall agriculture incomes are the second most important source, with almost 27 percent of total per capita household income (see Adams 1995). According to the Labor Force Survey, around 44 percent of the employed (10 years age and above) are working in the agriculture, forestry, and fishing sectors. Given these statistics, it seems that our simulation results indicate a redistribution within the agriculture sector, where the returns for farm owners are declining and the wages for employed labor in agriculture are increasing. The increase in the wages of nonagricultural unskilled labor also indicates a change in favor of the urban poor. However, we cannot ascertain the magnitude as the SAM data (in its present form) is not divided by urban/rural classification.

The return to land declines for all land classifications in the model. The returns for non-irrigated land decline more than irrigated land, and within the latter, the decline is greater for large and medium farms in Punjab.

The impact on value added can be seen in Table-7. These results are mixed not only across but also within sectors. In most sectors, the value addition declines or sees no change. The decline in the industrial sector's value addition is greater than that of the agricultural sector. In the case of agriculture, there is a marginal increase in value added in wheat, sugar cane, fruits, vegetables, and livestock. However, there is a decline in rice, forestry, and fishing. For the industrial sector, there is a general decline in value addition except for the cement, energy, vegetable oils, and wheat milling sectors.

We should also go on to analyze the sector-wise impact on imports and exports. In Table-8, we show disaggregated changes in the quantity of imports. The increase in foreign savings leads to an increase in imports for all sectors (except a marginal decline in the mining sector). This is primarily due to exchange rate depreciation (see Table-4). The highest increase is in leather, textiles, commerce, and livestock (cattle).

The impact on Pakistani exports is shown in Table-9. Increased foreign savings lead to a worsening of exports across all sectors and particularly in textiles, leather, cement, transport, rice, and livestock. Exports in value terms decline given the increase in output prices, which make exports relatively uncompetitive abroad.

In evaluating changes in welfare, we first examine how household incomes change for our simulations. These results can be seen in Table-10. We observe that the change mimics what we have seen for changes in factor returns (Table-6). When foreign savings increase, large or medium farms are the main losers, while all other household groups gain, most notably rural agricultural workers who are landless and small farm owners. As explained above, this also represents a redistribution in favor of low-income households. Household consumption, however, increases for all groups (Table-11). The increase is greater for rural workers.

Our micro-simulation results are given in Table-12. In line with the household welfare impact explained above, poverty decreases by 3.1 percent when foreign savings increase by 50 percent. The poverty gap and severity both show a decline. Poverty decreases in all provinces with Punjab having the highest decline by almost 3.3 percent followed by Sindh (2.8 percent).

The gini coefficient declines by 0.3 percent. If aversion to inequality is taken in to account, we see that the Atkinson index shows a larger decline for the top end of the distribution. As the inequality aversion parameter increases beyond 0.5, there is a smaller decline in the Atkinson index (measured in percentage terms). We also compute the percentile ratios for the distribution of post-shock incomes. The p90/p10 is the decile ratio, p75/p25 relates to the middle part of the distribution and p90/p50 shows the dispersion in the upper tail. In Table-12, the largest decrease is in the p90/p10 ratio, whereas the decrease is less than half this in the middle part of the distribution.

5. Results-II: Increase in Import Prices

Going back to theory, we understand that the domestic effects of an import price increase will be broadly similar to an increase in tariffs (see Go

1991). Viewed in the context of overall world prices, the Stolper-Samuelson theorem suggests that a rise in the relative price of a good will lead to a rise in the return to that factor which is used most intensively in the production of the good (and a fall in the return to the other factors). This theorem has been derived from the basic Heckscher-Ohlin model which is a general equilibrium model of international trade and shows that a country will export products that utilize its abundant factors of production and import products that employ a country's scarce factors and resources. A corollary to the Stolper-Samuelson theorem is the factor price equalization theorem which tells us that, regardless of factor mobility across international borders, factor prices tend to equalize for countries that do not differ in technology.[4]

We can see in Table-4 that a 10 percent increase in the import price of petroleum[5] (Sim-2) brings about a 0.7 percent decline in GDP. Private consumption declines by 4.3 percent. As a percentage of nominal GDP, investment and private savings increased by 1.1 percent. The current account deficit as a percentage of nominal GDP also increases by 0.2 percent. As expected, the direction of a change in trade decreases both real imports and exports by 11.2 and 1.8 percent, respectively. The overall import price index increases by 11.9 percent. This increase also depends on the weight of the petroleum group in overall imports. In relative terms, the domestic (non-tradables) price index decreases by 1.1 percent, indicating that domestically produced goods are now cheaper. We need to qualify this result by saying that the prices of only those goods will decrease that do not use petroleum intensively as an input in the production process. The world price index for tradable goods increases by 7.2 percent, indicating that Pakistani exports are now relatively expensive. The trade deficit-to-nominal GDP ratio increases by 0.2 percent. Because of declining imports there is an impact on tariff revenue and government savings, both decreasing by 0.2 and 0.3 percent of GDP, respectively.

The impact that an increase in the import price of petroleum has on the economy is greater than any other import commodity group. This is essentially due to the intensity with which this good is used in the production process, as well as by the consumers at the household level, and the knock-on effects that petroleum prices have at the intermediate demand stage.

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[4] What will be the effect of an increase in the physical endowment of factors? The Rybczynski theorem suggests that an increase in one of the two factors of production leads to a relative increase in the production of the good using more of that factor.

[5] In Pakistan, petroleum imports account for around 24 percent of the overall import bill (Economic Survey of Pakistan 2006-07).

In our next simulation (Sim-3), we increase the price of industrial raw materials (excluding petroleum) by 10 percent. This commodity group includes organic chemicals, inorganic compounds of precious metals, fertilizers, tanning or dyeing extracts, oils, resinoids, perfumery, albuminoidal substances, glues, enzymes, pyrotechnic products, pharmaceutical products, and related goods. An increase in the import price of this group decreases GDP by 0.5 percent where private consumption declines by 2.7 percent. The direction of change in major macroeconomic variables remains the same as in Sim-2. While the decrease in real imports is lower (7.4%) in comparison to Sim-2, the decrease in real exports is slightly higher (1.9%). The nominal exchange rate depreciates by 0.7 percent and the import price index increases by 7.1 percent. Firm incomes decline by 2.5 percent. Government savings and tariff revenues as a percentage of GDP both decrease by 0.2 percent.

Table-6 gives details on how import prices affect domestic prices. In both cases (Sim-2 and Sim-3), we see that external price changes impact the crop sector prices adversely. There is more than a 3 percent increase in the value added prices of wheat, rice, cotton, sugar cane, fruits, and vegetables. Another concern is how these experiments impact the competitiveness of the local manufacturing sector. Output prices increase for cotton lint, yarn, petroleum refining, chemicals, mining, vegetable oil, wood, and other manufacturing. We observe that the sectors relatively insulated from trade shocks see a decline in their prices. The decline is most apparent in poultry, rice milling (Irri/basmati), cement, and public and private services.

In the import price experiment, agricultural wage, nonagricultural unskilled labor, and agricultural skilled labor become the main losers given that activity levels are declining on the production side (Table-6). Returns to land and profits for farm owners increase, showing a change in favor of (agricultural) asset owners. The increase in factor prices is highest for the simulation where the import price of petroleum is increased by 10 percent. In this case, the returns to labor having a small farm increase the most (6.7 percent) followed by labor having a medium-size farm (6.3 percent). A similar pattern is observed in the case of changes in returns to land. The small land category gains the most (7.9 percent) followed by medium-size and large land. In this case one may infer that there is a redistribution taking place among agricultural asset owners, where those with small to medium ownerships are gaining.

As imports become expensive relative to domestically produced goods, there is an expansion in production particularly for nontradable industrial sectors (Table-7). This increases the demand for factor inputs in the beneficiary sectors, which in turn increases factor prices (land and labor

in our case as they are mobile across sectors). This argument will hold under the full-employment assumption.

The value addition increases for leather, textiles, chemicals, other manufacturing, petroleum refining, wood products and vegetable oil (Table-7). In overall terms, exporting sectors see a small increase or no change in value addition. However two major exports, cotton and rice, decline by 0.6 and 2 percent, respectively.

We also briefly look at the case where we increase the import price of the machinery group by 10 percent. This group includes electrical machinery, appliances, boilers, and related mechanical equipment. The decrease in GDP this time is greater than that in Sim-3 (decreases by almost 0.7 percent) and the decline in consumption is also greater (3.9 percent). However this decrease is again less than what we have seen for the case of petroleum (Sim-2). The magnitude of change in the case of import price shocks for different commodity groups shows that a 10 percent increase in the import price of petroleum and a 10 percent increase in the import price of machinery lead to almost the same level of change.

In line with our expectations, import price changes lead to a decline in imports in all sectors (Table-8). In both simulations for an increase in import prices, the manufacturing sector is the worst affected as this sector is relatively more dependent on imported inputs. The decline in imports is substantial in the case of vegetable oil, followed by declining imports in leather, textiles, and sugar. Such a change causes concern for overall production in the country because the imported content (particularly in developing countries) is indispensable for activities with lower Armington elasticities.[6] In the case of Pakistan, exports also embody a high degree of imported content.

The impact of import price increases on the value of exports seems mixed (Table-9). The depreciation of the nominal exchange rate causes exports to increase. However, export sectors, particularly those with a high imported content (as inputs), face a decline in output. An increase in the import price of petroleum has a positive effect on textile exports, while an increase in the import price of industrial raw material has a negative effect. A similar trend is observed for rice, leather, and wheat milling.

The redistribution results seen in the previous section are reversed in the case of import price shocks (Table-10), where only those households who

[6] This is the degree of substitutability between domestic and imported sources of supply. A higher value for Armington implies a higher possibility of substitution and vice versa.

own large and medium farms see an increase in their incomes. All other groups face a decline. As explained above, these changes follow what we have seen for changes in factor returns (Table-6). The same pattern evolves in the case of household consumption in Table-11. The negative impact of an import price increase on middle- and low-income groups indicates how consumer surplus is sharply reduced via the increase in domestic prices. We had seen earlier that the output price of mostly necessity items had increased. This included food and petroleum prices, items intensively used in consumption by low-income groups. We can see a one-to-one mapping of results for household income and expenditure. It cannot be stated with certainty that import price changes act in a manner similar to a regressive tax, because in Table-10 we observe that urban non-poor and rural nonfarm non-poor households also witness a decrease in their income level. This result seems logical as farm owners least use the commodity groups that have seen changes in import prices. Farm owners also have a low level of imported inputs in their output compared with industrial producers. In the case of an oil price hike, an increase in the import price of raw materials (such as chemicals), or import price of machinery, one can expect farm owners to remain insulated to some extent. In the case of Pakistan, this exhibits the low level of mechanization in the agriculture sector.

The import price increase leads to an increase in poverty level and inequality (Table-12). In the case of a 10 percent increase in the import price of petroleum, poverty increases by 4.1 percent and inequality worsens by 0.4 percent. For a 10 percent increase in the import price of industrial raw material, poverty increases by 3.4 percent and inequality worsens by 0.2 percent. Sindh is the worst affected where the headcount ratio increases by more than 6 percent under both simulations.

6. Conclusion

In this paper, we have studied the general equilibrium and micro-level impacts of (a) an increase in foreign savings, (b) an increase in the import price of petroleum, and (c) an increase in the import price of industrial raw material. An increase in foreign savings leads to an increase in imports and a decrease in exports. The main sectors facing a decline in exports are textiles, leather, cement, and livestock. The prices of non-tradable goods decline. Changes in price seem pro-poor as food and oil prices also decrease. The returns to labor with farm holdings and returns to land decline. The returns to non-irrigated land declines more than irrigated land. Those factors that gain under this change are agricultural wage labor and nonagricultural unskilled wage labor, the latter indicating a change in favor of the urban poor. Poverty decreases and there is some improvement in income distribution.

Increases in the import prices of petroleum or industrial raw material lead to a reduction in imports and exports (the magnitude of the former is greater). The competitiveness of local manufacturing is damaged as output prices increase for cotton lint, yarn, petroleum refining, and chemicals. Sectors relatively insulated from import shocks, e.g., rice and poultry, see a decline in their prices. In terms of factor returns, agricultural wage earners, nonagricultural skilled labor, and nonagricultural unskilled labor become the main losers given the decline in production activity. Returns to land and profits to farm owners increase, showing a change in favor of agricultural asset owners. Poverty increases by over 3 percent.

Among the abovementioned simulations, external oil price shocks have the greatest potential to impact the socioeconomy. Import price changes in comparison to changes in foreign savings have opposite effects at both the micro and macro levels.

7. Tables - Results

Table-4: Macroeconomic Changes (% Change over Base)

	BASE	Sim-1	Sim-2	Sim-3
GDP (mp)	3645*	0.1	-0.7	-0.5
Private Consumption	3053	2.8	-4.3	-2.7
Real Absorption (LCU at Base Prices)	4001	2.2	-3.3	-2.1
Total Real Exports (LCU At Base Prices)	692	-6.5	-1.8	-1.9
Total Real Imports (LCU At Base Prices)	1054	3.7	-11.2	-7.4
Enterprise Income	798	-0.8	-3.3	-2.5
PPP Real Exchange Rate (LCUs per FCU)	99	-4.0	8.4	4.5
Nominal Exchange Rate (LCUs per FCU)	102	-4.1		-0.7
Imports Price Index (FCU -- 100 for Base)	100		11.9	7.1
World (tradables) Price Index (FCU -- 100 for base)	100		7.2	4.3
Domestic (non-tradables) Price Index (100 for Base)	103	-0.1	-1.1	-0.9
Terms of Trade (ratio pwe index & pwm index) (100 for Base)	100		-10.7	-6.7
Investment (% of nominal GDP)	14	-0.3	1.1	0.5
Private (Household + Enterprise) Savings (% of Nominal GDP)	16	-2.4	1.1	0.6
Foreign Savings (% of Nominal GDP)	5	2.0	0.2	0.1
Trade Deficit (% of Nominal GDP)	11	1.8	0.2	
Government Savings (% of Nominal GDP)	-6	0.1	-0.3	-0.2
Tariff Revenue (% of Nominal GDP)	1		-0.2	-0.2

*In real rupees billion

**LCU: local currency unit, FCU: foreign currency unit.

***Sim-1: 50 percent increase in foreign savings, Sim-2: 10 percent increase in import price of petroleum, Sim-3: 10 percent increase in import price of industrial raw material

Table-5: Changes in Prices

	Value Added Price (% Change over Base)			Output Price (% Change over Base)		
	Sim-1	Sim-2	Sim-3	Sim-1	Sim-2	Sim-3
Wheat Irrigated	-1.9	4.0	3.1	-1.8	3.9	2.7
Wheat Non-Irrigated	-3.0	3.7	2.1			
Paddy IRRI	-2.8	5.8	4.6	-2.3	5.0	3.7
Paddy Basmati	-2.6	6.2	5.1	-2.2	5.3	4.0
Cotton	-3.3	6.2	4.9	-3.0	6.5	4.7
Sugarcane	-2.1	5.8	4.8	-2.0	5.5	4.2
Other Major Crops	-2.6	6.1	4.8	-2.1	4.9	3.8
Fruits/ Vegetables	-2.5	7.9	6.7	-1.7	4.9	4.2
Livestock/Cattle/Dairy	4.5	-5.1	-2.7	2.0	-2.3	-1.0
Poultry	5.4	-7.7	-4.5	2.2	-3.0	-1.6
Forestry	-3.9	3.2	1.1	-3.3	2.9	1.1
Fishing Industry	-3.1	-1.4	-1.4	-2.0	-0.8	-0.9
Mining	-5.4	7.2	2.1	-4.0	5.1	1.4
Vegetable Oil	0.5	43.9	44.4	-0.8	6.3	6.1
Wheat Milling	5.4	-13	-9.1	0.3	-1.4	-1.0
Rice Milling IRRI	-3.4	-7.2	-6.0	-2.0	-0.6	-0.7
Rice Milling Basmati	-0.7	-9.7	-7.5	-1.2	-1.1	-0.9
Sugar	4.3	-10	-7.0	0.9	-2.9	-1.9
Other Food	-5.8	1.3	0.2	-2.7	0.5	0.1
Cotton Lint/Yarn	-7.1	-4.3	-4.1	-3.5	1.5	0.6
Textiles	-4.7	-3.7	-2.8	-2.5	-0.1	-0.5
Leather	-10	1.8	0.4	-0.5	-1.0	-0.7
Wood Products	-4.6	5.1	1.5	-2.7	2.9	0.8
Chemicals	-4.7	12.3	8.3	-2.8	6.3	3.6
Cement/Bricks	4.5	-9.7	-6.0	1.9	-4.8	-3.5
Petroleum Refining	-3.9	10.9	5.8	-2.6	4.5	1.5
Other Manufacturing	-6.9	4.4	1.7	-3.5	4.2	1.7
Energy	0.2	-5.8	-3.9	-0.7	-2.6	-2.3
Construction	-0.2	-4.5	-3.1	-0.6	-1.1	-1.3
Commerce	0.3	-4.2	-2.8	0.4	-4.0	-2.7
Transport	0.9	-6.9	-4.5	-0.5	-1.8	-1.7
Housing	6.9	-12	-7.7	5.5	-9.5	-6.4
Private Services	0.8	-4.7	-3.4	0.5	-3.3	-2.5
Public Services	-0.8	-4.1	-2.9	-0.8	-2.7	-2.2

*Represents average output price.

** Sim-1: 50 percent increase in foreign savings, Sim-2: 10 percent increase in import price of petroleum, Sim-3: 10 percent increase in import price of industrial raw material

Table-6: Factor Wages / Returns (% Change from Base)

	Sim-1	Sim-2	Sim-3
Labor_Large Farm	-3.1	4.9	3.5
Labor_Medium Farm_Sindh	-3.1	6.0	4.5
Labor_Medium Farm_Punjab	-3.3	6.5	5.0
Labor_Medium Farm_Other Pakistan	-2.2	3.5	2.4
Labor_Small Farm_Sindh	-3.1	6.3	4.9
Labor_Small Farm_Punjab	-2.8	6.7	5.4
Labor_Small Farm_Other Pakistan	-2.7	6.7	5.1
Labor_Agricultural Wage	1.5	-1.5	-0.5
Labor_Non_Agricultural Wage Unskilled	0.5	-4.9	-3.3
Labor_Non_Agricultural Wage Skilled	-0.8	-4.1	-2.9
Land_Large Farm_Sindh	-2.4	4.5	3.5
Land_Large Farm_Punjab	-3.0	5.5	4.0
Land_Large Farm_Other Pakistan	-3.6	2.6	0.8
Land_Irrigated_Medium Farm_Sindh	-2.8	6.6	5.2
Land_Irrigated_Medium Farm_Punjab	-2.9	7.2	5.9
Land_Irrigated_Medium Farm_Other Pakistan	-2.0	4.6	3.6
Land_Irrigated_Small Farm_Sindh	-2.8	7.3	6.0
Land_Irrigated_Small Farm_Punjab	-2.6	7.9	6.7
Land_Irrigated_Small Farm_Other Pakistan	-2.4	7.9	6.5
Land_Non_Irrigated_Small Farm_Sindh	-4.4	2.7	0.1
Land_Non_Irrigated_Small Farm_Punjab	-4.2	2.7	0.3
Land_Non_Irrigated_Small Farm_Other Pakistan	-5.2	2.5	-0.5

Sim-1: 50 percent increase in foreign savings, Sim-2: 10 percent increase in import price of petroleum, Sim-3: 10 percent increase in import price of industrial raw material

Table-7: Quantity of Value Added (% Change from Base)

	BASE	Sim-1	Sim-2	Sim-3
Wheat Irrigated	63	0.7	-2.6	-2.3
Wheat Non-Irrigated	4	2.5	-0.1	1.1
Paddy IRRI	9	-0.8	-0.9	-0.9
Paddy Basmati	17	-0.1	-1.9	-1.6
Cotton	49	-2.7	0.1	-0.3
Sugarcane	35	1.8	-2.2	-1.5
Other Major Crops	96	-0.5	0.4	-0.2
Fruits/ Vegetables	123	0.2	2.9	2.9
Livestock/Cattle/Dairy	347	0.3	-0.3	-0.2
Poultry	24	0.4	-0.6	-0.4
Forestry	10	-1.8	-0.7	-1.7
Fishing Industry	18	-1.5	0.0	-0.3
Mining	20	-1.2	2.5	1.2
Vegetable Oil	9	0.2	15.8	15.3
Wheat Milling	40	2.0	-3.1	-2.2
Rice Milling IRRI	8	-1.5	-1.4	-1.4
Rice Milling Basmati	16	-0.2	-2.4	-2.0
Sugar	48	2.3	-2.9	-1.9
Other Food	60	-1.9	2.0	1.1
Cotton Lint/Yarn	49	-3.1	0.0	-0.6
Textiles	121	-2.4	0.3	0.1
Leather	4	-6.1	4.2	2.3
Wood Products	22	-1.2	2.6	1.3
Chemicals	17	-1.2	4.2	2.9
Cement/Bricks	49	0.6	-0.7	-0.4
Petroleum Refining	21	-1.2	4.9	2.9
Other Manufacturing	86	-2.3	3.0	1.7
Energy	115	0.2	-0.4	-0.2
Construction	106	0.0	0.0	0.0
Commerce	506	0.0	0.6	0.5
Transport	401	0.6	-1.9	-1.1
Private Services	426	0.5	0.0	-0.2
Public Services	285	0.6	-0.5	-0.3

Sim-1: 50 percent increase in foreign savings, Sim-2: 10 percent increase in import price of petroleum, Sim-3: 10 percent increase in import price of industrial raw material

Table-8: Quantity of Imports (% Change from Base)

	BASE	Sim-1	Sim-2	Sim-3
Wheat Irrigated	2.9	11.9	-13.4	1.4
Other Major Crop	6.2	8.6	-7.2	7.9
Fruits/Vegetable	17.2	11.3	-64.0	-57.2
Cattle	7.0	28.6	-42.8	-26.3
Forestry	2.9	3.9	-10.3	-1.6
Fishery	0.2	12.9	-28.2	-11.7
Mining	98.3	-0.4	1.0	0.8
Vegetable Oil	32.6	13.1	-68.5	-62.8
Wheat Non-Irrigated	8.5	20.2	-27.9	-12.0
Sugar	3.4	22.5	-31.4	-14.4
Other Food	16.0	10.5	-39.2	-29.3
Cotton Yarn/Lint	7.3	0.2	-13.4	-2.3
Textile	18.2	11.2	-51.8	-42.4
Leather	1.7	20.3	-57.0	-47.4
Wood	6.3	4.1	-11.3	-3.0
Chemical	122.6	4.6	-12.4	-8.4
Petroleum Refining	104.6	3.8	-10.1	-5.9
Other Manufacturing	571.0	1.8	-6.2	-3.6
Commerce	2.7	14.9	-27.9	-12.7
Private Services	52.5	10.4	-18.7	-8.8

Sim-1: 50 percent increase in foreign savings, Sim-2: 10 percent increase in import price of petroleum, Sim-3: 10 percent increase in import price of industrial raw material

Table-9: Quantity of Exports (% Change from Base)

	BASE	Sim-1	Sim-2	Sim-3
Wheat Irrigated	4.9	-8.6	-16.3	-14.3
Other Major Crop	3.8	-8.4	-17.2	-16.2
Fruits/Vegetable	7.3	-9.2	-15.2	-15.1
Cattle	0.6	-21.8	9.2	1.2
Poultry	0.2	-22.2	12.2	3.3
Forestry	3.1	-5.2	-11.7	-8.3
Fishery	8.2	-9.8	3.2	0.6
Mining	5.2	-1.6	-11.8	-4.9
Vegetable Oil	0.2	-9.6	-3.7	-5.5
Wheat Milling	3.6	-11.0	0.9	-1.1
Rice Milling Irri	10.4	-7.9	0.5	-1.3
Rice Milling Basmati	14.8	-8.9	0.8	-1.4
Sugar	0.3	-12.4	5.9	1.8
Other Food	76.1	-6.2	0.5	-1.1
Cotton Yarn / Lint	62.8	-4.8	-4.4	-4.1
Textile	217.9	-7.2	0.6	-0.5
Leather	13.6	-16.0	7.3	2.5
Wood	0.4	-5.5	-5.9	-3.0
Chemical	9.4	-5.2	-13.4	-9.4
Cement	0.3	-16.2	15.0	8.5
Other Manufacturing	111.7	-4.3	-8.9	-5.3
Commerce	0.6	-8.7	9.2	4.7
Transport	122.2	-6.6	1.8	1.0
Private Services	0.3	-8.5	6.8	3.7

Sim-1: 50 percent increase in foreign savings, Sim-2: 10 percent increase in import price of petroleum, Sim-3: 10 percent increase in import price of industrial raw material

Table-10: Household Income (% Change from Base)

	BASE	Sim-1	Sim-2	Sim-3
Large Farmers_Sindh	23	-1.1	2.4	2.2
Large Farmers_Punjab	68	-0.7	1.3	1.3
Large Farmers_Other	14	-0.1	-0.1	0.1
Medium Farmers_Sindh	48	-0.6	2.0	1.9
Medium Farmers_Punjab	151	-0.3	0.0	0.5
Medium Farmers_Other	39	-0.7	1.5	1.4
Small Farmers_Sindh	61	1.1	-1.1	-0.2
Small Farmers_Punjab	323	0.5	-1.1	-0.2
Small Farmers_Other	129	1.2	-2.6	-1.4
Small Farm Renters_Landless_Sindh	47	1.0	-0.8	0.0
Small Farm Renters_Landless_Punjab	50	0.4	-1.4	-0.5
Small Farm Renters_Landeless_Other	19	1.0	-1.4	-0.5
Rural agricultural Workers_Landless_Sindh	24	1.7	-3.7	-2.2
Rural Agricultural Workers_Landless_Punjab	72	1.4	-4.0	-2.4
Rural Agricultural Workers_Landess_Other	12	3.0	-4.5	-2.5
Rural Non_Farm Non_Poor	423	0.7	-5.1	-3.4
Rural Non_Farm Poor	143	1.0	-5.2	-3.5
Urban Non_Poor	1830	0.3	-4.2	-3.0
Urban Poor	194	0.4	-4.8	-3.2

Sim-1: 50 percent increase in foreign savings, Sim-2: 10 percent increase in import price of petroleum, Sim-3: 10 percent increase in import price of industrial raw material

Table-11: Household Consumption Expenditure (% Change from Base)

	BASE	Sim-1	Sim-2	Sim-3
Large Farmers_Sindh	20	1.2	1.3	1.5
Large Farmers_Punjab	59	1.6	0.2	0.7
Large Farmers_Other	13	2.3	-1.2	-0.5
Medium Farmers_Sindh	44	1.7	0.9	1.3
Medium Farmers_Punjab	137	1.9	-1.0	-0.1
Medium Farmers_Other	36	1.5	0.4	0.8
Small Farmers_Sindh	55	3.4	-2.2	-0.8
Small Farmers_Punjab	293	2.8	-2.1	-0.8
Small Farmers_Other	117	3.5	-3.6	-2.0
Small Farm Renters_Landless_Sindh	42	3.3	-1.9	-0.6
Small Farm Renters_Landless_Punjab	46	2.7	-2.4	-1.1
Small Farm Renters_Landeless_Other	17	3.3	-2.4	-1.1
Rural Agricultural Workers_Landless_Sindh	22	4.0	-4.8	-2.8
Rural Agricultural Workers_Landless_Punjab	65	3.7	-5.0	-3.0
Rural Agricultural Workers_Landess_Other	11	5.4	-5.5	-3.1
Rural Non_Farm Non_Poor	363	3.2	-6.1	-4.0
Rural Non_Farm Poor	130	3.3	-6.2	-4.1
Urban Non_Poor	1407	2.7	-5.3	-3.6
Urban Poor	176	2.7	-5.8	-3.8

Sim-1: 50 percent increase in foreign savings, Sim-2: 10 percent increase in import price of petroleum, Sim-3: 10 percent increase in import price of industrial raw material

Table-12: Poverty and Inequality Results (% Change from Base)

	Sim-1**	Sim-2	Sim-3
Overall Pakistan			
FGT (0)*	-3.083	4.054	3.426
FGT (1)	-2.955	5.008	4.060
FGT (2)	-2.794	4.597	3.695
Punjab Province			
FGT (0)	-3.258	2.844	2.559
FGT (1)	-1.484	2.613	2.232
FGT (2)	-0.894	1.583	1.341
Sindh Province			
FGT (0)	-2.843	8.250	6.345
FGT (1)	-3.694	6.081	4.177
FGT (2)	-2.908	4.541	3.061
NWFP Province			
FGT (0)	-2.701	1.089	1.031
FGT (1)	-1.214	2.045	1.752
FGT (2)	-0.957	1.504	1.263
Baluchistan Province			
FGT (0)	-0.687	0.558	0.558
FGT (1)	-1.270	1.881	1.458
FGT (2)	-0.512	0.863	0.674
Gini	-0.322	0.382	0.158
p90/p10***	-1.005	0.502	-0.100
p90/p50	-0.220	0.265	0.309
p75/p25	-0.228	0.913	0.639
A(0.5)****	-0.579	0.657	0.258
A(1)	-0.570	0.539	0.164
A(2)	-0.470	-0.130	-0.395

*FGT (0): Headcount Ratio (proportion poor), FGT(1): average normalized poverty gap, FGT(2): average squared normalized poverty gap.

** Sim-1: 50 percent increase in foreign savings, Sim-2: 10 percent increase in import price of petroleum, Sim-3: 10 percent increase in import price of industrial raw material

***Percentile ratios

****Atkinson measure

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Annex – A: Elasticities and Output Shares

	Armington Elasticity	CET Elasticity	Prod_e*	Share in Value Added	Value Added/ Output**
Wheat Irrigated	4.0	4.0	0.75	1.9	51.6
Wheat Non-Irrigated	-	-	0.75	0.1	53.0
Paddy IRRI	4.0	4.0	0.75	0.3	59.9
Paddy Basmati	4.0	4.0	0.75	0.5	59.6
Cotton	4.0	4.0	0.75	1.4	61.8
Sugarcane	4.0	4.0	0.75	1.0	60.5
Other Major Crops	4.0	4.0	0.75	2.9	70.8
Fruits/Vegetables	4.0	4.0	0.75	3.6	64.5
Livestock/Cattle/Dairy	4.0	4.0	0.75	10.3	53.4
Poultry	4.0	4.0	0.75	0.7	49.0
Forestry	4.0	4.0	0.75	0.3	75.3
Fishing Industry	4.0	4.0	0.75	0.5	51.0
Mining	3.0	3.0	0.75	0.6	66.6
Vegetable Oil	3.5	3.0	1.50	0.3	8.5
Wheat Milling	3.5	3.0	1.50	1.2	21.3
Rice Milling IRRI	3.5	3.0	1.50	0.2	27.6
Rice Milling Basmati	3.5	3.0	1.50	0.5	27.3
Sugar	3.5	3.0	1.50	1.4	31.5
Other Food	3.2	3.0	1.50	1.8	36.1
Cotton Lint/Yarn	3.2	3.0	1.50	1.5	21.4
Textiles	3.5	3.0	1.50	3.6	22.3
Leather	3.5	3.0	1.50	0.1	9.3
Wood Products	3.5	3.0	0.50	0.7	34.5
Chemicals	3.0	3.0	0.50	0.5	27.5
Cement/Bricks	3.5	3.0	0.50	1.4	53.0
Petroleum Refining	3.0	3.0	0.50	0.6	19.8
Other Manufacturing	3.2	3.0	0.50	2.6	25.3
Energy	3.0	3.0	0.50	3.4	60.2
Construction	3.2	3.0	1.50	3.2	41.1
Commerce	3.0	2.0	0.50	15.0	83.4
Transport	3.2	2.0	1.25	11.9	54.2
Housing	3.2	2.0	1.25	4.8	80.4
Private Services	2.0	2.0	1.25	12.7	53.5
Public Services	2.0	2.0	1.25	8.5	65.8

*Prod_e: Elasticity of substitution between factors - bottom of technology nest.
Prod_e_2: Elasticity of substitution between agg. factor & intermediate - top of tech nest = 0.6
Elasac: output aggregation elasticity = 4
Frisch = - 2
**SAM values from Dorsoh *et al.* (2004).

Annex – B: CGE Model

Price Block	
1. Import Price	$PM_c = (1+tm_c).EXR.pwm_c + \sum_{c' \in CT} PQ_{c'}.icm_{c'c}$ $c \in CM$
2. Export Price	$PE_c = (1-te_c).EXR.pwe_c - \sum_{c' \in CT} PQ_{c'}.ice_{c'c}$ $c \in CE$
3. Demand Price of Domestic Non-Traded Goods	$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'}.icd_{c'c}$ $c \in CD$
4.Absorption	$PQ_c.(1-tq_c).QQ_c = PDD_c.QD_c + PM_c.QM_c$ $c \in (CD \cup CM)$
5. Marketed Output Value	$PX_c.QX_c = PDS_c.QD_c + (PE_c.QE_c)$ $c \in CX$
6. Activity Price	$PA_a = \sum_{c \in C} PXAC_{ac}.\theta_{ac}$ $a \in A$
7. Aggregate Intermediate Input Price	$PINTA_a = \sum_{c \in C} PQ_c.ica_{ca}$ $a \in A$
8. Activity Revenue And Costs	$PA_a(1-ta_a).QA_a = PVA_a.QVA_a + PINTA_a.QINTA_a$ $a \in A$
9. Consumer Price Index	$\overline{CPI} = \sum_{c \in C} PQ_c.cwts_c$
10. Producer Price Index For Non-Traded Marketed Output	$\overline{DPI} = \sum_{c \in C} PDS_c.dwts_c$
Production and Commodity Block	
11. CES Technology: Activity Production Function	$QA_a = \alpha_a^a.\left(\delta_a^a.QVA_a^{-\rho_a^a} + (1-\delta_a^a).QINTA_a^{-\rho_a^a}\right)^{-\frac{1}{\rho_a^a}}$ $a \in ACES$ $a \in A$
12. CES Technology: Value-Added Intermediate-Input Quantity Ratio	$\frac{QVA_a}{QINTA_a} = \left(\frac{PINTA_a}{PVA_a}.\frac{\delta_a^a}{1-\delta_a^a}\right)^{\frac{1}{1+\rho_a^a}}$ $a \in ACES$
13. Leontief Technology: Demand for Aggregate Value-Added	$QVA_a = iva_a.QA_a$ $a \in ALEO$

14. Leontief Technology: Demand for Aggregate Value-Added

$$QINTA_a = \text{int}\,a_a.QA_a \qquad a \in ALEO$$

15. Value-Added and Factor Demands

$$QVA_a = \alpha_a^{va}.\left(\sum_{f\in F}\delta_{fa}^{va}.QF_{fa}^{-\rho_a^{va}}\right)^{-\frac{1}{\rho_a^{va}}} \qquad a \in A$$

16. Factor Demand

$$WF_f.\overline{WFDIST}_{fa} = PVA_a.(1-tva_a).QVA_a.\left(\sum_{f\in F'}\delta_{fa}^{va}.QI$$

$$f \in F, a \in A$$

17. Disaggregated Intermediate Input Demand

$$QINT_{ca} = ica_{ca}.QINTA_\alpha \qquad c \in C, a \in A$$

18. Commodity Production and Allocation

$$QXAC_{ac} + \sum_{h\in H} QHA_{ach} = \theta_{ac}.QA_\alpha$$

$$a \in A, a \in CX$$

19. Output Aggregation Function

$$QX_c = \alpha_c^{ac}.\left(\sum_{a\in A}\delta_{ac}^{ac}.QXAC_{ac}^{-\rho_c^{ac}}\right)^{-\frac{1}{\rho_c^{ac}-1}}$$

$$c \in CX$$

20. First-Order Condition for Output Aggregation Function

$$PXAC_{ac} = PX_c.QX_c\left(\sum_{a\in A'}\delta_{ac}^{ac}.QXAC_{ac}^{-\rho_c^{ac}}\right)^{-1}.\delta_{ac}^{ac}.QXA$$

$$a \in A, c \in CX$$

21. Output Transformation (CET) Function

$$QX_c = \alpha_c^t.\left(\delta_c^t.QE_c^{\rho_c^t} + (1-\delta_c^t).QD_c^{\rho_c^t}\right)^{\frac{1}{\rho_c^t}}$$

$$c \in (CE \cap CD)$$

22. Export-Domestic Supply Ratio

$$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c}.\frac{1-\delta_c^t}{\delta_c^t}\right)^{\frac{1}{\rho_c^t-1}}$$

$$c \in (CE \cap CD)$$

23. Output Transformation for Non-Exported Commodities

$$QX_c = QD_c + QE_c$$

$$c \in (CD \cap CEN) \cup (CE \cap CDN)$$

24. Composite Supply (Armington) Function

$$QQ_c = \alpha_c^q.\left(\delta_c^q.QM_c^{-\rho_c^q} + (1-\delta_c^q).QD_c^{-\rho_c^q}\right)^{-\frac{1}{\rho_c^q}}$$

$$c \in (CM \cap CD)$$

25. Import-Domestic Demand Ratio

$$\frac{QM_c}{QD_c} = \left(\frac{PDD_c}{PM_c} . \frac{\delta_c^q}{1-\delta_c^q} \right)^{\frac{1}{1+\rho_c^q}}$$

26. Composite Supply for Non-Imported Outputs and Non-Produced Imports

$$QQ_c = QD_c + QM_c$$
$$c \in (CD \cap CMN) \cup (CM \cap CDN)$$

27. Demand for Transactions Services

$$QT_c = \sum_{c' \in C'} \left(icm_{cc'} . QM_{c'} + ice_{cc'} . QE_{c'} + icd_{cc'} . QD_{c'} \right)$$
$$c \in CT$$

Institution Block

28. Factor Income

$$YF_f = \sum_{a \in A} WF_f . \overline{WFDIST}_{fa} . QF_{fa} \qquad f \in F$$

29. Institutional Factor Incomes

$$YIF_{if} = shif_{if} . \left[(1 - tf_f) YF_f - trnsfr_{row,f} . EXR \right]$$
$$i \in INSD, f \in F$$

30. Income of Domestic, Non-Government Institutions

$$YI_i = \sum_{f \in F} YIF_{if} + \sum_{i' \in INSDNG'} TRII_{ii'} + trnsfr_{i,gov} . \overline{CPI} + trnsfr_{i,ro}$$
$$i \in INSDNG$$

31. Intra-Institutional Transfers

$$TRII_{ii'} = shii_{ii'} . (1 - MPS_{i'}) . (1 - TINS_{i'}) . YI_{i'}$$
$$i \in INSDNG, i' \in INSDNG'$$

32. Household Consumption Expenditure

$$EH_h = \left(1 - \sum_{i \in INSDNG} shii_{ih} \right) . (1 - MPS_h) . (1 - TINS_h) . YI_h$$
$$h \in H$$

33. Household Consumption Demand for Marketed Commodities

$$PQ_c . QH_{ch} = PQ_c . \gamma_{ch}^m + \beta_{ch}^m . \left(EH_h - \sum_{c' \in C} PQ_{c'} . \gamma_{c'h}^m - \sum_{a \in A} \sum_{c' \in C}$$
$$c \in C, h \in H$$

34. Household Consumption Demand for Home Commodities

$$PXAC_{ac} . QHA_{ach} = PXAC_{ac} . \gamma_{ach}^h + \beta_{ach}^h . \left(EH_h - \sum_{c' \in C} PQ_c .$$
$$a \in A, c \in C, h \in H$$

35. Investment Demand

$$QINV_c = \overline{qinv_c} . \overline{IADJ} \qquad c \in CINV$$

36. Government Consumption Demand

$$QG_c = \overline{GADJ} . \overline{qg_c} \qquad c \in C$$

37. Government Revenue	$YG = \sum_{i \in INSDNG} TINS_i.YI_i + \sum_{f \in F} tf_f.YF_f + \sum_{a \in A} tva_a.PVA_a.Q$ $+ \sum_{a \in A} ta_a.PA_a.QA_a + \sum_{c \in CM} tm_c.pwm_c.QM_c.EXR + \sum_{c \in CE} te_c$ $+ \sum_{c \in C} tq_c.PQ_c.QQ_c + \sum_{f \in F} YIF_{gov,f} + trnsfr_{gov,row}.EXR$
38. Government Expenditures	$EG = \sum_{c \in C} PQ_c.QG_c + \sum_{i \in INSDNG} trnsfr_{i,gov}.\overline{CPI}$
	System Constraint Block
39. Factor Markets	$\sum_{a \in A} QF_{fa} = \overline{QFS}_f \qquad f \in F$
40. Composite Commodity Markets	$QQ_c = \sum_{a \in A} QINT_{ca} + \sum_{h \in H} QH_{ch} + qg_c + QINV_c + qdst_c$ $c \in C$
41. Current Account Balance for RoW (in foreign currency)	$\sum_{c \in CM} pwm_c.QM_c + \sum_{f \in F} trnsfr_{row,f} = \sum_{c \in C} pwe_c.QE_c + \sum_{i=IN}$
42. Government Balance	$YG = EG + GSAV$
43. Direct Institutional Tax Rates	$TINS_i = \overline{tins_i}.\left(1 + \overline{TINSADJ}.tins01_i\right) + \overline{DTINS}.tins01$ $i \in INSDNG$
44. Institutional Savings Rates	$MPS_i = \overline{mps_i}.\left(1 + \overline{MPSADJ}.mps01_i\right) + DMPS.mps0$ $i \in INSDNG$
45. Savings Investment Balance	$\sum_{i \in INSDNG} MPS_i.(1 - TINS_i).YI_i + GSAV + EXR.\overline{FSAV} = \sum_{c \in C} PC$
46. Total Absorption	$TABS = \sum_{h \in H} \sum_{c \in C} PQ_c.QH_{ch} + \sum_{a \in A} \sum_{c \in C} \sum_{h \in H} PXAC_{ac}.QHA_a$ $+ \sum_{c \in C} PQ_c.QINV_c + \sum_{c \in C} PQ_c.qdst_c$
47. Ratio of Investment to Absorption	$INVSHR..TABS = \sum_{c \in C} PQ_c.QINV_c + \sum_{c \in C} PQ_c.qdst_c$
48. Ratio of Government Consumption to Absorption	$GOVSHR.TABS = \sum_{c \in C} PQ_c.QG_c$

Model Notation	
Sets	Activities
$a \in A$	
$a \in ACES(\subset A)$	Activities with a CES function at the top of the technology nest
$a \in ALEO(\subset A)$	Activities with a Leontief function at the top of the technology nest
$c \in C$	Commodities
$c \in CD(\subset C)$	Commodities with domestic sales of domestic output
$c \in CDN(\subset C)$	Commodities not in CD
$c \in CM(\subset C)$	Imported commodities
$c \in CMN(\subset C)$	Non-imported commodities
$c \in CE(\subset C)$	Exported commodities
$c \in CNE(\subset C)$	Non-exported commodities
$c \in CT(\subset C)$	Transactions service commodities
$c \in CX(\subset C)$	Commodities with domestic production
$f \in F$	Factors
$h \in H(\subset INSDNG)$	Households
$i \in INS$	Institutions (domestic and rest of the world)
$i \in INSD(\subset INS)$	Domestic institutions
$i \in INSDNG(\subset INSD)$	Domestic non-government institutions

Parameters	
$cwts_c$	Commodity weight in cpi
$dwts_c$	Weight of commodity c in the producer price index
ica_{ca}	Quantity of c as intermediate input per unit of activity a
$icd_{cc'}$	Quantity of commodity c as trade input per unit of c' produced and sold domestically
$ice_{cc'}$	Quantity of commodity c as trade input per exported unit of c'
$icm_{cc'}$	Quantity of commodity c as trade input per imported unit of c'
$\text{int}a_a$	Quantity of aggregate intermediate input per activity unit
iva_a	Quantity of value-added per activity unit
$\overline{mps}_i$	Base savings rate for domestic institution i
$mps01_c$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates

pwe_c	Export price (foreign currency)
pmw_c	Import price (foreign currency)
$qdst_c$	Quantity of stock change
$\overline{qg}_c$	Base-year quantity of government demand
$\overline{qinv}_c$	Base-year quantity of private investment demand
$shif_{if}$	Share of domestic institution i in income of factor f
$shif_{ii}$	Share of net income of i' to i ($i' \in INSDNG'; i \in INSDNG$)
$t\alpha_\alpha$	Tax rate for activity a
te_c	Export tax rate
tf_f	Direct tax rate for factor f
$\overline{tins}_i$	Exogenous direct tax rate for factor f
$tins01_i$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates
tm_c	Import tariff rate
tq_c	Sales tax rate
$trnsfr_{if}$	Transfer from factor f to institution i
tva_a	Rate of value added tax for activity a
ty_h	Rate of household income tax
α_a^a	Efficiency parameter in the CES activity function
α_a^{va}	Efficiency parameter in the CES value-added function
α_a^{ac}	Shift parameter for domestic commodity aggregation function
α_c^q	Armington function shift parameter
α_c^t	CET function shift parameter
β_{ach}^h	Marginal share of consumption spending on home commodity
β_{ch}^m	Marginal share of consumption spending on marketed commodity c for household h
δ_a^a	CES activity function share parameter
δ_{ac}^{ac}	Share parameter for domestic commodity aggregation function
δ_c^q	Share parameter for composite supply (Armington function)
δ_c^t	Share parameter for output transformation (CET) function
δ_{va}^{fa}	CES value added function share parameter for factor f in activity a

γ_{ch}^{m}	Subsistence consumption of marketed commodity c for household h
γ_{ach}^{h}	Subsistence consumption of home commodity c from activity a for household h
θ_{ac}	Yield of commodity c per unit of activity a
p_a^a	CES production function exponent
p_a^{va}	CES value added function exponent
p_c^{ac}	Domestic commodity aggregation function exponent
p_c^q	Armington function exponent
p_c^t	CET function exponent

Exogenous Variables	
$\overline{CPI}$	Consumer price index
$\overline{DTINS}$	Change in domestic institution tax share (=0 for base; exogenous variable)
$\overline{FSAV}$	Foreign savings
$\overline{GADJ}$	Government consumption adjustment factor
$\overline{IADJ}$	Investment adjustment factor
$\overline{MPSADJ}$	Savings rate scaling factor (=0 for base)
$\overline{QFS_f}$	Quantity supplied of factor
$\overline{TINSADJ}$	Direct tax scaling factor (=0 for base; exogenous variable)
$\overline{WFDIST_{fa}}$	Wage distortion factor for factor f in activity a

Endogenous Variables	
$DMPS$	Change in domestic institution savings rates (=0 for base; exogenous variable)
DPI	Producer price index for domestically marketed output
EG	Government expenditures
EH_h	Consumption spending for household
EXR	Exchange rate (domestic currency per unit of foreign currency)
$GOVSHR$	Government consumption share in nominal absorption
$GSAV$	Government savings
$INVSHR$	Investment share in nominal absorption
MPS_i	Marginal propensity to save for domestic non-government institution (exogenous variable)

PA_a	Activity price (unit gross revenue)
PDD_c	Demand price of quantity produced and sold domestically
PDS_c	Supply price for commodity produced and sold domestically
PE_c	Export price (domestic currency)
$PINTA_a$	Aggregate intermediate input price for activity a
PM_c	Import price (domestic currency)
PQ_c	Composite commodity price
PVA_a	Value-added price (factor income per unit of activity)
PX_c	Producer price
$PXAC_{ac}$	Producer price of commodity c for activity a
QA_a	Activity level
QD_c	Quantity of domestic output sold domestically
QE_c	Quantity of exports
QF_{fa}	Quantity demanded of factor f by activity a
QG_c	Government consumption demand for commodity
QH_{ch}	Quantity consumed of commodity c by household h
QHA_{ach}	Quantity of household home consumption of commodity c from activity a for household h
$QINTA_a$	Quantity of aggregated intermediate input
$QINT_{ca}$	Quantity of commodity c as intermediate input to activity a
$QINV_c$	Quantity of investment demand for commodity
QFS_f	Supply of factor f
QH_{ch}	Quantity of consumption of commodity c by household h
$QINT_c$	Quantity of intermediate use of commodity c by activity a
$QINV_c$	Quantity of investment demand
QM_c	Quantity of imports
QQ_c	Quantity supplied to domestic commodity demanders (composite supply)
QT_c	Quantity of commodity demanded as trade input
QVA_a	Quantity of (aggregate) value added
QX_c	Quantity of domestic output
$QXAC_{ac}$	Quantity of marketed output of commodity c from activity a

$TABS$	Total nominal absorption
$TINS_i$	Direct tax rate for institution i ($i \in INSDNG$)
$TRII_{ii'}$	Transfers from institution i' to i (both in the set INSDNG)
WF_f	Average wage (rental rate) of factor f
YF_f	Transfer of income to household h from factor f
YG	Government revenue
YI_i	Income of domestic non-governmental institution
YIF_{if}	Income to domestic institution i from factor f

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Development of Supply and Demand Functions of Pakistan's Wheat Crop

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Abstract

A simultaneous-equations model was used to capture the supply and demand functions for Pakistan's wheat sector at the national level. This model reflects the fact that Pakistan's domestic wheat supply is price-responsive and positively affected by the use of nutrient fertilizers. While price appears to be a statistically significant factor on the supply side, it is statistically insignificant on the demand side. Population size appears to be very significant in determining wheat demand. The wheat import supply seems to be influenced by the current world wheat price, current world wheat supplies, Pakistan's domestic consumption in previous years, and domestic supply in previous years. We recommend that policymakers allow market forces to play a role in the wheat economy in a way that protects producers from adverse market conditions. The availability of various nutrient fertilizers should be central to policies on future inputs use. Work is also needed on wheat alternatives so that the country's dependence on wheat is eased as much as possible.

Keywords: Wheat, supply and demand, Pakistan.

JEL Classification: C59, Q11.

1. Introduction

The wheat crop occupies a vital position in Pakistan's agrarian economy. Its share in terms of percentage area under major crops has remained around 36% for the last three decades (Agricultural Statistics of Pakistan). The production of the wheat crop in Pakistan is handled by private producers, but its marketing and trade have mainly been regulated by the government through 'support price' policies announced by the Government of Pakistan at the beginning of each cropping season. According to economic theory, the announcement of 'support or

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procurement prices' at the time of wheat sowing, the practice of wheat procurement, and the size of wheat stocks procured positively affect the area under wheat production and level of wheat production.

Despite the fact that the wheat crop contributes significantly toward the economy of Pakistan, there has been little analytical research carried out on its supply and demand determinants, with the exception of some research on the cost of production, supply response, and demand elasticities. Even studies carried out on cost, supply, and demand do not provide a complete picture; for instance, most of the studies carried out on the cost of production provide different estimates for the same crop and year due mainly to over- or underestimation (Arifullah, 2007). Studies on supply response in Pakistan include Falcon (1964), Cumming (1975), Tweeten (1986), Ahmad and Chaudry (1987), and Ali (1988). However, these studies do not provide econometrically estimated full production or supply functions, which are expected to reflect the major determinants of supply. On the demand side, fewer studies are available; these include Cornelisse and Kuijpers (1987), Ahmad, et al. (1987), Hamid, et al. (1987), Alderman (1988), and Ashfaq, Griffith, and Parton (2001).

For quantitative and analytical research, one needs at least four econometrically estimated supply and demand functions (domestic supply, domestic demand, export or import supply, and export or import demand functions). Since little systematic research work has been carried out on the development of econometrically estimated functions, there have been few mentionable research studies on price and policy analysis, government interventions, and associated welfare effects.

The aforementioned discussion necessitates carrying out a comprehensive research study of Pakistan's wheat crop with the objective of developing supply and demand functions that will facilitate policymakers in evaluating government interventions and improving resource use efficiency in wheat crop production.

2. Material and Methods

Econometric Model

This section presents a methodological and analytical framework for carrying out the research at hand. The following general model of supply and demand was specified.

$$A = \alpha_0 + \alpha_1 A_{t-1} + \alpha_2 P_d \quad (1a)$$

$$S_d = \beta_0 + \beta_1 \hat{A} + \beta_2 FNT + \beta_3 PPT + \beta_4 WAT \quad (1b)$$

$$D_d = \gamma_0 - \gamma_1 P_d + \gamma_2 GDPP + \gamma_3 POPP \quad (1c)$$

$$I_d = D_d - S_d \quad (1d)$$

$$I_s = \theta_0 + \theta_1 P_i - \theta_2 P_w + \theta_2 S_w \quad (1e)$$

The definitions of the various variables included in the model are provided in Table-1. The aforementioned model of supply and demand is a simultaneous-equations recursive model occurs in Gujarati (2003, pp.764-766) and Maddala (2002, p.373). A number of different specifications of this model were tried, and the final estimated model was selected on the basis of economic theory and statistical/econometric diagnostics using R^2, F-test, t-test, Jarque-Bera (JB) Normality Test, DW test and Durban h tests (Zulfiqar, 2008).

Data and Data Sources

The model of wheat supply and demand functions specified above includes a number of dependent and explanatory variables: these include area and lagged area under wheat crop, domestic wholesale price for wheat, quantity supplied and demanded, quantity imported and import price, world average trade price, major inputs such as nutrient-fertilizers, pesticides and water used, gross domestic product (GDP) and population.

Data on most of the listed variables were downloaded from the FAO's website (www.fao.org; statistical databases). In addition, data were also obtained from the Government of Pakistan's Agricultural Statistics of Pakistan, and the UN COMTRADE database. GDP-related data were obtained from the IMF website. For estimation, time series data for the period 1979/80 to 2004/05 were used.

3. Empirical Results

After trying a number of different specifications of the model specified in 1 (a-e), we ended up with the final estimated model given in Table-2. The various equations of this model are evaluated as follows.

Wheat Acreage Equation

The estimated wheat-acreage equation ($A = 3695.163 + 0.48947A_{t-1} + 24.985TR$) fulfills all necessary diagnostic statistics; the explanatory variables included are in line with economic theory and are statistically

significant. The lagged area (A_{t-1}) positively determines the present acreage under wheat crop. The equation, however, seems to suffer from the problem of autocorrelation. As an autoregressive equation, DW is not valid and Durban h is -2.0996, which for no autocorrelation should fall in the interval 1.96.

Domestic Wheat Supply Equation

The estimated domestic wheat supply equation (S_d = -8458.219 + 2.4879Â + 0.41528P_d + 2.4625FNTWT) reflects that the area predicted (Â) in an earlier equation along with the wholesale wheat price (P_d) and nutrient fertilizers (FNTWT) used determines the domestic production/supply of wheat in Pakistan.

Domestic Wheat Demand Equation

The domestic wheat demand equation (D_d = 750.129 - 0.046974P_d + 136.07POP) indicates that, as per economic theory, the domestic demand for wheat is negatively influenced by wheat wholesale prices and positively by the size of Pakistan's population (POP). The size of population is statistically significant at $\alpha = 0.05$ while the price of wheat, although it carries the correct sign, is statistically insignificant. The latter results are acceptable in a situation where wheat is a major item of daily consumption, as in Pakistan. It is worth noting that price is one of the major and statistically significant determinants of wheat supply in Pakistan, as reflected by the earlier explained domestic wheat supply equation.

Wheat Import Price Equation

The estimated wheat import price equation (P_i = 23.1559 + 0.91124P_w) shows that Pakistan's import price is positively determined by the world wheat price.

Wheat Import Supply Equation

The estimated wheat import supply to Pakistan (I_s = -5642.2 + 5.2191$\hat{P}_i$ - 0.96151$S_{d,t-1}$ + 0.68329$D_{d,t-1}$ + 0.017019S_w) seems to have been positively affected by Pakistan's import price ($\hat{P}_i$; already determined in the last equation), the world supply of wheat (S_w), and previous years' wheat consumption ($D_{d,t-1}$), and negatively by previous years' wheat supply ($S_{d,t-1}$).

4. Conversion to an Easy-to-Use Model

Conversion Procedure

The econometrically estimated model of Pakistan's wheat supply and demand functions, detailed in Table-2 and explained in the preceding paragraphs, appears to be a good model in spite of certain weaknesses. It performed best among several specifications tried, both in terms of the usual diagnostic statistics and economic theory. However, this estimated model still needs to go through at least three major modifications. First, its first wheat acreage equation is an autoregressive function, which yields short-run results; it needs to be converted into a long-run version. Second, its second equation contains the predicted value of area ($\hat{A}$), which is estimated in the first equation; hence, $\hat{A}$ in the second equation will have to be replaced with its estimated value. Third, the model contains an import supply (I_s) function but lacks an import demand (I_d) function to be computed as per the identity equation $I_d = D_d - S_d$.

To convert the first equation from its short run to a long run version, we first need to compute the coefficient of adjustment (λ), and then adjust the short-run equation to its long-run version. In the short-run equation, the value of the estimated coefficient on the lagged dependent variable A_{t-1} is 0.48947, which is equal to $1 - \lambda$. Hence, solving for λ:

$$\lambda = 1 - 0.48947 \quad (2a)$$

$$= 0.51053 \quad (2b)$$

To convert the short-run wheat acreage equation into its long-run version, we need to divide all coefficients attached to explanatory variables and constant by the value of (λ) and omit the lagged variable from the equation. By doing so, we get the long-run version of the wheat acreage equation:

$$A = 7176.9189 + 48.93934TR \quad (3)$$

Since the estimated domestic wheat supply equation includes the predicted value of variable 'A', which we have now estimated in equation (3), we substitute equation (3) into the former equation, allowing the domestic wheat supply equation to take the following form:

$$S_d = -8458.219 + 2.4879\ (7176.919 + 48.9393\ TR) + 0.41528P_d + 2.4625$$

$$FNTW = 9397.238 + 0.41528P_d + 2.4625FNTWT + 121.7562TR \quad (4a)$$

We can remove variable TR by putting in its average value, multiplying with the estimated coefficient and adding the resultant figure to the intercept.

$$S_d = 11040.9577 + 0.41528P_d + 2.4625FNTWT \quad (4b)$$

By the same procedure, we can remove the variable FNTWT and further condense the domestic supply equation.

$$S_d = 13485.77 + 0.41528P_d \quad (4c)$$

Similarly, the domestic wheat demand (D_d) function can be further condensed as follows.

$$D_d = 750.129 - 0.046974P_d + 136.07POP \quad (5a)$$

$$= 16896.20 - 0.046974P_d \quad (5b)$$

The estimated model lacks an import demand (I_d) function, which is computed as an identity equation (difference between D_d and S_d); hence:

$$I_d = D_d - S_d \quad (6a)$$

$$= (16896.20 - 0.046974P_d) - (13485.77 + 0.41528P_d) \quad (6b)$$

$$= 3410.43 - 0.462254P_d \quad (6c)$$

The estimated wheat import price equation and wheat import supply equation, respectively, represent the effect of the world wheat trade price (P_w) on Pakistan's wheat import/trade price (P_i) and shows how Pakistan's wheat import supply (I_s) is affected by its various determinants.

$$P_i = 23.1559 + 0.91124P_w \quad (7)$$

$$I_s = -5642.2 + 5.2191\hat{P}_i - 0.96151S_{d,t-1} + 0.68329D_{d,t-1} + 0.017019S_w \quad (8a)$$

We can merge equation (7) with equation (8a) to create equation (8b).

$$I_s = -5521.1413 + 4.7556P_w - 0.96151S_{d,t-1} + 0.68329D_{d,t-1} + 0.017019S_w \quad (8b)$$

Replacing the average values of variables $S_{d,t-1}$ and $D_{d,t-1}$ and adding the intercept, we get a shortened version of the equation:

$$I_s = -8922.5358 + 4.7556P_w + 0.017019S_w \quad (8c)$$

We can further condense the equation by replacing the average values of variable S_w.

$$I_s = 389.5862 + 4.7556P_w \quad (8d)$$

Final Easy-to-Use Model

What has been computed and presented in equations (4) through (8) represents a full model of Pakistan's wheat crop sector. This model provides two equations for both the domestic wheat supply (4b and 4c) and domestic demand (5a and 5b). It further consists of one equation each for wheat import demand (6c) and wheat import price as it influenced by the world wheat price (7), and three equations for wheat export supply to Pakistan (8b-d). Table-3 presents a summarized version of this easy-to-use model of Pakistan's wheat supply and demand functions.

5. Conclusion and Recommendations

Conclusion

It appears that Pakistan's domestic wheat supply is not only price-responsive but also positively affected by the use of nutrient fertilizers. Policymakers need to take note of these factors.

While price appears to be a statistically significant factor on the supply side, it is a statistically insignificant factor on the demand side, while population size appears to be very significant in determining the total demand for wheat in Pakistan. These results portray the ground realities of Pakistan where wheat constitutes an essential sizeable proportion of the average person's daily diet.

Wheat import supply to Pakistan seems to be influenced by the current world wheat price, current world wheat supplies, domestic previous years' consumption, and domestic previous years' supply. The first three variables positively affect wheat import supply to Pakistan, while the last variable negatively affects it.

Recommendations

On one hand, Pakistani wheat growers are found to respond positively to wheat prices, while on the other hand, the incoming WTO regime has asked the government to abandon the announcement of support prices. It is therefore recommended that public and private sector policymakers formulate a policy that allows market forces to play a role in the wheat

economy such that the wheat producers do not suffer due to adverse market conditions.

Besides price, the use of nutrient fertilizers seems to play a positive role in determining wheat supply. Therefore, the supply of various nutrient fertilizers, their availability at appropriate times and easy-to-reach places and their use on crops in recommended amounts should be major measures under the government's future inputs use policy.

It is further recommended that policymakers and researchers work on other food alternatives so that Pakistan's dependence on wheat is eased as far as possible.

Table-1: Definitions of Variables and their Mean Values

Name of Variable	Mean Value
A = area under wheat in '000' hectares	7837.60
$\hat{A}$ = area predicted in '000' hectares	7837.60
A_{t-1}= lagged area in '000' hectares	7774.00
S_d = domestic supply in '000' tons	15512.00
$S_{d,t-1}$ = lagged domestic supply in '000' tons	15099.00
D_d = domestic demand in '000' tons	16667.00
$D_{d,t-1}$ lagged domestic demand in '000' tons	16269.00
S_w = world supply of wheat in '000' tons	547170.00
I_s= Net import in '000' tons	1154.60
P_d = domestic price in Pak. Rupees per m. ton.	4879.20
P_i = Pakistan level trade price per ton in US$	169.82
P_w =world level trade price per ton in US$	160.95
FNTWT, nutrient-fertilizers used in wheat in '000' tons	992.82
POT = population of Pakistan in millions	118.66
TR= trend variable for the years of observations included	

Table-2: Empirical Results of Estimated Econometrics Model

Wheat Acreage Equation						
Variable	**Coefficient**	**t-Ratio**	**p-Value**	**R^2**	**F**	**DW/ Durban h**
Intercept	3695.163	3.093	0.005			DW=2.3969
A_{t-1}	0.48947	2.864	0.009	0.8473	63.829	Durban h
TR	24.985	2.223	0.036			= -2.0996
Wheat Domestic Supply Equation						
Variable	**Coefficient**	**t-Ratio**	**p-Value**	**R^2**	**F**	**DW**
Intercept	-8458.219	-1.162	0.2580			
Â	2.4879	2.357	0.028	0.9252	90.685	2.5064
P_d	0.41528	2.308	0.031			
FNTWT	2.4625	1.310	0.204			
Wheat Domestic Demand Equation						
Variable	**Coefficient**	**t-Ratio**	**p-Value**	**R^2**	**F**	**DW**
Intercept	750.129	0.188	0.853			
P_d	- 0.04697	-0.1349	0.8940	0.7737	39.313	1.1857
POP	136.07	2.905	0.008			
Wheat Import Price Equation						
Variable	**Coefficient**	**t-Ratio**	**p-Value**	**R^2**	**F**	**DW**
Intercept	23.1559	0.8080	0.4270	0.5269	26.734	1.6565
P_w	0.91124	5.170	0.000			
Wheat Import Supply Equation						
Variable	**Coefficient**	**t-Ratio**	**p-Value**	**R^2**	**F**	**DW**
Intercept	-5642.2	-2.483	0.022			
$P^{\wedge}_i$	5.2191	0.7298	0.4740			
$S_{d,t-1}$	- 0.96151	-6.174	0.000	0.6666	10.498	2.2496
$D_{d,t-1}$	0.68329	5.109	0.000			
S_w	0.017019	3.130	0.005			

Table-3: The Final Easy-To-Use Wheat Supply and Demand Model

Wheat Domestic Supply Equation

Variable	Full Equation-1	Shortened Equation-2
Intercept	11040.9577	13485.77
P_d	0.41528	0.41528
FNTWT	2.4625	

Wheat Domestic Demand Equation

Variable	Full Equation-1	Shortened Equation-2
Intercept	750.129	16896.20
P_d	- 0.046974	- 0.046974
POP	136.07	

Wheat Import Demand Equation

Variable	Coefficient
Intercept	3410.43
P_d	-0.462254

Wheat Import Price Equation

Variable	Coefficient
Intercept	23.1559
P_w	0.91124

Wheat Import Supply Equation

Variable	Full Equation-1	Shortened Equation-2	Shortened Equation-3
Intercept	-5521.1413	-8922.5358	389.5862
P_w	4.7556	4.7556	4.7556
$S_{d,t-1}$	-0.96151		
$D_{d,t-1}$	0.68329		
S_w	0.017019	0.017019	

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Reaction of Stock Prices to Dividend Announcements and Market Efficiency in Pakistan

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Abstract

This study tests the semi-strong form of market efficiency by investigating the reaction of stock prices to dividend announcements. It analyzes cash, stock, and simultaneous cash and stock dividend announcements of 79 companies listed on the Karachi Stock Exchange from July 2004 to June 2007. Abnormal returns from the market model are evaluated for statistical significance using the t-test and Wilcoxon Signed Rank Test. The findings suggest negligible abnormal returns for cash dividend announcements. However, the average abnormal and cumulative average abnormal returns for stock and simultaneous cash and stock dividend announcements are mostly positive and statistically significant.

Keywords: Stock prices, market efficiency, dividend announcements, Pakistan.

JEL Classification: G14.

1. Introduction

The Efficient Market Hypothesis proposed by Fama (1965) suggests three types of market efficiency: (i) weak, (ii) semi-strong, and (iii) strong. The weak form of market efficiency proposes that current stock prices reflect all past information. It also suggests that changes in stock prices are random and no investment strategy that is based on past information can yield above average returns to the investor. This implies that technical analysis will not be rewarded with above average returns. The semi-strong form of market efficiency (informational efficiency) proposes that current stock prices incorporate material public information and changes in stock prices will only lead to unexpected public information. This suggests that fundamental analysis will not be rewarded with above average returns. Finally, the strong form of market efficiency proposes that insider trading

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will not be rewarded as current stock prices incorporate all material nonpublic information (Reilly and Brown, 2008).

Market efficiency, however, does not simply occur by itself or because information is freely and timely available in the market. As Osei (1998) suggests, it depends heavily on the analytical and interpretational abilities of those who trade in the market and the time they have and are ready to devote to obtaining and spreading price-sensitive information.

The semi-strong form of market efficiency has mostly been investigated using event study methodology. Information disclosures related to dividends and earnings announcements, macroeconomic variables, stock repurchase announcements, and mergers and acquisitions, etc., have been investigated in different studies to test the semi-strong form market efficiency.

1.1. Stock Prices, Dividends, and Semi-Strong Market Efficiency

Although there is abundant theoretical and empirical research on the relevance of and relationship between stock prices and dividends, it is inconclusive. Graham and Dodd (1951) point toward the relevance of and hence investors' preference for dividends. Contrary to this, Miller and Modigliani (1961) propose that, in a world of no taxes and transaction costs, dividends are irrelevant to investors. However, empirical research has revealed findings that support the relevance of the dividends proposition.

In his seminal investigation of dividends policy, Lintner (1956) suggests that a firm's management will resort to increasing dividends if it believes that the increase will be permanent. Bhattacharaya (1979) explains that there exists asymmetric information between a firm's management and its shareholders: hence, an increase or decrease in dividends conveys price-sensitive information to shareholders and prospective investors. Miller and Rock (1985) and John and Williams (1985) also support the signaling or information content proposition. Brickley (1983), Healy and Palepu (1988), and Aharony and Dotan (1994) find support for the information content of dividend hypothesis, while Penman (1983) and Benartzi et al (1997) fail to do so.

Black (1976) and Easterbrook (1984) propose that dividends play a role in decreasing or increasing agency conflict between management and shareholders. When a firm's management increases dividends to shareholders, it pays out any excess cash that is left with the firm after funding all projects that have positive net present values. Therefore, positive changes in stock prices occur as a result of an increase in the dividend payout ratio and vice versa.

Given this background on the relevance of dividend-for-stock prices, the semi-strong form of market efficiency postulates that stock prices incorporate all expected future dividends (cash and stock) and that, hence, their public announcement should not result in abnormal earnings for any investor because such dividends are fully accounted for in current stock prices. This implies that stock returns prior to the announcement data and after the announcement date should not exhibit abnormality. Therefore, both abnormal mean returns and cumulative abnormal mean returns in the event window should be statistically not different from zero. Also the semi-strong form suggests that stock prices rapidly adjust to any unexpected material (in this context, unexpected increases or decreases in dividends) information.

1.2. Dividend Announcements and Stock Returns

One of the earliest studies in this direction was done by Pettit (1972) who found that the market made use of dividend change announcements in pricing securities. Rozeff and Kinney (1976) explain that, since firms release more information to the public in the month of January, above-normal returns in the month of January can be attributed to this increased inflow of information by firms to the market. Ball and Kothari (1991), investigating quarterly earnings announcements and stock prices in the US from 1980 to 1988, find that abnormal returns persisted after earning announcements. Gordon (1959, 1962), Foster and Vickery (1978), and Lee (1995) document evidence that suggests positive abnormal returns to dividend payment announcements. Contrary to the above studies, Easton and Sinclair (1989) find negative abnormal returns, i.e., a negative reaction by stock prices to dividend announcements; this is normally attributed to the tax effect of dividends for shareholders.

Lonie, et al (1996) investigate the dividend announcements of 620 UK companies from January to June 1991 using event study and interaction tests. They find that investors responded to the increase or decrease in dividends. However, their findings also reveal that, even for companies with no change in dividends, the average abnormal returns one day prior to the announcements were significantly different from zero as indicated by the *t*-statistic. Below and Johnson (1996) also fail to support the semi-strong form of market efficiency for the US equity market. Adelegan (2003) conducts a study to analyze the reaction of stock prices to dividend announcements and capital market efficiency in Nigeria. He uses the standard event study methodology to test the semi-strong form of market efficiency and finds that the Nigerian stock market was inefficient in its semi-strong form.

Uddin and Chowdhury (2005) investigate dividend announcements on the Dhaka Stock Exchange and find that there were no statistically significant abnormal returns and that dividends had no information content for stock returns and prices in the Dhaka Stock Exchange. Gunasekarage and Power (2006) also find that dividend announcements influence stock returns at the time of announcements, but that the short-term influence of dividend announcements had no long-term implications. In the long run, firms with current reductions in dividends earned excess returns.

Kong and Taghavi (2006) analyze earning announcements for the Chinese equity markets. They use the M-EGARCH approach to model changes in stock returns with event study methodology and reject the semi-strong form of market efficiency on the basis of their findings. Acker (1999) investigates the impact of dividend announcements on stock volatility rather than stock returns and finds that stock volatility increases around dividend announcements, particularly final dividend announcement and interim dividend announcements when there is a dividend cut.

Husain (1998, 1999), Chakraborty (2006), and Ali and Akbar (2009) are a few of the studies that investigate the weak form of market efficiency in the Pakistani equity market. Ali and Mustafa (2001) examine the semi-strong form of market efficiency in the Karachi Stock Exchange (KSE) by analyzing public news in two daily newspapers and the changes in trade volume and stock returns. They conclude that public information did not play an important role in the determination of stock returns since stock returns appeared more sensitive to private information.

The above literature reveals mixed findings on the semi-strong form of market efficiency and the relevance of dividends in assessing stock prices. In Pakistan, few attempts have been made to test the semi-strong form of market efficiency. Capital gains in Pakistan's equity markets are exempt from tax which cash dividends are not. Therefore, an investigation of the different types of dividend announcements and stock price reaction becomes relevant to equity markets in Pakistan. To test for market efficiency in the semi-strong form in the KSE and the relevance of dividends in pricing stocks, this study investigates stock prices and returns around 193 dividend announcements of 79 companies included in the KSE100 index from 2004 to 2007.

2. Methodology

The study aims to investigate the semi-strong form of market efficiency by examining the reaction of stock prices to dividend announcements using event study methodology to explore stock returns around the dividend announcement date. The announcements concern (i)

only cash dividends, (ii) only stock dividends, and (iii) simultaneous cash and stock dividends. Therefore, we investigate the reaction of stock prices to all three types of dividend announcements and derive our conclusions concerning the level of market efficiency in its semi-strong form.

2.1. Hypotheses

The study investigates the following hypotheses:

H_1 = There are zero statistically significant abnormal average (positive or negative) returns (AABR) due to dividend announcements (cash, stock, and simultaneous cash and stock) in the KSE during the sample period.

H_2 = The cumulative average abnormal returns (CAABR) for all the time windows (time buckets) and types of dividend announcements considered are statistically insignificant.

H_3 = There is no statistically significant difference in the response of stock prices to different types of dividend announcements.

The null hypotheses above would imply that the KSE is efficient in its semi-strong form. Further, these would also negate the signaling (positive reaction) hypotheses of Bhattacharya (1979). The tax dividend hypothesis (which proposes that investors consider cash dividends bad because they have to pay tax on it) would also be negated. Therefore, cash dividend announcements should generate significantly negative abnormal returns.

2.2. Sample and Data

For this study, we use sample companies from the KSE-100 index (i.e., companies that were included among the KSE 100 index companies during the sample period) and have paid out cash dividends or bonus stocks or both at least once in the period from 1 July 2004 to 29 June 2007. A total of 79 companies out of the KSE 100 index were selected, which in all had made 193 dividend announcements during the sample period. The dividend announcements include 129 cash announcements, 24 stock announcements, and 40 simultaneous cash and stock dividend announcements.[1]

[1] Data on the dates of dividend announcements, stock prices of the companies, and KSE 100 index values was downloaded from the KSE website (www.kse.com.pk).

2.3. Procedure

In the first part of our analysis, we use the price of each stock (i.e., stock returns) and the KSE 100 index values (i.e., market returns) for 120 days 20 days prior to the announcement day to estimate the market model:

$$E(R_{it}) = a_i + \beta_i R_{mt} + \mu_i \quad (1)$$

where

$E(R_{it})$ = is the expected return on company i stock on any given day t,

α_i = is the constant term,

β_i = is the sensitivity of company i stock to market returns R_{mt}.

The actual returns on each stock are calculated for the market model and 41-day window using the following formula:

$$AR_{it} = (P_{it} - P_{it-1})/P_{it-1} \quad (2)$$

where

AR_{it} = actual returns on company i stock on any given day t,

P_{it} = closing price of stock i on any given day t,

P_{it-1} = closing price of stock i the previous day $t-1$.

In the same manner, market returns are calculated using the following formula:

$$R_{mt} = (KSE100_t - KSE100_{t-1})/KSE100_{t-1} \quad (3)$$

where

R_{mt} = market returns on any given day t,

$KSE100_t$ = the KSE 100 index value on any given day t,

$KSE100_{t-1}$ = the KSE 100 index value of the previous day $t-1$.

We then forecast the expected returns for 20 days prior to the announcement, the announcement day, and 20 days after the announcement

day for each stock using the market model. Following this, abnormal returns are calculated on each of the 41 days for each stock as:

$$ABR_{it} = AR_{it} - \hat{R}_{it} \tag{4}$$

where ABR_{it} = abnormal returns on company i stock on any given day t. AR_{it} is the actual return on any given day t for i company and $\hat{R}_{it}$ is the estimated return on company i stock on any given day t using market model (1). Further average daily abnormal returns for each of the 41 days are calculated for the sample as:

$$AABR_t = \sum_{i}^{n} ABR_{it} / n \tag{5}$$

where $AABR_t$ is the average abnormal return on a given day and n is the number of announcements made by the sample companies.

To determine the statistical significance of the $AABR_t$ we use a parametric test, i.e., the t-test. The t-test utilizes the cross-sectional standard deviation of abnormal returns (ABR_t). We also use a nonparametric test, i.e., the Wilcoxon Signed Rank Test (WCSRT) to investigate the robustness of the results for the $AABR_t$. Further cumulative average abnormal returns $(CAABR_t)$ are calculated as:

$$CAABR_t = \sum_{t=t_i}^{t_j} AABR_t \tag{6}$$

where t_i and t_j represent researchers' specified time windows to investigate the cumulative effect of dividend announcements on stock returns. In addition to 20 days before and after the window, we also use (+1, -10), (+10, -1), (+5, -1), (+1, -5) and (+1, -1) time windows. These time windows have been selected to evaluate how abnormal returns behave within any of these particular time windows before and after the dividend announcement. This will enable us to identify any significant holding period over which abnormal returns might be significant. The statistical significance of $CAABR_t$ is investigated in the same manner as for $AABR_t$.

3. Empirical Results

3.1. Cash Dividend Announcements

Table-1 contains the minimum, maximum, and mean actual returns as well as standard deviations of returns for the three types of dividend announcements on each day in the event window. Table-2 reports the AABR and CAABR for 129 cash dividend announcements for time windows of +20 days and -20 days from the announcement day. The results reveal that, except for day 6 (i.e., 0.4%) after the announcement, the AABR is mostly statistically insignificant according to the *t*-test. However, the nonparametric WCSRT reveals that the AABR, i.e., -0.4% on day 1 after the announcement, is significant.

Table-1: Descriptive Statistics
Actual Stock Returns [$AR_{it} = (P_{it} - P_{it-1})/P_{it-1}$]

	Cash Dividends				Stock Dividends				Cash & Stock Dividends			
Days	MIN	MAX	MEAN	SD	MIN	MAX	MEAN	S.D	MIN	MAX	MEAN	SD
Day -20	-0.05	0.04	0.00	0.01	-0.04	0.03	0.00	0.02	-0.02	0.05	0.00	0.01
Day -19	-0.04	0.05	0.00	0.01	-0.04	0.04	0.00	0.02	-0.04	0.04	0.00	0.02
Day -18	-0.05	0.04	0.00	0.02	-0.38	0.05	-0.01	0.08	-0.02	0.06	0.01	0.02
Day -17	-0.06	0.05	0.00	0.02	-0.02	0.03	0.00	0.01	-0.02	0.05	0.00	0.02
Day -16	-0.05	0.05	0.00	0.02	-0.03	0.05	0.00	0.02	-0.04	0.05	0.01	0.02
Day -15	-0.05	0.06	0.00	0.02	-0.03	0.05	0.01	0.02	-0.04	0.06	0.00	0.02
Day -14	-0.05	0.10	0.00	0.02	-0.01	0.05	0.01	0.02	-0.03	0.04	0.00	0.02
Day -13	-0.04	0.05	0.00	0.02	-0.03	0.06	0.00	0.02	-0.09	0.05	0.00	0.02
Day -12	-0.05	0.06	0.00	0.02	-0.02	0.05	0.01	0.02	-0.04	0.05	0.00	0.02
Day -11	-0.04	0.05	0.00	0.02	-0.05	0.04	0.00	0.02	-0.05	0.05	0.00	0.02
Day -10	-0.04	0.05	0.00	0.01	-0.03	0.05	0.01	0.02	-0.04	0.06	0.00	0.02
Day -9	-0.05	0.05	0.00	0.02	-0.02	0.05	0.01	0.02	-0.02	0.05	0.00	0.02
Day -8	-0.05	0.05	0.00	0.02	-0.04	0.05	0.00	0.02	-0.05	0.05	0.00	0.02
Day -7	-0.10	0.06	0.00	0.02	-0.02	0.05	0.00	0.02	-0.05	0.05	0.00	0.02
Day -6	-0.04	0.05	0.00	0.02	-0.02	0.05	0.00	0.02	-0.05	0.05	0.00	0.02
Day -5	-0.04	0.05	0.00	0.02	-0.01	0.06	0.01	0.02	-0.05	0.05	0.00	0.02
Day -4	-0.04	0.06	0.00	0.02	-0.06	0.06	0.00	0.03	-0.04	0.05	0.01	0.02

Day -3	-0.05	0.06	0.00	0.02	-0.05	0.05	0.01	0.03	-0.05	0.05	0.01	0.02
Day -2	-0.06	0.05	0.00	0.02	-0.04	0.05	0.00	0.02	-0.05	0.05	0.00	0.02
Day -1	-0.05	0.05	0.00	0.02	-0.05	0.06	0.00	0.02	-0.05	0.05	0.01	0.03
Day 0	**-0.06**	**0.06**	**0.00**	**0.03**	**-0.06**	**0.06**	**0.01**	**0.03**	**-0.05**	**0.05**	**0.02**	**0.03**
Day 1	-0.09	0.13	0.00	0.03	-0.03	0.05	0.02	0.03	-0.06	0.08	0.00	0.03
Day 2	-0.09	0.07	0.00	0.02	-0.04	0.05	0.01	0.03	-0.05	0.10	0.00	0.03
Day 3	-0.11	0.05	0.00	0.02	-0.04	0.05	0.00	0.03	-0.05	0.21	0.00	0.04
Day 4	-0.05	0.05	0.00	0.02	-0.04	0.05	0.01	0.02	-0.05	0.06	0.00	0.02
Day 5	-0.05	0.07	0.00	0.02	-0.03	0.06	0.00	0.02	-0.02	0.05	0.01	0.02
Day 6	-0.05	0.06	0.00	0.02	-0.02	0.05	0.01	0.02	-0.05	0.06	0.00	0.02
Day 7	-0.05	0.05	0.00	0.02	-0.02	0.05	0.01	0.02	-0.05	0.05	0.00	0.02
Day 8	-0.05	0.09	0.00	0.02	-0.05	0.04	0.00	0.02	-0.04	0.05	0.00	0.02
Day 9	-0.05	0.05	0.00	0.02	-0.03	0.04	0.00	0.02	-0.02	0.05	0.00	0.02
Day 10	-0.09	0.05	0.00	0.02	-0.05	0.04	0.00	0.02	-0.21	0.10	0.00	0.05
Day 11	-0.04	0.05	0.00	0.02	-0.02	0.04	0.00	0.02	-0.05	0.05	0.00	0.02
Day 12	-0.04	0.05	0.00	0.02	-0.28	0.03	-0.02	0.06	-0.20	0.05	0.00	0.04
Day 13	-0.10	0.05	0.00	0.02	-0.04	0.05	0.00	0.02	-0.18	0.04	-0.01	0.04
Day 14	-0.07	0.06	0.00	0.02	-0.39	0.07	-0.02	0.09	-0.25	0.03	-0.02	0.06
Day 15	-0.06	0.05	0.00	0.02	-0.55	0.05	-0.03	0.12	-0.17	0.05	-0.01	0.04
Day 16	-0.44	0.05	-0.01	0.04	-0.33	0.02	-0.02	0.07	-0.24	0.04	-0.03	0.07
Day 17	-0.06	0.05	0.00	0.02	-0.27	0.02	-0.02	0.06	-0.27	0.05	-0.02	0.05
Day 18	-0.09	0.05	0.00	0.02	-0.13	0.05	-0.01	0.03	-0.19	0.05	-0.02	0.05
Day 19	-0.05	0.05	0.00	0.02	-0.17	0.05	-0.01	0.05	-0.41	0.05	-0.03	0.09
n		**129**				**24**				**40**		

The lower part of Table-2 reports the CAABR for the alternative time windows considered. It indicates that the CAABR for the time windows of +1 day, -1 day (-0.9%) and +5 day, and -1 day (-1.4%) after the announcement is negative and statistically significant. Therefore, the returns for these two time windows reveal that the market fails to fully anticipate public information as both time windows report statistically significant abnormal returns.

The general conclusion drawn from the analysis of the AABR and CAABR for cash dividend announcements is that both are insignificant.

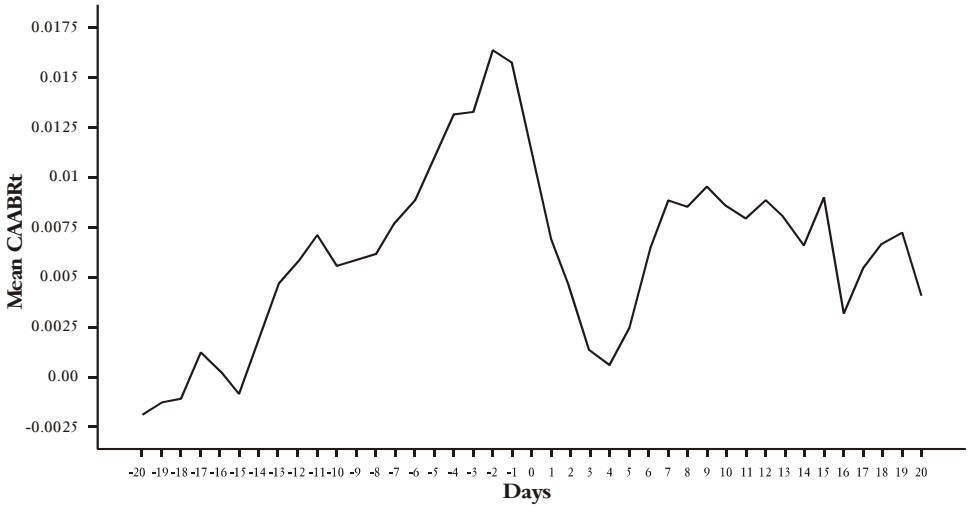
Table-2: *t*-Test Results (Cash Dividend Announcements, n = 129)

			***t* -Test**	**WCSRT**	***t* -Test**		**WCSRT**
	AABR	**S.D**	**t**	**Z**	**CAABR**	**t**	**Z**
Day -20	-0.002	0.015	-1.445	**-2.527**	-0.002	-1.445	**-2.527**
Day -19	0.001	0.015	0.469	-0.408	-0.001	-0.724	-1.420
Day -18	0.000	0.018	0.096	-0.457	-0.001	-0.483	-1.095
Day -17	0.002	0.017	1.549	-0.385	0.001	0.456	-0.035
Day -16	-0.001	0.018	-0.578	-1.244	0.000	0.110	-0.069
Day -15	-0.001	0.016	-0.820	-1.330	-0.001	-0.264	-0.040
Day -14	0.003	0.017	1.718	-0.971	0.002	0.491	-0.577
Day -13	0.003	0.016	1.961	-0.728	0.005	1.180	-0.890
Day -12	0.001	0.018	0.698	-0.300	0.006	1.314	-0.976
Day -11	0.001	0.017	0.957	-0.170	0.007	1.615	-1.212
Day -10	-0.002	0.013	-1.369	-1.913	0.006	1.232	-0.931
Day -9	0.000	0.018	0.200	-0.708	0.006	1.239	-1.149
Day -8	0.000	0.019	0.164	-0.207	0.006	1.146	-1.043
Day -7	0.002	0.021	0.859	-0.300	0.008	1.299	-1.215
Day -6	0.001	0.018	0.695	-0.088	0.009	1.345	-1.106
Day -5	0.002	0.019	1.357	-0.336	0.011	1.569	-1.355
Day -4	0.002	0.019	1.248	-0.227	0.013	1.739	-1.476
Day -3	0.000	0.022	0.039	-0.454	0.013	1.661	-1.403
Day -2	0.003	0.018	1.942	-1.399	0.016	1.939	-1.625
Day -1	-0.001	0.020	-0.305	-1.113	0.016	1.868	-1.446
Day0	-0.005	0.028	-1.887	-1.806	0.011	1.316	-0.824
Day1	-0.004	0.026	-1.797	***-2.730***	0.007	0.764	-0.139
Day2	-0.003	0.024	-1.200	-1.563	0.004	0.464	-0.060
Day3	-0.003	0.022	-1.580	-1.787	0.001	0.139	-0.342
Day4	-0.001	0.018	-0.422	-1.068	0.001	0.066	-0.222
Day5	0.002	0.020	0.999	-0.168	0.002	0.251	-0.035
Day6	0.004	0.017	**2.527**	-1.799	0.006	0.633	-0.245
Day7	0.003	0.019	1.560	-0.937	0.009	0.873	-0.475

Day8	0.000	0.020	-0.152	-0.987	0.008	0.820	-0.416
Day9	0.001	0.019	0.621	-0.226	0.010	0.892	-0.579
Day10	-0.001	0.019	-0.605	-1.462	0.009	0.796	-0.435
Day11	-0.001	0.017	-0.416	-1.574	0.008	0.720	-0.227
Day12	0.001	0.017	0.607	-0.850	0.009	0.788	-0.241
Day13	-0.001	0.020	-0.526	-0.537	0.008	0.704	-0.142
Day14	-0.001	0.020	-0.793	-0.590	0.007	0.572	-0.049
Day15	0.002	0.020	1.384	-1.291	0.009	0.751	-0.210
Day16	-0.006	0.045	-1.490	-1.184	0.003	0.266	-0.102
Day17	0.002	0.019	1.346	-0.948	0.005	0.451	-0.099
Day18	0.001	0.021	0.722	-1.090	0.007	0.536	-0.229
Day19	0.001	0.019	0.308	-0.261	0.007	0.571	-0.360
Day20	-0.003	0.025	-1.456	-1.006	0.004	0.313	-0.058
CAABR(+1,-1)	-0.009	0.0469	**-2.27**	**-2.29**	—	—	—
CAABR(-5,+1)	-0.002	0.0623	-0.35	-0.51	—	—	—
CAABR(+5,-1)	-0.014	0.0636	**-2.48**	***-2.58***	—	—	—
CAABR(-10,+1)	0.000	0.0810	-0.03	-0.70	—	—	—
CAABR(+10,-1)	-0.008	0.0868	-1.01	-1.36	—	—	—

* and ** indicate significance at 1% and 5%, respectively.

Figure-1: CAABR Graph for Cash Dividend Announcements



Furthermore, the *t*-values and *z*-values reported in the lower part of Table-3 are statistically significant for the CAABR for all the alternative time windows considered. A CAABR of 6.4% is reported for time windows of -10 days, +1 day and +10 days, and -1 day. This supports the argument that the KSE is inefficient in its semi-strong form. It also reveals that the value created by stock dividends is lost very quickly once the stock becomes ex-dividend. However, consideration must be given to the sample size (the number of stock dividend announcements, i.e., 24) which is small.

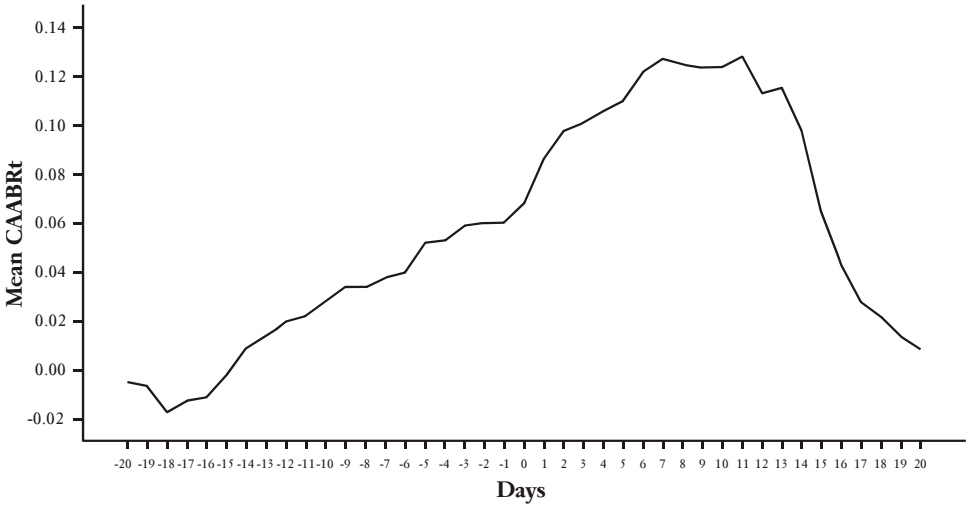
Table-3: *t*-Test Results (Stock Dividend Announcements, n = 24)

			***t* Test**	**WCSRT**	***t* Test**		**WCSRT**
	AABR	**SD**	**t**	**Z**	**CAABR**	**t**	**Z**
Day -20	-0.005	0.017	-1.375	-1.172	-0.005	-1.375	-1.172
Day -19	-0.002	0.024	-0.354	-0.400	-0.007	-1.094	-1.086
Day -18	-0.011	0.080	-0.650	-1.100	-0.017	-0.963	-0.443
Day -17	0.005	0.012	1.869	-1.714	-0.012	-0.729	-0.157
Day -16	0.001	0.018	0.396	-0.486	-0.011	-0.678	-0.171
Day -15	0.009	0.022	2.001	-1.686	-0.002	-0.115	-1.300
Day -14	0.012	0.020	**2.768**	**-2.200**	0.009	0.466	-1.686
Day -13	0.004	0.022	0.998	-0.157	0.014	0.634	-1.629
Day -12	0.006	0.020	1.463	-1.000	0.020	0.836	-1.543
Day -11	0.002	0.023	0.514	-0.343	0.022	0.861	-1.371
Day -10	0.006	0.022	1.366	-0.914	0.028	1.057	-1.286
Day -9	0.006	0.025	1.140	-0.371	0.034	1.208	-1.086
Day -8	0.000	0.020	-0.047	-0.486	0.034	1.250	-1.143
Day -7	0.004	0.019	1.015	-0.557	0.038	1.444	-1.257
Day -6	0.002	0.022	0.442	-0.429	0.040	1.441	-1.129
Day -5	0.012	0.021	***2.852***	**-2.272**	0.052	1.810	-1.629
Day -4	0.001	0.028	0.173	-0.271	0.053	1.769	-1.243
Day -3	0.006	0.026	1.161	-0.971	0.059	1.996	-1.657
Day -2	0.001	0.020	0.238	-0.400	0.060	1.998	-1.686
Day -1	0.000	0.024	0.054	-0.257	0.060	**2.128**	-1.943
Day0	0.008	0.035	1.101	-1.071	0.068	**2.396**	**-2.114**
Day1	0.018	0.028	***3.246***	***-2.631***	0.086	**2.765**	**-2.571**
Day2	0.011	0.031	1.799	-1.657	0.098	***2.843***	**-2.429**
Day3	0.003	0.027	0.573	-0.365	0.101	**2.779**	**-2.314**
Day4	0.005	0.025	1.003	-0.571	0.106	**2.799**	**-2.343**
Day5	0.004	0.022	0.882	-0.429	0.110	**2.829**	**-2.286**

Day6	0.012	0.020	***2.989***	**-2.429**	0.122	***2.996***	**-2.457**
Day7	0.005	0.019	1.338	-0.900	0.127	***2.977***	**-2.486**
Day8	-0.002	0.023	-0.475	-0.086	0.125	***2.904***	**-2.457**
Day9	-0.002	0.015	-0.485	-0.872	0.123	***2.851***	**-2.343**
Day10	0.000	0.017	0.139	-0.543	0.124	***2.873***	**-2.314**
Day11	0.004	0.017	1.259	-0.957	0.128	***2.985***	**-2.429**
Day12	-0.015	0.060	-1.241	-1.371	0.113	**2.710**	**-2.200**
Day13	0.002	0.020	0.584	-0.608	0.115	**2.666**	**-2.229**
Day14	-0.018	0.088	-0.977	-0.171	0.098	**2.257**	-1.886
Day15	-0.034	0.123	-1.355	-0.400	0.064	1.205	-1.086
Day16	-0.021	0.074	-1.393	-0.757	0.043	0.770	-0.629
Day17	-0.015	0.056	-1.349	-1.486	0.028	0.465	-0.371
Day18	-0.006	0.034	-0.812	-0.543	0.022	0.372	-0.414
Day19	-0.008	0.052	-0.758	-0.057	0.014	0.241	-0.200
Day20	-0.005	0.027	-0.958	-1.457	0.009	0.147	-0.229
CAABR(+1,-1)	0.026	0.0443	***2.91***	**-2.57**	—	—	—
CAABR(-5,+1)	0.047	0.0781	***2.93***	***-2.60***	—	—	—
CAABR(+5,-1)	0.050	0.1004	**2.43**	**-2.14**	—	—	—
CAABR(-10,+1)	0.064	0.1060	***2.97***	**-2.54**	—	—	—
CAABR(+10,-1)	0.064	0.1093	***2.86***	**-2.49**	—	—	—

* and ** indicate significance at 1% and 5%, respectively.

Figure-2: CAABR Graph for Stock Dividend Announcements



3.2. Stock Dividend Announcements

The AABR and CAABR of 24 stock dividend announcements for time windows of +20 days and -20 days are reported in Table-3. The table reveals that the AABR on day 5 (1.2%) and day 14 (1.2%) before, and day 1 (1.8%) and day 6 (1.2%) after the announcements are positive and statistically significant according to both the *t*-test and WCSRT. Since semi-strong market efficiency implies that stock returns should not exhibit abnormal returns both before and after the announcement, these abnormalities suggest a violation of the semi-strong form of market efficiency. Any reaction by the market should be instantaneous and the adjustment process should be rapid; hence, if there are any adjustments, they must occur instantaneously. The CAABR is also statistically significant from day 1 before the announcement until day 14 after the announcement. This suggests that the KSE is inefficient in its semi-strong form as revealed by the reaction of stock prices (returns) around the dividend announcement.

3.3. Cash and Stock Dividend Announcements

Table-4 contains the AABR and CAABR for 40 simultaneous cash and stock dividend announcements for a time window of +20 days, -20 days, and the announcement day. The *t*-values and *z*-values reveal that the AABR on day 4 before and day 5 after the announcement of a simultaneous cash and stock dividend is significantly different from zero and is positive. Further, the AABR on the announcement day is positive and statistically significant.

The AABR on the announcement day is 2.1%. However, the AABRs for days 14, 16, 17, 18, and 19 are negative and statistically significant. The CAABR from day 3 before the announcement till day 13 after the announcement is statistically significant and positive. This reveals that dividends result in short-term abnormal returns which accrue only up to the ex-dividend date. Once the stock becomes ex-dividend, stock prices fall and result in negative returns. The abnormal returns reported in this case are lower in value than reported for the stock dividend announcements in Table-3.

The CAABR for all five alternative time windows are reported in the lower part of Table-4. It shows that the returns (i.e. CAABR) for the five time windows are positive and statistically significant. The highest CAABR is 8.2%, reported for a time window of +5 days and -1 day.

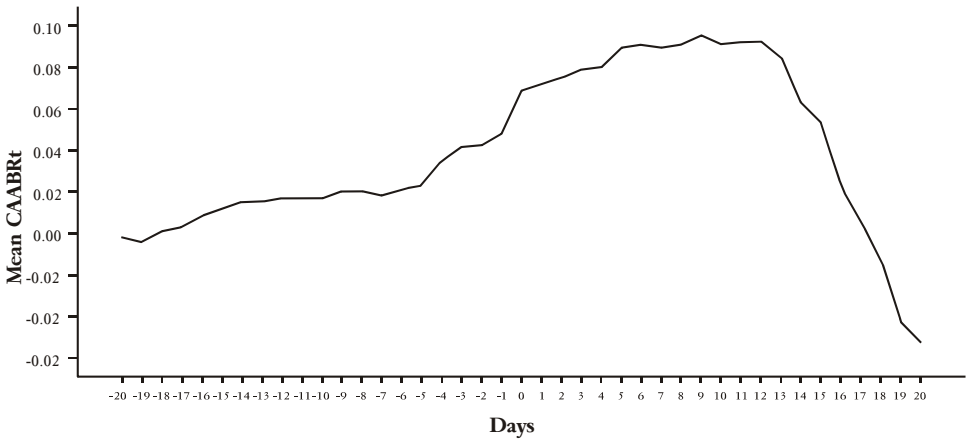
Table-4: *t*-Test Results (Both Cash and Stock Dividend Announcements, n = 40)

			***t* Test**	**WCSRT**	***t* Test**		**WCSRT**
	AABR	**S.D**	**t**	**Z**	**CAABR**	**t**	**Z**
Day -20	-0.001	0.015	-0.471	-1.331	-0.001	-0.471	-1.331
Day -19	-0.002	0.016	-0.926	-1.042	-0.003	-1.154	-1.493
Day -18	0.005	0.017	1.872	-1.122	0.002	0.433	-0.094
Day -17	0.002	0.017	0.770	-0.524	0.004	0.748	-0.040
Day -16	0.005	0.020	1.648	-0.948	0.009	1.388	-0.854
Day -15	0.003	0.022	0.927	-0.457	0.012	1.497	-1.048
Day -14	0.004	0.018	1.274	-0.645	0.016	1.761	-1.384
Day -13	0.000	0.023	0.104	-0.148	0.016	1.644	-1.425
Day -12	0.001	0.020	0.423	-0.094	0.018	1.723	-1.505
Day -11	0.000	0.024	0.011	-0.232	0.018	1.566	-1.411
Day -10	0.000	0.021	0.014	-0.628	0.018	1.328	-1.055
Day -9	0.003	0.019	1.034	-0.255	0.021	1.426	-1.055
Day -8	0.000	0.021	0.070	-0.155	0.021	1.255	-0.954
Day -7	-0.002	0.022	-0.583	-1.035	0.019	1.028	-0.686
Day -6	0.003	0.021	0.802	-0.625	0.022	1.159	-0.995
Day -5	0.002	0.019	0.776	-0.551	0.024	1.298	-1.465
Day -4	0.012	0.022	***3.408***	***-3.024***	0.036	1.842	-1.902
Day -3	0.007	0.024	1.766	-1.458	0.042	**2.066**	**-2.272**
Day -2	0.001	0.025	0.252	-0.007	0.043	**2.088**	**-2.057**
Day -1	0.005	0.027	1.204	-0.934	0.048	**2.257**	**-2.312**
Day0	0.021	0.029	***4.657***	***-3.616***	0.070	***3.120***	***-3.065***
Day1	0.003	0.032	0.620	-0.188	0.073	***3.070***	***-2.695***
Day2	0.003	0.033	0.587	-0.279	0.076	***2.889***	**-2.339**
Day3	0.004	0.041	0.647	-0.222	0.080	***3.018***	**-2.473**
Day4	0.001	0.023	0.280	-0.223	0.081	***2.977***	**-2.547**
Day5	0.009	0.020	***3.034***	***-2.339***	0.090	***3.215***	***-2.742***
Day6	0.002	0.020	0.494	-0.269	0.092	***3.151***	***-2.742***
Day7	-0.002	0.018	-0.577	-0.679	0.090	***3.118***	***-2.661***
Day8	0.002	0.018	0.575	-0.161	0.092	***3.197***	***-2.635***

Day9	0.005	0.016	1.742	-1.304	0.097	***3.242***	***-2.661***
Day10	-0.004	0.048	-0.570	-0.329	0.092	***3.099***	**-2.534**
Day11	0.001	0.022	0.304	-0.390	0.093	***3.026***	**-2.379**
Day12	0.000	0.037	0.032	-1.425	0.093	***2.990***	**-2.487**
Day13	-0.008	0.036	-1.398	-1.015	0.085	***2.765***	**-2.352**
Day14	-0.022	0.058	**-2.369**	**-2.272**	0.064	1.910	-1.579
Day15	-0.009	0.038	-1.545	-1.425	0.054	1.609	-1.304
Day16	-0.031	0.073	**-2.660**	**-2.178**	0.023	0.655	-0.040
Day17	-0.017	0.054	**-2.041**	**-2.043**	0.006	0.158	-0.363
Day18	-0.019	0.054	**-2.197**	**-2.245**	-0.013	-0.333	-0.941
Day19	-0.030	0.092	**-2.040**	-1.801	-0.042	-1.097	-1.734
Day20	-0.010	0.044	-1.408	-1.807	-0.052	-1.415	-1.707
CAABR(+1,-1)	0.030	0.0623	***3.14***	***-2.92***	—	—	—
CAABR(-5,+1)	0.054	0.0885	***3.98***	***-3.37***	—	—	—
CAABR(+5,-1)	0.082	0.2490	**2.13**	***-2.67***	—	—	—
CAABR(-10,+1)	0.059	0.1219	***3.15***	***-2.84***	—	—	—
CAABR(+10,-1)	0.059	0.1512	**2.51**	**-2.18**	—	—	—

* and ** indicate significance at 1% and 5%, respectively.

Figure-3: CAABR for Simultaneous Cash and Stock Dividend Announcements



To establish whether stock prices react differently to cash, stock, and simultaneous cash and stock dividends, we conducted a one-way ANOVA for all the 41 days' AABR for the entire sample, divided into three groups. Table-5 reports the results for those days on which the *F*-test

indicates that at least the returns of one sample group are significantly different from that of other sample groups. This suggests that investors react differently to different types of dividend announcements when quoting the prices of stocks expected to pay dividends.

Figure-4: ANOVA (1. Cash, 2. Stock, 3. Cash and Stock)

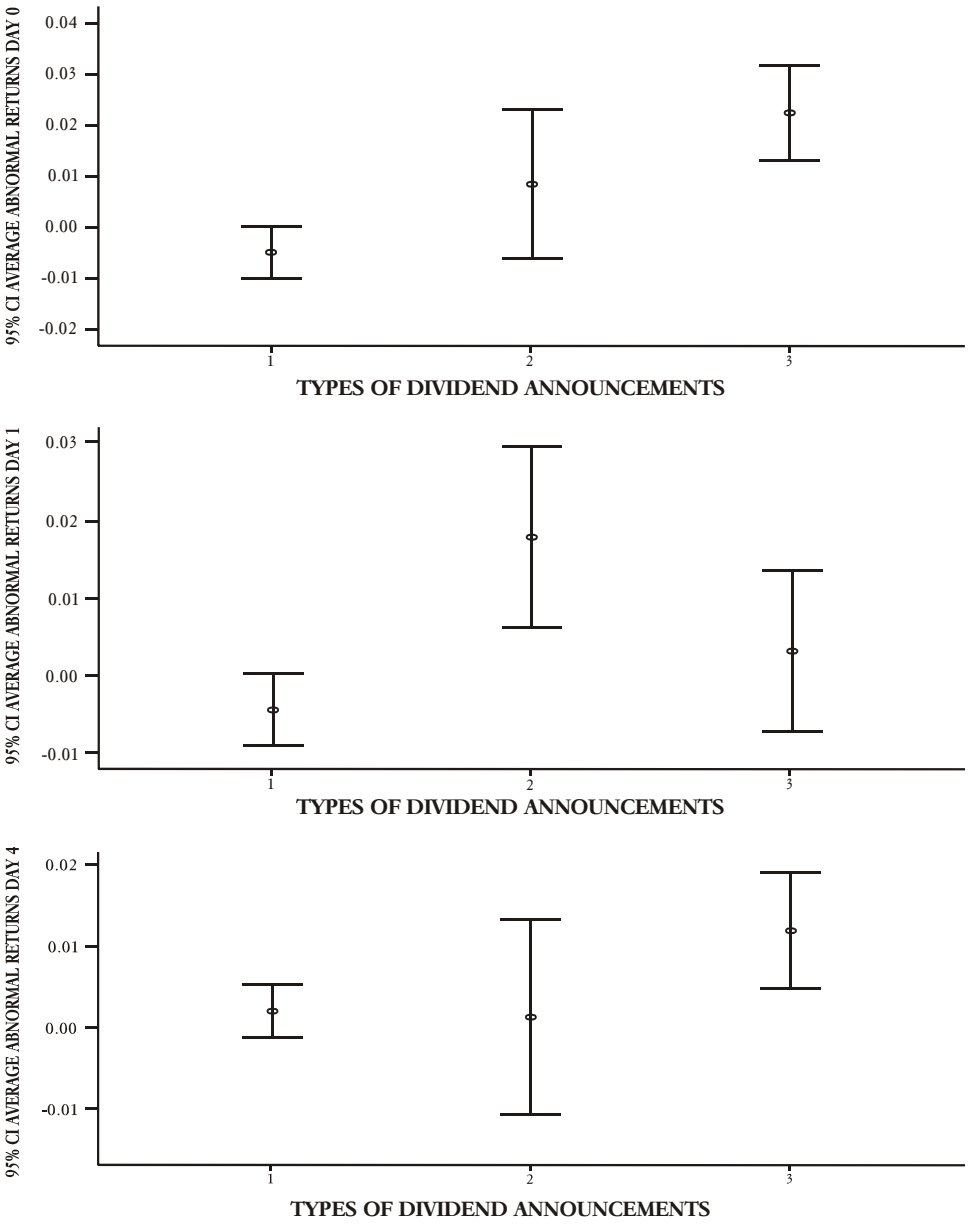


Table-5: ANOVA Test

		SS	df	MS	F	Sig.
AAR DAY-15	Between Groups	0.0030	2	0.0015	4.30	**0.01****
	Within Groups	0.0670	190	0.0004		
	Total	**0.0701**	**192**			
AAR DAY-4	Between Groups	0.0032	2	0.0016	3.61	**0.03****
	Within Groups	0.0856	190	0.0005		
	Total	**0.0888**	**192**			
AAR DAY 0	Between Groups	0.0237	2	0.0119	13.33	**0.00***
	Within Groups	0.1693	190	0.0009		
	Total	**0.1930**	**192**			
AAR DAY 1	Between Groups	0.0106	2	0.0053	6.77	**0.00***
	Within Groups	0.1482	190	0.0008		
	Total	**0.1588**	**192**			
AAR DAY 14	Between Groups	0.0160	2	0.0080	4.21	**0.02****
	Within Groups	0.3604	190	0.0019		
	Total	**0.3764**	**192**			
AAR DAY15	Between Groups	0.0276	2	0.0138	5.83	**0.00***
	Within Groups	0.4499	190	0.0024		
	Total	**0.4775**	**192**			
AAR DAY 16	Between Groups	0.0220	2	0.0110	3.47	**0.03****
	Within Groups	0.6021	190	0.0032		
	Total	**0.6241**	**192**			
AAR DAY 17	Between Groups	0.0160	2	0.0080	6.36	**0.00***
	Within Groups	0.2396	190	0.0013		
	Total	**0.2556**	**192**			
AAR DAY 18	Between Groups	0.0127	2	0.0063	6.15	**0.00***
	Within Groups	0.1954	190	0.0010		
	Total	**0.2081**	**192**			
AAR DAY 19	Between Groups	0.0271	2	0.0136	5.72	**0.00***
	Within Groups	0.4511	190	0.0024		
	Total	**0.4783**	**192**			

* & ** indicate significance at 1% & 5% respectively. The ANOVA results for all the other sample days are available with the authors.

4. Conclusion

The semi-strong form of market efficiency suggests that stock prices reflect all material past and public information. Therefore, an investment strategy based on public information should not result in above average returns. To investigate the semi-strong form of market efficiency in the KSE, we investigated stock prices (returns) around dividend announcements including cash, stock, and simultaneous cash and stock dividend announcements.

The literature suggests that those firms who have viable investment opportunities should retain their cash and invest in such opportunities. Therefore, when firms declare cash dividends, it indicates the lack of such investment opportunities and should be considered negatively, i.e., resulting in negative abnormal returns. Further cash dividends reduce cash flows for reinvestment which results in reducing future cash dividends. Since the literature defines the price of any asset as equal to the present value of its expected future cash flows, the price of the stock should fall.

Another explanation is the tax dividend hypothesis, which holds that investors dislike cash dividends since they are taxable. It also implies that stock dividends should result in positive abnormal returns. However, it is also held that firms will declare dividends when future prospects are bright for the firm's operations and profitability, i.e., the signaling effect. Therefore, stock prices (returns) should react positively to cash dividend announcements. The literature also suggests that payment of extra cash as dividends to shareholders reduces agency conflicts and costs and hence should result in a positive response by the market.

We found that the reaction of stock prices to cash dividend announcements is statistically insignificant. The returns are mostly negative for the 41-day window, which might be attributed to the tax effect of cash dividends. However, the negative returns are partly compensated by the cash dividends to investors which were not included in the calculations of returns. Also, the AABR and CAABR for stock dividend announcements are statistically significant, suggesting a positive reaction. Stock dividends are not taxed and are resorted to by firms when cash needs are high and future operations require an expanded equity base. Moreover, capital gains in the equity market are not taxed in Pakistan. Hence stock dividends are perceived favorably by investors in the KSE.

The results for simultaneous cash and stock dividend announcements are similar to those for the stock dividend announcements, and reject the

semi-strong form of market efficiency of the KSE. In simultaneous cash and stock dividends, an investor receives cash flows in the form of cash as well as additional stocks, i.e., capital gains from the company. This gives a very strong signal to investors regarding future growth in dividends and stock value. Therefore, such announcements are perceived positively and stock prices appreciate. However, it must be noted that the returns calculated for such announcements are net of cash dividends and if such dividends are included, the positive returns will further improve.

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Asset Allocation for Government Pension Funds in Pakistan: A Case for International Diversification

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Abstract

Reforms have begun in Pakistan to sustain the funded pension scheme for government-operated pension schemes such as the Employees Old Age Benefit Institution (EOBI). Presently, the EOBI operates its own fund and invests most of its assets in government-backed securities which are basically interest-bearing debt instruments. Although the returns on the EOBI's fund have been high for a short period due to higher interest rates and minimum pension distributions, this trend is not likely to continue. Funded pension schemes depend heavily on portfolio performance because risk is transferred to contributors. Therefore, asset allocation becomes considerably important. The purpose of this study is to determine optimal asset allocation and the role of international diversification specifically for the EOBI's funds and generally for newly created funded pension schemes in Pakistan. The article analyzes the potential benefits accrued through international investments based on historical returns over almost five decades with varying degrees of risk aversion coefficients. Varying degrees of risk may allow policymakers to incorporate their strategies for future asset behavior and take timely action to counter the potential threat of aging, demographic shifts, and liabilities and to ensure decent benefits for pensioners.

Keywords: Asset allocation, international diversification, pension fund, Pakistan.

JEL Classification: G11, G23.

1. Introduction

Pension reforms have become an important part of public policy across the globe and Pakistan is no exception. The existing pay-as-you-go (PAYG) or defined benefit (DB) schemes in which the government guarantees an agreed level of retirement benefits to government servants are

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losing favor due to demographic trends, unfunded future liabilities, higher fiscal deficits, and lower benefits for pensioners. These factors have prompted governments to gradually replace PAYG schemes with either fully or partially funded pension schemes where risks are borne by contributors to the fund rather than by the government. Keeping in view the above factors, the federal and provincial governments of Pakistan are implementing reforms by introducing funded pension schemes such as the Punjab Pension Fund, which became operational in 2009. Other provinces will follow suit. Also, the federal government is considering a funded pension scheme for federal government servants in order to provide resources for the economic development of Pakistan under the newly approved National Finance Commission Formula 2009.

Currently, there exists a government-operated pension scheme known as the Employees Old Age Benefit Institution (EOBI) for private workers of small and medium firms/establishments. The federal government intends to carry out meaningful reforms to the EOBI to make it economically viable and sustainable through actuarial valuations, converting it into a state pension scheme for employees based on defined contributions and benefits. Since retirement benefits in fully funded pension schemes depend on portfolio performance, asset allocation becomes important. Therefore, attention should be paid to reforming the EOBI's existing investment strategies. The EOBI invests in domestic assets as international investments are prohibited, but funded pension schemes invest more in foreign securities than defined benefit schemes (Jorge, 2004). The purpose of this study is to determine optimal asset allocation and the role of international diversification specifically for the EOBI's fund and generally for newly created funded pension schemes in Pakistan. The paper will analyze the potential benefits accrued through international investments based on historical returns over almost five decades with varying degrees of risk aversion coefficients. The varying degrees of risk may allow policymakers to incorporate their strategies for future assets and make timely decisions.

Asset allocation is a portfolio choice among broad investment classes. According to Swensen (2005):

> Construction of a financial asset portfolio involves full measures of science and art. The science encompasses the application of basic investment principles to the problem of combining core asset classes in an efficient, cost effective manner. The art concerns the use of common-sense judgment in the challenge of combining incorporating individual characteristics into the asset allocation process. (p. 81)

There are two types of asset classes: One is risk-free (less) assets and the other is risky assets. Usually, treasury bills or short-term instruments such as money market funds of up to one year's maturity are considered risk-free assets because they are not sensitive to interest rate fluctuations and there is widespread consensus that they will not default. On the other hand, risky assets contain various potential asset classes including domestic equities, foreign equities, domestic long-term government bonds, domestic real estate investment, domestic inflation-protected bonds, domestic corporate bonds, foreign government bonds, call options, and hedge funds, etc. In order to achieve higher-than-expected returns on a portfolio with a low level of risk or minimum risk with a given level of return, financial analysts use mean-variance analysis. Additionally, variance (square of standard deviation) measures volatility. Being volatile, risky assets have a high standard deviation while risk-free assets have a low standard deviation.

Efficient frontiers are used to construct efficient portfolios of risky assets and helps in calculating the optimal risky portfolio. The efficient frontier of risky assets gives the highest expected return for each unit of risk (Markowitz, 1952). It is constructed with the help of expected returns, standard deviations, and correlation coefficients between each pair of assets. The correlation coefficient among risky assets is a useful statistical tool used to calculate the benefits of diversification: the lower the correlation coefficient among assets, the greater the benefits of diversification. Markowitz (1952) further states that portfolios with low correlations among constituent assets will have superior risk-return profiles than highly correlated portfolios. A complete portfolio is the final step in optimal asset allocation, which is a combination of risk-free assets and risky assets. The asset allocation decision for a complete portfolio depends on the intersection of the capital allocation line (CAL) with the efficient frontier of risky assets.

After describing asset allocation theory, it is useful to discuss the theoretical and practical aspects of international diversification of funded Pakistani pension schemes. First, the international investment of pension funds is carried out to achieve the benefits of diversification. Modern portfolio theory (Solnik 1988, 1998) suggests that diversified domestic portfolios can eliminate unsystematic risk resulting from the different performance of industries and firms, but the systematic risk of the whole economy remains as such. Systematic risk can be minimized through international investments which play an important role in spreading risk. The expansion of investment opportunities helps investors reduce the total risk of their portfolios and offers additional profit potential (Solnik and McLeavey, 2005). The authors maintain that a reduction in the total risk of a portfolio is not the sole motive of international investment. In fact, risk reduction can easily be achieved

through investment in risk-free bills—such investments also lower the expected return. The authors believe that international diversification lowers risk without compromising the expected return.

Second, currency risk does not pose a problem from the perspective of pension fund investments. Although currency fluctuations affect not only the total return but also the volatility of any foreign currency investment, the contribution of currency risk is insignificant from the point of view of pension fund investment due to their long duration regardless of whether it is a developed or developing economy. Pfau (2009) states that the Pakistani pension system and population are young while pension liabilities are of long duration, hence currency risk becomes negligible (p. 4). He further proves that hedged international assets do not provide protection from high inflation to Pakistani investors (p. 13). Empirical studies indicate that currency risk is smaller than the risk of the corresponding stock market. (Solnik, 2005). In addition, Jorion, et al's (1999) study stresses that the contribution of country risk to the total risk of a portfolio, including a small proportion of foreign assets, is negligible. Solnik goes on to say that holding some foreign assets provides diversification from domestic fiscal and monetary risks, as bad domestic monetary policy can affect domestic asset prices, leading to home currency depreciation. The author further states that the contribution of currency risk decreases with long-term investment. In addition, currency risk is considered negligible as some authors argue that exchange rate risk does not add greatly to the long-run risks of international investment (Dimson, Marsh, and Staunton, 2002).

Third, pension fund managers usually adopt long-term management strategies so that international diversification is beneficial. Ilikiw (2004) mentions that asset allocation is primarily responsible for any pension fund's long-term investment performance. The author further states that asset allocation focuses on finding mathematically optimized portfolios of domestic and foreign asset classes. The author maintains that these portfolios are based on assumptions in order to achieve specific risk-return objectives with high confidence. The author goes on to say that these policy portfolios are "no-brainers" because they do not incur additional costs, or the risks and uncertainty of active management (Ilikiw, 2004: p. 220). Hence, active management policy involving real estate, private equity, and hedge funds which are return-enhancing investments are outside the scope of this paper. Additionally, the selection of international assets along with associated risk is not a problem in today's world due to the emergence of index funds with a low cost. This study uses the Vanguard Total Stock Market Index (VGTMX) and Vanguard International Stock Index (VGTSX) as proxies for US stocks and world stocks (non-US), respectively, providing a solution to the problem of

selecting appropriate asset classes. Fourth, financial theory arguments for international investments also apply to Pakistan. Kotlikoff (1999) argues that developing countries should invest all their assets in the world financial market. However, this investment strategy is difficult to implement in developing countries for economic and political reasons.

From the practical standpoint, Pakistan's domestic financial and capital markets are too small to absorb the growing size of pension funds. The asset allocation appropriate for a pension fund is about 15.4% of assets invested in domestic stocks. As the pension fund grows bigger, it will have a greater impact on the Pakistani stock market since it does not have the capacity to absorb ever-increasing pension fund assets, which would chase a few securities, resulting in a price bubble. Roldos (2004) (as cited by Pfau, 2009) says that the lack of supply and diversity of local security markets will distort prices and increase the volatility of pension funds. Although the capital markets in Pakistan have developed robustly in the last decade, external macroeconomic shocks such as oil shocks can lead to high inflation, which could damage domestic financial assets. Additionally, the Karachi Stock Exchange is poorly diversified and dominated by a few fund managers with a small number of actively traded companies and initial public offerings (IPOs). Indeed, small markets in developing countries are volatile and illiquid due to their inherent characteristics and the entry and exit of foreign institutional investors (Davis and Steil, 2001). As domestic and foreign markets do not move in tandem, international investments avert the risk of disasters such as war, earthquakes, and so on.

Another problem is the consistent and dependent supply of long-term government bonds in Pakistan. The Securities and Exchange Commission of Pakistan (2007) reports that the bonds market is both illiquid and insufficient as government instruments are held to maturity and are not available for trading (p. 6). The report further mentions that the National Savings Scheme (NSS) accounts for 41% of government debt as of 30 June 2006 while Pakistan investment bonds (PIBs) constitute 13% of government debt (p. 20). The NSS is under the control of Central Directorate of Savings while PIBs are controlled by the State Bank of Pakistan. The report goes on to say that the highly subsidized nature of the NSS, along with the inbuilt option that allows investors to redeem the investment at any point without penalty, makes it a costly source of funding for the government. In addition, the higher interest rate instruments of the NSS makes PIBs noncompetitive and unattractive (p. 22). Keeping in view the returns of the NSS, the EOBI started to liquidate its portfolio of PIBs around three years ago and is investing primarily in the NSS (p. 27). Taking the emerging issues into account, the State Bank of Pakistan started

electronic bond trading in January 2010 to develop the secondary debt market. Although a welcome step, it will take time to yield benefits. Under the circumstances, if Pakistan's pension funds continue to invest in government bonds, it will prove an expensive source of funding for the government and further worsen the economic situation.

On the other hand, a fund manager of the Voluntary Pension Scheme (VPS) has already calculated various individual investment options with reference to domestic asset classes.[1] Pension fund investments across various asset classes have been extensively studied both theoretically and empirically. However, analysts have rarely studied the allocation of pension funds across domestic and foreign holdings (Burtless, 2006). Burtless goes on to say that most academic analysts and financial planners believe in obtaining higher risk-adjusted expected returns by including foreign investments. In contrast, national provident funds in Asia follow conservative investment strategies (Chan-Lau, 2004). Additionally, the overall investment portfolios in most Asian countries are concentrated in government securities (Asher, 2000) although financial planners recognize that large unfunded debt may require governments to pay higher interest on debt issuance. Moreover, it is also perceived that international investment will worsen the domestic economy[2] as large capital outflows are likely to deplete a country's reserves. However, hardly any substantive academic research has been undertaken on optimal asset allocation with historical returns and the role of international diversification for government pension funds in Pakistan. This paper aims to guide policymakers in determining asset allocation for government pension funds in Pakistan.

Presently, government servants' pensions are financed by the annual budget while the EOBI operates its own fund. However, the EOBI is restricted to domestic investments and a large chunk of its funds are invested in interest-bearing debt instruments, financing government debt. Although the returns on domestic investments have historically been high over short periods, this trend is not likely to be continued in the future due to lack of sustainability and the benefits of international diversification. Reisen's (1997) study says that obtaining benefits for domestic financial markets does not mean prohibiting all foreign investment but striking a balance between foreign and domestic.

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[1] Mr. Nasim Beg of Arif Habib Investments discusses various individual investment options at the World Bank conference held in Karachi in May 2007.

[2] Mr. Muhammad Iqbal Hussain (Ministry of Finance) gave this opinion at the World Bank conference held in Karachi in May 2007.

The present study is divided into the following sections: The demography of Pakistan, the pension system in Pakistan, methodology, results, and conclusions.

2. Demography of Pakistan

The demographic pattern in Pakistan makes pension reforms an important issue of public policy. The website of the finance division of the Government of Pakistan reports that the population of Pakistan has increased from 32.4 million in 1947 to 163.76 million during 2008/09. The population of Pakistan has been increasing at an annual rate of 2.6% since inception. However, the population growth rate decreased to 1.87% by 2005 (Ministry of Finance [MOF], 2009).

Although the fertility rate has declined from 6.3% in 1974 to 3.0% in 2008, it is still greater than the replacement rate and the population will tend to increase due to the reduced infant mortality rate of 70.2 per thousand births in 2008 and increased life expectancy at birth. This trend will keep on increasing in the future as forecasted by Table 1.

The forecast of demographic variables in Table 1 shows that Pakistan's 60+ population takes on a U-shaped pattern. The number of people aged 60+ will touch 19.2 million in 2025, more than double the size it was 2005. Similarly, the old age dependency ratio has been increasing since 1990 and will become 16 in 2050. This aging of population calls for pension reforms at the earliest.

Another interesting feature reinforces this need. A significant proportion of Pakistan's population is settled in rural areas where the extended family system ensures that family members take care of one another. Specifically, elderly family members are given financial and moral support. The fast pace of urbanization has brought about to some extent a change the family structure to a nuclear one. This requires astute policymaking for social security and occupational and government pension schemes so that the elderly can enjoy a decent standard of living.

Table-1: Forecast of Some Demographic Variables for Pakistan

Year	Total Population ('000)	Population Growth Rate (%)	Total Fertility Rate (%)	Life Expecta-ncy at Birth Male	Life Expecta-ncy at Birth Female	Depen-dency Ratio Old	Depen-dency Ratio Child	Population 60+ ('000)	Popula-tion 60+ (%)
1950	36944					9	67	3040	8.2
1955	41127	2.15	6.6	44.8	42.1	9	70	3043	7.4
1960	46259	2.35	6.6	46.7	44.5	8	75	3081	6.7
1965	52327	2.47	6.6	48.6	46.8	7	79	3113	5.9
1970	59565	2.59	6.6	50.5	49.1	7	79	3367	5.7
1975	68294	2.74	6.6	52.4	51.5	6	79	3782	5.5
1980	79222	2.97	6.6	54.4	53.7	6	79	4312	5.4
1985	95005	3.63	6.6	56.4	56	6	80	5072	5.3
1990	112991	3.47	6.66	58.5	58.1	6	84	6079	5.4
1995	127766	2.46	5.8	60.5	61.4	7	85	7027	5.5
2000	144360	2.44	4.96	61.4	62.2	7	77	8167	5.7
2005	158081	1.82	3.99	63.3	63.9	7	63	9323	5.9
2010	173351	1.84	3.52	65.2	65.8	7	55	10765	6.2
2015	190659	1.9	3.16	66.9	67.5	7	50	13005	6.8
2020	208315	1.77	2.88	68.4	69.1	8	49	15893	7.6
2025	224956	1.54	2.67	69.7	70.5	9	47	19246	8.6
2030	240276	1.32	2.5	70.8	72	10	42	22725	9.5
2035	254730	1.17	2.37	71.9	73.5	11	38	26597	10.4
2040	268506	1.05	2.25	72.8	74.8	12	35	31706	11.8
2045	281201	0.92	2.15	73.6	76	13	34	38717	13.8
2050	292205	0.77	2.06	74.4	77	16	32	48112	16.5

Source: http://esa.un.org/unpp/

Notes:
1. All forecasts are using medium variant.
2. Years for pop. growth rate, total fertility rate, and life expectancy at birth are given in 6-year periods.
For example, Year 1955 represents 1950-1955,
Year 1960 represents 1955-1960,
Year 1965 represents 1960-1965.
3. The total dependency ratio is the ratio of the sum of the population aged 0-14 and that aged 65+ to the population aged 15-64.
All ratios are presented as number of dependants per 100 persons of working age (15-64).
- The child dependency ratio is the ratio of the population aged 0-14 to the population aged 15-64.
- The old-age dependency ratio is the ratio of the population aged 65 years or over to the population aged 15-64.

3. Pension System in Pakistan

Pakistan is gradually moving toward a multi-pillar model of pensions (Table-2). Pillar 1 takes the form of the EOBI fund for private workers of large and medium enterprises. The government servants' (central and provincial) pension scheme covers pillars 1 and 2. The newly introduced VPS for registered taxpayers is represented by pillar 3.

Table-2: Pension System

	Private Workers	Government Servants	Registered Taxpayers
Pillar 1	EOBI	Pension-cum-gratuity	×
Pillar 2	×	General Provident Fund	×
Pillar 3	×	VPS	VPS

3.1. EOBI

The EOBI was conceived by the Federal Ministry of Labour, Manpower, and Overseas Pakistanis in 1976. It is a corporate body that provides national pensions to employees (laborers) of private sector industries/commercial establishments employing 10 or more persons (excluding managerial and professional staff). Establishments formed after 2008 and employing five or more workers also register with the institution. The EOBI provides registered employees with an age, invalid, and survivor's pension. It manages its administrative affairs but takes policy guidance from the federal ministry.

The EOBI is engaged in identifying and registering establishments and employees, and collecting and managing pension funds. The minimum amount required for a pension is Rs. 2,000 per month while the maximum amount, introduced in 1983, is calculated according to the formula below:

$$\text{Pension} = \frac{(\text{Average salary of final 12 months' wages} \times \text{no. of years of insurable employment})}{50}$$

The pension calculation is based on average final 12 months of wages. The possible retirement age is 60 years for men and 55 years for women, while the contribution of employees should not span less than 15 years. Until 2001, only employers contributed to the fund. The mandatory

contribution on the part of employers is 5% of the minimum wage (Rs. 6,000) of employees, while employees have had to contribute 1% of their wages to the pension fund since 2002. In 2005, contributions were linked to the minimum wage and benefits were also enhanced. The federal government started contributing a matching grant in 1986 under Section 9-A of the EOBI Act but stopped this in July 1995. Since then, the EOBI has had to generate an income from its own resources.

Table-3: EOBI Fund (Rs Billion)

Year	Fund at Beginning of Year	Govt. Contribu-tion	Contributions from Employers and Employees	Income from Assets	Pension Pay-ments	Fund at Year's End
FY1994	11.6	0.7	0.8	2	0.4	14.5
FY1995	14.5	0.6	1	2.5	0.5	18
FY1996	18		1.2	3	0.5	21.4
FY1997	21.4		1.3	3.6	0.6	25.5
FY1998	25.5		1.3	4.3	0.6	30.3
FY1999	30.3		1.4	5	0.7	35.9
FY2000	35.9		1.5	5.4	0.9	41.5
FY2001	41.5		1.7	6.3	1.3	47.9
FY2002	47.9		1.9	8.4	1.4	58.9*
FY2003	58.9		2.3	10.3	1.6	69.3
FY2004	69.3		2.7	12	1.7	81.6
FY2005	81.6		2.7	14.18	1.9	96.001
FY2006	96.001		3.37	17.45	2.89	109.95
FY2007	109.95		4.85	26.02	3.45	131.95
FY2008	131.95		5.84	27.32	4.23	154.37

Source: FY1994 to 2005, State Bank of Pakistan.
Source: FY2005 to 2008, EOBI.

In the fiscal year (FY) 1994, the EOBI had an accumulated fund of Rs14.5 billion, which increased to Rs. 154.37 billion by the end of FY2008. However, the distribution of the fund in terms of pensions remained as low as 16.3% of its income during this period (State Bank of Pakistan [SBP], 2004). During FY1999 to 2008, pension payments increased by more than three times due to enhanced pension benefits committed by the government and the increasing number of pensioners.

The EOBI Act says that money not required immediately for expenses may be invested. EOB investment (rules) 1979 allow investment in diversified assets such as government guaranteed securities, interest-bearing deposits in guaranteed banks, securities and preference securities in Pakistan along with real estate either freehold or leasehold. However, investment was restricted to fixed income securities of government schemes such as federal investment bonds (FIBs), PIBs, and NSSs. The government banned institutional investors from investing in NSSs in 2000 (SBP, 2004), however the restriction was removed in November 2006. Therefore, the EOBI has started to increase its domestic equity investment; the predominance of government securities in its portfolio is shown in Table-4.

Table-4: Portfolio Position of EOBI's Fund

	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004
Government Securities	90.39%	91.10%	93.09%	96.14%	93.85%	91.73%
Other	9.51%	8.82%	6.82%	3.63%	4.33%	3.70%
Equity	0.10%	0.08%	0.08%	0.23%	1.82%	4.57%
Total	**100**	**100**	**100**	**100**	**100**	**100**

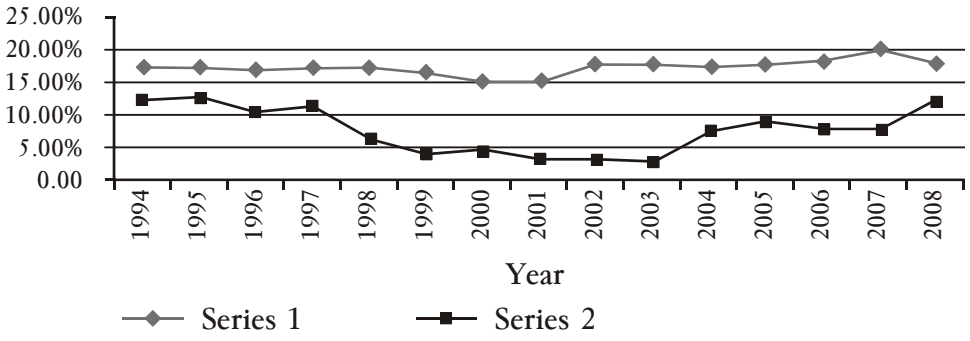
Source: State Bank of Pakistan.

The approximate return calculated as income from fund assets divided by the value of the fund at the beginning of the year from FY1994 to FY2008 is shown in Figure-1. The fund has yielded a high nominal return on its investments of between 15 and 18% during this period. There are a number of factors behind this high return. First, the fund invested in government-backed securities such as FIBs, PIBs, and NSSs, which yielded a high average return of around 17% during that period. Furthermore, this huge investment in interest-bearing debt instruments implies converting explicit debt to implicit debt.[3] An increasing budget deficit pushes governments to issue bonds, i.e., investing fund money in bonds mean financing the deficit. Additionally, the volume of assets could grow rapidly because the pensions distributed from the fund remained very low (between 2.5 and 3.5%) during the period due to nominal pensions committed by the government. The income from assets includes office premises and their rents, which is the lowest investment priority of the fund. Pfau (2009) states that the EOBI ignores capital gains/losses resulting from changing bond

[3] Mr. Muhammad Iqbal Hussain (Ministry of Finance) mentioned this point at the World Bank conference in Karachi in May 2007.

prices since government securities are held to maturity. But yields have fallen in recent years and it is doubtful whether such high returns can be maintained in the future.

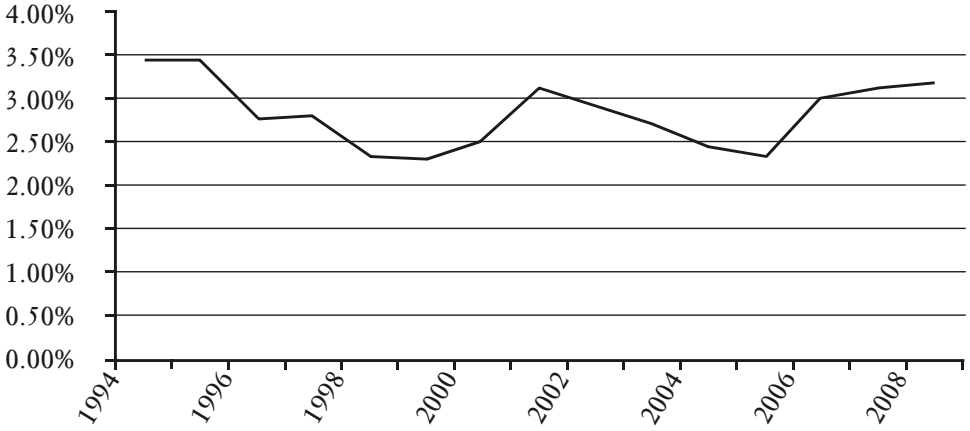
Figure-1: E.O.B.I's Fund Returns and Inflation



Source: Author's calculation.
Series 1= return, Series 2= inflation.

Note: Inflation calculation from International Financial Statistics.

Figure-2: Percentage of Pension Distributed



Source: Author's calculation from information in Table-3.

Note: Percentage of pension distributed = pension amount distributed/Fund at the beginning of the year.

The last actuarial valuation of the fund was carried out on 30 June 2002 and indicated that the existing scheme is not financially viable. The fund will start depleting in 2024 and will become negative in 2035 keeping in view simultaneous government reforms such as enhancing pension benefits and minimum wages (EOBI, 2009). Moreover, the fund does not

invest in US or world stocks and is hence devoid of the advantages of international diversification.

3.2. Government Servants' Pensions

The present pension system for government servants in Pakistan was introduced in 1954 comprising a pension-cum-gratuity-cum-General Provident Fund (GPF). This matches pillars 1 and 2 of the World Bank's pensions model. Pillar 1 includes DB pensions and gratuities, which are usually financed through taxes. No contributions are made by employees, and thus it is maintained on an unfunded basis. Pillar 2 is the mandatory contribution of government servants in the form of either a GPF or contributory provident fund (CPF). The pension system has been amended many times since then. The salient features of this system are as follows:

The retirement age for civil servants is 60 years. There are no pension benefits for up to 10 years of service, although pension benefits start after 10 years in case of invalid government servants. A civil servant is eligible for a pension provided s/he completes 25 years of service. A pension is calculated according to the following formula:

Full (gross) Pension =

$$\frac{\text{Last Pay / Pensionable Emoluments X (10-30 years) Service x 7}}{300}$$

The full (gross) pension is calculated at 70% of the last current basic pay/pensionable emoluments on completion of 30 years' qualifying service; where the period of qualifying service is less than 30 years but not less than 10 years, there is a proportionate reduction in percentage. The minimum replacement rate is 70/300 for up to 10 years of service while the maximum replacement rate is 210/300 after completing 30 years of service. There is no benefit toward a pension after 30 years of service.

3.2.1. GPF

All government servants in permanent pensionable or nonpensionable service or those temporary or officiating posts who have completed two years of continuous service are bound to join the GPF as compulsory subscribers. From time to time, the government fixes the amount of subscription toward the GPF in the form of interest. According to a government provision, the

interest is credited to the subscriber's account note.[4] The interest rate is determined each year according to the method of calculation prescribed from time to time by the government. If a subscriber is not interested in the interest rate, it is not transferred to his or her account, and s/he is allowed the facility of interest-free house building/conveyance.

Although the GPF is considered the savings of salaried employees, it is very small. The government does not utilize the contribution of employees to the fullest extent. Instead, it uses contributions to meet annual government expenditures and payments to retiring employees in that year. Since the government does not invest the GPF properly, it places an additional burden on the government exchequer. The outstanding amount of the GPF stood at Rs. 21.5 billion in April 2005 (SBP, 2004).

3.3. VPS

The Securities and Exchange Commission of Pakistan (SECP) introduced the third pillar in the form of a VPS through pension system rules in 2005. This is a voluntary self-contributory pension scheme for salaried and self-employed individuals with a valid national tax number (NTN). Employers can also contribute to the pension accounts of their employees. Pension account holders have individual pension accounts and have the option of holding more than one account. They can also move their pension account from one fund manager to the other. Finally, account holders have the option of withdrawing 25% of the balance amount at retirement age (SECP, 2005).

The SECP has already given licenses to four asset management companies under VPSs. These asset management companies offer three types of accounts, i.e., equity fund, debt fund, and money market fund to account holders. However, the coverage of the VPS scheme remains limited because there were 1.8 million taxpayers (around 1% of the total population) on 30 June 2009 (MOF, 2009). The VPS covers contractual government servants who are not covered under the government pension system and private employees not covered by any other scheme. Despite its limited coverage, it is a step in the right direction.

[4] Finance Division Notification SRO 423 (1) / 90 dated 24 April 1990.

4. Analyses

4.1. Methodology

This section describes how pension funds in Pakistan can benefit from international diversification through optimal asset allocation. Asset allocation is a portfolio choice among broad investment classes and an application of mean-variance analysis. Mean variance analysis requires not only the inputs of expected return and standard deviation of each asset class, but also the correlations of returns for each pair of assets. In this case, the inclusion of international assets will expand the set of available asset classes which increases return per unit of risk as the total standard deviation of a portfolio will be less than the standard deviation of the individual asset. As correlation across asset classes in usually low and even negative, mean variance analysis is a powerful tool in asset allocation for risk reduction through diversification.

Mean variance analysis is based on the premise that investors prefer higher returns and avoid risk or volatility of returns. Investors try to maximize expected portfolio returns r_p for a given level of portfolio risk (variance) σ_P or minimize risk for a given level of return. We assume that investors choose the portfolio weights that maximize utility U with the common utility function:

$$U_p = r_p - 0.005A\sigma_P^2$$

U_p is the utility of the portfolio. Here A is the investor's risk aversion coefficient; r_p is the expected return of the portfolio and σ_P is the expected standard deviation. The above equation shows that utility increases with portfolio return r_p and decreases with portfolio variance σ_P^2. Thus, of all feasible portfolios, the investor should consider those that maximize expected return for a given level of variance. A=0 implies that the investor is risk-neutral, A=2 implies an aggressive investor. By increasing the values of A, risk can be minimized. A=5 to 8 indicates a conservative investor, typically a pension fund manager.

We use a standard finance statistical package to calculate the optimal portfolio. The package includes a set of portfolio construction and optimization functions designed to build an optimal portfolio that optimize risk-adjusted returns. Since the efficient frontier is a line on the risk return plane, we need inputs in the form of compatible matrices of expected returns on each asset class, the variance-covariance matrix, and number of

portfolios to be analyzed along the efficient frontier. We call the function used to compute the efficient frontier, ***frontcon***.

In the next step, we define the ***portalloc*** function which comprises input arguments of portfolio risk, portfolio expected returns, and portfolio weights, all of which are outputs of the ***frontcon*** function. Other input arguments are the risk-free rate r_f, the borrowing rate (which is not specified and taken as default), and the degrees of risk aversion of investors which are 2, 5, and 8 for portfolio allocation of international assets and 3 for the calculation of a portfolio without international assets. We use varying degrees of risk aversion coefficients to determine optimal asset allocation. However, the final decision with regard to the suitability of risk-averse coefficients for Pakistani funded pension schemes lies with fund managers/policymakers. ***Portalloc*** is an inbuilt function which returns the optimal capital allocation of individual classes along the efficient frontier. The difference between ***portalloc*** and ***frontcon*** is that ***portalloc*** divides the whole portfolio into risk-free investments and risky investments depending on the investor's propensity for risk. It then calculates the weights of different asset classes in the portfolio along the efficient frontier. This is called a capital allocation decision between a risky portfolio and nonrisky assets. The point at which the capital allocation line (CAL) intersects, the efficient frontier becomes our desired complete portfolio with weights assigned to different asset classes. A complete portfolio would be based on the separation property (Tobin, 1958) principle in which portfolio choice is based on the technical requirements of a portfolio and personal preferences of investors, i.e., to achieve the best mix of risky and risk-free assets.

There are certain limitations to the mean-variance model since it depends on input data. Small changes in input data can affect optimal asset allocation a great deal. To minimize this effect, we use historical time series data of long duration with boom and bust cycles. Pfau (2009) states that the mean-variance approach is static, focusing only on a given point without considering the future. The author also says that the limitation becomes less important for a long lived pension fund (p. 11).

Keeping in view the above methodology, our calculations are based on historical time series data of assets such as US large stocks, world stocks, Pakistani stocks, and Pakistani treasury bonds. We do not include US bonds and world bonds for two reasons. First, the historical returns on these assets are quite low over a long period of time. Second, long-term bonds are illiquid compared to stocks and hence it is better to invest in foreign stocks. We have selected US large capital stocks and ignored emerging markets for various reasons. First, the US stock market is more transparent than stock

markets in emerging markets. Second, the US stock market accounts for around 46% of the total market capitalization of the world as reported by the World Bank in 2008. Pension fund investment is done primarily following a passive investment strategy where stable and large security markets are important. On the contrary, emerging markets are riskier and more volatile, and an active investment strategy has to be followed. Practically, this is difficult for Pakistani fund managers to adopt given their lack of expertise. Third, larger security markets are better regulated and entail lower trading costs (Bodie, Kane, and Marcus, 2007). Similarly, we select world stocks (non-US) which represent the world stock markets of developed countries keeping in view the aforementioned factors. Emerging markets' stocks have been excluded to avoid potential losses associated with their riskier nature; pension fund investment should not be done in riskier assets. Moreover, emerging markets would be highly correlated with Pakistani markets and devoid of the benefits of diversification. Finally, although real estate investments in Pakistan may yield better returns, we exclude them from the data due to valuation problems, nontransparency, and nonregulation of real estate assets.

4.2. Data Sources

The historical data to be used for this study consist of five asset classes. The dataset includes US large capital stocks, world stocks (excluding US stocks), Pakistani stocks, Pakistani treasury bond returns, and 1-year treasury bills. We use annual data for the returns at the year's end for the period 1962 to 2009. The annual returns on US large capital stocks are obtained from the website (www.mhhe.com/bkm) for the period 1962 to 2003 while the Vanguard Total Stock Market Index (VTSMX) has been used as a proxy from the site www.yahoofinance.com for the period 2004 to 2009 by taking the adjusted returns in December every year. Similarly, the annual returns of world stocks are obtained from the website (www.mhhe.com/bkm) for the period 1962 to 2003 while Vanguard Total International Stock Index (VGTSX) has been used as a proxy from the site www.yahoofinance.com for the U.S. stocks for the period 2004 to 2009 by taking the adjusted close returns for December every year. All non-Pakistani assets are quoted in terms of $US and are converted to Pakistani rupees by taking the annual percentage changes at the year's end from the International Financial Statistics (IFS) database for the period 1962 to 2009. Exchange rate data is used to convert the returns on non-Pakistani assets into Pakistani rupees so that the results are from the point of view of Pakistani investors. Similarly, data on Pakistani stocks is obtained from two sources. Annual stock returns are calculated using the State Bank's General Index of Share Prices from 1962 to 1991. Annual returns on the KSE 100 Index are calculated for the period 1992 to 2009.

The annual yield of Pakistani long-term treasury bonds is obtained from the IFS database for the period 1962 to 2009. In order to be consistent with the other data, we calculate the total return *(RET)* on these bonds which consists of the yield and capital gains/losses from the interest rate movements using the following formula.

$$RET_t = yield_{t-1}/yield_t + (1-yield_{t-1}/yield_t)/(1+yield_t/100)^{10} - 1 + yield_{t-1}/100$$

The data is presented in Table-5.

Table-5: Asset Returns

Year	Pakistani Stocks	Pakistani Treasury Bonds	US Stocks	World Stocks
1962	13.742	2.78	-8.790	-7.200
1963	13.649	3.22	22.630	14.350
1964	-6.565	3.62	16.670	11.050
1965	-4.594	1.49	12.500	10.490
1966	-1.065	1.98	-10.250	-6.470
1967	-3.653	4.55	24.110	23.750
1968	14.793	2.2	11.000	19.920
1969	4.393	1.32	-8.330	-6.210
1970	10.950	3.02	4.100	-2.940
1971	-37.689	3.56	14.170	19.220
1972	-15.412	5.76	101.450	107.540
1973	15.222	5.76	0.370	0.760
1974	-18.924	5.68	-27.341	-24.951
1975	29.263	5.78	37.260	31.840
1976	1.354	-15.17	23.980	16.760
1977	17.537	7.58	-7.260	6.430
1978	31.205	7.95	6.500	21.140
1979	23.394	7.80	18.770	18.020
1980	-0.930	1.28	32.480	30.430
1981	14.228	22.53	-4.980	-4.180
1982	-48.149	9.67	41.762	30.932
1983	31.272	9.68	33.085	34.575
1984	38.522	9.67	13.545	10.435
1985	-3.307	9.60	45.399	53.769
1986	-3.006	11.91	22.915	43.095
1987	30.207	12.15	9.853	20.703

1988	17.024	7.90	20.334	25.324
1989	4.866	9.20	45.439	33.049
1990	3.740	9.04	2.476	-11.984
1991	36.749	9.23	40.304	28.574
1992	-25.650	-20.6	13.096	-0.874
1993	74.020	12.30	21.928	32.568
1994	-5.320	14.91	10.040	15.420
1995	-26.900	13.06	41.231	24.081
1996	-10.540	13.0	37.089	26.219
1997	30.890	12.73	47.120	29.920
1998	-46.110	77.45	38.152	30.122
1999	46.000	9.9	30.928	36.988
2000	9.990	3.8	-0.721	-4.721
2001	-16.130	5.8	3.542	-0.388
2002	112.210	8.9	-25.658	-20.578
2003	65.520	6.2	25.388	34.458
2004	39.07	-6.2	11.85	13.34
2005	53.68	-8.5	3.88	12.70
2006	5.06	-4.0	14.22	26.22
2007	40.18	12.0	-1.2	9.90
2008	-58.33	-12.0	-54.4	-63.3
2009	60.05	26	18.01	24.74

Sources: Pakistani Stocks: State Bank of Pakistan, Karachi Stock Exchange. Pakistani Treasury Bonds: International Financial Statistics. U.S. Stocks: S&P 500, Center for Research in Security Prices (CRSP), University of Chicago and Vanguard Total Stock Market Index (VTSMX) World Stocks: Datastream and Vanguard Total International Stock Index (VGTSX).

5. Results

The objective is to consider the role of international assets for funded Pakistani pension schemes. Table-6 presents the means, standard deviations, and correlation coefficients. The historical data is used to determine optimal asset allocations for varying degrees of risk aversion. Finally, we check optimal asset allocation by prohibiting foreign assets.

Table-6: Historical Mean Returns, Standard Deviations, and Correlation Coefficients

	Pakistani Stocks	Pakistani Treasury Bonds	US Stocks	World Stocks
Means	11.6	6.95	16.10	16.15
Standard Deviations	32.40	13.41	24.40	24.33
Correlation Coefficients				
Pakistani Stocks	1	-0.059	-0.074	0.072
Pakistani Treasury Bonds	-0.059	1	0.23	0.23
US Stocks	-0.074	0.23	1	0.93
World Stocks	0.072	0.23	0.93	1

Pakistani stock returns show a high volatility with a mean return of 11.6% and standard deviation of 32.4%, while the total returns on Pakistani bonds are 6.95% with a 13.41% standard deviation. The risk-free rate is assumed to be 5%. In Pakistani rupees, the mean returns on US stocks are 16.10% with a 24.4% standard deviation; the mean returns on world stocks are 16.15% with a standard deviation of 24.33%.

The correlation of 1 between asset classes will not show any benefits of diversification. Similarly, the correlation between US stocks and world stocks (non-US) is 0.93 which is quite high from the perspective of diversification. However, decreasing correlations imply greater benefits of diversification. Negative correlations are attractive for optimal portfolios as they reduce portfolio variance with the same returns. The correlations among Pakistani stocks, Pakistani bonds, and US stocks is -0.059 and -0.074. Being negative, they provide the benefits of diversification. Moreover, the correlation between Pakistani stocks and world stocks (non-US) are 0.072 so there are fewer benefits of diversification. However, the correlation among Pakistani bonds, US stocks, and world stocks is 0.23. The results help in calculating optimal asset allocation (Table-7).

Table-7: Results of Portfolio
Asset Allocation for Varying Degrees of Risk Aversion Based on Annual Data, 1962-2009.

		Risk Aversion Coefficient		
		2	5	8
Return (%)		15.03	10.3	8.30
Risk (%)		19.63	10.3	6.4
Portfolio Weights (%)	Pakistani Stocks	23.6	15.4	9.60
	Pakistani Bonds	0	7.8	4.9
	Pakistani Bills	0	39.8	62.4
	US Stocks	66.0	37.0	23.1
	World Stocks (Non-US)	10.4	0	0
Percentage Stocks		100	52.4	32.7
Percentage International		76.4	37.0	23.1

Reward to Variability Ratio = 0.51

Optimal Asset Allocation with International Assets

Table-7 presents the optimal asset allocation of historical data with risk aversion coefficients of 2, 5, and 8. In this section, we vary the risk aversion coefficients to observe the corresponding changes in optimal asset allocation decision. Risk aversion coefficient A = 2 implies an aggressive investor while A = 5 and 8 indicates a risk-averse investor. The calculation using an A = 2 portfolio shows that Pakistani assets constitute 23.6 of the complete portfolio while the remaining 76.4 goes to US stocks and world stocks with an overall return of 15.03% and a risk of 19.63%. The biggest allocation is for US stocks at 66.0, followed by Pakistani stocks at 23.6, and world stocks at 10.4. Pakistani bonds play no role. Additionally, the reward to variability ratio is 0.51 for all portfolios as all exist on the same CAL.

Although we have started our analysis from the point of view of an aggressive investor, pension fund investments are more suited to conservative investors. For risk aversion coefficients of 5 and 8, asset allocations change in favor of Pakistani bonds and bills. With a risk aversion coefficient of 5, the percentage allocated to US stocks and Pakistani stocks decreases to 37.0 and 15.4%, respectively. Interestingly, world stocks lose their position while the major portion of the portfolio is dominated by

Pakistani bills and bonds. The portfolio seems good from the perspective of Pakistani pension funds as it gives an overall return of 10.3% with a 10.3% standard deviation. The average inflation rate of five decades becomes 7.3% (IFS database) and the real returns on the fund are 3.0%, which is a plausible investment for a pension fund such as the EOBI along with newly created funded pension schemes. Additionally, the portfolio is balanced with stocks' share of 51% and aggregate bonds and bills' share of 47%. The portfolio with its international components also fulfills the requirements of the EOBI's long-term commitments.

With a risk aversion coefficient of A = 8, the portfolio favors Pakistani bills and bonds with an overall return of 8.3% and standard deviation of 6.4%. Although the portfolio favors bonds and bills, US and Pakistani stocks hold an adequate share of 23.1 and 9.6%, respectively. However, the ultimate decision to select a portfolio depends on policymakers' insights and priorities.

Optimal Asset Allocation with Pakistani Assets

Table-8: Asset Allocation of Pakistani Assets Based on Annual Data 1962-2009
Risk Aversion=3

Return (%)	7.2
Risk (%)	8.6
Pakistani Stocks	21.9
Pakistani Bonds	39.1
Pakistani Bills	39.0

Reward to Variability Ratio - 0.26

Table-8 presents the results of the portfolio after removing international assets. We start calculating the optimal asset allocation with Pakistani assets for the historical period with a risk aversion coefficient of 3. The portfolio gives an overall return of 7.2% with a standard deviation of 8.6% and heavily tilts toward Pakistani bills and bonds. Almost 82% of the total assets go toward bonds and bills. Moreover, the reward to variability ratio decreases to 0.26, showing an increase in portfolio variance by compromising returns in comparison with optimal asset allocation with international assets. If the risk aversion coefficient A increases further, the

percentage allocated to Pakistani bills will increase. Thus, we stop calculations at A = 3 as the overall return will further decrease.

Moreover, if we allocate about 82% of the assets to Pakistani treasury bonds and bills, the pension fund will generate almost the same payment stream as a PAYG system, which is already in practice in Pakistan. As Funke and Stadtmann (2004) explain, the only difference between a pure PAYG system and pension fund is that the government undertakes its financing through the medium of a pension fund rather than income tax. Such an approach makes the pension fund irrelevant. In addition, the ever-increasing budget deficit prompts the government to issue bonds: if we allocate most of our assets toward treasury bonds, it will simply help in financing the budget deficit.

6. Conclusion

We have found that a risk-aversion coefficient of 5 may be suitable to sustain the defined benefit pension fund of the EOBI as it gives an overall return of 10.3% with a 10.3% standard deviation. With an average inflation rate over five decades of 7.3%, the real returns on the fund become 3.0%, which is a plausible investment for a pension fund such as the EOBI and newly created funded pension schemes alike. Additionally, the portfolio is balanced with stocks' share of 51% and aggregate bonds and bills' share of 47%. The portfolio with its international components also fulfills the requirements of the EOBI's long-term commitments. Another reason to include US and world stocks in the asset allocation is that pensioners' consumption of goods and services and prices of goods and services are highly correlated with stock prices in Pakistan.

The removal of international assets from the optimal portfolio enhances the portfolio's variance and compromises returns. The portfolio gives an overall return of 7.2% with a standard deviation of 8.6% and heavily tilts toward Pakistani bills and bonds even with a risk-averse coefficient of A = 3. Almost 82% of the total assets go toward bonds and bills. Moreover, the reward to variability ratio decreases from 0.51 to 0.26, showing an increase of portfolio variance by compromising returns in comparison with optimal asset allocation with international assets. In short, the present study presents a strong case for international diversification. However, pension fund assets should neither be invested to retire the government debts of provincial governments nor to bolster the stock exchanges in times of economic crises. It is important to note that the EOBI's sustainability depends on allowing for international investments. The findings are highly relevant to the newly created Punjab Pension Fund.

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