Four Essays on Trade, Foreign Direct Investment, and Markets in Pakistan

Fire artikler om handel, utlendingers direkte investeringer og markeder I Pakistan.

Philosophiae Doctor (PhD) Thesis

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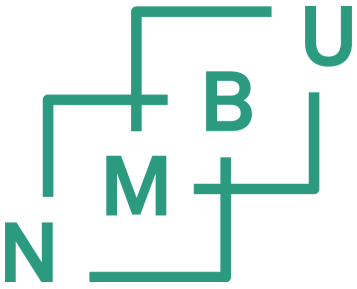

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Abstract

This dissertation seeks to study aspects of economic growth and development in Pakistan that have been pursued through enhancing commodity-specific exports, attracting foreign investment and improving the functioning of commodity markets. It is comprised of four research articles. Article 1 investigates the factors affecting commodity exports and identifies markets that have unexploited export potential. Rice exports from Pakistan during 1991-2010 are taken as the example and studied using panel data and techniques. It is found that Pakistan's economic growth, importers income, export prices, specialization, the currency exchange rate and transactions costs are the major factors affecting rice exports from Pakistan. A high unexploited export potential is also found in 49 export markets out of the 92 countries. The second article measures the economic and institutional determinants of Foreign Direct Investment (FDI) inflows into Pakistan and answers why FDI has been low and uneven despite investment-friendly policies during 1996-2010. Pakistan's market size, governance, infrastructure, human capital, favorable business environment and income and governance of the foreign investors are the major factors responsible for attracting foreign direct investment in Pakistan. Low economic growth, bad governance, and a lack of skilled human capital are possible reasons for low and variable net FDI inflows. Article 3 answers the question whether commodity markets such as rice are integrated domestically and with the international markets. It also examines the effects of government policies on the extent of market integration employing time series data and techniques. It is found that Pakistan's domestic markets are integrated domestically and with the international markets. The price support policy abolition seems to have contributed to greater domestic integration, while the subsequent export policies seem to have decreased the extent of Pakistan's integration with the international markets. Article 4 examines the spatial differences in volatility across regional rice markets of Pakistan using time series data and techniques. Volatility clustering is found in all markets. Volatility and its persistence differ spatially reflecting differences in infrastructure that make some regions more exposed to risk. A positive association of volatility across markets is found, and its degree is reviewed in light of market geography and infrastructure. Overarching conclusions of this dissertation are the following: Higher productivity and economic growth, specialization, developing infrastructure and human capital, and improving institutional quality are the important factors that can contribute to the economic development of Pakistan. Investments on education and research and development, bringing in technology, improving infrastructure and institutional quality and implementing bilateral trade and investment agreements would strengthen the foundation for economic development of Pakistan through accelerating exports, foreign direct investment and improving the functioning of markets.

Contents

Four Essays on Trade, Foreign Direct Investment, and Markets in Pakistan

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1 Introduction

Sustainable growth and economic development can be achieved by increasing exports and promoting foreign investment, improving the functioning of markets and through effective government policies. In developing countries this is particularly important to raise people's incomes and to reduce poverty. Capital scarcity, the lack of technology, low productivity, high levels of unemployment, weak institutions, market access and poor infrastructure affect the process of economic growth and development in the developing economies (Zaidi 2005; Todaro and Smith 2012; Gov.uk 2013).

Exports facilitate the process of economic development through specialization, generating employment and enhancing income levels (Majeed et al. 2006). The export-led growth hypothesis suggests that exports are the important driver of overall economic growth. Exports can engender positive spillovers on non-export sectors, enhance productivity, reduce foreign-exchange limitations and hence, can expand access to international markets. The literature on endogenous growth theory argues that exports can play an important role in long-run growth by bringing in new technology and through learning-by-doing from abroad (Feder 1982; Helpman and Krugman 1985; Lucas 1988; and Edwards 1992 in Ahmed et al. 2003). The Asian tiger economies are an example of the success of this growth strategy (Shirazi and Manap 2005). Foreign direct investment (FDI) can generate employment, develop human capital, bring in more advanced technology, bridge investment-savings gaps and provide necessary capital to enhance economic growth in developing economics. Well-functioning markets particularly of food

commodities help to equate demand and supply between different locations and regions and across seasons which benefit both producers and consumers by increasing sales and access and availability of the products. Nobel Prize winner of economics, Amartya Sen, enunciated that the main reasons for famine are the low incomes and poor market access instead of low production (Tadesse 2010). Hence, well-functioning markets can improve the allocation of resources by the economic agents and contribute to economic growth and development.

The economy of Pakistan is comprised of about 180 million people with a 47 million person labor force and is endowed with abundant natural resources. Successive governments have pursued trade liberalization and have pro-investment policies (Siddique and Kemal 2002; BOI 2013). However, the economic growth has been lower than other South-Asian countries and has been led by consumption rather than investment (Economist Intelligence Unit (EIU) 2014; World Bank 2013a; World Bank 2013b). The trade deficit has remained higher while domestic savings and investment, foreign exchange reserves, and foreign direct investment have been lower than many Asian countries. Exports are concentrated in few markets and products. The economy is also lacking good quality and appropriate infrastructure. That is, roads are of poor quality and safety, there is low productivity of transportation and an energy shortfall, particularly of electricity and natural gas (World Bank 2013b; World Bank 2013c).

This dissertation seeks to study aspects of economic growth and development in Pakistan that have been pursued through enhancing commodity-specific exports, attracting foreign investment and improving the functioning of commodity markets. It is comprised of four research articles. Article 1 investigates the factors affecting commodity exports and identifies the markets having unexploited export potential taking the example of rice exports from Pakistan during 1991-2010 using panel data and techniques. It aims at enhancing exports particularly of rice from

Pakistan that can contribute to sustainable growth and economic development of Pakistan through reducing trade deficit, earning foreign exchange and generating employment. The second article measures the economic and institutional determinants of net FDI inflows into Pakistan and answers why FDI has been low and uneven despite investment-friendly policies during 1996-2010 by employing panel data and techniques. It aims at increasing FDI inflows into Pakistan which would enhance economic growth and development of Pakistan through reducing the investment-savings gap, providing capital, bringing in technology, generating employment and developing human capital. Article 3 answers the question whether commodity markets such as rice are integrated domestically and with the international markets. It also examines the effects of government policies on the extent of market integration. Article 4 is an extension of article 3 which measures the volatility in regional rice markets of Pakistan. It also examines the spatial difference in the volatility as well as measures the relationship between the volatility of geographically separated markets. Both of the articles employ time-series data and techniques. These studies on market integration and price volatility identify infrastructural bottle necks and examine policy effects on functioning of commodity markets helping in decision making regarding allocation of resources by the economic agents and policy makers and contributing to economic growth and development of Pakistan.

The rest of this chapter is comprised of four sections. Section 2 provides the comparative and historical view of the economy of the Pakistan. Section 3 presents some empirical evidences on the export-growth, FDI-growth and market functioning-growth relationships. Section 4 briefly describes the data and methods used in this dissertation. Section 5 presents the summary of main findings while section 6 concludes the dissertation.

2 The Economy of Pakistan

Pakistan is the world's 6th populous economy and ranks 36th with respect to area, having strategic geographical location in central and Southeast Asia. It provides low-cost labor and a large market for consumer goods (Yousaf et al 2008; EIU 2014). It is the second most urbanized country in southern Asia (World Bank 2013a). The country is endowed with natural resources such as fertile agricultural land, water resources (with one of the largest irrigation systems in the world), mining and fuel resources. However, efficient use of these human and natural resources is a major concern. The country has experienced democracy and dictatorship since its existence in 1947. The democracy index 2008, produced by the Economist Intelligence Unit (EIU), categorized it as "Hybrid Regime" and ranked Pakistan as the 108th out of 167 countries. Economic policies are aimed at liberalized trade and investment (EIU 2008, World Bank 2013a). This section provides the economic performance of Pakistan compared with other Asian countries and historical development in the economic indicators and policies indicting the importance of research on enhancing exports, foreign investment and markets.

2.1 The economy of Pakistan: A comparative view

Table 1 compares the economic growth, trade, foreign exchange reserves, savings and investment in Pakistan with other Asian countries; Bangladesh, India, Indonesia, Malaysia, Sri Lanka, Thailand and Viet Nam during the 1990s and the average over 2001-11. The intention is to compare the economic performance of Pakistan with other countries in the region particularly with the less populated than Pakistan and consider ways of improving its economic performance, e.g., by promoting exports and foreign investment and improving the functioning of markets.

Table 1: Economic Indicators in Asia

Indicator	Years	Bangla-desh	India	Indo-nesia	Malay-sia	Paki-stan	Sri Lanka	Thai-land	Viet Nam
Pop. mln	1990s	121.2	964.4	195.5	21.0	128.7	18.2	59.5	72.5
	2001-12	147.1	1166.2	232.6	27.1	165.6	20.1	65.9	84.7
GDP % chg	1990s	4.8	5.6	4.4	7.2	4.0	5.2	4.6	7.6
	2001-12	5.9	7.1	5.4	4.8	4.1	5.6	4.2	6.5
Exports bln $	1990s	3.9	30.1	46.1	65.7	7.7	3.8	48.5	6.9
	2001-12	14.8	170.1	125.0	172.5	18.8	6.6	152.4	57.1
Imports bln $	1990s	5.6	37.0	34.7	58.1	10.1	4.6	47.7	7.6
	2001-12	16.1	199.1	83.1	111.5	23.7	7.7	112.8	50.6
Trade bal. bln $	1990s	-1.7	-6.9	11.5	7.6	-2.4	-0.8	0.8	-0.8
	2001-12	-1.3	-29.0	41.9	61.0	-4.9	-1.1	39.6	6.5
Dom. sav. bln $	1990s	5.6	86.2	50.2	33.2	9.1	2.2	46.8	4.1
	2001-12	12.9	336.0	145.0	75.8	15.9	5.7	72.7	21.9
Dom. sav. % of GDP	1990s	14.1	22.9	30.2	41.8	15.6	16.3	35.0	18.1
	2001-12	17.5	29.5	31.2	41.8	12.6	16.7	31.7	26.3
Dom inv. bln $	1990s	7.8	86.6	43.2	28.1	9.8	3.3	46.4	6.6
	2001-12	18.1	338.0	128.4	24.6	2.3	21.6	7.7	59.7
Dom inv. % of GDP	1990s	19.7	23.0	25.8	35.5	16.9	25.2	34.2	25.9
	2001-12	24.3	29.4	25.9	22.6	15.6	24.1	25.9	30.4
Net FDI inflows (mln$)	1990s	83.5	1840.8	1593.2	4276.9	507.1	168.1	3237.9	1449.6
	2001-11	619.1	19218.0	5986.7	5490.6	2365.9	434.1	7146.8	4493.0
FOREX (bln$)	1990s	2.0	24.0	18.0	40.7	2.0	1.6	29.5	2.3
	2001-12	5.6	189.1	53.6	77.9	11.1	3.6	89.7	12.6

Source: World Bank 2013b

Among these selected countries, the population of India and Indonesia are larger than Pakistan while the rest these countries are less populated than Pakistan. Pakistan's GDP growth averaged at about 4% in both the periods which was lower than the other Asian countries. The value of Pakistan's exports was greater than that of Bangladesh, Sri Lanka and Viet Nam during the

1990s, but was surpassed by Viet Nam during 2001-12. However, Pakistan's trade deficit remained higher than that of Bangladesh and Sri Lanka in both period. Indonesia, Malaysia and Thailand have maintained a trade surplus. Viet Nam while a trade deficit country in the 1990s exported its way into a trade surplus during 2001-11. Foreign exchange reserves of Pakistan have also remained lower than other Asian countries except Sri Lanka. Domestic savings as a percent of GDP also remained lower than other Asian countries except Bangladesh in the 1990s. Domestic investment as a percent of GDP has also been low compared with other Asian economies during both periods while net foreign direct investment inflows were only higher than Bangladesh and Sri Lanka. This comparison indicates that there is a high potential of in economic growth, exports and investment in Pakistan.

2.2 The economy of Pakistan: A historical view

Table 2 provides the historical development in policies and different economic indicators of the economy of Pakistan. The private sector remained the main vehicle for domestic and foreign industrial investment during the 1950s and 1960s and the involvement of the public sector was restricted to three out of 27 basic industries (Khan and Kim 1999). At the start of the 1970s, the economy was largely dominated by the private sector in important areas such as banking, insurance, certain basic industries, and international trade in major commodities. Trade policies such as import quotas and tariffs protected domestic industries, which continued into the 1970s. In addition, the exchange rate was overvalued, implicitly subsidizing the inflow of imported inputs into priority areas. In the late 1960s, the government started promoting export growth by taking a number of measures to reduce the anti-export bias of the trade regime through policies such as: providing an export bonus (monetary incentive given after meeting a firm met some specific export target); preferential access to foreign exchange for firms engaged in exports; and

limited import liberalization (e.g. automatic renewal of import licenses for industrial raw materials and consumer goods). The degree of trade liberalization was minimal (Khan 1997, Khan and Kim 1999). A sudden shift toward nationalization of private sector industrial units in the 1970s adversely affected private investors' confidence. However, there was an expansion in direct investment by the public sector in new industries ranging from the basic manufacture of steel to the production of garments (Khan and Kim 1999). In the 1980s liberalization of the trade policy regime began: quotas were removed and replaced by tariffs; average tariff rates declined from 22% in 1980 to 12% in 1999; and import licensing was eliminated in 1993. These reforms created an efficient and competitive manufacturing industry through easier access to raw materials, intermediate goods and machinery and also contributed in poverty reduction (Siddique and Kemal, 2002). Price support and procurement policies had been applied for a number of agricultural commodities including staple foods, wheat and rice. However, for rice this policy ceased in 2001-02 while it is continued for wheat. Rice exports were privatized in 1989.

GDP growth has been uneven over decades in Pakistan since its birth in 1947. GDP grew at an average rate of 3.1% during the 1950s but economic growth rates have surpassed that in every decade since. GDP growth recovered to 4.6%, on average, in 2000s after the slow average growth in the 1990s at 4%. The external debt almost doubled in each decade from the 1970s to the 1990s and reached $41.6 billion in the 2000s, about 44% of GDP. Foreign exchange and gold reserves increased from $0.26 billion in the 1950s to $12.2 billion in the 2000s, but remained insufficient to finance imports and the external debt. Inflation hit a 30-year high in 2008 at 20%, which can be attributed to the global financial crisis 2007-08 and the international price surge for a number of commodities. However, in the late 1990s and the early 2000s there were the periods with relatively low inflation.

Table 2: Selected macroeconomic data and policy regimes in Pakistan, 1950-2009

Economic indicators	1960s	1970s	1980s	1990s	2000s
Unemployment (%)				11.41	14.98
GDP ($bln)	12.3	21.3	39.4	63.7	93.7
GDP growth (%)	7.24	4.72	6.29	3.96	4.57
GDP per capita ($)	230	292	406	512	599
Agriculture share of GDP (%)	40	33	28	26	22
Industry share in GDP (%)	20	23	23	24	26
Services share in GDP (%)	40	44	49	50	52
Agricultural growth (%)	5.1	2.4	5.4	4.4	3.2
Fixed capital share of GDP (%)	17.29	15.24	16.95	16.90	17.10
Gross domestic savings ($bln)	0.33	1.05	2.98	9.05	17.37
Savings as share of GDP (%)	9.65	7.95	8.74	15.61	14.35
Trade as share of GDP (%)	24	24	28	30	31
Exports ($bln)	0.54	1.19	3.43	7.69	14.57
Imports ($bln)	0.92	2.16	5.94	9.94	23.81
BOT ($bln)	-0.38	-0.97	-2.51	-2.25	-9.24
FDI ($mln)	23.4	25.2	134.5	522.2	2407.5
FDI (% of GDP)	0.30	0.11	0.36	0.89	1.09
External debt ($bln)		6.41	14.66	28.91	41.59
Foreign Exchange reserves ($mln)	246	686	1719	2231	12204
Trade Policy regime	Import substitution with trade restrictions		Export promotion and trade liberalization		
Exchange rate regime	Fixed		Managed from 1982-99		Flexible
Regulations on ownership (1, 2 = periods of nationalization and of privatization, respectively)	2	1	2	2	2

Sources: State Bank of Pakistan (SBP) 2010; World Bank 2011; Khan 1997; Khan and Kim 1999; Hyder and Mehboob 2006

The transformation from primarily an agricultural economy in the 1950s, when agriculture's share of GDP averaged 48%, towards an industry- and services-based economy has been on a steady march. Industry's share of GDP doubled from 13% in the 1950s to 27% in 2000s and services' share increased from 38% to 53%. The agricultural sector's rate of growth has persistently been slower than GDP growth and the rates of growth have decreased since the 1980s. Despite the economic transformation that has occurred, the major industrial export sub-sector is textile manufacturing which is dependent on agriculture, reflecting the economy's agro-industrial composition. The agricultural sector contributed to about 23% of GDP, employed about

42% of the total employed labor force during 2002-2012 and provided raw material to industries (GoP 2013; SBP 2010). However, yield growth of major crops has remained slow since the 1960s (World Bank 2013a).

Apart from the 1950s, Pakistan is a trade deficit country and this deficit has been increasing over decades. The trade deficit increased from about $2.25 billion in the 1980s and the 1990s to $9.24 billion in the 2000s. Pakistan's major exports have been concentrated in a few export items, comprised mostly of cotton manufactures, rice, leather, fish and fish preparations and sporting goods. Table 3 provides decade-wise share of exports of these major commodities as a share of the total value of exports from Pakistan. During the 1960s, these commodities contributed to about 39% of the total value of exports from Pakistan while this share almost doubled to 70% in the 1970s and then decreased to 62% in the 1980s. Textile manufacturers have been the biggest exports items ranging from 59.5% to 64.5% of total value of exports during the 1990s and 2000s. Rice has remained Pakistan's second largest export item after cotton and cotton products and contributes (SBP 2010). The share of rice exports in the total value of exports of Pakistan increased from 5% in the 1960s to 18% in the 1970s (SBP 2010). This can be attributed to the green revolution in the 1960s and the increase in supply of water in the early 1970s. This share steadily decreased from 10% and to 6% in the 1980s and 1990s, respectively, before recovering slightly to 8% in the 2000s (UN FAO 2012; GOP 2013). Nevertheless, it captures a large share of almost two-thirds of the value of exports of all primary commodities. Rice production accounts for almost 6% of the value added in agriculture, while contributing to 1.3% of GDP (SBP 2010; UN FAO 2012; GOP 2013).

Table 3: share of exports of various commodities in total value of exports of Pakistan (%)

Exports	1960s	1970s	1980s	1990s	2000s
Fish & Fish Preparations	3.02	2.58	2.57	1.88	1.20
Rice	4.80	18.12	10.04	5.71	7.81
Cotton	11.80	10.19	13.37	3.03	0.58
Leather	3.31	5.39	5.31		
Textile Yarn and Thread	5.06	12.37	11.83	16.38	8.07
Cotton Fabrics	5.37	12.40	10.61	13.36	11.64
Sports Goods	0.72	1.50	1.59	3.06	2.09
Sub-total	34.08	62.55	55.32	43.41	31.39
Other Commodities	65.92	37.45	44.68	56.59	68.61
Total	100.00	100.00	100.00	100.00	100.00
Primary Commodities				13.56	12.47
Textile manufactures				64.49	59.50
Other manufactures				14.14	18.44

Source: State Bank of Pakistan (2010)

In addition to Pakistan's exports being concentrated on a few products, the markets to which they are exported are also concentrated indicating potential to identify and explore more markets to increase exports. The US, the UK, Germany, France, Japan, China, Hong Kong, Kuwait and Saudi Arabia have been the major export markets since 1960s. Table 4 exhibits shares of major export markets of Pakistan in total value of exports of Pakistan. These markets accounted for between 45-48% of the total value of Pakistan's exports from the 1960s through the 1980s. This share increased to 50% on average during the 1990s and the 2000s. The UAE, Italy and Netherlands are the other major markets. These markets, together with the UAE, Italy and the Netherlands, amounted to 62% of the total value of Pakistan's exports. The US alone has remained the single biggest market for the last two decades, capturing a share of between 17% and 23%. This share increased from 10% in the 1960s (SBP 2010). The concentration of Pakistan's exports in few markets and fluctuating behavior reflects the lack of success in identifying and exploring new markets as well as sustaining the existing markets.

Table 4: Export markets shares in total value of exports of Pakistan (%)

	1960s	1970s	1980s	1990s	2000s
USA	9.74	5.64	10.75	17.02	23.28
France	3.32	2.22	3.03	3.49	2.43
Germany	3.88	5.18	2.88	5.70	4.76
UK	13.19	6.74	6.18	6.94	6.18
China	4.61	2.61	2.74	1.34	3.14
Hong Kong	4.84	8.73	3.86	7.15	4.23
Japan	6.01	9.00	9.78	6.07	1.26
Kuwait	1.17	2.02	1.17	0.53	0.54
Saudi Arabia	1.08	4.47	4.87	3.12	2.71
Sub-Total	47.84	46.61	45.26	51.36	48.52
Singapore				1.22	0.55
UAE				4.19	7.92
Italy				4.01	3.26
Netherlands				3.13	2.53
Total				63.90	62.77

Source: Source: State bank of Pakistan (2010)

Domestic investment and savings have been low and fluctuating over the decades. The share of gross fixed capital formation as a percent of GDP was about 17% from the 1980s through the 2000s, an improvement over the 1970s, but still a low rate given the stage of Pakistan's development. The national savings rate has been low amounted to about 15% of GDP through the 1990s and the 2000s. The low savings rate might be due to high consumption and low income. The low domestic savings and capital formation reflect the need for foreign investment (Zaidi 2005; SBP 2010; GOP 2013; World Bank 2013b) to boost GDP growth but also address rising unemployment rates that have crept up to 15% in the 2000s from about 11% in the 1990s. FDI could be an important instrument to overcome many of the structural weaknesses necessary for transition towards sustainable growth and development. Probably the most important role of FDI in a developing economy is the supply of capital, as the deficiency in the capital stock is a fundamental problem (Zaidi 2005, Khan and Kim 1999).

The average level of FDI has increased steadily over the decades but from a very small base, 0.30% of GDP in the 1960s, reaching 1% of GDP in the 2000s (SBP 2010). Trends on net inflows of FDI into Pakistan present a fluctuating picture. Regulations on investment were liberalized in the 1990s; however, the rate of investment increased after 2001 when the US allied itself with Pakistan to fight its war on terror (Khan and Khan 2011). The Board of Investment (BOI) was the main agency to help government in formulating investment-friendly policies. The BOI has recently formulated the Investment Policy 2013 that has set out a target of 25% annual growth in FDI inflows into Pakistan.

The five major source countries of FDI are Netherlands, Switzerland, the USA, the UK, and the UAE, which account for about 62% of total net FDI inflows into Pakistan during 1996-2010. The USA alone accounts for about 24% of total net FDI inflows into Pakistan while UAE and the UK capture 15% and 13% of net FDI inflows into Pakistan. The USA, UK and UAE are also the major sources of FDI as mentioned earlier (SBP 2010).

Major cities/markets in Pakistan are Karachi, Lahore, Islamabad, Rawalpindi, Faisalabad, Peshawar, Quetta, Sukhar and Hyderabad in the four provinces of Pakistan. Peshawar (1.3 million inhabitants) and Quetta (0.8 million) are the provincial capitals of Khyber Pakhtoonkhan and Baluchistan provinces, respectively. Rawalpindi (1.8 million) is the neighbor city of the provincial capital of Pakistan, Islamabad. Hyderabad (10.4 million) is located close to Karachi, the provincial capital of Sindh and a port city. Sukhar (0.4 million) is located in Sindh province close to Hyderabad and also to Multan (1.55 million), Hyderabad and Sukhar are located relatively close to the major rice production regions, while Quetta and Peshawar are relatively remote. Rawalpindi lies between Multan and Peshawar but is closer to Peshawar. Peshawar is

situated close to the border of Afghanistan while Quetta is located close to the borders of Iran and Afghanistan. Both countries are among the largest markets for rice exports from Pakistan.

These markets are connected with national highways and motorways. Road infrastructure has improved in Pakistan as paved roads increased from about 53% of total roads in 1991 to about 72% of total roads in 2010. This percentage of paved roads is greater than in China, India, Indonesia, and Viet Nam and less than Thailand and Malaysia. Thailand had 99% paved roads in 2000 while 80% of total roads were paved roads in Malaysia in 2010 (World Bank 2013b). However, about half of the national highways are in poor conditions in Pakistan and poor road safety is a major concern along with low productivity of the transportation system. Trucks usually travel at a speed of 40-50 km per hour which is half of the speed in Europe. This low speed is mainly because of overloaded trucks and poor quality of vehicles. Railway freight accounts for about 5% of total freight services indicating a low productivity. Pakistan's railways freight productivity is 8 times less than that of China, 3 times of India and 2 times less than that of Thailand (World Bank 2013c). The economy suffers periodic energy shortfalls, particularly of electricity and natural gas that results in several hours of load shedding each day, adversely affecting domestic households and industries (World Bank 2013a).

Given the description of comparative and historical perspectives of Pakistan, there can be many ways to enhance economic growth and development of Pakistan, however, this dissertation focuses on enhancing economic growth and development through increasing exports and foreign direct investment and improving functioning of the commodity markets. The following section reviews some literature on the relationship between exports, FDI and market functioning with economic growth particularly on Pakistan.

3 Exports, FDI, functioning of commodity markets and economic growth

3.1 Empirical evidence on the export-growth relationship

The export-growth relationship has been the topic of many studies; however, there is no general consensus on this relationship / causality between exports and economic growth in the literature. This is partly due to data and methods used in these studies (Dreger and Herzer, 2013). Similarly, literature on the export-growth relationship presents mixed results for the case of Pakistan. Khan and Saqib (1993); Khan et al. (1995); Anwar and Sampath (2000) and Kemal et al. (2002) found bidirectional causality between exports and economic growth in the case of Pakistan. Din (2004) found a long- run relationship between exports, imports and economic growth for two economies of southern Asia, Pakistan and Bangladesh; however, he did not find such a relationship for three other countries in the region, India, Sri-Lanka and Nepal. Shirazi and Manap (2004) examined the export-led-growth hypothesis for Pakistan and found evidence for a long-run association among exports, imports and real output. They also found bi-directional causality between import and economic growth and unidirectional causality between exports and economic growth. Quddus and Saeed (2005) and Siddiqui et al. (2008) also found support for the hypothesis for Pakistan. Samiullah et al. (2009) found support for the hypothesis and concluded that increased exports led to economic growth. They also found a unidirectional causality among exports, imports and economic growth. Lee (2010) tested the export-led and import-led hypothesis for Pakistan but he neither found support for the export-led hypothesis nor for import-led hypothesis of growth in the long-run; however, there was support for bidirectional causality between exports, imports and growth in the short run. Ismail et al. (2010) found positive and significant effects of exports and investment and negative effects of inflation on growth in short and long run in the case of Pakistan. However, exports were found to be insignificant in the long run and they

concluded that in the long run the export-led growth hypothesis did not hold. Afzal and Hussain (2010) do not find any evidence for export-led growth hypothesis as well as causality among growth-exports and growth-imports but they found bidirectional causality in import-export in their study on Pakistan. They also found negative effects of income shocks on exports as well as imports and more variation in imports relative to exports due to changes in income. However, the effects of exports on income and imports were moderate. Imports caused more variation in exports compared with income.

These differences in results can be attributed to data and methods used in these studies. However, given the theoretical importance of exports in the economies of developing countries such as Pakistan and the need for foreign exchange to finance imports and the external debt, empirical research is necessary. The first research article in this dissertation investigates factors affecting commodity-specific exports from Pakistan to identify markets with unexploited export potential. This is done by taking the example of rice. GDP and exports are treated as endogenous because of possible bi-directional causal relationship.

3.2 Empirical evidence on FDI-growth relationship

The theory and the empirical literature lack a consensus on the costs and benefits of FDI inflows. Arguments in favor say that FDI plays a key role in the development process of a country if the recipient country has attained a certain level of development such as a minimum level of education, technology and infrastructure. The counter-argument is that some costs are too high, such as the deterioration of the balance of payments as profits are repatriated back to the foreign investor's home country, the exploitation of labor or the non-transparent management of national resources by foreign multinational or the ability of the government to properly supervise their actions (Hansen and Rand, 2006).

Several studies researched this relationship and the causality in the case of Pakistan. These studies found positive as well as negative effects of FDI on economic growth in Pakistan and both unidirectional and bi-directional causality. Ahmad et al. (2003) found a long-run relationship among FDI, exports and domestic output and found support for the export-led growth hypothesis and significantly positive effects of FDI on domestic output. Klasra (2011) studied the relationship between growth, FDI and trade openness in Pakistan and Turkey during 1975-2004 by using a bound testing co-integration approach. He found bi-directional association between exports and trade openness and argued that adoption of a more liberal attitude to imports and foreign investments fostered domestic competition through efficient allocation of domestic resources and also enhanced the economy's productivity and local firms' export competitiveness. Iqbal et al. (2010) found a long-run relationship among the factors and bi-directional causality between FDI, exports and economic growth with a positive impact of FDI on growth. Mughal (2008) found positive effects of FDI on growth rates in the short term but also found a less important role of FDI compared with domestic investment with negative effects of FDI on human capital. He concluded that FDI had neither been an absolute boon nor a downright bane for growth. Falki (2009) examined the impact of FDI on economic growth of Pakistan during 1980-2006 through applying OLS on the (aggregate) production function under endogenous growth theory. He found a negative and statistically significant impact of FDI on economic growth. He suggested that green-field investment and FDI in the manufacturing sector should be encouraged so that exports can be increased, which, in turn, enhance growth. Khan and Khan (2011) found a positive effect of FDI on output and causality running from GDP to FDI in the long run while in the short run a two-way causality between FDI and GDP was evident in the case of Pakistan. Moreover, they argued that FDI caused growth in the primary and services sectors, while growth attracted FDI in the manufacturing sector.

The differences in these results might be because of the differences in data and methods used. However, given the theoretical importance of FDI in the development of the economies of developing countries (e.g., providing capital to fill the investment-savings gap, bringing in technology, developing human resources and generating employment) article 2 focused on determining the economic and institutional factors related to Pakistan and home countries that can affect the FDI inflows into Pakistan.

3.3 Functioning of commodity markets and economic growth

Market integration and volatility are two important concepts regarding the functioning of commodity markets. Market integration can be defined as a measure of the extent to which demand and supply in one location are transmitted to another (Negassa et al., 2003). Spatial market integration refers to both short-term co-movements and long-run relationships among prices. It is defined as the smooth transmission of price signals and information across geographically separated markets (Goletti et al., 1995). Well-functioning commodity markets and price transmissions play an important role in efficient resource allocation and economic growth. Slow and imperfect price transmissions leave producers and consumers to make decisions based on prices that do not reflect their real social costs and benefits, leading to slow economic growth (World Bank, 2012a).

In the same vein, less volatile markets promote efficient decisions by the economic agents regarding allocation of resources and hence enhancing economic growth. Primary products or exports are subject to greater price volatility, which negatively affects economic growth. Blattman, Hwang and Williamson (2007) found that countries dependent on commodities with relatively low price volatility enjoy more rapid growth, more foreign direct investments and less volatile terms of trade as opposed to countries specializing in more volatile commodities. Even

non-commodity sectors are negatively affected by high volatility in commodity prices combined with price booms and real exchange rate appreciations. Sachs and Warner (1995) find that commodity price volatility leads to volatility of output growth, which is more pronounced in economies with large share of natural resources. To our knowledge, empirical evidence on the relationship between market functioning and economic growth is lacking in the case of Pakistan, hence, this is a potential area for research.

4 Data and methods

Article 1 used panel data and employed pooled regression, fixed effects, random effects and Hausman-Taylor estimation techniques. In this article, the dataset spans 92 countries that make up about 84% of total rice volume exported from Pakistan, on average, during 1991-2010. The analysis is done under the framework of the gravity model. The gravity model has performed well when used to analyze international trade flows since the early 1960s, but strong theoretical foundations were not produced until the end of the 1970s. Among others, Anderson (1979); Bergstrand (1985, 1989); and Deardorff (1998) provided the theoretical foundations of the gravity model through deriving it from various economic theories.

The gravity model has been the most popular approach employed to predict the international trade flows (Abler 2007). However, its application to Pakistan has been very limited and at aggregate exports e.g. Butt (2008), Gul and Yasin (2011). There is no application on rice exports from Pakistan. The dependent variable is rice export volume from Pakistan to 92 markets. Explanatory variables include real GDPs and per capita GDPs of Pakistan and of respective export markets, unit export prices in these markets, exchange rate of Pakistani rupee to each export market's currency, the distance between the capital cities and a dummy variable for common history of British colonization.

In the second article, the dataset spans a panel of 15 FDI source countries (home countries) that accounts for about 77% of total net FDI inflow into Pakistan, on average, during 1996-2010. This is the dependent variable in the regression model. The explanatory variables included in the model are the GDPs of Pakistan and of home countries, an average of the governance indicators of Pakistan and home countries (which include: the rule of law; political stability and terrorism; voice and accountability; government effectiveness; and regulatory quality), human capital, energy use per capita, the distance between capital cities and dummy variables for common language and bilateral investment treaties between Pakistan and home countries.

Articles 3 and 4 employed time series data for rice prices in the regional markets of Pakistan and in the international market. Stationarity and co-integration test were performed and vector error correction models (VECM) were estimated. Analysis in the article 4 was enhanced to include variance tests; moving window of standard deviations of differenced log prices; autoregressive conditional heteroscadisticity (ARCH), generalized autoregressive conditional heteroscadisticity (GARCH), and dynamic conditional correlations (DCC) model which is a simple class of multivariate GARCH models to model volatility in prices.

4.1 Data sources

The data in all the articles are taken from secondary sources which include the *Handbook of Statistics for Pakistan* 2010 available at the Central Bank's on-line database (SBP 2010), Kaufmann et al. (2010), *World Development Indicators*, available on the online database of the World Bank (2011, 2013b), World bank's pink sheet (World Bank 2012a), web pages of the central intelligence agency (CIA 2013); travel distance calculator between Cities" under the Chemical-ecology website (2012, 2013); United Nations Food and Agriculture Organization's

Agricultural Trade on-line database (UN FAO 2012, 2013); United Nation Centre for Trade and Development on-line database (UN CTAD 2012); the web pages of the Commonwealth Organization (Common Wealth 2011); *Agricultural Statistics* of Pakistan (GoP, 2012) and exchange rate data under Oanda's website (2012).

5 Summary of the main findings

5.1 Article 1

The real GDP of Pakistan and unit export prices are modeled as endogenous variables using the Hausman-Taylor estimation technique for panel data. Both of these variables have the expected positive sign and are statistically significant at the 1% level. The real GDP of Pakistan is strongly elastic (3.56) on export supply while price elasticity is unitary. The negative and statistically significant coefficient on Pakistan's real per capita GDP illustrates that rice exports are labor-intensive and follows the Hecksher-Ohlin explanation of trade, strengthening the case for greater specialization in rice production.

The exchange rate is also found to be positively and significantly affecting rice exports from Pakistan. The distance between partner countries was used as a proxy of transportation costs is also statistically significant having a negative effect on trade and common British historical ties have positive and significant effect on rice exports from Pakistan. The poor infrastructure in developing countries, e.g., in African markets, could be a factor that limits Pakistan's short-term ability to exploit potential in those markets.

There is unexploited potential of Pakistan's rice exports in 49 export markets out of the 92 which includes emerging and developed economies and some of them impose high tariffs on rice exports from Pakistan. Unexploited potential in these markets can be exploited through

enhancing production capacity (GDP), establishing bilateral trade agreements with importing countries and better marketing efforts. An increase in rice exports will also help in reducing the trade deficit of the country and earn more foreign exchange, which will help in financing the country's imports and paying its foreign debt.

5.2 Article 2

The estimates of GDP and governance in Pakistan are positive and statistically significant factors affecting net FDI inflows into Pakistan. Human capital positively and significantly affects the FDI inflows into Pakistan. A positive and statistically significant relationship between the per capita energy use and net FDI inflows into Pakistan is also found. Positive and statistically significant estimates of GDP and governance of investing countries suggest that these would create a favorable environment for increasing FDI inflows into Pakistan. Significant negative and positive coefficients on the distance and common language between partner countries respectively suggest that reducing the cost of and improving the ease of doing business would attract more FDI into Pakistan.

According to the results, it can be stated that despite investment-friendly policies being pursued in Pakistan, low and uneven economic growth of Pakistan, bad governance, the lack of skilled human capital, energy crises and global financial crises are the possible reasons for the uneven and low level of net FDI inflows into Pakistan during 1996-2010. Hence, raising GDP and improving good governance, increasing the share of the budget on education and research and development, overcoming the energy crisis, would play an important role in getting investor's confidence and attracting FDI.

The findings of the study support polices, under the investment policy 2013, of providing ease and reducing cost of doing business in Pakistan through establishing industrial zones and

clusters and providing with one window operation and recommend the implementation and real practice of the BOI's role; however, there is gap in the policy regarding improving the quality of institutions and good governance which are very important to uplift investors' confidence and to attract FDI into Pakistan. The Investment Policy of 2013 sets out a target of 2.5 billion of FDI inflows in 2014 and 25% annual growth which can be achieved with about 2.5% increase in GDP, energy use, human capital and quality of institutions in Pakistan.

5.3 Article 3

The results from the EG and Johansen tests for co-integration strongly indicate that all the domestic markets are cointegrated, possibly excepting Hyderabad–Peshawar, Hyderabad–Rawalpindi, Hyderabad–Multan and Hyderabad–Quetta indicating infrastructural bottlenecks in the marketing system. The VECM estimates of the domestic markets reveal that prices converge in the long run; however, the speed of adjustment towards long-run equilibrium is generally low. The long-run coefficient varies from 0.89 to 1, revealing that about 90 to 100% of price changes are transmitted across different pairs of the markets in the long run. The ending of the support price policy seems to have resulted in an improvement in the integration of domestic markets as the number of non-integrated market pairs decreased after 2002.

All the domestic markets in Pakistan appear to be integrated with the international market, with the possible exception of Hyderabad and Sukhar, although the speed of adjustment is rather low. The estimated coefficients of adjustments indicate that the domestic markets tend to converge with the international market in the long run. The long-run elasticity of price transmission ranges from 0.68 to 0.98 across markets, suggesting that 68–98% of changes in the international price are transmitted to domestic prices in the long run. Among the export markets for rice, Pakistan’s rice markets seem to be integrated with the markets of Thailand and Vietnam.

The co-integration and VECM results suggest that while domestic markets are integrated with, and responsive to, changes in the international market and domestic markets, responsiveness to own (local) shocks is relatively higher. Support price policy reforms have improved market integration within Pakistan; however, they do not seem to have affected the integration of Pakistan with the international market, while export policies have reduced the extent of market integration of Pakistan with the international market. Therefore, it is reasonable to conclude that reducing government intervention would increase international market integration further. Investment on infrastructure between non-integrated markets can help them to integrate.

5.4 Article 4

A clear rising trend in volatility particularly after the food crisis during 2007-08 is observed while differences exist across markets. The results of variance tests also exhibit spatial differences in volatility across markets. In general, distant markets show statistically significant differences in variances while closer markets have statistically equal variance. Multan, Rawalpindi and Quetta contain only ARCH effects while Peshawar, Hyderabad and Sukhar possess both ARCH and GARCH effects.

Positive conditional correlations in dynamic conditional correlation (DCC) model reveal that volatility in one market is positively associated with the other across regional rice markets of Pakistan. Moreover, high and low correlations were found between closer and distant markets, respectively. Differences in behavior of volatility across markets reflect differences in infrastructure, transportation and communication services. Given the poor quality of national highways, slow driving freight vehicles and inefficient railway freight, investments on infrastructure and transportation can reduce the price risk across markets. For producers, higher

volatility can result in inefficient allocation of resources while inventory holders would store in a volatile environment resulting in increase in the inventories that in turn can negatively affect food security. Maintaining buffer stocks might help to control volatility particularly due to a high surge in prices such as during the food crisis of 2007-08.

6 Conclusions

Pakistan's economic growth, importers income, export prices, specialization, the exchange rate and transactions costs are the major factors affecting rice exports from Pakistan. Whereas, Pakistan's market size, governance, infrastructure, human capital, promising business environment and income and governance of the foreign investors are the major factors responsible for attracting foreign direct investment in Pakistan. Most of Pakistan's rice markets are integrated domestically and with the international market. Termination of price support policy enhanced the domestic market integration while export policies reduced integration of domestic markets with the international markets. Rice prices are volatile and volatility differs across markets reflecting bottlenecks in the infrastructure and transportation.

Higher productivity and economic growth, specialization, infrastructure development through improving road and rail freight system and overcoming energy crisis, developing human capital, and improving institutional quality are the important factors that can contribute to the economic development of Pakistan. Investments on education and research and development, bringing in technology, improving infrastructure and institutional quality and implementing bilateral trade and investment agreements would strengthen the foundation for economic development of Pakistan through accelerating exports, foreign direct investment and improving the functioning of markets.

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Paper I

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MEASURING COMMODITY-SPECIFIC TRADE DETERMINANTS AND EXPORT POTENTIAL: A GRAVITY MODEL OF PAKISTAN'S RICE EXPORTS

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ABSTRACT

Pakistan's milled rice exports to 92 markets during 1991-2010 are analyzed applying an augmented gravity model, treating Pakistan's real GDP and export prices as endogenous, and regressing using Hausman-Taylor estimation technique. Rice is a necessity whose export follows the Heckscher-Ohlin rationale. Real GDP in import markets positively affects demand. Pakistan's real GDP, export prices and the exchange rate affect export supply. Distance negatively affects exports. Historical ties positively affect exports. Raising Pakistan's GDP, improving market access through trade agreements and better marketing would help exploit export potential, earning Pakistan foreign exchange, reducing its trade deficit and improving rural welfare.

JEL codes: F14, F17, C23
Keywords: Pakistan, rice, gravity model, export potential, determinants, panel data

INTRODUCTION

Since its existence in 1947, Pakistan has had a positive trade balance in very few years, mostly in the 1950s. Hence, Pakistan is a trade deficit country that has had a narrow range of export items and few sources of foreign exchange earnings. The major export items include rice, raw cotton and textile manufactures, leather and related products, all of which account for about 76% of the total export earnings during 2000-2010. In these years, almost half of all of Pakistan's exports were comprised by a narrow range of five major export markets that included the USA, the UK, Saudi Arabia, Japan and Hong Kong. Agriculture remains a key sector of the economy contributing to about 23% of GDP, employing about 42% of the total

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employed labor force during 2000-2009, and is the source of most exports (SBP 2010; GOP 2010; Hyder and Mehboob 2006).

Rice is Pakistan's second largest export item after cotton and cotton products and contributes nearly 15% to the country's foreign exchange (GOP 2010, Siddique and Kemal 2002). The major export markets in the Middle East amount to 40% of Pakistan's total exports of milled rice. The major African markets account for another 16% of total rice exports (UN FAO 2012). About 40% of the rice produced is exported due to the relatively low annual per capita domestic consumption of about 10 kg (Anwar 2004). Rice production covers about 20% of the total cropped area under food grains in the country, accounts for almost 6% of the value added in agriculture, contributes to 1.3% of GDP, and employs a number of people who are economically active in its production, domestic marketing and export (GOP 2010).

Given the importance of rice to Pakistan's economy, the identification of factors that affect its international trade and marketing and understanding the factors that can help to exploit market potential is essential. Use of this type of information would help the sector to develop, contribute to foreign exchange earnings, reduce the country's overall trade deficit, and enhance economic growth.

The gravity model is the most popular approach employed to predict the international trade flows (Abler 2007). It is widely used to measure the potential for and factors affecting bilateral trade flows at an aggregate level (e.g. Martínez-Zarzoso and Nowak-Lehmann 2003; Ricchiuti 2004; Brülhart and Kelly 2004; Hatab, Romstad and Huo 2010). However, few studies have attempted to apply it at a commodity-specific level (e.g. Dascal Mattas and Tzouvelekas 2002; Eita and Jordaan 2007; Vollrath et al. 2009) and its application to Pakistan has been very limited (But 2008, Gul and Yasin 2011). This study is an addition to that literature by applying a gravity model to measure the commodity-specific export potential of Pakistan's milled rice using panel data on exports to 92 rice markets for 1991-2010 and to investigate the economic, geographical and cultural factors that affect rice exports. Given the commodity-specific nature of rice, the study analyzes supply-side effects such as Pakistan's GDP, GDP per capita and export prices and, demand-side factors such as income and income per capita in importing countries. Exchange rates and distance to export markets are included in the model to consider macro-financial and geographical factors, respectively, while a cultural factor is included to consider the effect of a common history under British colonization.

The real GDP of Pakistan and export prices are entered into the models as endogenous variables and estimated using the Hausman-Taylor estimation technique. However, pooled, fixed effects and random effects models are also estimated and the results are compared.

AN OVERVIEW OF THE RICE SECTOR OF PAKISTAN

Table 1 presents the data for the area, production, exports and average unit export value of Pakistan's rice. While the area under rice cultivation has varied by 50%, between 1.97 and 2.96 million hectares, production has nearly doubled during 1991-2010, reaching to a maximum of 10.43 million tons (UNFAO 2012). The fluctuations in area and production are primarily due to the lack of timely availability of fertilizer and pesticides, water availability, inaccessibility to credit to purchase inputs, adverse weather conditions, the effect that

unstable farm income has on the timing of sowing, and the ability to respond to external shocks. Moreover, the domestic marketing system is constituted by intermediaries who have buying power relative to the rice producers and who make payments to farmers that are often late. Storage facilities are limited and markets are distant from the production areas. These factors, in turn, affect the farmer's ability to exploit the full production potential (Iqbal et al. 2009, GOP 2010).

Table 1. Pakistan's Rice Area, Production, Export and Prices

Year	Area (mill ha)	Paddy Production (mill tons)	Export Quantity (mill tons)	Export Value (mill $)	Export Price ($/ton)	Average World Price ($/ton)
1991	2.10	4.86	1.20	345.24	286.60	340.35
1992	1.97	4.67	1.51	412.28	272.70	331.64
1993	2.19	5.99	1.03	320.34	310.37	307.23
1994	2.12	5.17	0.98	241.52	245.37	347.62
1995	2.16	5.95	1.85	462.84	249.88	331.63
1996	2.25	6.46	1.60	514.23	321.29	389.14
1997	2.32	6.50	1.77	479.78	271.49	370.51
1998	2.42	7.01	1.97	567.68	287.93	331.20
1999	2.52	7.73	1.79	591.12	330.01	312.00
2000	2.38	7.20	2.02	533.31	264.50	276.18
2001	2.11	5.82	2.42	520.83	214.88	262.41
2002	2.23	6.72	1.68	460.45	273.37	243.34
2003	2.46	7.27	1.82	561.74	308.65	256.03
2004	2.52	7.54	1.82	627.24	344.12	308.64
2005	2.62	8.32	2.89	930.77	321.91	325.51
2006	2.58	8.16	3.69	1150.10	311.79	344.77
2007	2.52	8.35	3.13	1124.07	359.21	407.46
2008	2.96	10.43	2.81	1681.61	598.54	675.31
2009	2.88	10.33	2.75	1894.45	688.52	642.77
2010	2.37	7.24	4.18	2152.81	515.05	594.14

Source: UN FAO, 2012.

Despite the various constraints and inefficiencies in the domestic marketing channel, the volume of exports has steadily increased, having been briefly interrupted in 2000-2002. Exports have increased by more than 300% to 4.13 million tons amounting to USD 2.2 billion, permitted by a slower rate of growth in domestic per capita consumption.

Government Policies

A wide range of government policies and regulations have been enacted, but the intervention was either temporary or has not been implemented to an extent that directly restricted economic behavior. For example there have been restrictions on the movement of rice across regions within the country and bans on the production of certain varieties and sowing in certain areas to reclaim saline lands. Price supports and government procurement programs existed until 2001-02. After 2002 the government's role has been limited to the occasional and irregular announcement of an indicative support price (Salam 2009). This essentially is to create a floor price during the post-harvest period when supply is abundant, but does not replace market-determined prices. The intention is to correct shortcomings in the marketing system (Anwar 2004) such as to curb the market power of intermediaries. There have been no government purchases of rice since 1995-96. Farooq et al. (2001) found a very low response of basmati rice producers to the support prices. Mushtaq and Dawson (2001) also found that the support price policy was ineffective and proposed that it be discontinued. The unit export value of Pakistan's milled rice ranges from $215 to $359 per ton. In most years during 1991-2007 the unit value of Pakistan's rice remained below the world average, showing that Pakistani rice is competitive in the international market. It can also be noted that exports of rice from Pakistan are higher in the years when the unit export prices are less than the world average unit prices and vice versa (UN FAO 2012).

In 1987-88, the government began to allow the private sector to export rice which gave rise to the Rice Exporters Association of Pakistan (REAP) formed in 1988-89 by private exporters. Before this, the Rice Export Corporation of Pakistan (RECP) had a monopoly in the procurement and export of rice. The REAP interacted with the government department for improving the rice exports and established rice quality standards with the cooperation of Pakistan Standards Institution in 1992. It identifies problems in rice exporting such as marketing issues, quality control and barriers in the import of milling machinery etc. and proposed some solutions as well. It also made efforts to improve market access to the EU market (REAP 2010).

Trade policies include export taxes, export subsidies, and tariffs on the imports of milling machinery and other inputs (Salam 2009). During the study period no export taxes were imposed; however, an export subsidy was provided during 2002-04 (WTO 2011). However, on account of high international prices in 2007-08 the government fixed the minimum export prices in April 2008, but was abolished by October 2008 (Salam 2009). Import tariffs on rice were in effect, but were reduced from 15% to 10% on an MFN basis in 1999. Finally, exchange rate policies had been used in Pakistan to achieve export objectives, but by 1982 a managed float was the primary exchange rate regime. There was a brief stint where a multiple exchange rate regime was applied after Pakistan's nuclear tests in 1998 (which resulted in international sanctions). However, since 2000, the current flexible exchange rate has been in place (Hyder and Mehboob 2006).

World Rice Market

Rice is the basic staple food in many countries and of about half of the world's population. Trade in rice on the international market is very thin, with only about 5 to 7% of

the total world production being traded globally (Childs and Hoffman 1999; Razzaque and Laurent 2006; Childs and Baldwin 2010; *Economist* 2011). Wheat trade, by contrast, amounts to about 20% of total world production. The international market rice market is thin because the main global producing countries also tend to be populated by its chief consumers (Wailes 2005), but also because domestic rice markets are highly protected and strictly regulated. This helps to ensure that tastes are inclined to the domestic varieties produced (*Economist* 2011). In Asia, domestic policies basically ensure self-sufficiency. Finally, given that rice comes in many varieties (e.g., long- and short-grain, sticky, fluffy, wild, etc.), it can also be claimed that consumers will prefer that variety that they are used to, rather than relying on imported varieties with different characteristics.

The major exporters of milled rice in the world include Thailand, Viet Nam, Pakistan, India, China, the USA and Italy. However, two exceptional rice trading nations are Pakistan and Thailand, whose domestic consumption is less than 50% of their total production (Childs and Baldwin 2010). This information coupled with Pakistanis low per capita consumption of rice should imply the possibility of meeting increasing world import demand through an expansion of Pakistan's exportable surplus. Price volatility occurs in the international market due to the thin nature of the world market and exporters' and importers' protectionist trade policies such as regulated prices, procurement and government storage, import tariffs, export subsidies and export taxes (Childs and Baldwin 2010, Razzaque and Laurent 2006). However, the restricted nature of so many domestic markets could mean that domestic markets are insulated from international price changes. Some of the principal importers of milled rice comprise Bangladesh, Japan, Iran, Indonesia, Philippines, Saudi Arabia, the UK, the EU and the USA.

METHODS AND EMPIRICAL STRATEGY

Gravity Model

The gravity model has performed well when used to analyze international trade flows since the early 1960s, but strong theoretical foundations were not produced until the end of the 1970s. This led to many studies to modify the original Newtonian gravity equation. Among others, Anderson (1979) presented the theoretical foundations of the gravity model by deriving the gravity model from an expenditure system by assuming Armington preferences and considering goods differentiated by the country of origin. Bergstrand (1985) then derived the gravity model in the form of a partial equilibrium sub-system of a general equilibrium model by using the same Armington assumptions. Bergstrand (1989) derived a theoretical gravity model that includes exporter and importer's per capita incomes. Deardorff (1998) employed the Heckscher-Ohlin model to derive the gravity model.

The traditional gravity model includes the income variables of the importing and exporting country, represented by the GDP, and the distance between the two markets, as presented in equation 1:

$$X_{ij} = Y_i^{\beta 1} Y_j^{\beta 2} D_{ij}^{\beta 3} \zeta_{ij} \quad (1)$$

where X_{ij} denotes export from country i to country j; Y_i and Y_j represent the GDP of exporting and importing countries, which are proxies for income variables, respectively; D_{ij} is the distance between the capital cities or economic centers of the respective countries used as a proxy for transportation costs; and ξ_{ij} is an error term.

The present study uses a gravity model under a panel data framework to investigate the factors affecting trade at the commodity-specific level, i.e., Pakistan's export of rice to its principal partners. Panel data specifications of the gravity model are more appropriate than cross-sectional and time-series specifications (Egger and Pfaffermayr 2003, Martínez-Zarzoso and Nowak-Lehmann 2003) because of the model misspecification that can arise under the cross-sectional and time-series approaches. In a cross-sectional specification of a gravity model, the analysis is restricted to one point of time and does not capture the time-variant effects. The time-series specifications, by contrast, do not allow studying the fixed-country pair effects. Moreover, cross-sectional and time-series specifications can affect the sign and magnitude of the effect of the explanatory variables. The problems with the misspecifications establish the basis for the panel specification of the gravity model (Egger 2002, Ricchiuti 2002). Among others Egger (2002), Eita (2008), Egger and Pfaffermayr (2003), Martinez-Zarzoso and Nowak-Lehman (2003), Filippini and Molini (2003) and Mátyás (1997) used panel data to estimate gravity equations and argued that panel data specifications are more appropriate and useful in explaining the bilateral trade flows and determining factors contributing to these trade flows compared to cross-sectional and time-series data.

Empirical Strategy

The model employed here is an augmented form of the basic gravity equation. Cortes (2007) pointed out that additional variables other than basic income and distance variables could be added to improve the basic formulation of the selected gravity equation. Moreover, the addition of variables allows the possibility of adapting the gravity equation to the particular circumstances of the bilateral trade under study. The inclusion of some additional explanatory variables to the basic gravity model helps to better understand the factors that affect Pakistan's rice exports. This augmented gravity model is represented in equation 2:

$$X_{ij} = Y_j^{\beta 1} Y_i^{\beta 2} PCY_j^{\beta 3} PCY_i^{\beta 4} P^{e}_{ij}{}^{\beta 5} E_{ij}^{\beta 6} D_{ij}^{\beta 7} CH_{ij}^{\beta 8} \zeta_{ij} \quad (2)$$

where X_{ij} is the tons of milled rice exports from Pakistan (country i) to its j major importing partners (j = 92 export markets); Y_j and Y_i are the real GDP in the importing country and in Pakistan, respectively, measured in million US constant dollars of 2005; PCY_j and PCY_i represents the real per capita GDP of importing countries and Pakistan, respectively, measured in 2005 constant US dollars; P^{e}_{ij} is the unit export price (USD/ton) for respective import markets at Pakistan's border; E_{ij} is the rupee-foreign currency exchange rate; and D_{ij} is distance, a proxy variable for transport costs; CH_{ij} is a dummy variable for common history intended to capture any effects of shared historical ties that may have led to the development of formal marketing channels, bilateral trade agreements or other political initiatives (i.e., taking on a value of one if the importing country is also a member of the British

Commonwealth and zero otherwise); and ξ_{ij} is the error term which comprises two parts, an individual effects term and the usual error term.

By taking the natural log of equation 2 and separating the individual country effects from the error term, the linear form of the final model to be estimated becomes:

$$\ln X_{ij} = \beta_0 + \beta_1 \ln Y_j + \beta_2 Y_i + \beta_3 \ln PCY_j + \beta_4 PCY_i + \beta_5 \ln P^e_{ij} + \beta_6 \ln E_{ij} + \beta_7 \ln D_{ij} + \beta_8 CH_{ij} + \eta_j + \delta_{ij} \quad (3)$$

where η_j shows the individual country effects and δ_{ij} represents the usual error term. The βs are the parameters to be estimated.

The real income variable (GDP) of the importing countries is intended to capture the demand or absorption effect. The coefficient on the Y_j variable is expected to be positive for normal goods as demand increases with the increase in income for normal goods and negative for inferior goods as demand decreases with the increase in income for these commodities. Pakistan's real GDP is employed to capture the supply effects (production capacity) and is expected to have a positive coefficient, reflecting a larger export supply.

The importer's real GDP per capita is used to determine the type of the product. Its coefficient is expected to have a positive sign in the case of a luxury good and a negative sign in the case of a necessity (Bergstrand, 1989). Rice is expected to be a necessity.

The exporter's per capita income is used as proxy for resource use in the production of crop and trade theory explaining the exports. A negative (positive) sign of the coefficient entails that commodity is labor- (capital-) intensive and resource endowments in the country explain the reason for exports. Among others Bergstrand (1989) employed these four variables as a part of their model specifications.

The unit export price in respective import markets, measured in US dollars per ton at Pakistan's border, P^e_{ij}, is intended to measure the price effect on the decision of exporters regarding the choice of markets. Exporters are inclined to export more to those markets where they obtain a higher price; therefore, this variable is expected to have a positive sign. This variable also partly captures the effects of importer's trade policies such as tariffs. Bergstrand (1985) used export and import unit value indices in his gravity model on aggregate trade flows. Estimating a model without this price variable causes considerable changes in the magnitude and statistical significance of the other coefficients and the performance of the overall estimation and its explanatory power. This suggests that specifying a model of Pakistani rice exports without the unit export prices variable would suffer from the omission of a relevant variable.

The exchange rate is defined as the quantity of Pakistani rupees that must be exchanged to receive one unit of foreign currency in each partner country. The sign of the coefficient is expected to be positive as an appreciation of the exchange rate, i.e. a depreciation in the value of the rupee, reduces the relative cost of rice from Pakistan and should result in stronger import demand. Among others Bergstrand (1985), Martínez-Zarzoso and Nowak-Lehmann (2003), Ricchiuti (2004), Hatab, Romstad and Huo (2010) specified an exchange rate variable in their gravity models.

The proxy variable for transportation costs is measured as the distance, D_{ij}, between capital cities or commercial center and is expected to be negatively related to export.

Common historical ties of British Empire, $CH_{ij,}$ are expected to be positive. The estimation of time-invariant variables in a fixed effects model are estimated in a second step regression with the individual effects as the dependent variable and distance and dummies as explanatory variables. This is estimated as:

$$IE_{ij} = \gamma_0 + \gamma_1 D_{ij} + \gamma_2 CH_{ij} + \upsilon_{ij} \quad (4)$$

where IE_{ij} denotes individual effects; D_{ij} and CH_{ij} are as previously defined; and υ_{ij} is an ordinary error term. One of the factors affecting rice exports from Pakistan during 1991-2010 could be the presence of a large community of people with an origin from Asia, but the lack of detailed population census data on Asian migrants in Pakistan's export markets did not permit the inclusion of such a variable to capture this effect.

Data and Diagnostic Testing

The dataset spans 92 countries that make up about 84% of total rice volume exported from Pakistan, on average, during 1991-2010. The dataset includes high, medium and low income countries and the share of these export markets ranges from negligible to 10% of the total. The broad selection of export markets removes the possibility of selection bias in the sample. Data for milled rice exports are collected from both UN FAO and UN Comtrade online data bases as reported by both Pakistan and importing countries, but many of the importing countries did not report imports at all or for many of the years during the study period. Hence, data that are used come from the most complete data series which is found in the UN FAO data base as reported by Pakistan. Nevertheless, for some countries, particularly those with negligible import volumes, data are not always reported, which can imply a missing entry or zero trade flows. To avoid loss of observations and because the model employs a double log functional form, such data points are replaced with a value of 0.0001. Avoiding the loss of observations helped to including more countries and to conduct the IPS unit root test for testing the stationarity of the data.

Data Sources

All trade volume and value data are taken from the UN FAO agricultural trade on-line database (UN FAO 2012). Unit prices are computed from the volume and value data. Real GDP, real GDP per capita and exchange rate data are from the UN CTAD on-line database (UN CTAD 2012). The information on membership of the British Commonwealth is taken from the web pages of the Commonwealth Organization (The Common Wealth 2011). The distance data between the capital cities of Pakistan and the trading partners are collected from Travel Distance Calculator between Cities, under the Chemical-ecology website (Chemical Ecology).

Testing

Prior to estimating the model, it is important to check the stationarity of the variables, particularly that of the dependent variable, to avoid spurious correlation. If the dependent variable is non-stationary then the resulting regression will be spurious and a co-integration test should be performed.

Table 2. Panel Unit Root Test

Variable	IPS				LLC		
	Coeff. of test statistic	Stat. sig.	No. of lags and trend		Coeff. of test statistic	Stat. sig.	No. of lags and trend
X_{ij}	-10.024	***					
Y_j	-2.5093	***	2 with trend				
Y_i	-4.4181	***	4 with trend		-8.2254	***	4 with trend
PCY_j	2.8495		1				
PCY_i	-4.7724	***	4 with trend		-9.8786	***	trend
P^e_{ij}	-9.2924	***					
E_{ij}	-6.7784	***	1 with trend				

Notes: ***/**/* denotes rejection of the null hypothesis at 1%/5%/10% level respectively
Source: Author's calculations

The IPS test developed by Im, Pesaran and Shin (2003) and the LLC test developed by Levin, Lin and Chu (2002) are unit root tests performed to check the stationarity of dependent variable as well as independent variables. The IPS test allows the autoregressive parameters to vary across countries and also for individual unit root processes. It is computed by combining the individual countries' unit root tests to come up with a result that is specific to a panel. It has more power than the single-equation Augmented Dickey Fuller (ADF) test (Eita and Jordaan 2007; Eita 2008; Levin, Lin and Chu 2002; Hatab, Romstad and Huo 2010). The null hypothesis is that all series contain a unit root and the alternative is that at least one series in the panel does not have a unit root. This test can be applied to an unbalanced panel, one that does not have an observation of all the cross sections' elements for all the years, e.g., the values of the dependent variable, Pakistan's rice exports to its principal markets, are missing for some years for some countries. The LLC test is used for balanced panel data only, using a null hypothesis of a unit root and an alternative hypothesis that all panels are non-stationary. It assumes that the autoregressive parameters are common across countries (Eita and Jordaan 2007; Eita 2008; Levin, Lin and Chu 2002; Hatab, Romstad and Huo 2010).

The results of the stationarity tests are reported in table 2. The dependent variable has an unbalanced panel and an IPS test is conducted. The results of this test show that the dependent variable, the natural log of the volume of rice exports from Pakistan to its partner countries, is stationary. This implies that the co-integration test is not required and the ordinary least squares method can be used to estimate the gravity model represented by equation 3.

Only the natural logs of Pakistan's real GDP and the real GDP per capita variables are balanced panels. Therefore, both the IPS and LLC tests were applied to test their stationarity.

The natural log of the real GDP variable becomes stationary after including a trend and four lag terms in both tests, while the log of real GDP per capita becomes stationary after including a trend and four lag terms in the IPS test and by only including a trend in the LLC test. The other variables are unbalanced panels, so only the IPS test is performed for them. The natural log of real GDP of importing countries becomes stationary after including the trend and two lag terms while the natural log of GDP per capita of the importing countries is a non-stationary variable. The natural log of the exchange rate is also a stationary variable with a trend and one lag term.

Model Identification

Panel data permit the construction of the Hausman-Taylor model, the fixed-effects model, random-effects model, and a pooled regression. The main problem with the pooled model is that it assumes a common intercept for all the countries and does not allow for heterogeneity of countries. It does not estimate country-specific effects and assumes that all countries are homogenous (Dascal, Mattas and Tzouvelekas 2002). An F-test is performed to make a choice between the pooled regression and the fixed-effects model having the null hypothesis of common intercept for all the cross sections versus an alternative hypothesis of the presence of individual effects (Dascal, Mattas and Tzouvelekas 2002; Hatab Romstad and Huo 2010). A Breusch-Pagan Langrange Multiplier (LM) test is performed to choose between the pooled regression and the random-effects regression with the null hypothesis that the variance across all cross sections is zero, i.e., no panel effects (Dascal, Mattas and Tzouvelekas 2002; Hatab, Romstad and Huo 2010). Either the fixed effects or the random effects are used to measure the individual country effects and a choice between them is needed to know which one yields consistent results. The main distinction between the fixed and random effects models is that a random effects model assumes that individual effects and regressors are not correlated, while a fixed effects model would allow this correlation. For example, in the context of this study, the individual effects of a country such as good weather conditions can increase the production of rice in an importing country, reducing the net import volume required, which affects one of the dependent variables in the model. A Hausman specification test is applied to test this correlation (Egger 2000). Basically, the Hausman test distinguishes the differences between estimates of the fixed and random effects model. The null hypothesis is that the difference is not systematic and if the null hypothesis is rejected then it means that coefficients of both models are significantly different. In other words, there is correlation between regressors and individual effects. Under the rejection of null hypothesis, estimates from fixed effects model are consistent while estimates from random effects model are not consistent. The Hausman-Taylor model is used because it is a hybrid of the fixed and random effects model that allows the correlation among regressors and individual effects, estimates the time invariant variables such as distance and dummy variables (e.g., historical ties), and treats some variables as endogenous (e.g., the real GDP of Pakistan and unit export prices variables).

RESULTS AND DISCUSSION

Panel data are employed for the reasons described in section 3.2 regarding the appropriateness of this specification relative to cross-sectional and time-series specifications. In table 3, the results of the gravity model are reported for the estimation of equation (3) under a Hausman-Taylor model, a fixed effects (FE) model, a random effects (RE) model and a pooled model. Robust standard errors are used for the estimation. Regarding the selection of the model, the coefficient value of the F-test is 22.18, which is statistically significant at the 1% level. Hence, the null hypothesis of a common intercept across all the countries is rejected, implying that individual effects are present and the FE estimation technique is more appropriate relative to the pooled regression model

Table 3. Gravity Model Estimated Results

Variables and test statistics		Pooled model		RE model		FE model		Hausman-Taylor	
		Coeff.	Stat sig	Coeff.	Stat sig	Coeff.	Stat sig.	Coeff.	Stat sig.
Y_j		0.26	***	0.34	***	1.34	*	0.39	***
Y_i		2.25	**	3.56	***	3.13	**	3.65	***
PCY_j		-0.33	***	-0.49	***	-1.42	**	-0.55	***
PCY_i		-2.07		-3.89		-3.82		-4.04	***
P^e_{ij}		1.13	***	1.07	***	1.06	***	1.06	***
E_{ij}		-0.09	***	0.04		0.08	*	0.06	*
D_{ij}		-0.92	***	-0.94	**			-0.97	***
CH_{ij}		0.90	***	1.02	***			1.03	*
Constant		-3.49		-5.97		-12.37	***	-5.79	
Wald chi2				3408.38	***			13185.61	***
Number of obs.		1749		1749		1749		1749	
[a]F test		4020	***			502	***		
R-square	Within			0.88		0.88			
	Between			0.84		0.69			
	Overall	0.87		0.86		0.79			
LM		3405	***						
Hausman test						33.73	***		
[b]F test						22.18	***		

Note: ***, **, * represent statistical significant at 1%, 5%, and 10% level, respectively.

[a] F test for overall model fit

[b] F test for choice between fixed effects and pooled regression

Source: Author's calculations

The coefficient value of the LM-test is 3405 with zero probability of accepting the null hypothesis at a 1% level of significance. Thus, the null hypothesis of no panel effects is rejected, which also implies that the pooled regression model is not appropriate. The Hausman specification test, applied to choose between the FE and RE models and the results of the test show that the null hypothesis is rejected as the value of the chi square statistic is 33.73 with zero probability of accepting the null hypothesis. The statistical significance level of this coefficient is 1%. Hence, the coefficients of the FE model are consistent and robust. Eita (2008), Ricchiuti (2004) and Dascal (2002) each applied a gravity model to panel data to determine the factors affecting exports and found that the FE model was more appropriate than either a pooled or random effects model. The values of within, between and overall R-squares are reported. The overall R-square values for all the models are about 80% or above implying a good fit of the model specification.

The results of the coefficients in the four models presented are the same in terms of their sign, in general, and similar in their level of statistical significance. This is an indication of consistency in the relationship between dependent and independent variables. The exceptions are that the real per capita GDP of Pakistan is only significant in Hausman-Taylor estimates and the exchange rate is only insignificant in RE model estimates. All variables that are statistically significant have the expected signs, although there is some variation in the level of significance.

In the FE model, the time-invariant variables such as distance and common historical ties cannot be estimated directly; however, the Hausman-Taylor model has the advantage of directly estimate them. Moreover, the real GDP of Pakistan is likely to be endogenous because exports can also affect GDP and unit export prices are also likely to be endogenous as they are the equilibrium prices that depend on excess supply (Pakistan's exports) and excess demand in the international market. Another advantage of the Hausman-Taylor estimation technique is to estimate the models considering the endogeneity of the model. As a result of the potential endogeneity and time-invariant variables included in the model, the implications and insights behind the results are from those of the Hausman-Taylor model.

The positive coefficient on Y_j, the real GDP in the importing country, shows that rice is a normal good. The value of the income elasticity is 0.39, suggesting that a 1% increase in importer's income results in a 0.39% increase in Pakistan's rice exports.

The coefficient on Y_i, the real GDP of Pakistan, is positive as expected and significant at the 1% level of significance. The coefficient is relatively elastic and its value indicates that a 1% increase in real GDP results in an increase in rice exports of 3.65%. Hatab, Romstad and Huo (2010) computed a similar income elasticity of 5% for Egypt in their study on determinates of total Egyptian agricultural exports. This positive and elastic coefficient implies that rice exports are sensitive to domestic supply (production capacity); hence, economic growth and greater production of rice (contributing to 1.3% of GDP) can stimulate rice exports. On the other hand, a supply shock such as a drought can adversely reduce the exports.

The coefficient on importer's GDP per capita is negative as expected, illustrating that rice is a necessity rather than a luxury product, and is statistically significant at the 1% level of significance. The coefficient on Pakistan's GDP per capita is negative as expected and statistically significant at the 1% level of significance. The negative sign suggests that rice is a labor-intensive commodity. Ali and Flinn (1989) also stated rice to be a labor-intensive crop. This finding further suggests that rice exports are explained by the H-O factor

endowment theory. In other words, there is an argument that Pakistan's rice sector enjoys an international comparative advantage and specialization in rice production to increase rice exports should result in an efficient allocation of resources (land and labor) to enhance economic growth.

The coefficient on the unit export price is positive as expected and statistically significant at the 1% level of significance. The price elasticity is 1.06 (unitary elasticity) indicating that a 1% increase in the export price of rice at an export market increases rice exports from Pakistan to that market by about 1%. The exporter's decision regarding the choice of an export market responds closely to price, i.e., that more is exported to markets where a higher price is obtained.

The coefficient on the exchange rate variable is positive illustrating that 1% depreciation in the value of the rupee leads to an increase in rice exports of 0.06%. During the period of the study the country shifted from a managed exchange rate regime to a more flexible regime, but the rupee depreciated by about 26%, which had a positive effect on the country's rice exports.

The coefficients on distance and historical ties have expected signs and are statistically significant at the 1% and 10% level of significance, respectively. The coefficient on the measure of distance is negative, suggesting that increased transport costs negatively affect Pakistan's export. The sign of the coefficient on historical ties is positive, which is reasonable to expect because marketing/trade linkages in regions that were once part of the British Empire should serve existing trade relations and facilitate exports of rice to such markets as Australia and the UK.

Time invariant variables in the fixed effects model are estimated in a second stage regression as describes in section 3.2 and the results are given in table 4. The coefficients on distance and historical ties variables are statistically significant at the 1% level of significance using robust standard errors and the signs are as expected.

Table 4. Second Stage Regression for Time Invariant Variables

Explanatory Variables	Coefficient	Robust standard errors	Statistical Sig.
Distance	-1.21	0 .10	***
Common wealth	1.49	0.11	***
Constant	9.96	0.93	***
R- squared	0.12		***

Notes: ***/**/* statistical significant at the 1%, 5%, and 10% level, respectively.
Source: Author's calculations

Export Potential

The country-specific effects show the factors which are unique to each country but which are not included in the estimation of the gravity model. The results in table 5 show that there are unobservable unique characteristics in some countries which promote rice exports from Pakistan, e.g., to Afghanistan, Australia, Bahrain, Indonesia, Iran and Kenya, UAE, the USA and the UK, countries with positive country-specific effects. However, other results suggest that there are characteristics that are not observable and discourage rice exports from Pakistan, e.g., to Argentina, Bangladesh, Philippines, and Sweden, countries with negative country-specific effects.

Table 5. Individual Effects by HT estimates

Country	Mean	Country	Mean	Country	Mean
Afghanistan	1.62	Guinea	1.78	Philippines	-0.51
Angola	-0.73	Guinea-Bissau	2.32	Poland	-0.41
Argentina	-1.82	Haiti	0.06	Portugal	-1.02
Armenia	-1.38	Hungary	-1.08	Qatar	2.80
Australia	0.70	Iceland	-0.53	Romania	-1.65
Austria	-2.70	Indonesia	0.61	Russian Federation	-1.26
Azerbaijan	-1.82	Iran	3.14	Rwanda	-1.68
Bahrain	2.39	Iraq	0.16	Saudi Arabia	2.99
Bangladesh	-0.57	Ireland	-0.86	Sierra Leone	-0.10
Belarus	-1.63	Italy	-0.43	Singapore	0.33
Belgium	1.09	Japan	-1.70	Somalia	-0.09
Benin	1.74	Jordan	0.49	South Africa	2.17
Brunei Darussalam	-0.70	Kenya	2.98	Spain	-0.92
Bulgaria	-1.81	Kuwait	2.91	Sri Lanka	0.90
Canada	-0.32	Lesotho	-1.48	Sweden	-0.67
Chile	-0.52	Liberia	-0.85	Switzerland	0.35
China. Hong Kong SAR	-0.56	Libya	-1.82	Syrian Arab Republic	-1.19
Congo	1.72	Lithuania	-0.27	Togo	2.87
Côte d'Ivoire	3.74	Madagascar	3.06	Tunisia	-0.69
Cyprus	-2.36	Malaysia	0.89	Turkey	-0.87
Dem. Rep. of the Congo	-2.05	Maldives	-1.12	Turkmenistan	-3.39
Denmark	-1.19	Mauritania	0.74	Uganda	-1.55
Djibouti	0.77	Mauritius	2.31	United Arab Emirates	4.54
Egypt	-2.42	Morocco	-0.43	United Kingdom	0.81
Finland	-2.99	Mozambique	0.15	Tanzania	1.90
France	-0.05	Netherlands	0.89	USA	1.58
Gambia	1.57	New Zeeland	-0.75	Uzbekistan	-4.26
Georgia	-1.98	Niger	-0.17	Yemen	1.85
Germany	-0.38	Norway	-0.30	Zambia	-2.16
Ghana	0.35	Oman	2.80	Zimbabwe	-1.11
Greece	-0.51	Peru	-0.29		

Source: Author's calculations.

Two main approaches have been used in literature to measure the export potential under a gravity model: the within-sample approach (e.g. But 2008; Eita 2008; Gul and Yasin 2011) and out-of-sample approach (e.g. Brülhart and Kelly 2004). The gap between the actual and predicted values in the within-sample approach measures the exploited or unexploited export potential. Egger (2002) criticized this approach by saying that this gap reflects residuals and misspecification of the model. In the out-of-sample approach, the model is estimated on a reference group and the coefficients obtained are used on the actual data of concerned country/countries to predict potential, and the actual values are compared with these predicted values. However, it is assumed that this potential will prevail if the concerned country/countries would behave like the reference group, or whether trade would be more liberalized or integrated. It is very difficult to find a reference group and impose such an assumption in rice trade as rice is a highly protected crop through importer's and exporter's policies and rice is traded thinly on the international market. Therefore, a within-sample approach is used to identify the potential markets for Pakistan's milled rice. However, both the FE and HT models were used to predict potential markets and these markets are very similar. Predictions are made by including the individual effects that capture the unobserved heterogeneity due to country-specific characteristics among the partner countries and are expected to be better than when excluding them.

The coefficients of the estimated model in equation (4) are used to predict the potential within the sample markets. This potential prevails if the exports are determined by the variables of the model. A different model specification might generate different results. The potential-to-actual export ratios, which are averaged over 1991-2010, are calculated and presented in tables 6 and 7. A ratio with a value greater than one indicates the existence of an unexploited potential. Unexploited potential is predicted within the existing markets because it is relatively easy to capture greater market share than to enter into a new market. However, the data set covers a wide range of countries, those with negligible import volumes and those which account for a large share of Pakistan's rice exports. Capturing potential in markets with a low share of imports could be somewhat similar to entering into a new potential market. However, the intention is not to shift export from existing markets to new or potential markets, but rather to maintain the current markets and concentrate on marketing to countries where there is unexploited potential.

There is high unexploited export potential in 49 export markets out of the 92 countries (indicated with * in tables 6 and 7) included in the sample, such as Argentina, Austria, Bangladesh, Benin, Georgia, Ghana, Hungry, Indonesia, Japan and the Philippines. The potential market development will depend on, among other factors, Pakistan's existing share in the total rice imports of the importing countries, importers' share in the total export of rice from Pakistan and on the preferences of consumers in those countries and their share in the total world rice import. The shares for the potential markets are given in table 8.

Among the 49 countries with potential, 13 are the members of the EU. Each of these countries have a low share of the total rice exported by Pakistan, between 0-2%, and Pakistan's exports also accounted for a low share of their total rice imports, ranging between 0-13% (UN FAO 2012). The EU-wide tariff on rice is 175 EUR/ton (WTO 2013); however, concessionary access to the EU was granted to Pakistan in 2002 for three years. Autonomous trade preferences were given to Pakistan in 2012 due to heavy floods in 2010 and 2011 which covers about 27% of all Pakistan trade with the EU. More importantly, the EU announced its new generalized system preferences (GSP^{+}) that will be implemented on January 1, 2014.

Table 6. Market Potential for Rice Exports

Country	Mean	Country	Mean	Country	Mean
Afghanistan	0.47	Guinea*	4.52	Philippines*	12.53
Angola	0.56	Guinea-Bissau*	1.64	Poland*	1.88
Argentina*	2.08	Haiti	0.64	Portuga*l	1.12
Armenia	0.49	Hungary*	1.83	Qatar	0.38
Australia	0.38	Iceland*	1.48	Romania*	2.45
Austria*	1.81	Indonesia*	9.08	Russian Federation*	6.83
Azerbaijan	0.70	Iran	0.49	Rwanda	0.90
Bahrain	0.38	Iraq*	7.01	Saudi Arabia	0.40
Bangladesh*	6.80	Ireland*	1.24	Sierra Leone*	3.47
Belarus*	1.85	Italy*	5.05	Singapore	0.58
Belgium	0.61	Japan*	1.65	Somalia*	1.52
Benin*	2.49	Jordan*	1.46	South Africa	0.66
Brunei Darussalam*	1.05	Kenya	0.40	Spain*	1.56
Bulgaria*	1.64	Kuwait	0.39	Sri Lanka*	1.23
Canada	0.58	Lesotho*	1.61	Sweden*	1.02
Chile*	1.65	Liberia*	2.07	Switzerland *	2.48
China. Hong Kong SAR	0.67	Libya	0.90	Syrian Arab Republic	0.93
Congo	0.96	Lithuania*	2.57	Togo*	1.72
Côte d'Ivoire	0.73	Madagascar*	1.88	Tunisia *	2.29
Cyprus	0.69	Malaysia	0.65	Turkey*	1.31
Democratic Republic of the Congo*	3.07	Maldives	0.54	Turkmenistan*	1.03
Denmark	0.46	Mauritania*	1.46	Uganda*	1.49
Djibouti	0.44	Mauritius	0.56	United Arab Emirates	0.40
Egypt	0.74	Morocco*	3.83	United Kingdom	0.41
Finland	0.72	Mozambique*	2.03	Tanzania	0.66
France	0.92	Netherlands	0.90	USA	0.51
Gambia	0.51	New Zeeland*	2.22	Uzbekistan	0.79
Georgia*	0.55	Niger*	2.14	Yemen	0.52
Germany	0.54	Norway	0.55	Zambia*	2.97
Ghana*	4.70	Oman	0.38	Zimbabwe*	1.33
Greece*	1.36	Peru	0.59	Total	1.71

Source: Author's calculations.

* Markets with high unexploited export potential

Table 7. Predictions employing Fixed Effects Model

Country	Mean	Country	Mean	Country	Mean
Afghanistan	0.51	Guinea*	4.66	Philippines*	12.81
Angola	0.56	Guinea-Bissau*	1.79	Poland*	1.88
Argentina*	1.81	Haiti	0.64	Portugal*	1.16
Armenia	0.45	Hungary*	1.76	Qatar	0.38
Australia	0.38	Iceland*	1.49	Romania*	2.42
Austria*	1.60	Indonesia*	9.39	Russian Federation*	6.48
Azerbaijan	0.65	Iran	0.53	Rwanda	0.90
Bahrain	0.43	Iraq*	6.81	Saudi Arabia	0.45
Bangladesh*	7.31	Ireland*	1.28	Sierra Leone*	3.33
Belarus*	1.53	Italy*	5.21	Singapore	0.60
Belgium	0.62	Japan*	1.51	Somalia*	1.50
Benin*	2.71	Jordan*	1.46	South Africa	0.71
Brunei Darussalam*	1.01	Kenya	0.43	Spain*	1.49
Bulgaria*	1.68	Kuwait	0.42	Sri Lanka*	1.19
Canada	0.57	Lesotho*	1.71	Sweden*	1.02
Chile*	1.72	Liberia*	2.17	Switzerland	2.47
China. Hong Kong SAR	0.64	Libya	0.85	Syrian Arab Republic	0.84
Congo	0.94	Lithuania*	2.92	Togo*	1.94
Côte d'Ivoire	0.83	Madagascar*	1.85	Tunisia *	2.09
Cyprus	0.63	Malaysia	0.64	Turkey*	1.28
Democratic Republic of the Congo*	2.83	Maldives	0.51	Turkmenistan*	0.90
Denmark	0.44	Mauritania*	1.59	Uganda*	1.34
Djibouti	0.46	Mauritius	0.58	United Arab Emirates	0.54
Egypt	0.68	Morocco*	3.65	United Kingdom	0.41
Finland	0.67	Mozambique*	1.91	Tanzania	0.70
France	0.93	Netherlands	0.92	USA	0.51
Gambia	0.56	New Zeeland*	2.15	Uzbekistan	0.68
Georgia*	0.53	Niger*	2.39	Yemen	0.51
Germany	0.56	Norway	0.54	Zambia*	2.78
Ghana*	4.91	Oman	0.41	Zimbabwe*	1.25
Greece*	1.38	Peru	0.59	Total	1.72

Source: Author's calculations.

* Markets with high unexploited export potential

Pakistan can qualify for this scheme provided that it would be able to prove its seriousness in the implementation of international human rights, labor rights and environment and good governance conventions. Pakistan's rice exports qualify under GSP^{+} and the government of Pakistan has been making efforts for this access (The Nations 2012). Market access under GSP is different from the autonomous trade preferences in that it covers all products except arms and ammunitions and is expected to be of greater importance for EU-Pakistani trade (The EU delegation to Pakistan 2012).

The Philippines, Japan and Indonesia are included among the largest importers of rice in the world having 4.5%, 2.5% and 4.9% share in the total world rice imports, but Pakistan's exports captured only 1.8%, 3.5% and 3% of their imports, respectively. These exports accounted for about 1% of total rice exports from Pakistan (UN FAO 2012). The applied MFN tariff on rice in Philippine is 50% while in Indonesia and Japan imposed non-advalorem duty amounted to 450 Rs/Kg and 342 yn/kg, respectively (WTO 2013). Some other potential import markets where rice exports face high applied MFN tariffs are Morocco with 156%, Turkey with 45%, Tunisia with 36% and Uganda levies a 75% or 200USD per metric ton duty (WTO 2013). Many of the export markets of developing countries for which Pakistan's rice has an export potential have applied tariffs ranging from 5 to 16% (WTO 2013). This restricted market access, and each of those markets accounted for less than 2% of Pakistan's rice exports (UN FAO 2012). Developing bilateral trade agreements to improve South-South market access and better marketing efforts to reduce transport costs are a means of exploiting the market potential and increase overall exports.

On the other hand, there is no applied MFN tariff in Bangladesh, Brunei Darussalam, Iceland, Jordan, Lesotho Madagascar and New Zeeland. Pakistan captured between 0 and 30% of these market's total rice import during 1991-2010 (UN FAO 2012). Bangladesh is among the largest consumers as well as producers of rice in the world and its imports account for about 3% of the world total, but those imports only accounted for 2.5% of Pakistan's rice exports (UN FAO 2012). Better marketing practices are the means to exploit market potential in these markets. With regard to adopting better marketing efforts and establishing bilateral agreements, Government should cooperate with exporters such as sending delegations of exporters and government officials for promotional purposes and negotiating with importers and officials in the partner countries. Importers and delegations from the partner's countries can also be hosted.

Government should devote attention to improving yield per hectare through technological improvement by encouraging research and development as Pakistan's yield per hectare, 2862 kg/ha, is lower than the world average yield per hectare, 3856 kg/ha during 1991-2010, and much lower compared with Australia's yield of 8479 kg/ha and the USA's of 6980 kg/ha. Even regional competitors had higher yields: Indonesia's was 4429 kg/ha while Bangladesh, Malaysia, Philippines and Sri Lanka had rice yields above 3000 kg/ha during the same period (UN FAO 2012). Moreover, Abedullah et al. (2007) found that rice producers in Pakistan were about 91% technically efficient and there was less room to increase rice productivity through improving resource use efficiency given existing seeds and technology. Hence, technological improvement through research and development was argued to be a requirement for the rice sector to increase production, reducing cost of production and making rice prices more competitive in the international market. Furthermore, government should improve the quality standard of the crop by educating the producers, exporters and other

market players about sanitary and phytosanitary measures and technical requirements by the partner's countries. This will reduce the probability of possible rejection at the customs point as happened in the past and increase the probability of more orders.

Table 8. Market Shares during 1991-2010 (%)

Countries	Share in world rice Imports	Importer's Share in Pak rice exports	Pak Exports share in total rice import of importing countries
Argentina	0.040	0.001	0.320
Austria	0.180	0.037	2.450
Bangladesh	2.780	2.514	12.990
Belarus	0.100	0.013	2.240
Benin	1.230	0.779	5.660
Brunei Darussalam	0.130	0.028	1.340
Bulgaria	0.110	0.078	7.310
Chile	0.350	0.007	0.200
Dem. Rep. of the Congo	0.410	0.063	1.620
Georgia	0.020	0.012	3.050
Ghana	1.220	0.579	6.720
Greece	0.060	0.071	11.750
Guinea	0.970	1.169	10.720
Guinea-Bissau	0.260	0.361	12.750
Hungary	0.160	0.050	2.520
Iceland	0.000	0.002	5.080
Indonesia	4.900	2.006	2.740
Iraq	3.090	1.023	3.060
Ireland	0.050	0.062	9.690
Italy	0.380	0.443	8.280
Japan	2.500	0.075	3.590
Jordan	0.480	0.625	14.260
Lesotho	0.040	0.110	6.490
Liberia	0.490	0.055	0.780
Lithuania	0.040	0.150	8.890
Madagascar	0.490	2.231	33.840
Mauritania	0.310	0.157	4.480
Morocco	0.030	0.259	
Mozambique	0.740	2.156	12.010

Table 8. (Continued)

Countries	Share in world rice Imports	Importer's Share in Pak rice exports	Pak Exports share in total rice import of importing countries
New Zealand	0.120	0.077	4.550
Niger	0.510	0.139	4.640
Philippines	4.490	1.145	1.840
Poland	0.360	0.220	4.720
Portugal	0.420	0.078	2.470
Romania	0.280	0.315	12.300
Russian Federation	1.330	0.409	2.860
Sierra Leone	0.610	0.649	13.650
Somalia	0.390	0.666	10.920
Spain	0.440	0.144	2.940
Sri Lanka	0.510	1.894	45.210
Sweden	0.230	0.220	6.940
Switzerland	0.320	0.341	9.980
Togo	0.280	1.405	31.340
Tunisia	0.060	0.073	10.270
Turkey	1.050	0.327	2.240
Turkmenistan		0.006	33.870
Uganda	0.160	0.158	7.930
Zambia	0.050	0.043	9.370
Zimbabwe	0.110	0.041	3.720

Source: UN FAO, 2012

SUMMARY AND CONCLUSION

A gravity model of 92 export markets of Pakistan's milled rice is estimated using panel data to determine factors affecting exports of rice from Pakistan during 1991-2010. An effort is made to determine in which countries there is unexploited export potential as a means to identify country-specific factors that could lead to increased marketing efforts, political responses such as the pursuit of bilateral trade agreements or preferential market access arrangements, and other economic actions that can improve Pakistan's competitiveness in the existing markets.

The real GDP of Pakistan and unit export prices are modeled as endogenous variables using the Hausman-Taylor estimation technique for panel data. Both of these variables have

the expected positive sign and are statistically significant at the 1% level. The real GDP of Pakistan is strongly elastic (3.56) on export supply while price elasticity is unitary.

Pakistan's production capacity should be enhanced to exploit potential. The yield per hectare in Pakistan is less than the world average and compared with other rice producers in the region. In this regard timely sowing and availability of irrigation water and other essential inputs should be ensured to the rice farmers. Easy and timely access to credit to buy inputs is also important to sow the crop in time and to increase yields and production. The government should devote attention to technological improvements by encouraging research and development. Rice availability for export can also be increased by reducing post-harvest losses that amount to about 16% (Khan and Khan 2010) through improved post-harvest management practices.

The real GDP of importing countries is also found to be a significant determinant of exports of Pakistan's rice. This result suggests that greater specialization in rice, all else the same, could boost income and welfare in rice producing regions of the country. The negative and statistically significant coefficient on Pakistan's real per capita GDP illustrates that rice exports are labor-intensive and follows the H-O explanation of trade, strengthening the case for greater specialization in rice production.

The exchange rate is also found to be positively and significantly affecting rice exports from Pakistan. The distance between partner countries was used as a proxy of transportation costs is also statistically significant having a negative effect on trade and common British historical ties have positive and significant effect on rice exports from Pakistan. The poor infrastructure in developing countries, e.g., in African markets, could be a factor that limits Pakistan's short-term ability to exploit potential in those markets.

There is unexploited potential of Pakistan's rice exports in emerging and developed economies that can be exploited through enhancing production capacity (GDP), establishing bilateral trade agreements with importing countries and better marketing efforts. Particularly, with regard to exploit potential in the EU markets government should make every effort to qualify for GSP^{+} through implementing international human rights, labor rights and environment and good governance conventions, the pre-requisite for qualifying for GSP^{+}. Furthermore sanitary and phyto-sanitary (SPS) measures should also be adopted to avoid problems at customs points and facilitate trade.

The exploitation of this export market potential would increase the production activity, marketing activity, storage activity, processing and export activity that will ultimately increase the incomes and livelihoods of all these people. An increase in rice exports will also help in reducing the trade deficit of the country and earn more foreign exchange, which will help in financing the country's imports and paying its foreign debt.

Such kind of analysis can be replicated for commodity exports of other countries particularly treating GDP and price variables as endogenous and these variables are expected to play a similar role.

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Paper II

Governance, Market size and Net Foreign Direct Investment Inflows:

Panel Data Estimation of Home and Host Country Effects

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Abstract

Foreign direct investment (FDI) can bridge investment-savings gaps and provide necessary capital to enhance economic growth in developing economics. Net inflows of FDI into Pakistan from 15 major investment-source countries during 1996-2010 are analyzed treating Pakistan's GDP and human capital as endogenous using a Hausman-Taylor estimation. Pakistan's market size, measured by GDP, governance indicators and human capital positively affect net FDI inflows, as do the GDP and governance indicators of the investment-source countries. Time-invariant variables such as distance negatively affect net FDI inflows, while common language has a positive effect. Low economic growth, bad governance, and a lack of skilled human capital are possible reasons for low and variable FDI inflows. The financial crisis of 2007-08 might account for the low levels of FDI since 2008. China, Italy and Switzerland are potential source of FDI inflows. However, to attract greater foreign participation in investment, the government must pursue strategies that: promote faster macroeconomic growth; implement institutional mechanisms that strengthen governance such as political stability through democratic elections, taking control over terrorism, tackling corruption, and applying the rule of law; and that invest in education and research and development particularly in sectors in which Pakistan has a comparative advantage.

Key words: FDI, governance, market size, panel data, Pakistan, Hausman-Taylor

JEL classification codes: D73. E02. F21. F23 E22

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1 Introduction

The economies of slow and uneven growing developing countries are typified by having a large resource (investment-savings) gap, budget deficits, current account deficits, a low level of industrialization over a narrow manufacturing base, a low capital-labor ratio, large disguised unemployment, a lack of technical and managerial skills, a culture of inefficiency and narrow export base (Zaidi 2004). This characterizes the macroeconomic situation of Pakistan. FDI could be an important instrument to overcome many of these structural weaknesses necessary for transition towards sustainable growth and development. Probably the most important role of FDI in a developing economy is the supply of capital, as the deficiency in the capital stock is a fundamental problem (Zaidi 2004, Khan and Kim 1999).

Pakistan's economy is agro-industrially based and exposed to external shocks brought on by nature, such as droughts and floods. Since its existence in 1947, the country has had a history of running trade deficits, except for a few years mostly in the 1950s. The economy's annual average growth rate hit a low level of 1.6% in 2008, which might be attributed to the global financial crisis of 2007-08. During 1991-2012, total domestic investment, defined as gross fixed capital formation, averaged 16.5% of GDP while gross domestic savings at 14.2% remained too low to finance the total investment (World Bank 2013; SBP 2010; GoP 2013).

Pakistan liberalized trade and investment in the 1980s to attract foreign investment. Reforms continued through the 1990s and the 2000s to help overcome the structural weaknesses (Siddique and Kemal, 2006). For example, the Investment Policy of 1997 sought to expand the country's industrial base through increased participation of foreign investment. Immigration law was reformed to ease the movement of temporary persons through a simplified visa process. Special industrial zones (SIZs) were set up with fiscal incentives to

attract FDI in export-oriented industries, which was complemented by privatization programs and deregulation (Khan 1997, Khan and Kim 1999).

However, trends on net inflows of FDI into Pakistan present a fluctuating picture. Net FDI inflows increased up to $1.1 billion in 1996, but decreased to $322 million in 2001. After 2001, net FDI inflows climbed to $5.4 billion in 2008 before more than halving to $2.2 billion in 2010. The average level of FDI into Pakistan during 1991-2011 remained low compared with other Asian countries despite liberal investment policies being adopted as early as the 1980s. The average net FDI inflows into Pakistan for 1991-2011 amounted to $1.48 billion while the value for India was $10.9 billion. In the early 1990s, the level of FDI inflows was similar in India and Pakistan, and was actually higher in Pakistan ($246 million) compared with India ($155 million). The averages in Honk Kong, Malaysia and Thailand, less populated economies than Pakistan, amounted to $30 billion, $4.9 billion and $5.3 billion, respectively. These trends raise a question. Why have FDI inflows into Pakistan remained low and uneven despite the pursuance of investment-friendly policies? Answering this question motivates the investigation into the drivers of FDI inflows into Pakistan.

It is expected that both home- and host-country characteristics (factors) play an important role as determinants of FDI into the host country (Liu et al. 1997 and Frankel et al. 2004). Home-country characteristics serve as push factors that encourage investors to pursue FDI opportunities abroad because they are connected to the level of economic development, the macroeconomic situation of the home country, and are linked to the strategic international concerns of home-country based firms (Frankel et al. 2004). The host-county's characteristics serve as pull factors that indicate the potential of the country to attract foreign investment. These factors are associated with the locational advantages of the host countries such as market size and income levels, human capital, and cost of production (Frankel et al. 2004).

Behind the positive macroeconomic characteristics of an economy is good governance or the institutional qualities of a country. This also plays an important role in the FDI decisions by investors (Mengistu and Adhikary 2011; Kaufmann et al. 2010; Gani 2007; Globerman and Shapiro 2002).

The purpose of this study is to analyze whether home- and host-country characteristics explain the variability and low level of inward-FDI flows into Pakistan during 1996-2010, despite the pursuance of investment-friendly policies. Particular attention is given to economic growth and the governance indicators of Pakistan as the host country. Panel data of the 15 principle FDI-source countries are used to model net inflows of FDI. Earlier studies on the determinants of FDI in Pakistan have focused on the pull factors that are responsible for making FDI attractive by employing time-series data and techniques or cross-country panel data. Country-specific studies on panel data and the role of governance indicators controlling for home- and host-country effects for attracting FDI inflows are limited in general and do not exist for Pakistan. This study intends to fill this gap by providing a more detailed analysis of the institutional and economic determinants of net FDI inflows into Pakistan by incorporating both home- and host-country factors, particularly the governance indicators that can drive net FDI inflows into Pakistan.

The results of this study should provide useful insights into the potential effectiveness of Pakistan's new Investment Policy of 2013 and its latest IMF program. The Investment Policy set a target of FDI growth of 25% bringing it up to $2.5 billion in 2014 and to $4 billion by 2017. The plan is to reduce the cost of and improve the ease of doing business through online registration processes and improvement of services provision through a single-window operation, and through the establishment of industrial clusters and special economic zones. The intention is to more clearly outline policy objectives across trade, industrial and

monetary policy to improve policy coherence. To facilitate the implementation of the policy, a detailed FDI strategy for 5-years (2013-2017) containing facilitation procedures has been specified under which the Board of Investment (BOI) would play its role as one-window operation (BOI 2013a). Prime Minister Nawaz Sharif, elected in May 2013, committed the Government of Pakistan (GOP) to privatize loss-making state-owned enterprises (32 companies in total) and to reform the energy sector, including the sale of two large gas companies, the oil company and power distribution companies (IMF 2013, Dawn 2013). However, skepticism remains because 11 of 12 IMF programs since 1998 have been scrapped or abandoned because Pakistan failed to institute reforms. Hence, the effect that governance and economic growth has had on FDI inflows should shed light on how necessary are proposed policy initiatives such as development of human resources, facilitating the linkage between foreign investors and research institutes, organizing training program for agencies that are involved in investment promotion, and continued application of liberal investment regulations (BOI 2013a, Hussain 2013).

2 Background

2.1 The Macroeconomy of Pakistan

In table 1 a macroeconomic profile of the economy is presented for the 1960s through 2000s, which includes annual averages over the respective decades for several key indicators of performance. Annual average GDP growth rates have been uneven over the decades, but growth averaged 4.57% during 2000 after the slower average growth of 3.96% in the 1990s. In the 2000s GDP fluctuated and has remained relatively low since 2007, dipping to its lowest level in 2008 due to global financial crisis. On a per capita basis, GDP has steadily increased, amounting to about $762 in nominal terms in the 2000s. The transformation from primarily an agricultural economy in the 1950s, when agriculture's share of GDP averaged 48%, towards

an industry- and services-based economy has been on a steady march. Industry's share of GDP doubled from 13% in the 1950s to 27% in 2000s and services' share increased from 38% to 53%. The agricultural sector's rate of growth has persistently been slower than GDP growth and the rates of growth have decreased since the 1980s. This reflects the bias shown toward industrial development and the neglect of the agricultural sector. The uneven rates of growth also reflect the country's difficulties in managing natural disasters and adverse weather conditions. Despite the economic transformation that has occurred, the major industrial export sub-sector is textile manufacturing which is dependent on agriculture, reflecting the economy's agro-industrial composition (SBP 2010).

[Table 1 about here]

The share of gross fixed capital formation as a percent of GDP was about 17% from the 1980s through the 2000s, an improvement over the 1970s, but still a low rate given the stage of Pakistan's development. The low level of foreign investment inflows was made worse by the relatively low national savings rate, which has amounted to about 15% of GDP through the 1990s and the 2000s. The low domestic savings and capital formation reflect the need for foreign investment (Zaidi 2004; SBP 2010; GOP 2013; World Bank 2013) to boost GDP growth but also address rising unemployment rates that have crept up to 15% in the 2000s from about 11% in the 1990s.

The trade deficit increased from about $2.25 billion in the 1980 and the 1990s to $9.24 billion in the 2000s. The external debt almost doubled in each decade from the 1970s to the 1990s and reached $41.6 billion in the 2000s, about 44% of GDP. Foreign exchange and gold reserves increased from $0.26 billion in the 1950s to $12.2 billion in the 2000s, but remained insufficient to finance imports and the external debt. Inflation hit a 30-year high in 2008 at 20%, which was due to the global financial crisis and the international price surge for a

number of commodities. However, in the late 1990s and the early 2000s there were the periods with relatively low inflation.

Energy use per capita (i.e., equaling the equivalent that can be extracted from 1 kg of crude oil) increased from 294 kg of oil equivalent in the 1970s to 350 kg in the 1980s and average percent increase in energy use per capita almost doubled; 1.9%, in the 1980s compared with the 1970s, 1%. However, average percent increase in energy use per capita in the 1990s; 1.34%, was less than in the 1980s and this percent increase in the 2000s; 1.1%, was less than in the 1990s indicating a declining trend in average percent increase in the energy use per capita. The total energy use per capita increased to 474 kg of oil equivalent in the 2000s from 421 kg in the 1990s. Currently the economy is suffering an energy shortfall, particularly of electricity and natural gas that results in several hours of load shedding each day.

FDI can be a source to improve some of these macro-economic indicators such as generating employment, developing human capital and bridging the investment-saving gap. The five major source countries of FDI are Netherlands, Switzerland, the USA, the UK, and the UAE, which account for about 62% of total net FDI inflows into Pakistan. The rest of the ten countries included in the study are Australia, Canada, China, France, Hong Kong, Germany, Japan, Italy, Singapore and Saudi Arabia, which contribute to another 15% of total inflows (SBP 2010).

The net FDI inflows into various sectors as a percent share of total net FDI inflows are shown in table 2 for 1996-2010. All the sectors present an uneven trend in general and a decreasing trend since 2007-08. The financial services and transport, storage and communication sub-sectors captured a relatively higher share of total FDI during 1996-2010 amounting to 14.19% and 20.84%, on average, respectively. The services sector's share of

FDI was quite low in 2001-02, but increased with liberalization and the implementation of privatization programs (e.g., telecommunications and commercial banking). FDI inflows declined again when the programs were concluded (Khan and Khan 2011). Mining, quarrying, and oil and gas exploration accounted for about 19% of the total net FDI inflows; however, it is a sector in which fluctuations were greatest, reaching a high of 56% in 2001-02 before declining sharp after 2005. The energy sector also received a relatively higher share in the mid-to-late 1990s ranging from 12 to 40%, but has been low since 2000. Its average share during 1996-2010 has been 11.33%. However, this is a targeted sector to attract investment because of ongoing energy shortfall in the country. Among the key state-owned enterprises which are being considered for privatization are Pakistan's airlines, railway and the Water and Power Development Authority (WAPDA).

[Table 2 about here]

2.2 Policies to attract foreign investment

In the 1980s, liberalization of the trade and investment policy regime began. Quota restrictions were removed and replaced by tariffs. Trade liberalization continued into the 1990s. The average tariff rate declined from 22% in 1980 to 12% in 1999. Import licensing was eliminated in 1993. These reforms created an efficient and competitive manufacturing industry through easier access to raw materials, intermediate goods and machinery (Siddique and Kemal, 2006). To encourage FDI in export-oriented industries such as textiles, an export-processing zone (EPZ) was set up in Karachi (Zakaria 2008). In addition to foreign investors, Pakistanis residing abroad were also encouraged to invest in industrial projects in the EPZ on a non-repatriable investment basis and various other incentives were offered (Khan 1997).

The Investment Policy of 1997 included a major policy initiative to enhance the level of foreign investment. The intention was to expand the country's industrial base in the

following sectors: infrastructure and software development, electronics, engineering, agro-food, value-added textiles, tourism, and construction. The BOI was the main agency to help government in formulating investment-friendly policies, identifying the potential sectors for investment and provide the necessary information and assistance to domestic and foreign investors. The Board's web page provides information in English about investment policies, potential sectors for investment, ongoing projects, services offered and an investment guide.

The board has formulated investment policy 2013 that sets out a target of 25% annual growth in FDI inflows into Pakistan. Policy measures in the investment policy 2013 include reduction in the cost of business through removing equity caps on banking and non-banking financial institutions by the central bank and the Securities and Exchange Commission of Pakistan. To ease doing business in Pakistan, the BOI established forward and backward linkages in the market and more appropriate business infrastructure was provided. Following the lead of China, Malaysia and Thailand, the BOI was to establish special industrial zones and industrial clusters. Incentives for zone developers and enterprises include duty-free import of capital goods, tax exemptions for a period of ten years, adequate infrastructure, dry-port facilities and security. The BOI also coordinates with other ministries and institutions in the country e.g. working closely with the Planning Commission of Pakistan. The new growth framework laid out by the Planning Commission of Pakistan focuses on four areas: improved productivity, better governance, competitive markets and innovations and entrepreneurship, which are closely related with the Investment Policy 2013. For instance, increased productivity attracts foreign investors and foreign investment also contributes to improve productivity. Better governance in the form of provision of quality public services and reducing public interventions that distort markets would attract foreign investment (BOI 2013a).

Pakistan has signed bilateral investment treaties (BITs) with 47 countries and 26 of them are in force. Negotiations are in process with another 27 countries. The BITs between home and host countries provide protection to investors. Targeted sectors are manufacturing including textile, food processing, consumer goods and engineering, energy, mining and exploration, construction and real estate, automotive and agriculture including livestock, dairies and fisheries (BOI 2013a, 2013b). Nevertheless, despite these previous efforts Pakistan has not been successful in attracting higher amount of FDI, suggesting that other governance-related factors affect FDI decisions.

2.3 Governance indicators for Pakistan

Kaufmann et al. (2010) defined governance as "the traditions and institutions by which authority in a country is exercised (p. 4)". This definition encompasses six measures of governance: (1) voice and accountability provides an indication of the ability of the people to participate in the selection of the government, their freedom of expression and free media; (2) regulatory quality reflects the ability of the government to articulate supportive policies for private sector development (e.g., market-friendly policies such as lifting price controls); (3) the rule of law measures the degree of contract enforcement, the incidence of crime and violence, the degree of security of property, individual rights, and the enactment of policies supporting free and open markets; (4) government effectiveness measures the independence of public and civil services and the ability of the government to frame policies and implement them; (5) political stability and the absence of violence is a measure of the probability that a government cannot be destabilized due to unconstitutional means including politically-driven violence and terrorism; and (6) the control over corruption measures the use of public power for private gains including corruption as well as capture of the state by elites and private interests (Mengistu and Adhikary 2011; Kaufmann et al. 2010; Stasavage 2002; Vittal 2001).

Table 3 presents data for the six governance indicators for Pakistan during 1996-2011 (Kaufmann et al. 2010). The values of the indicators ranged from -2.5 to +2.5. A positive sign suggests good performance and negative sign poor performance of the respective governance indicator. All of the indicators are negative although variation exists through time and across indicators. The indicator of voice and accountability fluctuated between -0.64 to -1.26 during 1996-2010, but improved during the mid and late 2000s because of greater independence of the media and the holding of democratic elections. The world ranking improved from 11th worst in 2000 to 26th worst in 2011. The sharp increase in its negative estimate and world ranking as worst in 2000 from 1998 can be attributed to the military dictatorship. Estimates of regulatory quality varied between -0.45 and -0.88 averaging -0.61, but this indicator improved in the mid-to-late 2000s possibly due to implementation of the privatization process.

[Table 3 about here]

The governance estimates for the rule of law fluctuated between -0.66 to -0.90, with an average of -0.83. This indicator also improved in the mid-to-late 2000s due to the continuous liberalization of policies and improvements in protecting individual property rights. The average value of political stability was -1.95 and the values ranged from between -1.14 and -2.73, ranking Pakistan as the 5th worst in this category, on average, and the worst category during late 1990s mainly due to terrorism and the shifts from democracy to dictatorship and back. The election in 2013 brought in a new government and was the first democratic handover of power in the history of Pakistan, but this event falls outside the period of the study. Finally, the values for the control over corruption remained between -0.76 and -1.15, with an average of -1. This indicator has worsened due to the increase in the level of corruption. These governance indicators are to be incorporated into the model to ascertain

whether institutional mechanisms played a role in attracting FDI into Pakistan and to determine the extent to which they may have played a role.

3 Data and Methodology

3.1 Model specification

Market size, governance indicators, human capital, the cost of labor, distance and common language are the factors included in the model affecting FDI inflows into Pakistan. These factors are modeled as:

$$(1)\ FDIij = Y_j^{\beta 1} Y_i^{\beta 2} GOV_j^{\beta 3} GOV_i^{\beta 4} HK_j^{\beta 5} EC_j^{\beta 6} BIT_{ij}^{\beta 7} D_{ij}^{\beta 8} CL_{ij}^{\beta 9} \zeta_{ij}$$

where FDI_{ij} is net FDI inflows into Pakistan, country j, measured in million US dollars from major foreign investors (i = 15 source countries of FDI); Y_j and Y_i are the GDP in Pakistan and in the exporting country, respectively, measured in million US dollars; GOV_j and GOV_i represents the aggregated average of the six governance indicators of Pakistan and investing countries, respectively; HK_j represents the human capital measured by the secondary school enrollment in Pakistan; EC_j is the per capita energy use defined as the use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport (WB 2013); BIT_{ij} is a dummy variable for the existence of an investment treaty between Pakistan and the source country, taking on a value of one from the year in which agreement was signed and 0 otherwise; D_{ij} is distance between the capital city of the home country and Islamabad used as a proxy for cost of information, transportation of raw material and managing an affiliate in Pakistan; CL_{ij} is a dummy variable for common language taking on a value of one if the official language in the investing country is English

as the official language in Pakistan is English; and ξ_{ij} is the error term which comprises two parts, an individual effects term and the usual error term.

Taking the log of equation (1) and decomposing the error term in its components forms the following model:

$$(2)\ \ln FDIij = \beta_1 \ln Y_j + \beta_2 \ln Y_i + \beta_3 GOV_j + \beta_4 GOV_i + \beta_5 \ln HK_j + \beta_6 \ln EC_j + \beta_7 BIT_{ij} + \beta_8 CL_{ij} + \beta_9 \ln D_{ij} + \eta_i + \delta_{ij}$$

where η_j shows the individual country effects and δ_{ij} represents the usual error term. The individual country effects capture the unobserved heterogeneity among the investing countries. These are unobserved factors that may promote or hinder the investment decisions in the home countries. This is one of the advantages of employing the panel data over cross-sectional and time series data. Liu and Wei (2001) argued that panel data capture the effects of unobserved behavior of the investing countries (investors or investing firms) due to their heterogeneous nature and these effects are not included in the regression equation. Hsiao (2007) noted that panel data can control for the effects of omitted variables which is an important advantage of using panel data. Another important advantage of panel data is attributed to the increased number of degrees of freedom.

The market-size hypothesis states that FDI inflows are a function of the market size of the host country which is measured by GDP (Liu et al. 1997; Frankel et al. 2004). In general, the more an economy grows, the more attractive the country can be for investors in search of higher returns. Hence, the expected sign of the coefficient 'Y_j' of the GDP variable used as a measure of market size of Pakistan is positive. Aqeel and Nishat (2004), Shah and Ahmed (2003), and Awan et al. (2010) used the GDP of Pakistan as a determinant of FDI inflows into Pakistan employing time-series data and techniques. They found a positive and significant coefficient on the GDP of Pakistan. Hashim et al. (2008) used the GDP of Pakistan to explain

the determinants of FDI inflows into the telecommunication industry using time-series data and techniques and found positive and significant effects of GDP. The market-size hypothesis was supported by Azam and Luqman (2008) and Çeviş and Çamurdan (2007) who also employed GDP as a factor attracting FDI into Pakistan, India and Indonesia, and developing countries, respectively, employing time-series data and techniques. It was also supported by Mengistu and Adhikary (2011) who included the GDP of 15 Asian countries, including Pakistan, as an explanatory variable to study FDI inflows into these economies during 1996–2007 using cross-country panel data and estimation techniques.

The expansion of the capital base and the technology and managerial skills that accompany FDI might enhance the country's productive capacity and economic growth. So, the relationship between FDI and growth can be bi-directional (Roy and Van den Berg 2006). The empirical literature recognizes this bi-directional relationship for Pakistan. Iqbal et al. (2010) found a long-run relationship and bi-directional causality between FDI, exports and economic growth with a positive impact of FDI on growth. Khan and Khan (2011) found a positive effect of FDI on output and causality running from GDP to FDI in the long run while in the short run a two-way causality between FDI and GDP was evident. Moreover, they argued that FDI caused growth in the primary and services sectors, while growth attracted FDI in the manufacturing sector. Khan and Khattak (2008) studied the FDI-growth relationship in a system of two simultaneous equations for 1971-2005 by employing two-stage least squares and generalized methods of moments and found a positive impact of FDI on growth. Therefore, GDP is considered as endogenous in this study.

The size of the home market (as measured by the GDP) is also argued to positively affect FDI inflows into the host country. The size of the market is used as a proxy for the number of firms. A large country is expected to have a greater number of firms that intend to

expand and this expansion causes more FDI inflows into the host county. Moreover, higher income levels should reflect the availability of funds for FDI (Grosse and Trevino 1996, Frankel et al. 2004). Hence, a positive coefficient on the home country's GDP 'Y_i' is expected. Frankel et al. (2004) specified the GDP of the home countries in their empirical models to study determinants of FDI into the host (developing) countries and found positive and significant effects of the home country's GDP on FDI inflow into the host countries.

All of the six indicators of governance are expected to have a positive relationship with the inflows of FDI into the host country. Political stability of the host country is argued to be important for long-term investment as investors are reluctant to invest in a situation of uncertainty. East Asian countries provide a good example of this, such as Indonesia. The greater the control over corruption, the higher economic growth rates are expected to be and the greater will be FDI inflows to the host country. A higher degree of voice and accountability is a kind of political checks and balance forming a positive relationship with FDI. Similarly, a higher degree of government effectiveness, good regulatory quality and the implementation of rule of law are expected to favor FDI inflows. Good governance in the home country can also facilitate investment abroad as is expected to enhance economic activity in the home country and the availability of funds for FDI projects. Globerman and Shapiro (2002) argued that investment in governance infrastructure creates a conducive environment for domestic multinational corporations to develop and invest overseas. Hence, positive signs on governance in the host and home countries, GOV_j and GOV_i, are expected.

The six indicators are not independent of each other. Better accountability and voice can lead to less corruption; a higher degree of government effectiveness supports the regulatory environment; and the rule of law facilitates a transparent system of selecting and replacing governments and less misuse of public authorities for private gains. These

relationships indicate that governance indicators are strongly positively correlated (Kaufmann et al. 2010). Thus, an aggregated average of these six indicators for Pakistan is used in the analysis to avoid a multicollinearity problem. Earlier specifications included all six indicators as separate variables or included only one indicator in separate regressions, but the aggregation provided the best results in terms of statistical significance and the effect on the other parameters. Mengistu and Adhikary (2011) found that political stability and absence of violence, government effectiveness, rule of law, and control of corruption were significant determinants of FDI inflows. However, voice and accountability and regulatory quality were not significant in attracting FDI inflows. Bannaga et al. (2013) investigated the effects of governance on the inflows of FDI into Arab countries and found positive and significant effects.

Human capital generally complements physical capital. It refers to skills developed by the labor force through investment in education, health and training. Knowledge is considered as a factor of production (Mengistu and Adhikary 2011). New growth theory emphasizes that growth is an endogenous outcome of an economic system and that technology is not exogenous (Romer 1994). This includes investment on human capital, innovation and knowledge and their spillover effects. Borensztein et al. (1998) found that FDI was an important source of transferring technology and that it stimulated growth more than domestic investment. However, they added that the growth-enhancing effects required a minimum level of human capital in the host countries, which reflected the absorption capacity of new technology. The World Bank (1993) found that there was a 0.3% increase in per capita GDP growth due to a 10% increase in the primary and secondary school enrollment ratio. Increased growth rates can attract more FDI. However, FDI can also affect human capital as it accompanies managerial skill and contributes to human resource development establishing an endogenous relationship. Secondary school enrollment in Pakistan is used as a measure of the

human capital variable, HK_j, in a manner used by Mengistu and Adhikary (2011), except that it is treated endogenous here and is expected to positively affect the FDI inflows.

Per capita energy use is employed as a proxy for infrastructure. Good infrastructure is expected to attract FDI as it facilitates the operation at high rates of capacity utilization. Hence, the coefficient on EC_j is expected to be positive. Part of the motivation for studying the relationship of this variable with the net FDI inflows is to gauge the effects of severe energy shortfalls particularly of electricity and natural gas since 2007-08. The load shedding of electricity and natural gas adversely affected both domestic households and industry.

A dummy for BITs is expected to positively affect FDI inflows into Pakistan as they signal security to the investors and reduce barriers and transactions cost. The geographic distance dummy, D_{ij}, is considered to be negatively related to FDI inflows in the host country (Bhavan et al. 2011; Cuyvers et al. 2008; Liu et al. 1997; Frankel et al. 2004). Grosse and Trevino (1996) reported that the greater geographic distance between the home and host countries represented a higher cost of obtaining information and managing an affiliate in the host country's market, which resulted in smaller inward FDI. Common language intends to capture the ease of communication, documentation and execution of operations regarding FDI. Hence, common language between home and host country is expected to facilitate investors in their actions and positive effects on FDI inflows into the host country.

The estimation of time-invariant variables in a fixed-effects model are estimated in a second- step regression with the individual effects as the dependent variable and distance and dummies as explanatory variables. This is estimated as:

$$(3)\ IE_{ij} = \gamma_0 + \gamma_1 D_{ij} + \gamma_2 CL_{ij} + \upsilon_{ij}$$

where IE_{ij} denotes individual effects; D_{ij} and CL_{ij} are as previously defined; and υ_{ij} is an ordinary error term.

3.2 Sources of Data

The dataset spans 15 countries that accounts for about 77% of total net FDI inflow into Pakistan, on average, during 1996-2010. Data on net FDI inflows into Pakistan and human capital, secondary school enrollment, are taken from the *Handbook of Statistics for Pakistan 2010* available at the Central Bank's on-line database (SBP 2010). For some countries the data on net FDI inflows are available from 1998; hence, the dependent variable is an unbalanced panel. Data on governance indicators are taken from the World Bank, which were compiled by Kaufmann et al. (2010). Data on governance indicators are available from 1996 to 2011 except for 1997 and 1999. For the years 1997 and 1999 averages of 1996 and 1998, and 1998 and 2000, were used, respectively. GDP data are from the World Development Indicators, available on the online database of the World Bank (2013). The information on common language is taken from the web pages of the Central Intelligence Agency (CIA 2013). The distance data between the capital cities of Pakistan and the trading partners are collected from the "Travel Distance Calculator between Cities" under the Chemical-ecology website (2013). As the number of years spans from 12 to 15 years of observation, the data set is more likely to be a micro-panel and stationary tests are not of great importance and were not performed.

3.3 Model Identification

Panel data permit the construction of a Hausman-Taylor model, a fixed-effects model, a random-effects model, and a pooled regression. The main problem with the pooled model is that it assumes a common intercept for all the countries, does not estimate country-specific effects and assumes that all countries are homogenous (Dascal, Mattas and Tzouvelekas

2002). An F-test is performed to make a choice between the pooled regression and the fixed-effects model, having the null hypothesis of a common intercept for all the cross sections versus an alternative hypothesis of the presence of individual effects (Ahmad and Garcia 2012; Dascal, Mattas and Tzouvelekas 2002; Hatab Romstad and Huo 2010). A Breusch-Pagan Langrange Multiplier (LM) test is performed to choose between the pooled regression and the random-effects regression with the null hypothesis that the variance across all cross sections is zero, i.e., no panel effects (Ahmad and Garcia 2012; Dascal, Mattas and Tzouvelekas 2002; Hatab, Romstad and Huo 2010).

Either the fixed effects (FE) or the random effects (RE) are used to measure the individual country effects and a choice between them is needed to know which one yields consistent results. The main distinction between the fixed- and random-effects models is that a random-effects model assumes that individual effects and regressors are not correlated, while a fixed effects model would allow this correlation. A Hausman specification test is applied to test this correlation (Egger 2000). The null hypothesis is that the difference is not systematic and if the null hypothesis is rejected then it means that coefficients of both models are significantly different. In other words, there is a correlation between regressors and individual effects. A rejection of the null hypothesis implies that the estimates from fixed effects model are consistent while those from the random-effects model are not. The Hausman-Taylor model is a hybrid of the fixed and random effects models, allowing the correlation among regressors and individual effects, the estimation of the time invariant variables such as distance and dummy variables (e.g., common language), and treating some variables as endogenous (e.g., net FDI inflows to Pakistan and the GDP and human capital in Pakistan). Estimates from the Hausman-Taylor model are given more priority in the discussion of the results because of these properties.

4 Results and discussion

In table 4, the results are reported for the estimation of equation (2) under a Hausman-Taylor model, a fixed-effects (FE) model, a random-effects (RE) model and a pooled model. Robust standard errors are used for the estimation. Regarding the selection of the model, the coefficient value of the F-test is 14.21, which is statistically significant at the 1% level. Hence, the null hypothesis of a common intercept across all the countries is rejected, implying that individual effects are present and the FE estimation technique is more appropriate relative to the pooled regression model. The coefficient value of the LM-test is 151.19 with zero probability of accepting the null hypothesis at a 1% level of significance. Thus, the null hypothesis of no panel effects is rejected, which also implies that the pooled regression model is not appropriate. The Hausman specification test is applied to choose between the FE and RE models and the results of the test show that the null hypothesis cannot be rejected as the value of the chi square statistic is 1.12 with about 100% probability of accepting the null hypothesis. Hence, the coefficients of the RE model are efficient compared to Fixed effects model.

[Table 4 is about here]

The results of the coefficients in the four models presented are the same in terms of their sign with only one exception. This is an indication of consistency in the relationship between dependent and independent variables. The statistical significance of the coefficients is similar in the pooled regression, random effects and Hausman-Taylor models with few exceptions. All variables that are statistically significant have the expected signs, although there is some variation in the level of significance. As described earlier, GDP and the level of human capital of Pakistan are likely to be endogenous because FDI inflows are expected to enhance economic growth in the host countries through generating employment, increasing

managerial skill (human capital) and transfer of technology. The Hausman-Taylor estimation technique considers the variables as endogenous, and the model includes time invariant variables, distance and common language. The presentation of results of particular coefficients is restricted to the output from the Hausman-Taylor estimation.

The coefficient on Y_j, the GDP of Pakistan indicating market size of Pakistan, is positive as expected and significant at the 10% level of significance. The coefficient is relatively elastic, indicating that a 1% increase in GDP attracts 1.84% net FDI inflows into Pakistan. The positive and significant coefficient is consistent with the empirical evidence in the literature on FDI determinants in general and regarding Pakistan in particular. The elastic value of the estimate indicates that FDI inflows to Pakistan are more sensitive to growth in the market size of the economy and that economic growth would bring more FDI into the country. During the study period, GDP growth was uneven and low which can account for the fluctuations and the low levels of FDI inflows. GDP growth was relatively higher during the early 2000s and lower in the late 2000s, and FDI inflows reflected a similar pattern.

The positive coefficient on Y_i, the GDP in the investor's countries, shows that FDI inflows to Pakistan increase with the increase in GDP of the investor country. The value of the income elasticity suggests that a 1% increase in the home-country GDP of an investor results in a 0.86% increase in net FDI inflows. This finding is consistent with results in the literature. This result can partly explain the decrease in FDI inflows into Pakistan after 2007 in light of the global financial crises of 2007-08. This decrease in FDI inflows in 2009 also occurred in other countries such as India, China, Philippines, Malaysia, the UK and the USA.

The coefficient on average governance indicators in Pakistan is positive as expected and statistically significant at the 1% level. This indicates that good governance would significantly attract more FDI and vice versa. This finding could also explain the lower levels

of FDI inflows into Pakistan as compared with other Asian countries despite investment-friendly policies. This finding is supported by the data and description presented in table 3 and section 2, respectively, whereby all six of the governance indicators are negative, suggesting poor governance. For instance, the increase in the number of terrorist occurrences such as bombings, suicide attacks, target killings and the general breakdown in law and order can be regarded as the major reasons for political instability in Pakistan. Karachi is the biggest and most populated industrial city and port. Baluchistan is the biggest province in terms of the area and possesses high potential to receive foreign investment (because of the presence of natural resources such as coal and a new port at Gwadar). However, these are the primary victim of the very poor law and order condition. Khan (1997) described the political instability and poor law and order condition in Karachi as one of the reasons for low FDI inflows into Pakistan. Khan and Kim (1999) reported that the major reasons behind Pakistan's very low share of FDI inflows were due to urban violence, inconsistent economic policies and government bureaucracy. Zakaria (2008) asserted that high business costs, political instability, corruption, government bureaucracy, inconsistent government policies, and the poor law and order situation were the major obstacles in the way FDI inflows in Pakistan. The results of this study empirically confirm the views reported in the literature, which are more qualitative assessments of the political economic factors affecting FDI.

The Investment Policy of 2013 is not geared toward improving governance; however, its intention is to improve inter-institutional coordination. Good governance is very important to gain investors' confidence as is the improvement in the quality of institutions that control for corruption and terrorism, implement the rule of law, promote democracy and allow more independent media. Such measures would be expected to attract more FDI inflows into Pakistan in the future.

The coefficient on the average governance indicators in the investing countries is also positive as expected and statistically significant at the 1% level. This suggests that good governance in the home countries would create a healthy environment and policies for the development of multinational companies to invest abroad encouraging capital inflows into the host countries. This is in line with what Globerman and Shapiro (2002) argued.

The coefficient on human capital, which uses secondary school enrolment as a proxy, is positive as expected and statistically significant at the 10% level. The value of the coefficient is highly elastic at 3.11, suggesting an increase in school enrollment could bring about considerable FDI inflows into Pakistan. Mengistu and Adhikary (2011) also found a positive and significant effect on FDI from human capital in Asian countries. Pakistan ranks among the countries with high illiteracy rates and the allocated budget for education and research and development sector is only about 2-3% of the total national budget. There is a strong argument that this should be increased. This factor can be regarded as one of the factors responsible for low FDI inflows into Pakistan and low growth enhancing effects of FDI. Khan (1997) also identified lack of trained and educated labor force as one of the reasons of low foreign investment in Pakistan which is empirically supported by this study. This also supports the findings of Borensztein et al. (1997), and would suggest that education, and vocational education in particular, should be a priority to produce skilled labor that can use and maintain equipment. Investment in higher education could promote a research and development culture in the country and facilitate training manpower. This supports the BOI's plan to develop human capital according to the needs of foreign investors and to link domestic research and development to sectors in which foreign investors are interested in participating.

The coefficient on per capita energy use, a proxy for infrastructure, is positive as expected and statistically significant at the 10% level. The result suggests that a 1% increase

in per capita energy use would attract 3.1% additional FDI inflows, all else the same. The elasticity of the result makes a strong case for improvements in energy-related infrastructure which could ensure a more reliable supply of energy so that energy use per capita can increase. This is an important for investors deciding whether or not to set up an affiliate in the host country. With Pakistan passing through a period of energy shortfalls adversely affecting the overall economic activity in the country and the efficiency of the industries and institutions, this is a major concern.

Another problem is electricity theft which causes about 30% of transmission losses. Privatization of WAPDA could help resolve the transmission problem as well as generation of electricity. Detailed opportunities in each province and special incentives to invest in the energy sector to overcome the energy shortfall are provided on the BOI's web page. The US State Department is encouraging investors to invest in energy sector in Pakistan saying it as an attractive place to invest, particularly in offshore gas exploration, equipment provision, and liquid natural gas supply (Iqbal 2013).

The average level of FDI inflows during 2009-2011 remained at $1.9 billion while the set target for 2014 is $2.5 billion. This implies that about a 27% increase in FDI inflows would be required to meet this target. Moreover, the Investment Policy also sets out a target of 25% annual growth in net FDI inflows. Government can make efforts to improve the GDP, quality of institutions, human capital and energy use. The elasticity coefficients on these variables suggest that an improvement of 2.5% in each of these four variables would meet the target of about 25% increase in FDI.

The coefficients on distance and common language have the expected signs and are statistically significant at the 1% level. The coefficient on the measure of distance is negative, suggesting that increased costs for getting information, or transporting imported raw materials

and higher costs of establishing a subsidiary such as visiting the subsidiary in Pakistan negatively affects FDI inflows. Frankel et al. (2004) and Bhavan (2011) found negative and significant effects of distance on FDI inflows into the host countries. The positive sign of the coefficient on common language is reasonable because it facilitates the information flow to investors and greater ease to set up operations. The Investment Policy of 2013 has had a special focus in this direction. The positive and significant coefficients on these two variables support deregulation and policies that are related to reducing the cost of and improving the ease to conduct business or manage an affiliate in Pakistan through a one-window operations, online registration and visa policy etc. These results reflect positively on the efforts of the BOI which provides information in English on its web page about the investment opportunities and policies etc. that reduces the cost of getting information. However, its efficiency might be enhanced by putting regular updates on its web page, and detailed information about the potential companies for joint venture and mergers and acquisitions. Further, BOI officials can update the investors about new opportunities and policies through direct contact such as sending electronic mails to the investors and make efforts to ensure the security of their investments to attain the investor's confidence for instance by giving the examples of success stories etc.

The coefficient on the BIT dummy is statistically insignificant. The BIT variable might become more important in the near future as some of the agreements have only recently been signed, e.g. 2009, and some are under negotiations and it might take more time for investors' confidence to come around and for firms to set up their operations.

The results of second-stage regression in equation 3 are presented in table 5. Estimates of the distance and common language variables have the expected negative and positive sign, respectively, and are both statistically significant at the 1% level. Other important variables

that could have played an important role in attracting FDI were included in earlier specifications of the model, but were not statistically significant. These included wages, domestic investment, openness to trade and the exchange rate. These were not included in the final model as they were not significant; however, as the model is estimated employing panel data and controlling for individual country specific effect which captures the effects of unobservable factors and might also capture the effects of some of these variables.

[Table 5 about here]

4.1 Individual home countries effects and potential countries for FDI inflows

The home country-specific effects show the factors which are unique to each country but which are not included in the estimation of the model. The results in table 6 show that there are unobservable unique characteristics in some countries which promote net FDI inflows into Pakistan, e.g., from Australia, Hong Kong, Japan, Netherlands, Saudi Arabia, Switzerland, UAE, the USA, countries with positive country-specific effects. However, other results suggest that there are characteristics that are not observable and discourage FDI from some investment sources, e.g., from Canada, China, France, Germany, Italy, Singapore and the UK, countries with negative country-specific effects. Hence, the results suggest that special efforts should be directed towards these countries to attract FDI inflows such as ensuring the safety of their investments, and reducing cost and providing ease of conducting FDI operations particularly in the sectors of their interest, through developing direct contacts with the investors and supporting the enforcement of bilateral investment treaties. Among the sample countries, Pakistan does not have investment agreements with Canada, Saudi Arabia and the USA and the signing of agreements could help to attract FDI from these countries.

The coefficients of the estimated model in equation (4) are used to predict the potential within the sample markets. This potential prevails if the net FDI inflows are determined by

the variables of the model. A different model specification might generate different results. The potential-to-actual export ratios, which are averaged over 1991-2010, are calculated and presented in table 6.

[Table 6 about here]

A ratio with a value greater than one indicates the existence of an unexploited potential to attract FDI from these countries. However, the intention is not to shift focus to attract FDI from existing sources to potential sources, but rather concentrating more on these sources. The identified potential sources for attracting FDI inflows to Pakistan by the model are China, Italy and Switzerland, having ratio more than one and probably Hong Kong which has this ratio almost equal to one. Other potential sources could be Australia, Canada and Germany which have ratios of about 0.80. It is important to identify the areas of interest and facilitating them in those investments. For instance, China has a big investment project in Gwadar port which is expected to provide employment and develop infrastructure. The Pakistan-China currency swap accord was implemented in May 2013 (BOI 2013a) which is expected to promote trade and investment between Pakistan and China. Such an accord can be executed with other investors to further promote inward investment.

5 Summary and conclusions

This study sets out to answer why net FDI inflows into Pakistan continue to fluctuate and remain low despite the pursuance of investment-friendly policies through investigating factors related to home and host countries which affect the net FDI inflows into Pakistan by employing panel data of 15 major investing countries during 1996-2010. A Hausman-Taylor estimation technique for panel data is used, treating the GDP of Pakistan and human capital as endogenous variables. The results suggest that low and uneven economic growth of Pakistan, bad governance, the lack of skilled human capital, energy crises and global financial crises are

the possible reasons for the variability and low level of net FDI inflows into Pakistan during 1996-2010.

The positive and statistically significant coefficient on GDP and governance in Pakistan demonstrate that despite investment-friendly policies being pursued in Pakistan the low economic growth and bad governance made net FDI inflows low and uneven. Hence, raising GDP and improving good governance would play an important role in raising investors' confidence and in attracting FDI.

Positive and significant coefficient on human capital suggests that an increase in share of the budget on education and research and development can help in raising the level of human capital and promote labor productivity and industrial development. In the same vein, an increase in energy use could gain the investor's confidence in the availability of energy for production processes and vice versa. It is very important that government take immediate steps to overcome the energy crisis to improve investor's confidence and attract FDI, and improve overall macroeconomic activity. This would be compatible with the positive and significant estimates of GDP and governance of investing countries which would create a conducive environment for increasing FDI inflows into Pakistan. Significant negative and positive coefficients, respectively, on the distance and common language between partner countries suggest that reducing the cost of and the ease of doing business would attract more FDI into Pakistan.

The study used panel data for the analysis, allowing heterogeneity among the investor countries and estimation of individual country-specific effects. The results show that there are some unobservable individual country specific factors that discourage investment from Canada, China, France, Germany, Italy, Singapore and the UK, i.e., countries with negative country-specific effects. This suggest that these sources should be focused to attract FDI

inflows to gain their confidence through ensuring security to their investments; supporting the conduct of FDI operations particularly in the sectors of their interest etc., through developing direct contacts with the investors and the implementation of bilateral investment treaties. Further, research can focus on identifying country-specific factors that can affect net FDI inflows into Pakistan, particularly following up with the effectiveness of the Investment Policy of 2013. The Policy sets out a target of 2.5 billion of FDI inflows in 2014 and 25% annual growth which can be achieved with about 2.5% increase in GDP, energy use, human capital and quality of institutions in Pakistan. However, the gap in the policy regarding improving the quality of institutions and good governance is very important for investor's confidence to meet those targets.

Table 1: Selected macroeconomic data and policy regimes in Pakistan, 1950-2009

Economic indicators	1960s	1970s	1980s	1990s	2000s
Population (Million No.)	52.64	69.70	96.62	128.72	159.72
Population growth (%)	2.41	2.78	3.00	2.33	1.66
Labor force (Million No.)				36.82	53.52
Emp. Labor force (Million No.)				32.62	45.50
Unemployment (%)				11.41	14.98
GDP ($bln)	12.3	21.3	39.4	63.7	93.7
GDP growth (%)	7.24	4.72	6.29	3.96	4.57
GDP per capita ($)	230	292	406	512	599
Agriculture share of GDP (%)	40	33	28	26	22
Industry share in GDP (%)	20	23	23	24	26
Services share in GDP (%)	40	44	49	50	52
Agricultural growth (%)	5.1	2.4	5.4	4.4	3.2
Growth of fixed capital (%)	10.2	4.0	5.5	1.9	4.8
Fixed capital share of GDP (%)	17.29	15.24	16.95	16.90	17.10
Gross domestic savings ($bln)	0.33	1.05	2.98	9.05	17.37
Growth in savings (%)	6.5	12.1	12.4	13.0	5.9
Savings as share of GDP (%)	9.65	7.95	8.74	15.61	14.35
Trade as share of GDP (%)	24	24	28	30	31
Exports ($bln)	0.54	1.19	3.43	7.69	14.57
Imports ($bln)	0.92	2.16	5.94	9.94	23.81
BOT ($bln)	-0.38	-0.97	-2.51	-2.25	-9.24
FDI ($mln)	23.4	25.2	134.5	522.2	1668.0
FDI (% of GDP)	0.30	0.11	0.36	0.89	1.09
External debt ($bln)		6.41	14.66	28.91	41.59
Foreign Exchange reserves ($mln)	246	686	1719	2231	12204
Inflation (%)	3.51	12.42	6.98	9.25	8.92
Energy use per capita (Kg of oil equiv.)		294.09	350.31	420.66	473.92
Trade Policy regime	Import substitution with trade restrictions		Export promotion and trade liberalization		
Exchange rate regime	Fixed		Managed from 1982-99		Flexible
Regulations on ownership (1, 2 = periods of nationalization and of privatization, respectively)	2	1	2	2	2

Sources: State Bank of Pakistan (SBP) 2010; World Bank 2011; Khan 1997; Khan and Kim 1999; Hyder and Mehboob 2006

Table 2: Sector-wise share of net FDI inflows as a % of total FDI

Years	Chemical, pharma & fertilizers	Construction & cement	Financial services	Food, beverage, tobacco & textiles	Energy	Petro-chemical & refining	Trade	Transport, storage & communication	Mining, quarrying, oil & gas	Others
1996-97	7.58	9.37	15.61	9.37	35.89	0.22	-	0.94	5.53	15.50
1997-98	11.99	4.08	3.39	7.72	39.83	0.27	2.10	1.25	16.48	12.91
1998-99	11.45	3.36	5.17	1.93	27.82	8.22	1.16	7.05	23.88	9.95
1999-00	25.52	4.51	6.30	11.56	14.34	2.55	1.62	6.60	16.96	10.04
2000-01	8.16	8.59	-9.16	15.42	12.5	2.70	4.09	25.28	26.27	6.14
2001-02	3.67	2.72	2.84	2.75	7.51	1.03	7.06	7.03	56.69	8.69
2002-03	11.58	2.16	28.47	4.15	4.11	0.38	4.90	14.30	34.44	6.37
2003-04	3.00	3.57	27.23	4.2	-1.5	7.63	3.75	24.30	28.94	6.37
2004-05	5.84	2.87	19.29	4.08	4.81	1.63	3.42	34.90	18.03	9.29
2005-06	- 0.29	3.65	11.19	3.09	9.11	1.16	3.35	55.56	7.80	4.08
2006-07	1.72	3.72	19.82	11.2	3.98	3.14	3.37	37.66	5.35	4.31
2007-08	2.32	3.54	36.48	1.62	1.3	1.88	3.25	31.45	5.08	5.61
2008-09	2.81	3.39	21.75	5.85	3.51	4.23	4.48	26.15	7.39	6.57
2009-10	5.65	4.57	10.33	5.95	-4.62	5.15	5.32	19.22	12.48	14.17
Average	7.21	4.29	14.19	6.35	11.33	2.87	3.42	20.84	18.95	8.57

Sources: State Bank of Pakistan (SBP) 2010; SBP electronic correspondence

Table 3: Governance indicators for Pakistan 1996-2011

Year	WB Code	Voice & account.	Rule of law	Regulatory quality	Political stability	Govt. effective.	Control of corruption
1996	Estimate	-0.67	-0.66	-0.45	-1.21	-0.59	-1.15
1998	Estimate	-0.64	-0.76	-0.49	-1.18	-0.45	-0.96
2000	Estimate	-1.31	-0.94	-0.73	-1.14	-0.58	-0.82
2002	Estimate	-1.22	-0.75	-0.79	-1.71	-0.39	-0.92
2003	Estimate	-1.26	-0.73	-0.73	-1.59	-0.39	-0.73
2004	Estimate	-1.23	-0.83	-0.88	-1.56	-0.45	-1.06
2005	Estimate	-1.06	-0.88	-0.61	-1.76	-0.42	-1.05
2006	Estimate	-0.93	-0.83	-0.44	-2.05	-0.36	-0.76
2007	Estimate	-0.99	-0.89	-0.49	-2.43	-0.45	-0.73
2008	Estimate	-0.89	-0.97	-0.56	-2.58	-0.68	-0.81
2009	Estimate	-0.89	-0.89	-0.55	-2.69	-0.78	-1.09
2010	Estimate	-0.84	-0.79	-0.58	-2.73	-0.77	-1.11
2011	Estimate	-0.83	-0.90	-0.61	-2.70	-0.82	-1.00
Avg.	Estimate	-0.98	-0.83	-0.61	-1.95	-0.55	-0.94
1996	Rank	29.33	28.71	30.88	12.50	30.73	8.78
1998	Rank	31.25	24.88	27.94	13.46	36.10	15.61
2000	Rank	11.06	20.57	21.08	14.42	31.22	22.44
2002	Rank	14.42	28.23	21.08	5.77	41.46	21.95
2003	Rank	12.98	28.23	23.04	6.73	40.49	27.32
2004	Rank	14.90	20.57	18.14	6.73	39.51	12.68
2005	Rank	16.83	21.53	26.47	5.29	40.00	13.66
2006	Rank	22.60	23.44	36.27	2.40	41.95	23.41
2007	Rank	20.19	19.62	32.04	0.96	40.29	24.27
2008	Rank	22.60	19.23	32.04	0.96	28.64	21.84
2009	Rank	23.22	20.85	33.01	0.95	23.92	12.44
2010	Rank	26.54	25.59	31.10	0.47	26.32	11.96
2011	Rank	26.29	20.66	29.86	0.47	22.27	15.64
Avg.	Rank	20.94	23.24	27.92	5.47	34.07	17.85

Source: The world wide governance indicators 2012; World Bank (2013)

Table 4: Estimation results: coefficients and test statistics

Independent variables	Pooled model		FE model		RE model		Hausman-Taylor	
	Coeff.	Stat sig	Coeff.	Stat sig	Coeff.	Stat sig	Coeff.	Stat sig
Y_i	0.85	***	0.79		0.86	***	0.86	***
Y_j	1..75		2.02		1.84		1.84	*
GOV_i	1.09	***	2.36	**	1.53	***	1.43	***
GOV_j	6.13	***	6.42	***	6.26	***	6.25	***
HK_j	3.39		2.96		3.11		3.11	*
EC_j	2.14		3.27	**	3.11	**	3.07	*
BIT_{ij}	-0.04		0.06		-0.05		-0.05	
D_{ij}	-3.84	***			-4.25	***	-4.18	***
CL_{ij}	2.16	***			2.17	***	2.20	**
Constant	-7.29		-49.76	*	-11.02		-11.27	
Wald chi2					404.91	***	122.60	***
Number of Observations	200		200		200		200	
[a]F test	19.89	***	23.18	***				
R-square within			0.39		0.39			
R-square between			0.06		0.44			
R-square overall	0.42		0.13		0.41			
LM					151.19	***		
Hausman test					1.12			
[b]F test			14.21	***				

Note: ***, **, * represent statistical significant at 1%, 5%, and 10% level, respectively.
[a] F test for overall model fit
[b] F test for choice between fixed effects and pooled regression

Table 5: Second Stage Regression for Time Invariant Variables

Explanatory variables	Coefficients	Robust standard errors	Statistical sig.
Distance	-4.86	0.26	***
Common language	2.16	0.24	***
Constant	41.12	2.19	***
R-squared	0.66		

Notes: ***/**/* statistical significant at the 1%, 5%, and 10% level, respectively.
Source: Authors' calculations

Table 6: Home country-specific individual effects and potential countries

Country	Individual Effects	Potential
Australia	0.75	0.83
Canada	-1.38	0.83
China	-0.20	1.87
France	-0.95	0.63
Germany	-1.21	0.77
Hong Kong	0.05	0.98
Italy	-1.00	1.39
Japan	0.11	0.67
Netherlands	0.74	0.46
Saudi Arabia	1.02	0.54
Singapore	-1.20	0.58
Switzerland	0.86	1.23
UAE	0.61	0.72
The UK	-0.09	0.48
The USA	1.88	0.37

Source: Authors' calculations

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Paper III

Are Pakistan's Rice Markets Integrated Domestically and with the International Markets?

Burhan Ahmad[*] and Ole Gjølberg[**]

Abstract

We analyze whether Pakistan has become a single domestically integrated rice market and whether Pakistan's rice markets are integrated with the international markets, using monthly data from 1994 to 2011. During this period, major policy shifts took place; i.e., in 2002 when Pakistan terminated the price support policy, in 2002–04 when export subsidies were introduced, and in 2008 when the minimum export price policy was adopted. We compare the degree of integration before and after 2002. We find that most of the rice markets in Pakistan are integrated domestically. Pakistan's rice markets are also integrated with the international markets, using prices in Thailand and Vietnam as benchmarks. Regional prices adjust relatively quickly when deviating from long-run disequilibrium because of domestic shocks compared with adjustments to shocks in the international markets. The price support policy abolition seems to have contributed to greater domestic integration, while the subsequent export policies seem to have decreased the extent of Pakistan's integration with the international markets.

Keywords: Rice markets, Cointegration, trade policy, Pakistan.

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1 Introduction

Well-functioning domestic and international agricultural commodity price transmissions play an important role in efficient resource allocation and economic growth. Slow and imperfect price transmissions leave producers and consumers to make decisions based on prices that do not reflect their real social costs and benefits, leading to slow economic growth (World Bank, 2012a). The issue of market functioning became a hot issue during and after the so-called "food crisis" in 2007–08, when a variety of policies were adopted by the importers and exporters of food commodities (Gilbert, 2010), which attracted the attention of many researchers.

An understanding of spatial market integration is important in order to formulate good economic policies (Dutoit et al., 2009; Moser et al., 2009; Varela et al., 2012). Spatial market integration refers to both short-term co-movements and long-run relationships among prices. It is defined as the smooth transmission of price signals and information across geographically separated markets (Goletti et al., 1995). Market integration can also be defined as a measure of the extent to which demand and supply in one location are transmitted to another (Negassa et al., 2003). Price differences beyond what can be explained by transportation and transaction costs reflect inefficient arbitrage and possibly the existence of market power. If markets are not well integrated, this often reflects the presence of infrastructural and institutional bottlenecks that interfere with the efficient flow of goods and prices between markets (Goletti and Babu, 1994).

Investigating price transmission from the international to the domestic market and integration among domestic markets within a country helps governments in formulating effective polices regarding investments in infrastructure and decisions aimed at improved food security and reduced poverty. Regional and international price differences and spatial price dynamics provide important information for public market regulation and intervention, as well as information to

producers and consumers when making decisions regarding resource allocation. Weak market integration may convey incorrect signals to both producers and consumers (Alexander and Wyeth, 1994; Dawe, 2008; Dutoit et al., 2009; Varela et al., 2012).

Rice is the basic staple food for about half of the world's population. International trade in rice is thin, with only about 5–7% of total world production being traded globally (Childs and Baldwin, 2010; Childs and Hoffman, 1999; Economist, 2011; Razzaque and Laurent, 2006). In Asia, domestic policies basically ensure self-sufficiency in many countries. The major exporters of milled rice include Thailand, Vietnam, Pakistan, India, China, USA and Italy. However, two exceptional rice trading nations are Pakistan and Thailand, whose domestic consumption is less than 50% of total production (Childs and Baldwin, 2010).

The thin nature of the world rice market may generate local price patterns and excessive local volatility. Protectionist trade policies such as regulated prices, procurement and government storage, import tariffs, export subsidies and export taxes adopted by importers and exporters of rice may strengthen price hikes and volatility in rice markets (Childs and Baldwin, 2010; Childs and Hoffman, 1999; Economist, 2011; Razzaque and Laurent, 2006; Wailes, 2005).

Rice is an important food and cash crop within Pakistan's agricultural industry, being the second largest staple food crop after wheat and the second largest export item after cotton and cotton products (GoP, 2011). Pakistan ranks twelfth in paddy rice production and fourth in milled rice exports in the world. Paddy rice contributes 1.3% to world production, and exports of milled rice account for 10.9% of total world rice exports (UN FAO, 2010). Two main varieties of rice; IRRI and Basmati, are produced. In this study, we employ monthly prices in the major IRRI rice markets in Pakistan, while the price of Thai FOB 5% broken rice (a close substitute for IRRI rice)

is used as an international benchmark price[1] in order to test the level of market integration between domestic and international markets. Export prices for Pakistan, Thailand and Vietnam 25% broken rice are also used to test the integration among them. Earlier studies such as Mushtaq et al. (2006) and Ghafoor and Aslam (2012) focused mainly on the market for Basmati rice in Punjab province. The present study uses the price of IRRI rice—a species with higher yields, production and exports—to analyze the effects of the support price policy that was ended in 2002, export subsidies between 2002–03 and 2003–04, and minimum export price policies in 2008, and a comparison of market integration before and after 2002.

2 An overview of the rice sector in Pakistan[2]

Pakistan—a developing country with an agro-based economy—has 42% of its labour force working in agriculture, which accounts for 23% of its GDP. Rice production covers about 20% of the total cropped area for food grain production in the country. It accounts for almost 6% of the value added in agriculture and contributes 1.3% of GDP. About 40% of the rice produced is exported because of the relatively low annual per capita domestic consumption of about 10 kg (Anwar, 2004; GoP, 2011). This also explains higher exports of IRRI rice compared with Basmati rice, as consumption of Basmati rice is higher than that of IRRI rice. The marketing chain is composed of domestic producers, village dealers, commission agents, wholesalers, retailers, processors and exporters before reaching domestic and international consumers.

[1] Since 2011, the Thai rice price has no longer been used as an international reference price. After being elected in 2011, Prime Minister Yingluck Shinawatra introduced substantial subsidies to Thai rice farmers, causing Thai rice prices to increase substantially above international prices.

[2] Some details can be found in Ahmad and Garcia (2012).

Punjab province is a major producer of Basmati rice, while Sindh province is a major producer of IRRI rice. There was no Basmati production in Sindh province until 2008, and only a very small area was allocated subsequently. While the area under total rice cultivation has varied by 25%—between 2.1 and 2.6 million hectares—production nearly doubled between 1994 and 2011, reaching 7.1 million tons. The area under basmati rice cultivation varied between 1.3 and 1.7 million hectares, while production of Basmati rice fluctuated between 1.2 and 3.1 million tons. The area under cultivation and the production of IRRI rice ranged between 0.62 and 0.92 million hectares, and between 0.3 and 3.0 million tons, respectively. Despite the lower area under IRRI rice cultivation, its production remained higher than Basmati because of its high yield per hectare. The average yield of IRRI and Basmati production was 2468 and 1208 kg per hectare, respectively, from 1993 to 1996; yet it was 2931 and 1737 kg per hectare from 2008 to 2011. During 2001–11, total exports of rice varied between 1.58 and 4.18 million tons, with Basmati and non-Basmati (mainly IRRI6 and IRRI9)[3] exports varying between 0.55 and 1.17 million tons and 1.01 and 3.15 million tons respectively. In the latter period, exports of non-Basmati rice varieties were greater than that of Basmati rice, which reflects the increasing importance of IRRI rice for export. During the crisis period 2007–08, exports for both varieties decreased, possibly because of the minimum export price policy during this period. However; after the crisis period and the withdrawal of the policy, exports of both varieties increased, with a larger increase seen for non-Basmati rice exports, indicating a greater responsiveness of non-Basmati rice exports to increased prices during the crisis period. As a result of the decrease in prices in 2009–10, exports of non-Basmati rice decreased again (GoP, 2012; UN FAO, 2010).

[3] IRRI6 and IRRI9 coarse rice varieties were developed at the International Rice Research Institute (IRRI) in the Philippines. IRRI9 was developed by crossing the IRRI6 and Basmati rice varieties.

2.1 Pakistan's government policies

A wide range of government policies and regulations influencing the rice markets have been enacted in Pakistan. Still, the interventions in many cases have been temporary or they have not been implemented to an extent that has had strong effects on economic behavior. For example, there have been restrictions on the movement of rice across regions within Pakistan and bans on the production of certain varieties and sowing in certain areas to reclaim saline lands. Price supports and government procurement programs existed until 2001–02. After 2002, the government's role has been limited to the occasional and irregular announcement of an indicative support price (Salam, 2009). This essentially is to create a price floor during the post-harvest period when supply is abundant, but it does not replace market-determined prices. The intention is to correct shortcomings in the marketing system (Anwar, 2004). In 1987–88, the government allowed the private sector to export rice, which gave rise to the Rice Exporters Association of Pakistan (REAP, 2010), formed in 1988–89 by private exporters. During the study period, no export taxes were imposed; however, an export subsidy was provided in two years, 2002–03 and 2003–04 (WTO, 2011). However, on account of the high international prices in 2007–08, the government fixed the minimum export prices in April 2008, but this was abolished by October 2008 (Salam, 2009). Import tariffs on rice were in effect but were reduced from 15% to 10% on an MFN basis in 1999. Exchange rate policies include a managed float since 1982 and multiple exchange rate regimes in 1998 after the nuclear tests. Since 2000, the current flexible exchange rate system has been in place (Hyder and Mahboob, 2006).

3 Domestic and international rice prices 1994–2011

Punjab, Sindh, Baluchistan and Khyber Pakhtoonkhan are the four provinces of Pakistan (see the maps in the appendix). Punjab and Sindh are the major producers of Basmati and IRRI rice,

respectively. Among the selected markets for the present study, Peshawar and Quetta are the provincial capitals of Khyber Pakhtoonkhan and Baluchistan provinces, respectively, while Rawalpindi is the neighbor city of the provincial capital of Punjab, Islamabad. Hyderabad is located close to Karachi, the provincial capital of Sindh and a port city. Sukhar is located in Sindh province close to Hyderabad and also to Multan, close to the border between Sindh and Punjab provinces. Hyderabad and Sukhar are located closer to the major production regions, with populations of about 1.4 and 0.40 million, respectively. Multan is close to Sukhar and has a population of about 1.55 million. Quetta and Peshawar are more remote from the production regions, with populations of about 0.84 and 1.3 million, respectively; however, Peshawar is situated close to the border of Afghanistan while Quetta is located close to the borders of Iran and Afghanistan. Both countries are among the largest markets for rice exports from Pakistan. Rawalpindi has about 1.83 million inhabitants and lies between Multan and Peshawar but is closer to Peshawar.

The monthly prices of rice in international markets represented by Thai (FOB) 5% broken long grain white rice and the prices in Pakistan's domestic markets along with their average are plotted in figure 1. Price fluctuations are evident, along with a declining price trend during the period 1995–2001, followed by rising prices and a sharp increase in price during the international food crisis in 2007–08. Domestic prices are lower than international prices as transportation costs are not included in domestic prices. Quality differences can be another reason as they are close but not perfect substitutes. Low domestic prices represent an incentive and potential to export. However, our main concern is to study the co-movement of prices in the domestic and international markets and to examine whether the changes in the international markets are being transmitted to the domestic markets.

[Figure 1 about here]

4 Data and methodology

4.1 Data sources

The data for Thai 5% broken white rice in US dollars for the period January 1994 to April 2011 are taken from the World Bank pink sheet (World Bank, 2012b), while the data for Pakistan's domestic markets are taken from agricultural statistics of Pakistan (GoP, 2012). Domestic prices are converted to US dollars using monthly exchange rates from Oanda (2012). The data for Pakistan, Thailand and Vietnam 25% are taken from various monthly issues of Rice Market Monitor published by the United Nations Food and Agriculture Organizations (UNFAO, 2013) for the period 2006–2013.

4.2 Methodology

Cointegration is a standard approach in studies of spatial market integration. Mushtaq and Dawson (2001) applied Johansen's test and the VECM methodology to measure the acreage response of agricultural commodities in Pakistan. Asche et al. (2012) employed Johansen's test to test the central market hypothesis in the Sorghum markets of Tanzania. Acharya et al. (2012) applied cointegration and VECM techniques to measure market integration in the rice and wheat markets of India. Silvapulle and Jayasuriya (1994) employed Johansen's methodology to test the market integration of rice in the domestic markets of the Philippines. Minot (2011) applied cointegration and error correction techniques to investigate the effects of changes in the world food markets on the staple foods of Sub-Saharan Africa using the small-country assumption. Greb et al. (2012) studied co-links among domestic markets of agricultural commodities in developing countries with those among international markets, using cointegration and error correction techniques.

Following the approach of many studies of spatial integration, we apply the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit-root tests to test the stationary of the data. All the price series are found to be non-stationary in levels in log form and stationary in first differences, allowing for the testing of cointegration among the price series. We apply the Johansen methodology (Johansen, 1990) estimating the trace and maximum eigenvalues to test for cointegration among the prices series. The Engle and Granger (1987) two-step procedure (EG hereafter) is also employed to test for cointegration. To analyze the effects of the support policy that was ended in 2002 and the export policies that were adopted after 2002, the data are divided into two periods, before and after 2002.

Vector error correction models (VECMs) are estimated if the series are cointegrated. The general form of the VECM is as follows:

$$\Delta P_t = \mu + \sum_{i=1}^{k-1} \Gamma_i \Delta P_{t-i} + \prod_k P_{t-k} + \varepsilon_t \,, \qquad (1)$$

where P_t denotes n x1 vector of prices, Δ is a first difference operator, such that $\Delta P_t = P_t - P_{t-1}$, Γ_i with $i = 1,...,k-1$ is the short-run coefficient, $\prod = \alpha\beta'$ is a long-run impact matrix summarizing all the long-run information in P_t process, in which α and β are $n \times r$ matrices of full column rank, the matrix β contains cointegrating vectors and the matrix α is the matrix of the adjustment coefficients to the long-run disequilibrium errors represented by the cointegrating relations, ε_t represents an i.i.d error term, and μ is an intercept.

5 Econometric results

The results for the ADF and PP unit-root tests are presented in table 1. The hypothesis that the log prices contain a unit root could not be rejected at the 5% level of significance, indicating that all the prices are non-stationary except the Vietnam 25% price, which is stationary at the 5%

level of significance according to ADF test, but non-stationary according to the PP test. The ADF test statistic of –2.91 is very close to the 5% critical value of –2.89. However, taking the first differences of the logs of prices, the unit root hypothesis is clearly rejected. These tests were also applied by including a trend term, but the stationarity results remain unchanged. So, all the prices series are I (1), permitting an analysis of cointegration among the prices obtained in the different markets.

[Table 1 about here]

5.1 Market integration

In previous studies on domestic market integration, Silvapulle and Jayasuriya (1994) found integration among domestic rice markets in the Philippines, while Dawson and Dey (2002) found highly integrated rice markets in Bangladesh. Van Tilburg et al. (2008) tested law of one price for potato markets in Bhutan employing three auction prices. They found integration during 1996-2000 while market imperfections existed for the period 2002-2005. Munir et al. (1997) found market integration among all the selected markets of vegetables in Indonesia. Kaur et al. (2009) found market integration in the broiler sector in Malaysia although structural rigidities were present. Nga (2009) found integration among nine out of 34 rice markets in Vietnam, while Ghosh (2010) found integration of grain markets within and across different states in India. Acharya et al. (2012) found integration among most domestic rice and wheat markets in India.

Among the studies on integration of domestic markets with international markets, Conforti (2004) investigated price transmission for a number of agricultural commodities for 16 countries in Asia, Africa and Latin America using autoregressive distributed lag models and cointegration tests. He found relatively incomplete transmission in African markets relative to that in Asian and

Latin American markets. For Pakistan, he used annual data for some of the major crops and animal products such as meat. He found a long-run relationship between the domestic price and the world reference price for wheat, rice, maize and bovine meat; however, cointegration tests did not confirm the results for the latter. He also found a long-run relationship between export prices of Basmati rice and domestic wholesale prices of IRRI rice. Sanogo and Amadou (2010) found that prices of coarse rice in Nepal responded to shocks originating in India. Minot (2011) found long-run relationships with the world food prices for only 13 out of 62 domestic markets in Sub-Saharan Africa. Rice prices are more closely related to international market prices than are maize prices. John (2013) found that Thai rice export price shocks are transmitted into the domestic markets of Thailand, although the causality tests between export and domestic prices were not clear possibly because domestic pricing policies were in place.

Market integration studies were also conducted to analyze the policy effects. Among others, Ghosh (2011) investigated the effects of agricultural policy reforms on spatial market integration of food grain markets in India. He found that policy reforms contributed to improvement of spatial market integration in the post-reform period as segmented or poorly integrated markets in the pre-reforms period were strongly integrated in the post-reform period. Sekhar (2012) found market integration among those agricultural markets of India that did not face restrictions on interstate or interregional trade such as chick-peas and edible oils. He added that rice markets were not integrated at the national level because of restrictions on interstate trade. Chand (2008) found that the price spike in 2007–08 was not transmitted to the domestic markets of India because of policy intervention by the Indian government (Acharya et al., 2012). Nga (2009), however, found integration among the rice export prices in Vietnam and Thailand, and that removal of export quotas did not have a significant effect on the relationship between prices in these two countries. Dorosh and Rashid (2013) found that before the crisis in 2007, domestic

prices in Bangladesh were cointegrated with subsidized import parity prices; however, after mid-2007, prices in Bangladesh increased because of the restrictive export policies of India, which is one of the biggest import markets for Bangladesh. John (2013) concluded that Thailand's domestic price policies are not creating large distorting effects on world rice markets.

In this study, pairwise market integration among Pakistan's domestic markets is tested using the Johansen and EG methodologies. Lag selection was made using the Akaike information (AIC), Schwarz Bayesian information criteria (SBIC) and/or Hannen-Quim information criteria (HQIC) selection criteria for Johansen tests while four lags were selected for EG tests. Using Johansen's method (table 2), we find all the pairs to be cointegrated except for Hyderabad–Peshawar and Hyderabad–Quetta. Applying the EG test (table 3), we find that the Hyderabad–Peshawar, Hyderabad–Rwalapindi and Hyderabad–Multan pairs are not cointegrated (indicated with bold letters). No cointegration indicates that price signals are not transmitted efficiently from one market to another, possibly resulting in non-optimal decisions among producers, consumers and inventory holders. Moreover, marketing margins are likely to be higher than in other markets as the absence of cointegration can be exploited by traders. The possible absence of cointegration and inefficient flow of information between Hyderabad and Peshawar/Quetta may reflect the distance between these markets, situated in three different provinces and having the greatest distance among the sample markets. The result may also reflect low levels of trade and poor infrastructure. Government investment, particularly in infrastructure and transportation, in markets that are not integrated might help to integrate these markets.

[Tables 2 and 3 about here]

Johansen cointegration and EG tests are applied to test for international cointegration, and the results are presented in tables 4 and 5, respectively. The results indicate that a long-run

cointegration relationship exists between the prices. The trace and maximum eigenvalue statistics are greater than their respective critical values, suggesting that all six domestic markets are integrated with the international market and that there is one cointegrating vector in each pair of domestic markets and the international market. The results also show that the average prices of rice in the domestic markets of Pakistan and the price of Thai 5% broken rice are also cointegrated. The ADF results for the EG tests show that all domestic prices including their average are integrated with the Thai 5% prices except for prices in Hyderabad and Sukhar markets.

The trace and maximum eigenvalue statistics for Thai and Viet 25% broken rice show that these export prices are integrated, while the results of the EG test indicate that these markets are not integrated. Both the Johansen and EG tests find that Pak and Viet 25% export prices are cointegrated, while results for Pak and Thai 25% are mixed. According to the trace statistics, these markets are integrated, while the maximum eigenvalue statistics and EG tests show that they are not integrated.

[Tables 4 and 5 about here]

As described in Section 2.1, there was a policy change in 2001–02, when the support price policy was terminated. Moreover, after 2002, export subsidies were granted to rice exporters for the two years 2002–03 and 2003–04, and a minimum export price policy was adopted on account of the price spike during the so-called food crisis in 2007–08. After 2002, the government's role was limited to the occasional and irregular announcement of an indicative support price (Salam, 2009). The data set is divided into two parts—i.e., before and after 2002—and the results are presented in tables 6, 7 and 8. The Johansen and EG tests were used to test for cointegration among pairs of domestic markets as well as the international market. The ADF stationarity test

results (table 6) for the EG test reveal that ten market pairs were not integrated until 2002, while the number of non-integrated market pairs falls from ten to eight after 2002. This indicates that the degree of cointegration among the domestic markets increased after the termination of the support price policy. However, before 2002, this policy did not seem to influence the degree of cointegration of Pakistan's domestic markets with the international market as almost all the markets were integrated with the international market. The results suggest a positive influence of the policy change on the functioning and degree of cointegration within the domestic markets, which supports the cessation of the costly support price policy and government procurement. Mushtaq and Dawson (2001) recommended ending the support price policy for rice in Pakistan.

Both the Johansen and EG test results show that all the domestic rice markets were integrated with the international market before 2002 except for Hyderabad, which was not integrated according to Johansen's test but integrated according to the EG test results. Using the average domestic price as a proxy for Pakistan's rice market, we also find Pakistan to be integrated with the international market before 2002. However, both tests show that the degree of market integration with the international market decreased after 2002 as Sukhar and Multan were no longer integrated according to the Johansen test results (table 7), while all the markets were no longer integrated according to EG results (table 8). Moreover, both of the test results show that average domestic prices were not cointegrated with the international reference price after 2002. The export subsidy policies adopted by Pakistan during the period 2002–04 and the minimum export price policy in 2008 may have caused this decrease in the degree of integration.

[Tables 6, 7 and 8 about here]

5.2 *VECM for domestic markets*

The pairwise vector error correction model's (VECM) estimates using the maximum likelihood method for those domestic markets found to be cointegrated are reported in table 9. Lag selection was made using the Akaike information (AIC), Schwarz Bayesian information criteria (SBIC) and/or Hannen-Quim information criteria (HQIC) selection criteria which suggested the lag order of two. Langrangian-Multiplier (LM) test was applied to test autocorrelation between the VECM residuals. The results accept the hypothesis of no autocorrelation at 5% level of significance in most of the market-pairs except Quetta-Rawalpindi, Quetta-Sukhar and Quetta-Peshawar, however, autocorrelation do not exist at lag one. As the estimations for all other market-pairs are conducted at lag level 2, we did the same for these market pairs for getting short run elasticities and better comparisons. However, there is no change in the level of significance of the coefficients while their magnitude varies a little. The coefficients for the long-run relationships are statistically significant and negative at the 1% level of significance in all pairs. The long-run elasticity of price transmission ranges from 0.89 to 1.0 indicating a high degree of transmission of price changes from one market to the other in the long run. The Johansen test results for cointegration show that a long-run relationship exists among these markets. However, the degree and statistical significance of the coefficients on the speed of adjustment vary across the pairs. For most of the pairs, the coefficients on the speed of adjustment are statistically significant at the 1% or 5% level of significance, except for Multan–Quetta, which is significant only at the 10% level of significance. These coefficients have the expected signs, indicating that prices converge. However, there are two exceptions, Rawalpindi–Quetta and Peshawar–Quetta, whose coefficients are not statistically significant. In contrast, the coefficients of Quetta–Rawalpindi and Quetta–Peshawar are statistically significant, implying

that prices in the Quetta markets adjust to correct any disequilibrium between these pairs. The values of the coefficients of short-run adjustment are all small, varying from 0.02 to 0.22. The pairs including Hyderabad have the lowest speed of adjustment. The pairs including Rawalpindi, the neighboring city of Pakistan's capital Islamabad, move quickly towards equilibrium with a speed of adjustment from 11% to 22%, except for Rawalpindi–Quetta, which has an insignificant coefficient as described earlier. A possible reason is the large distance between the two markets, resulting in low volumes of trade. The actual data on trade between these markets are not available; however, it can be approximated on the basis of the distance between the cities and from the location of the production regions. For instance, Quetta and Rawalpindi are both non/very small producers and very far from each other, being situated on two different sides of the producing regions and in two different provinces.

[Table 9 about here]

In general, the process of adjustment towards long-run equilibrium appears to be slow. The estimated correction parameters are in the range 0.03 to 0.22 across the different market pairs, implying that 3–22% of any divergence from long-run equilibrium is corrected monthly. Possible reasons for this slow adjustment are the low level of domestic consumption, low volume of trade in distant market pairs, poor infrastructure, and market power of traders. The coefficients on the short-run elasticity of price transmission are statistically significant and have the expected signs in many cases, suggesting that price changes in recent months significantly affect current and future changes in the prices among these market pairs. These results are helpful for forming expectations of future prices and accordingly decisions regarding storage and resource allocation. However, there are market pairs where the short-run price transmission elasticity coefficients are not significant, suggesting that past changes in prices are not transmitted in the short run,

although there exist significant long-run equilibrium relationships. This might be due to the direction of causality, distance and infrastructure between them resulting in weak market integration or a low speed of adjustment.

5.3 *VECM for domestic and international markets*

The vector error correction model's (VECM) results for the Pakistan's domestic and international markets are reported in table 10. Lag selection was made using the Akaike information (AIC), Schwarz Bayesian information criteria (SBIC) and/or Hannen-Quim information criteria (HQIC) selection criteria which suggested the lag order of two. Langrangian-Multiplier (LM) test was applied to test autocorrelation between the VECM residuals. The results accept the hypothesis of no autocorrelation at 5% level of significance. The coefficients on the speed of adjustment in domestic as well as international markets are statistically significant at 1 or 5% level of significance except for Peshawar. This suggests that both the prices adjust to deviations from the long run equilibrium, however, coefficients values are very small ranging from 0.03 to 0.11 which suggest that process of adjustment is very slow. About 3-11% of deviation from the long run equilibrium is adjusted every month. The possible reasons can be the infrastructure deficiencies, slow transportation and trade rigidities. Our objective in this article is to examine the price transmission from the international markets to the domestic markets of Pakistan. Hence, interpretation of the results focuses on the results of domestic market equations in the VECM.

[Tables 10 about here]

The VECM estimates for each of the individual domestic markets paired with the international market show that the coefficients of the speed of adjustment in all markets are statistically significant at the 1% level of significance, except for the Hyderabad market, which is significant at the 5% level of significance. This coefficient is not significant for Peshawar. This implies that

prices in all individual markets except Peshawar move toward a long-run equilibrium with the international market. The coefficient value in Rawalpindi, Multan and Quetta markets is about 0.10. The values of these coefficients for Sukhar and Hyderabad, the closest markets geographically, are 0.07 and 0.02 respectively. The coefficient for the Hyderabad market is quite low despite the fact that the Hyderabad is not far away from Karachi from where it is easy to ship rice to the international markets. This reflects that direct trade from Sukhar to Karachi is taking place. Sukhar is located relatively closer to the production areas and it makes a little difference to travel to Karachi or Hyderabad. The coefficients on the long-run equilibrium in all the markets are statistically significant at the 1% level of significance. The coefficient values ranges from 0.68 to 0.98, showing that in the long run, about 68–98% of changes in the international market are transmitted to the domestic markets of Pakistan.

The short-run elasticity of price transmission with respect to own lagged differenced market price and lagged differenced international price presents a mixed picture. All the short-run elasticity coefficients are statistically significant at the 1% or 5% level of significance except for Sukhar and Quetta. In Sukhar, its own price short run coefficient is not significant while in Quetta, short run coefficient with respect to world's price is not significant. The values on these coefficients range from 0.21 to 0.32. The Hyderabad market captures more of the effect of past changes in its own price, 32%, compared with the international price. Only 3% of changes in the international market price are transmitted within two months. The Sukhar market price does not respond significantly to past changes in its own price; however, about 28% of changes in the international price are transmitted within one month. In Rawalpindi, 42% of past price changes are transmitted each month compared with 33% of changes in the international market over a month. The values for the Peshawar market are 19% and 18% in one month, respectively. The coefficients on the short-run elasticities with respect to the international price in the Quetta

market are not significant, while with respect to its own market, it is significant. This shows a low responsiveness of the Quetta market to the international market, although it is integrated with the international market and its long-run coefficient is statistically significant. Low responsiveness may be due to its geographical location, which is far from most of the other major markets, small size of the market and poor law and order condition. Greb et al. (2012) found that rice market pairs are less cointegrated than maize markets. They also found that domestic prices adjust to international prices for most agricultural commodities except rice. Contrary to Greb et al. (2012), we find that Pakistan's domestic prices for rice adjust to the international market; however, the level of the adjustment is low.

The above results can be helpful in decision-making regarding allocation of resources by producers and inventory holders as well as consumers. Producers and traders can form forecasts of future price changes based on changes in prices in the current and recent past period, and can make their production and storage decisions accordingly. Producers can allocate more resources to increase production if they expect increases in prices, and vice versa, based on the long-run price adjustment coefficient. Inventory holders can form expectations based on the short-run coefficients. They will store if they expect prices to increase in the coming months, and vice versa. These production and storage decisions can affect food security.

6 Summary and conclusions

This study analyses whether Pakistan's rice markets are integrated domestically and with international markets. We test for cointegration and estimate the speed of price adjustments and short-run elasticities using a VECM. We focus on the possible effects of the change in policy that took place in 2002, when Pakistan terminated its support price policy and subsequently introduced export policies, export subsidy and minimum export price policy, after 2002.

The results from the EG and Johansen tests strongly indicate that all the domestic markets are integrated, possibly excepting Hyderabad–Peshawar, Hyderabad–Rawalpindi, Hyderabad–Multan and Hyderabad–Quetta. The VECM estimates of the domestic markets reveal that prices converge in the long run; however, the speed of adjustment towards long-run equilibrium is generally low. The adjustment coefficients vary from 0.02 to 0.22 across various pairs of markets, indicating that about 2–22% of the divergence from the long-run equilibrium is being corrected monthly. The long-run coefficient varies from 0.89 to 1, revealing that about 90 to 100% of price changes are transmitted across different pairs of the markets in the long run. The ending of the support price policy seems to have resulted in an improvement in the integration of domestic markets as the number of non-integrated market pairs decreased after 2002.

All the domestic markets in Pakistan appear to be integrated with the international market possibly excepting Hyderabad and Sukhar, although the speed of adjustment is rather low. The estimated coefficients of adjustments indicate that the domestic markets tend to converge with the international market in the long run, and about 3–11% of the divergence from long-run equilibrium due to shocks in the international market is corrected within a month. Slow adjustment may be due to the existence of infrastructure deficiencies, slow transportation and trade rigidities. The long-run elasticity of price transmission ranges from 0.68 to 0.98 across markets, suggesting that 68–98% of changes in the international price are transmitted to domestic prices in the long run. Among the export markets for rice, Pakistan's rice markets seem to be integrated with the markets of Thailand and Vietnam.

The cointegration and VECM results suggest that while domestic markets are integrated with, and responsive to, changes in the international market and domestic markets, responsiveness to own (local) shocks is higher although exceptions exist. Producers and traders can form

expectations of future changes in prices based on changes in prices in the current and last period, and can make their production and storage decisions accordingly.

Support price policy reforms have improved market integration within Pakistan; however, they do not seem to have affected the integration of Pakistan with the international market, while export policies have reduced the extent of market integration of Pakistan with the international market. It is, therefore, reasonable to conclude that reducing government intervention would increase international market integration further.

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Figure 1: Rice prices in the international and domestic markets of Pakistan ($ per ton)

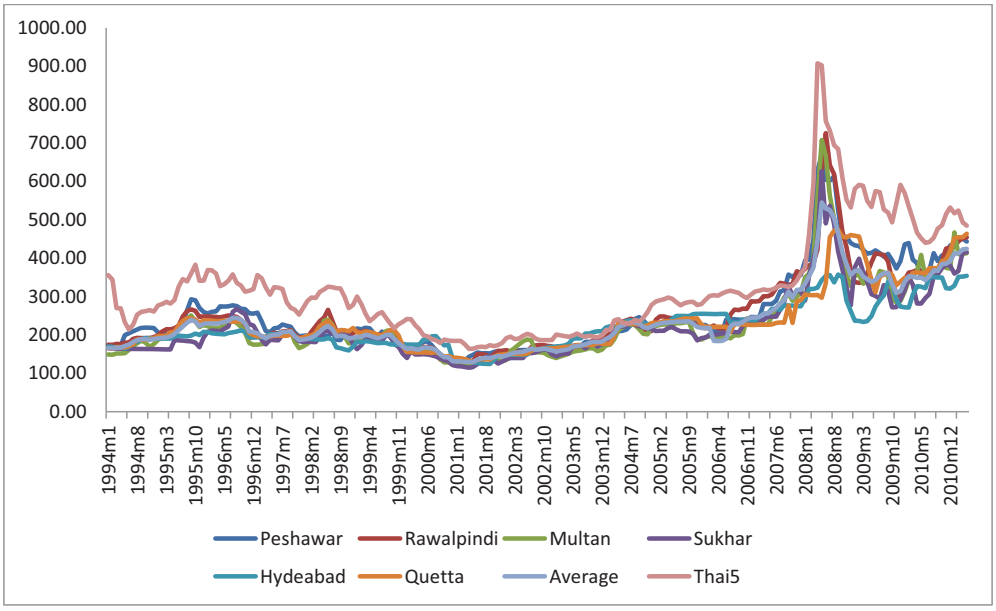


Table 1: Unit root tests.

	Log Levels				First differences	
	Augmented Dickey fuller (ADF)		Phillips–Perron (PP)		ADF	PP
Variables	No trend	With trend	No trend	With trend	No trend	No trend
Thailand 5%	–1.15	–1.70	–1.27	–1.98	–7.06	–2.88
Avg. dom. price	–0.88	–1.71	–0.48	–1.32	–6.65	–9.00
Domestic markets						
Hyderabad	–0.45	–2.82	–0.30	–2.50	–7.39	–10.39
Sukhar	–0.52	–2.35	–0.46	–2.31	–8.08	–13.26
Multan	–0.83	–2.40	–0.77	–2.22	–7.32	–9.97
Rawalpindi	–0.59	–2.27	–0.48	–2.03	–7.31	–9.33
Peshawar	–0.56	–1.73	–0.43	–1.60	–7.10	–10.89
Quetta	–0.31	–1.88	–0.03	–1.43	–7.34	–12.14
Thailand's 25%	–2.02	–2.99	–1.45	–1.91	–5.26	–5.31
Vietnam's 25%	–2.91	–3.31	–2.03	–2.04	–5.32	–5.41
Pakistan's 25%	–2.40	–2.98	–1.69	–1.86	–5.29	–5.29
Critical values (5%)	–2.89	–3.45	–2.89	–3.45	–2.89	–2.89

Table 2: Johansen's test for cointegration 1994-2011

Markets	Null	Alternative	Trace	5% CV	Max. eigen.	5% CV
All IRRI rice markets	$r = 0$	$r \geq 1$	183.42	39.37	74.95	94.15
	$r \leq 1$	$r \geq 2$	108.47	33.46	40.13	68.52
	$r \leq 2$	$r \geq 3$	68.35	27.07	33.24	47.21
	$r \leq 3$	$r \geq 4$	35.10	20.97	25.68	29.68
	$r \leq 4$	$r \geq 5$	9.42	14.07	9.29	15.41
	$r \leq 5$	$r \geq 6$	0.13	3.76	0.13	3.76
	Null	Alternative	Trace	Max. eigen.		
Hyderabad–Sukhar	$r = 0$	$r \geq 1$	20.70	20.68		
	$r \leq 1$	$r \geq 2$	0.04	0.04		
Hyderabad–Multan	$r = 0$	$r \geq 1$	16.60	16.44		
	$r \leq 1$	$r \geq 2$	0.16	0.16		
Hyderabad–Rawalpindi	$r = 0$	$r \geq 1$	15.51	15.35		
	$r \leq 1$	$r \geq 2$	0.16	0.16		
Hyderabad–Peshawar	$r = 0$	$r \geq 1$	**11.62**	**11.53**		
	$r \leq 1$	$r \geq 2$	**0.09**	**0.09**		
Hyderabad–Quetta	$r = 0$	$r \geq 1$	**13.98**	**13.96**		
	$r \leq 1$	$r \geq 2$	**0.10**	**0.01**		
Sukhar–Multan	$r = 0$	$r \geq 1$	31.72	31.21		
	$r \leq 1$	$r \geq 2$	0.50	0.50		
Sukhar–Rawalpindi	$r = 0$	$r \geq 1$	40.02	39.77		
	$r \leq 1$	$r \geq 2$	0.25	0.25		
Sukhar–Peshawar	$r = 0$	$r \geq 1$	23.87	23.61		
	$r \leq 1$	$r \geq 2$	0.26	0.26		
Sukhar–Quetta	$r = 0$	$r \geq 1$	38.79	38.75		
	$r \leq 1$	$r \geq 2$	0.04	0.04		
Multan–Rawalpindi	$r = 0$	$r \geq 1$	37.49	36.91		
	$r \leq 1$	$r \geq 2$	0.57	0.57		
Multan–Peshawar	$r = 0$	$r \geq 1$	35.05	34.55		
	$r \leq 1$	$r \geq 2$	0.49	0.49		
Multan–Quetta	$r = 0$	$r \geq 1$	61.64	61.48		
	$r \leq 1$	$r \geq 2$	0.15	0.15		
Rawalpindi–Peshawar	$r = 0$	$r \geq 1$	35.77	35.38		
	$r \leq 1$	$r \geq 2$	0.38	0.38		
Rawalpindi–Quetta	$r = 0$	$r \geq 1$	48.53	48.36		
	$r \leq 1$	$r \geq 2$	0.17	0.17		
Peshawar–Quetta	$r = 0$	$r \geq 1$	44.63	44.45		
	$r \leq 1$	$r \geq 2$	0.18	0.18		
Critical values (5%)	$r = 0$	$r \geq 1$	15.41	14.07		
	$r \leq 1$	$r \geq 2$	3.76	3.76		

Table 3: Stationarity of residuals from pairwise regressions 1994–2011 (Engle–Granger tests)

Market pairs Regression residuals	ADF No trend	Lags
Hyderabad–Sukhar	–3.251	4
Hyderabad–Multan	**–3.018**	4
Hyderabad–Rawalpindi	**–2.610**	4
Hyderabad–Peshawar	**–2.777**	4
Quetta–Hyderabad	–3.468	4
Sukhar–Multan	–4.088	4
Sukhar–Rawalpindi	–4.349	4
Sukhar–Peshawar	–3.402	4
Quetta–Sukhar	–3.989	4
Multan–Rawalpindi	–5.353	4
Multan–Peshawar	–5.277	4
Multan–Quetta	–5.141	4
Rawalpindi–Peshawar	–4.837	4
Quetta–Rawalpindi	–4.321	4
Quetta–Peshawar	–3.760	4
Engle and Yoo 5% critical values	–3.25	

Table 4: Johansen's cointegration tests for Pakistan's rice markets with the international market 1994-2011

Markets	Null	Alternative	Trace	Max. eigen.
Avg. dom. price–Thailand	$r = 0$	$r \geq 1$	29.91	14.07
	$r \leq 1$	$r \geq 2$	0.92	3.76
Hyderabad–Thailand	$r = 0$	$r \geq 1$	19.69	19.04
	$r \leq 1$	$r \geq 2$	0.65	0.65
Sukhar–Thailand	$r = 0$	$r \geq 1$	23.74	22.49
	$r \leq 1$	$r \geq 2$	1.25	1.25
Multan–Thailand	$r = 0$	$r \geq 1$	34.68	32.27
	$r \leq 1$	$r \geq 2$	2.41	2.41
Rawalpindi–Thailand	$r = 0$	$r \geq 1$	36.90	35.20
	$r \leq 1$	$r \geq 2$	1.70	1.70
Peshawar–Thailand	$r = 0$	$r \geq 1$	36.27	35.09
	$r \leq 1$	$r \geq 2$	1.17	1.17
Quetta–Thailand	$r = 0$	$r \geq 1$	35.39	35.38
	$r \leq 1$	$r \geq 2$	0.02	0.02
Viet–Thai 25%	$r = 0$	$r \geq 1$	17.98	15.88
	$r \leq 1$	$r \geq 2$	2.09	2.09
Pak–Thai 25%	$r = 0$	$r \geq 1$	15.92	11.46
	$r \leq 1$	$r \geq 2$	4.45	4.45
Pak- Viet 25%	$r = 0$	$r \geq 1$	29.55	23.99
	$r \leq 1$	$r \geq 2$	5.56	5.56
Critical values 5%	$r = 0$	$r \geq 1$	15.41	14.07
	$r \leq 1$	$r \geq 2$	3.76	3.76

Table 5: Stationarity of residuals for Pakistan and international markets (Engle–Granger tests) 1994-2011

Market pairs Regression residuals	ADF	Lags
Avg. dom. Price	–3.638	4
Hyderabad–Thailand	**–2.778**	4
Sukhar–Thailand	**–2.734**	4
Multan–Thailand	–3.765	4
Rawalpindi–Thailand	–3.523	4
Peshawar–Thailand	–4.068	4
Quetta–Thailand	–3.638	4
Thai–Viet 25	**–2.522**	4
Pak –Thai 25	**–2.634**	4
Pak–Viet 25	–4.564	4
Engle and Yoo 5% critical values	–3.25	

Table 6: Stationarity of residuals from pairwise regressions (two-step procedures)

Market pairs Regression residuals	ADF 1994–2002	ADF 2003–2011	Lags
Hyderabad–Sukhar	**–2.497**	**–2.652**	4
Hyderabad–Multan	**–2.332**	**–2.570**	4
Hyderabad–Rawalpindi	**–2.220**	**–1.858**	4
Hyderabad–Peshawar	**–2.048**	**–2.478**	4
Quetta–Hyderabad	**–2.437**	–3.669	4
Sukhar–Multan	**–2.836**	–4.102	4
Sukhar–Rawalpindi	**–2.893**	–3.700	4
Sukhar–Peshawar	**–2.951**	**–2.965**	4
Quetta–Sukhar	–3.319	**–2.678**	4
Multan–Rawalpindi	–4.972	–3.356	4
Multan–Peshawar	–3.731	–4.285	4
Multan– Quetta	–4.490	–3.337	4
Rawalpindi–Peshawar	**–2.898**	–4.418	4
Quetta–Rawalpindi	–4.145	**–2.762**	4
Quetta–Peshawar	**–2.970**	**–2.384**	4
Engle and Yoo 5% critical values	–3.17	–3.17	

Table 7: Johansen's test for cointegration.

Markets	Null	Alternative	1994–2002 Trace	1994–2002 Max. eigen.	2003–2011 Trace	2003–2011 Max. eigen.
Hyderabad–Thailand FOB	$r = 0$	$r \geq 1$	**14.753**	**13.443**	20.208	16.925
	$r \leq 1$	$r \geq 2$	**1.309**	**1.309**	3.282	3.282
Sukhar–Thailand FOB	$r = 0$	$r \geq 1$	25.592	24.362	**12.629**	**9.094**
	$r \leq 1$	$r \geq 2$	1.229	1.229	**3.534**	**3.534**
Multan–Thailand FOB	$r = 0$	$r \geq 1$	31.605	29.851	**14.941**	**11.339**
	$r \leq 1$	$r \geq 2$	1.754	1.754	**3.602**	**3.602**
Rawalpindi–Thailand FOB	$r = 0$	$r \geq 1$	32.705	31.264	18.235	14.701
	$r \leq 1$	$r \geq 2$	1.440	1.440	3.535	3.535
Peshawar–Thailand FOB	$r = 0$	$r \geq 1$	28.04	27.24	16.209	13.824
	$r \leq 1$	$r \geq 2$	0.804	0.804	2.385	2.385
Quetta–Thailand FOB	$r = 0$	$r \geq 1$	35.350	34.414	22.949	21.682
	$r \leq 1$	$r \geq 2$	0.936	0.936	1.267	1.266
Average–Thailand FOB	$r = 0$	$r \geq 1$	36.030	35.065	**13.643**	**11.319**
	$r \leq 1$	$r \geq 2$	0.965	0.965	**2.324**	**2.324**
Critical values	$r = 0$	$r \geq 1$	15.41	14.07	15.41	14.07
	$r \leq 1$	$r \geq 2$	3.76	3.76	3.76	3.76

Table 8 Engle–Granger tests test results for domestic and international market cointegration before and after 2002.

Market pairs Regression residuals	ADF 1994–2002	ADF 2003–2011	Lags
Hyderabad–Thailand FOB	–3.827	**–2.906**	4
Sukhar–Thailand FOB	–3.558	**–1.691**	4
Multan–Thailand FOB	–4.304	**–2.423**	4
Rawalpindi–Thailand FOB	–3.720	**–2.998**	4
Peshawar–Thailand FOB	–3.995	**–2.835**	4
Quetta–Thailand FOB	–3.467	**–2.637**	4
Average–Thailand FOB	-4.428	**-2.339**	4
Engle and Yoo 5% critical values	–3.17	–3.17	

Table 9: VECM estimates for the domestic (all) and international markets during 1994-2011

	Dependent variable: Prices in the domestic markets				
Independent variables	HYD–RWP[d]	RWP–HYD	HYD–MTN	MTN–HYD	HYD–SKR
Speed of adjustment	–0.06[a]	0.05[b]	–0.05[a]	0.06[b]	–0.06[a]
Long-run coefficient	–0.89[a]	–0.89[a]	–0.89[a]	–0.89[a]	–0.89[a]
Own lagged differenced price	0.24[a]	–0.08	0.25[a]	–0.21[a]	0.3[a]
Other market's lagged diff. price	0.12[a]	0.45[a]	0.11[a]	0.4[a]	0.02
Constant	0.005[b]	0.006[c]	0.006[a]	0.007[c]	0.008[a]
Langrangian–Multiplier (LM) test	0.11		0.45		0.21
Independent Variables	SKR–HYD	RWP–MTN	MTN–RWP	RWP–SKR	SKR–RWP
Speed of adjustment	0.1[a]	–0.11[a]	0.22[a]	–0.11[a]	0.19[b]
Long-run coefficient	–0.89[a]	–1.00[a]	–1.00[a]	–1.00[a]	–1.00[a]
Own lagged differenced price	–0.05	0.19[a]	–0.10	0.38[a]	–0.11
Other market's lagged diff. price	0.13[c]	0.34[a]	0.48[a]	0.10[c]	0.18[a]
Constant	0.004	0.005[b]	0.002	0.007[b]	0.004
Langrangian–Multiplier (LM) test			0.81	0.32	
	RWP–PSW	PSW–RWP	QTA–RWP	RWP–QTA	MTN–SKR
Speed of adjustment	–0.13[a]	0.12[a]	0.19[a]	–0.02	–0.10[a]
Long-run coefficient	–0.98[a]	–0.98[a]	0.97[a]	–1.00[a]	–1.00[a]
Own lagged differenced price	0.34[a]	0.08	0.04	0.44[a]	0.37[a]
Other market's lagged diff. price	0.35[a]	0.33[a]	0.04	–0.08	0.01
Constant	0.004	0.005	0.001	0.007[b]	0.007[c]
Langrangian–Multiplier (LM) test		0.91	15.11[a]		
Independent Variables	SKR–MTN	MTN–PSW	PSW–MTN	QTA–MTN	MTN–QTA
Speed of adjustment	0.17[a]	–0.17[a]	0.09[a]	0.19[a]	–0.06[c]
Long-run coefficient	–1.00[a]	–0.98[a]	0.02[a]	–1.00[a]	–1.00[a]
Own lagged differenced price	0.19[b]	0.33[a]	0.26	–0.08[c]	0.42[a]
Other market's lagged diff. price	0.03	0.22[a]	0.01[a]	0.08	–0.13
Constant	0.004	0.004	0.005	0.003	0.009[b]
Langrangian–Multiplier (LM) test	0.71		0.53		7.72[c]
Independent Variables	SKR–PSW	PSW–SKR	SKR–QTA	QTA–SKR	PSW–QTA
Speed of adjustment	–0.16[a]	0.07[a]	–0.06	0.14[a]	–0.02
Long-run coefficient	–0.97[a]	–0.97[b]	–0.99[a]	–0.99[a]	–1.00[a]
Own lagged differenced price	0.06	0.02	0.11	–0.06	0.28[a]
Other market's lagged diff. price	0.30[a]	0.26[a]	0.01	0.13[b]	–0.01
Constant	0.003	0.007[b]	0.010[b]	0.004	0.008[b]
Langrangian–Multiplier (LM) test	0.65		11.66[a]		16.86[a]
	QTA–PSW				
Speed of adjustment	0.17[a]				
Long-run coefficient	–1.00[a]				
Own lagged differenced price	–0.18[a]				
Other market's lagged diff. price	0.17[a]				
Constant	0.001				

Notes: [a/b/c] statistically significant at the 1%, 5%, and 10% levels, respectively.
[d] Hyderabad (HYD); Rawalpindi (RWP); Multan (MTN); Sukhar (SKR); Peshawar (PSW); Quetta (QTA)

Table 10: VECM estimates for the domestic (all) and international markets.

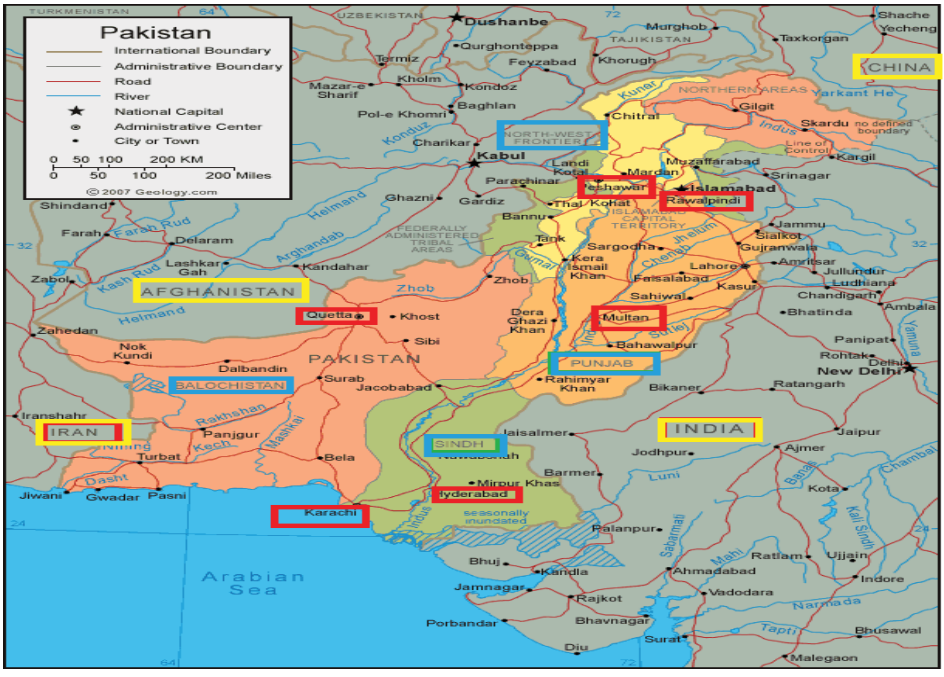
	Dependent variable: Prices in the respective markets				
Independent variables	HYD–THAI[d]	Thai–Hyd	SKR–Tahi	Tahi–SKR	MTN–Thai
Speed of adjustment	–0.03[c]	0.10[a]	–0.07[b]	0.10[a]	–0.10[a]
Long-run coefficient	–0.68[a]	–0.68[a]	–0.89[a]	–0.89[a]	–0.90[a]
Domestic market's differenced price	0.31[a]	–0.10	0.04	–0.12[b]	–0.28[a]
International market's lagged diff. price	0.03[a]	0.39[a]	0.32[a]	0.43[a]	0.34[a]
Constant	0.002	0.0007	0.003	0.002	0.002
Langrangian–Multiplier (LM) test	0.94		0.75		7.98[c]
Independent Variables	THAI–MTN	RWP–Thai	Thai–RWP	PSW–Thai	Thai–PSW
Speed of adjustment	0.10[a]	–0.11[a]	0.12[a]	–0.04	0.17[a]
Long-run coefficient	–0.90[a]	–0.90[a]	–0.91[a]	–0.98[a]	–0.98[a]
Domestic market's differenced price	–0.09	0.19[a]	0.16[a]	0.19[a]	0.07
International market's lagged diff. price	0.42[a]	0.34[a]	0.44[a]	0.18[a]	–0.42
Constant	0.002	0.005[b]	0.001	0.003	0.0009
Langrangian–Multiplier (LM) test		0.43		8.13[c]	
	QTA–Thai	Thai–QTA			
Speed of adjustment	0.09[a]	0.13[a]			
Long-run coefficient	–0.89[a]	–0.89[a]			
Domestic market's differenced price	–0.15[b]	–0.06			
International market's lagged diff. price	0.04	0.44[a]			
Constant	0.003	0.002			
Langrangian–Multiplier (LM) test	7.9[c]				

Notes: [a]/[b]/[c] statistically significant at the 1%, 5%, and 10% levels, respectively.
[d] Hyderabad (HYD); Rawalpindi (RWP); Multan (MTN); Sukhar (SKR); Peshawar (PSW); Quetta (QTA)

Appendix

Figure 2: Map of Pakistan showing provinces and their capitals and selected markets in this study

Figure 3: Detail map of Pakistan showing various cities and road networks.



Notes: Major cities are in red highlights while blue and yellow highlights show Pakistan's provinces and neighboring countries

Paper IV

Spatial Differences in Rice Price Volatility: A Case Study of Pakistan 1994-2011

Burhan Ahmad[*] and Ole Gjølberg[**]

Abstract

The present study analyses spatial differences in volatility across regional rice markets in Pakistan from 1994 to 2011. Volatility clustering is found in all markets. Positive conditional correlations in the dynamic conditional correlations (DCC) model indicate positive association of volatility across markets. Volatility and its persistence differ spatially reflecting differences in infrastructure that make some regions more exposed to risk. Sukhar is the most volatile market, and its volatility is highly persistent, which makes it the riskiest rice market in Pakistan. Investments in infrastructure and particularly in transportation may reduce price risk across markets with largest effects anticipated in the most risky markets.

Key words: Rice prices volatility. Regional markets. Pakistan. GARCH-models

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1 Introduction

Commodity prices are generally volatile and agricultural commodity prices are typically more volatile than, for example, metals (Deaton and Laroque 1992; Pindyck 2004, Newbery, 1989). High volatility poses difficulties in prediction of agricultural commodity price changes which may have large impacts on developing economies relying on agricultural production, exports and import of food commodities. Price risk raises problems for macroeconomic as well as microeconomic policy (Deaton and Laroque 1992; Stigler 2010). Prolonged periods of high volatility raise concerns for governments, traders, producers and consumers (Kroner et al. 1993). Persistent high price volatility can increase economic inequality and strengthen poverty traps particularly in the presence of inadequate liquidity and asset resources (Zimmerman and Carter 2003 in Rapsomanikis 2010).

High food price volatility became a hot issue during and after the 2007-08 food crises and received an extra attention of researchers and policy makers. The World Bank (World Bank 2009) stated that "high volatility in food prices combined with the impact of financial crisis, threaten to further increase food insecurity". In times of crisis volatility may be self-leading, generating cascades of volatility. Such a phenomenon can lead to "herd-like" behavior where market agents make decisions following price trends instead of market fundamentals (Rapsomanikis 2010). Hence, a better understanding of price volatility is a prerequisite for developing strategies to reduce negative effects from high volatility and also policies aiming at stabilizing commodity prices.

In this article we analyze price volatility in Pakistan's rice markets with focus on regional differences which may convey important information to decision makers at political levels. Bottlenecks in the distribution of goods may be a major factor behind spatial differences in price

volatility. Hence, information on price volatility, in general, and regional differences in volatility, in particular, can be an important input in political decisions on interventions in transportation and trading infrastructure and policies aiming at improved functioning of markets.

In Pakistan, rice production is an important part of agriculture, rice being the second largest staple food crop after wheat and the second largest export item after cotton and cotton products (GOP 2011). Rice production covers about 20% of the total cropped area under food grains in the country and rice accounts for almost 6% of the value added in agriculture, contributing to 1.3% of GDP (GOP 2011). Pakistan is a net exporter of rice and earns about 15% of all its foreign exchange from rice exports (Siddique, 2002). Paddy rice production in Pakistan contributes 1.3% to the global production volume and Pakistan's export of milled rice is entitled to have an 11% share in the world rice export levels (FAO, 2010). Two main varieties of rice, IRRI and Basmati, are produced. The eight major domestic wholesale markets are Karachi, Lahore, Rawalpindi, Multan, Sukhar, Hyderabad, Peshawar and Quetta. Six of these markets are included in this study, while Karachi and Lahore are not included due to lack of data.

Given the economic importance of the rice sector in Pakistan's economy, it is important to understand the functioning of the rice markets and the behavior of price volatility. Specifically, we seek the answers for the following questions:

1. What is the general development in rice price volatility in Pakistan's domestic markets?
2. Are there spatial differences in volatility?
3. Are volatilities correlated between markets?

This study employs monthly price data from 1994 to 2011 from the six major markets of IRRI rice in Pakistan, while the price of Thai 5% broken rice is included for international

comparisons. Changes in the logarithmic prices, their squares and (rolling) standard deviations are used as proxies for volatility. Pairwise tests of equality of variances are applied to identify spatial differences in volatility. ARCH-LM tests and univariate GARCH models are applied to analyze volatility clustering and persistence. Dynamic conditional correlations (DCC) model is applied to examine conditional correlations across markets.

2 The rice sector in Pakistan[1]

Two types of rice are grown in Pakistan; Basmati (fine grained fragrant) and IRRI (coarse rice). Table 1 presents production area, volume and yield per hectare of both varieties, and annual percentage changes of area and volume. Punjab province is a major producer of Basmati rice while Sindh province is a major producer of IRRI rice. There was no area under production of Basmati in the province of Sindh until 2008 and a very small area was allocated afterwards. The area of Basmati rice varied between 1.3 and 1.7 million hectares while its production fluctuated between 1.2 and 3.1 million tons. The variation in the area and production of IRRI rice ranged from 0.6 to 9.2 million hectares and from 0.3 to 3.0 million tons, respectively (GoP 2012). The fluctuations in area and production primarily depend on the timely availability of fertilizer and pesticides, water availability, access to credit, weather conditions and the effect that unstable farm income has on the timing of sowing, the purchase of inputs and the ability to respond to external shocks. The domestic marketing system is constituted by intermediaries who may have buying power relative to the rice producers and who make payments to farmers that are often late. Storage facilities at farm level are limited and markets, in many cases, are distant from the production areas. These factors, in turn, affect the farmer's ability to exploit the full production potential (Iqbal et al. 2009).

[1] More details can be found in Ahmad and Garcia (2012)

[Table 1 about here]

Table 2 reports the data for total rice exports as well as the exports of Basmati and non-Basmati (mainly IRRI6 and IRRI9)[2] rice from Pakistan for the period 2001-11. During this period total exports varied between 2.7 million tons and 4.2 million tons while such variations for IRRI and Basmati rice are 0.8 – 1.2 million tons and 1.7 – 3.2 million tons respectively. For the last few years, exports of non-Basmati rice that mainly consist of IRII6 and IRRI9 varieties have been greater than that of Basmati rice which reflects the increasing importance of IRRI rice for export purpose. Exports of both varieties decreased during the food crisis of 2007-08, probably due to the minimum export price policy during this period. After the crisis period and withdrawal of the policy, exports of both varieties increased. The increase in non-Basmati rice export was larger than that of Basmati.

[Table 2 about here]

Pakistan has enacted a wide range of government policies and regulations influencing the rice markets. These include privatization of exports in 1988-89; a price support policy until 2001-02; export subsidies during 2002-04; minimum export price policy during 2007-08; and decreasing import tariffs (Salam 2009; REAP 2010; WTO 2011)[1].

3 Domestic rice markets

Punjab, Sindh, Baluchistan and Khyber Pakhtoonkhan are the four provinces of Pakistan (see maps in the appendix). The distances between the selected markets in this study are given in the table 3. Among the selected markets for the present study, Peshawar and Quetta are the

[2] IRRI6 and IRRI9 coarse rice varieties were developed at the International Rice Research Institute (IRRI) in the Philippines. IRRI9 was developed by crossing the IRRI6 and Basmati rice.

provincial capitals of Khyber Pakhtoonkhan and Baluchistan provinces, respectively. The distance between the two is roughly 850km. Quetta and Peshawar are relatively far from the production regions, with populations of about 0.84 and 1.3 million, respectively. Peshawar is situated close to the border of Afghanistan while Quetta is located close to the borders of Iran and Afghanistan. Rawalpindi is the neighbor city of Islamabad, the capital of Pakistan, and is situated 183km away from Peshawar. Rawalpindi has about 1.83 million inhabitants and lies between Peshawar and Multan. Multan is located in South Punjab at a distance of 549 km from Rawalpindi and has a population of about 1.55 million. Sukhar is located in Sindh province and is 468 km far from Multan. Hyderabad is located close to Karachi, the provincial capital of Sindh and a port city. Hyderabad and Sukhar are located at a distance of 323 km from each other with populations of about 1.4 and 0.40 million, respectively. These are located relatively closer to the production regions as Sindh is the largest producing province of IRRI rice. Distance from Sukhar and Hyderabad to Quetta are 400km and 722 km respectively.

All of these markets are connected with motorways, highways or railways. Cargo transportation goes mostly on highways. Infrastructure, in general, is relatively more developed in the Punjab province compared with the other provinces. National highways and motorways network spans some 9,600km, forming about 3.7% of total road network, accounting for about 95% of freight of all goods. So, road transport is the backbone of the transport sector of Pakistan. Road infrastructure has improved in Pakistan as percentage of paved roads increased from about 53% of total roads in 1991 to about 72% in 2010. This percentage is greater than in China, India, Indonesia, and Viet Nam but lesser than in Thailand and Malaysia. However, about half of Pakistan's national highways are in poor condition and poor road safety is a major concern along with low productivity of the transportation system. Trucks usually travel at a speed of less than

50 km per hour mainly because of overload and poor quality of vehicles. Railway freight accounts for only 5% of total freight services. Pakistan's railways freight productivity is considered to be significantly inferior and lower than the productivity of railways in India and Thailand. Low productivity resulted into its non-competitiveness against road network (World Bank 2013). Another problem is the high cost of transportation which is mainly dependent on prices of fuel. Fuel is one of the major import items of Pakistan and its imports are highly taxed which provides an important source of revenue to the government (Afia 2008). Imposition of tariff on oil imports is one of the reasons for increase the domestic prices of oil and ultimately cost of transportation. Mode of transportation and cost of transportation are likely to affect the prices and volatility in different markets.

4 Data and methods

The data for monthly IRRI rice prices in six domestic markets: Rawalpindi, Multan, Peshawar, Hyderabad, Sukhar and Quetta, were taken from agricultural statistics of Pakistan (GoP, 2012) while data for Thai prices were downloaded from World Bank's pink sheet (The World Bank 2012). Thai prices were converted to Pakistan rupees for comparison with the domestic markets using exchange rate from Oanda (2012) web page.

Augmented Dickey-Fuller and Phillips-Perron unit root tests applied on logarithmic prices indicated non-stationarity at levels but stationarity on first-difference form (i.e. logarithmic price returns). We apply autoregressive conditional heteroskedasticity (ARCH) and generalized ARCH (GARCH) models on price returns to analyze clustering and persistence of volatility in each market separately. The ARCH (p) model introduced by Engle (1982) can be written as following:

$$\sigma_{it}^2 = c_i + \sum_{j=1}^{p} \alpha_i \xi^2_{i,t-j} \quad (1)$$

Here σ^2 is the conditional variance, ξ^2 is the squared error term from the equation for conditional mean (if this equation is omitted, then it is just the logarithmic price returns), *i* indexes markets and *t* indexes time periods. ARCH model and its extensions have been applied in numerous studies. GARCH model proposed by Bollerslev (1986) is the most common extension of ARCH. A GARCH (*p, q*) model has *p* lagged terms of the squared error, ξ^2, and *q* terms of the lagged conditional variances, σ_{it}^2, i.e.

$$\sigma_{it}^2 = c_i + \sum_{j=1}^{p} \alpha_i \xi^2_{i,t-j} + \sum_{j=1}^{q} \beta_i \sigma^2_{i,t-j} \quad (2)$$

To examine relationships of volatilities across different markets, we append the univariate GARCH models by a dynamic conditional correlations (DCC) model proposed by Engle (2002). It allows us to estimate the conditional correlations between pairs of domestic markets. The time-varying conditional covariance matrix in the DCC model can be written as following:

$$H_t = D_t^{1/2} R_t D_t^{1/2} \quad (3)$$

Here H_t is the time-varying conditional covariance matrix; D_t is a diagonal matrix of conditional variances (σ_{it}^2) in which each σ_{it}^2 is generated according to a univariate GARCH model of the form presented in equation 2; and R_t is a matrix of conditional quasi-correlations, measuring the time varying conditional correlation across markets.

There are a number of applications of GARCH models on commodity markets. Valadkhani et al. (2005) investigated Australia's export price volatility by employing GARCH models and

presented evidence that Australia's export prices significantly vary with world prices. Baharom et al (2009) found that Thailand's rice export price had been volatile during 1961-2008. They also found asymmetry in volatility indicating that positive shocks lead to larger increases in volatility than the negative shocks. Apergis and Rezitis (2003) described that agricultural input and retail food prices wield positive and significant effects on the volatility of agricultural output prices by employing multivariate GARCH models. They also illustrated that output prices exert significant positive effects on their own volatility in Greece. Rapsomanikis (2010), employing multivariate GARCH models, found that wheat market in Peru and maize markets in Mexico were not showing an increasing trend in price volatility while the world wheat and maize markets showed increasing price volatility. He also found volatility clustering in all the markets during 2008 on account of food crises. He added that domestic price volatilities are more responsive to domestic shocks compared with shocks in the international market prices. He also found that India's power in the international rice market led to bidirectional causality between Indian and international market prices; a similar relationship existed between the volatilities in Indian and international market prices. However, Indian price stabilization policies such as restrictions on exports on account of price surge during 2007-08 reduced the volatilities in the domestic markets and raised volatility in the international market.

5 Stylized facts on regional rice prices and volatility

The average monthly prices of rice in Pakistan's domestic markets and price in the international market (Thai 5% broken) are plotted in figure 1. In general, there is a rising trend in all the regions and internationally, which is however often interrupted by relatively large short-term fluctuations. Dividing the sample into sub-periods, a declining price trend during 1995–2001 is followed by a rising trend during 2001-2005. Highly volatile prices may be observed after 2005

with a sharp increase during 2007–08 marking the international food crisis. Gilbert and Morgan (2010) found that rice price volatility was higher compared with other food grains during and after the food crisis period 2007-08. They also added that evidence was weak for the perception of increasing grain price volatility.

To further visualize price volatility, monthly percentage price changes in domestic price (average of all markets) and international market prices are plotted in figure 2. Graphs for monthly percentage price changes in all domestic markets are shown in the appendix. Here again large fluctuations reflecting high volatility can be viewed particularly after 2008. As an alternative measure of volatility, rolling 48-month standard deviations of logarithmic prices are depicted in figure 3. Increases in rolling standard deviations are observed since 2008, falling in line with earlier argument.

[Figure 1 and 2 about here]

Equality of volatility among pairs of markets is tested employing an F-test of equal variances and the results are given in table 3. Pairwise test results show mixed picture demonstrating that some market pairs possess statistically equal volatility while other pairs exhibit differences in volatility. Volatilities of average domestic and international market price are also found to be different. Among domestic markets, markets that are located far from each other possess statistically different volatilities while volatility in neighboring markets is similar with few exceptions. For instance the results for Sukhar and Hyderabad markets pair show dissimilar volatility despite the fact that these markets are not far from each other. A possible reason for this difference could be the exposure of these markets to the production area and international market. Hyderabad is located close to the Karachi port and therefore exposed to the international markets while Sukhar is located close to the production areas and act as a source of

supply to both domestic as well as international markets. Quetta and Peshawar are located far from each other but show a similar behavior of volatility, again possibly due to their exposure to international markets: Peshawar is located close to the border of Afghanistan while Quetta is situated close to the borders of Afghanistan and Iran. Peshawar may also have been affected by the war against terrorism after the 9/11 incident, while Quetta has poor law and order situation. Quetta and Rawalpindi are also situated far from each other but possess statistically equal variance, which can be attributed to the fact that they are situated far from the production areas. Quetta-Sukhar and Multan- Peshawar market pairs, situated relatively far from each other, also showed statistically similar variance which possibly is because of expected higher trade between them. The actual data for trade is not available; however, we can expect this as Sukhar and Multan are located relatively close to the production regions and product move from Sukhar and Multan.

The volatility in all regions and in the international market measured by moving window of standard deviations of price returns over 48 months (figure 3) shows a rising trend in particular after the boom-and-bust period 2007-08. To further visualize the trends in volatility, the data set is divided into three sub-sets, 1994-1999; 2000-2005 and 2006-2011. Volatility is measured as standard deviations of logarithmic price returns over the selected period. Results are shown in table 4. These results, in general, support a rising trend. The highest level of volatility occurred in 2006-2011. During this period, volatility almost doubled in all of the regions and even more than doubled in some markets. However, level of volatility differs across markets during these sub-periods. Three markets, Rawalpindi, Multan and Hyderabad, showed an increase in volatility from 1994-1999 to 2000-2005 while Sukhar, Peshawar and Quetta showed a decrease in volatility during the same sub-periods.

6 Econometric Results

ARCH-LM tests were applied on logarithmic price returns to examine the presence of volatility clustering, or ARCH effects. The results (table 5) support the hypothesis of presence of ARCH effects in the domestic as well as international markets. This evidence is weak for Rawalpindi and Hyderabad where the test statistic is significant at 10 percent level. Univariate ARCH/GARCH models were estimated and the results are reported in table 6. All models included a first-order autoregressive term (lagged logarithmic price returns) in the conditional mean equation to control for the predictability of conditional mean. The coefficients on AR (1) in all the markets are positive and statistically significant at 1% level suggesting that specification of GARCH models without any model for conditional mean would not be appropriate. Ljung-Box test for autocorrelation and ARCH-LM test for remaining ARCH effects were applied on standardized model residuals as diagnostics tests. The results show that the residuals do not have autocorrelation and conditional heteroscedasticity.

The ARCH coefficients in domestic markets are positive and statistically significant except for Multan and Peshawar. These coefficients are significant at 10% level in Hyderabad and Multan while at 5% and 1% in Sukhar and Quetta, respectively. Their magnitudes range from around 0.2 in Hyderabad and Sukhar to around 0.7 in Rawalpindi and almost 1.0 in Quetta. In the international market, ARCH (1) coefficient is not significant while ARCH (2) coefficient is significant at 5% level; the sum of the two is 0.4. Significant ARCH (1) coefficients imply that that the most recent shock to logarithmic price returns significantly affects the current conditional variance. A relatively large ARCH coefficient (e.g. in Rawalpindi and Quetta) implies that the most recent shock has a sizeable impact of increasing the current period's conditional variance. A relatively small ARCH coefficient (as in Hyderabad and Sukhar)

indicates that shocks to logarithmic price returns have little impact on subsequent period's conditional variance.

The GARCH coefficients are not significant in Multan, Rawalpindi and Quetta markets while these are significant in Sukhar, Hyderabad and Quetta at 1% level of significance. The GARCH coefficient in the international market is significant at 5% level. Significant GARCH coefficients indicate autoregressive memory in conditional variance, that is, current conditional variance depends on past conditional variances. A relatively large GARCH coefficient implies that current conditional variance tends to remain close to its most recent value rather than at its basis level. Such a pattern is strongest in Hyderabad and Sukhar (GARCH coefficient values of around 0.8 and 0.7) and less pronounced in Peshawar (around 0.5). The international market has the least pronounced autoregressive memory in conditional variance with a GARCH coefficient of around 0.4.

Significant GARCH effects together with significant ARCH effects indicate that volatility depends on both previous shocks and previous conditional variances. The sum of the ARCH and GARCH coefficient values measures the persistence in volatility, and values close to unity reflect high persistence (Verbeek 2008). This sum for international market is 0.86, which is relatively high. Persistence in Hyderabad and Sukhar amounts to 0.98 and 0.89, respectively, even higher than that of the international market.

Differences in the significance and magnitude of ARCH and GARCH coefficients reflect spatial differences in behavior of volatility across regional rice markets in Pakistan. Hyderabad and Sukhar are the only two markets in Pakistan having both significant ARCH and GARCH effects, hence can be regarded as most risky markets. However, Sukhar contained a higher

variance during the recent period 2006-11 as well as during the whole study period 1994-11 (table 4), hence is the most risky region.

The results of the equality of variance tests, volatility trends measured by rolling window of standard deviations and 5-years standard deviations of differenced logarithmic prices and ARCH/GARCH models reveal spatial differences in volatility across regional markets in Pakistan. It is reasonable to assume that these spatial differences reflect the differences in infrastructure such as cost of transportation and communication services, storages and possibly also the existence of market power by the market intermediaries. Moreover, the price surge during the 2007-08 food crisis also affected the volatility in the regional markets. Inventory holders would intend to store more in a volatile environment resulting in increase in the inventories. Buildup in inventories can create shortage in domestic supply that in turn can increase the demand and ultimately also prices. Increased price could negatively affect the food security. Differences in the volatility across markets can result in regional differences in decision making by the inventory holders, generating increased volatility.

6.1 Volatility association across regional rice markets in Pakistan

Dynamic conditional correlation (DCC) model proposed by Engle (2002) was applied to the domestic markets of rice in Pakistan to estimate dynamic conditional correlations. The estimates of univariate GARCH models in the DCC model are same as presented earlier, hence, are not reported. Time-varying conditional correlations between market pairs are presented in figure 4. Figure 4 depicts that each market has a different correlation with the other market and over-time development of the conditional correlations vary across markets pairs. In general, these conditional correlations are low. These facts reflect that spatial differences exist across markets and market pairs. The average dynamic conditional correlations during 1994-2011 are given in

table 7.The highest conditional correlation exists between Multan and Sukhar, 0.29. This is as was expected given the fact that these two markets are relatively close. Multan and Rawalpindi possess second highest conditional correlation, 0.28, which are located in the same province. Both have better road infrastructure and more trade can be expected from Multan to Rawalpindi as Multan is relatively closer to production / supply areas.

Average conditional correlation between Rawalpindi and Sukhar is 0.23 which reflects that there is direct trade between Sukhar, which is located closer to supply areas, and Rawalpindi. However, it is lower than between Multan and Rawalpindi possibly due to larger distance. Average conditional correlation between Peshawar and Rawalpindi is relatively lower, 0.17, in spite of the fact that they are located closer, although in different provinces, and have good infrastructure. This reflects that there is more direct trade between Peshawar and Multan having higher average conditional correlation, 0.33, as it is of little difference to travel between Multan and Peshawar or Multan and Rawalpindi. This also suggests that good infrastructure promotes direct trade between different markets.

The conditional correlation between Hyderabad-Sukhar markets pair is low, which is somewhat counterintuitive since these markets are situated close to each other. On the other hand, already the test of equality of variance showed a difference between the two markets, and possible reasons for that were also provided.

In general it can be said that there is higher degree of association in volatility between closer markets than between distant markets although exceptions exist. Distance is a proxy measure of infrastructure such as roads, transportation, communication and geopolitical conditions of the markets and these can be the possible reasons for differences in volatility and

the varying degree of conditional correlations across rice markets in Pakistan. Hence, investments on infrastructure and transportation can reduce the spatial differences in volatility across markets in Pakistan. Improving the efficiency of the railways would reduce the transportation cost and possibly price uncertainty across markets.

7 Summary and Conclusions

We started this study by raising three questions about general development in rice price volatility in Pakistan's domestic markets, possible presence of spatial differences in volatility and presence of correlation between volatilities in different markets. In order to answer these questions we analyzed volatility trends and patterns by applying standard tests for equality of variance and ARCH/GARCH and DCC models. We have found a rising trend in rice price volatility in regional markets of Pakistan as well as in the international market during the period 1994-2011. We also found differences in volatility across regional markets. In general, markets situated far from each other show statistically significant differences in variances while the markets located relatively closer to each other possess statistically equal variance, although exceptions exist. ARCH-LM tests on logarithmic price returns in individual markets show the presence of ARCH effects in all domestic markets and the international market. The significance and magnitude of ARCH and GARCH coefficients vary across markets reflecting spatial differences in volatility. Highest persistence in volatility is found in Sukhar and Hyderabad. Coupled with its high unconditional variance, Sukhar can be regarded as the most risky domestic market.

Analysis of conditional correlations using DCC model reveals positive association of volatility across markets. It also elucidates spatial differences since correlations are inversely related to distance between markets. Differences in behavior of volatility across markets reflect differences in infrastructure, transportation and communication services, and possibly the market

power exercised by the market intermediaries. Given the poor quality of national highways, slow driving freight vehicles and inefficient railway freight, investments in infrastructure and particularly in transportation may reduce the price risk across markets. Hyderabad and Sukhar are found to be the risky markets and Sukhar the most risky, hence, infrastructural investments in this region should be prioritized. Reducing price risk can improve the market functioning and decision making by the economic agents. As for producers, higher volatility can result in inefficient allocation of resource. Meanwhile, inventory holders would likely to store more in a volatile environment resulting in an increase in inventories that in turn can negatively affect food security. Maintaining buffer stocks might help to reduce volatility, particularly in instances of large surges in prices such as during food crisis 2007-08, and may help bear such shocks.

Table 1: Production area, volume and yield of rice crop in Pakistan

Year	Area (000, hectares)				Production (000, tons)				Yield (Kg/ha)	
	Basmati	% Change	IRRI	% Change	Basmati	% Change	IRRI	% Change	Basmati	IRRI
93-94	1104		961		1267		2524		1148	2627
94-95	1145	3.8	865	-10.0	1352	6.7	1927	-23.7	1180	2226
95-96	1148	0.2	895	3.4	1488	10.1	2282	18.4	1296	2550
96-97	1174	2.3	952	6.4	1564	5.1	2528	10.8	1372	2656
97-98	1106	-5.8	952	0.1	1439	-8.0	2468	-2.4	1302	2592
98-99	1216	10.0	989	3.8	1687	17.2	2593	5.1	1387	2623
99-00	1296	6.5	1016	2.7	1871	10.9	2912	12.3	1444	2867
00-01	1158	-10.6	927	-8.8	1701	-9.1	2556	-12.2	1468	2759
01-02	1332	15.0	667	-28.0	1999	17.6	1695	-33.7	1501	2539
02-03	1377	3.4	722	8.2	2304	15.3	1942	14.6	1673	2690
03-04	1521	10.4	718	-0.6	2522	9.4	1901	-2.1	1659	2648
04-05	1558	2.5	678	-5.6	2555	1.3	1908	0.4	1639	2816
05-06	1659	6.4	750	10.7	2920	14.3	2214	16.0	1761	2952
06-07	1589	-4.2	757	0.9	2736	-6.3	2238	1.1	1721	2958
07-08	1467	-7.7	747	-1.3	2643	-3.4	2284	2.1	1801	3058
08-09	1697	15.7	915	22.5	2901	9.8	2984	30.6	1710	3261
09-10	1544	-9.0	894	-2.3	2732	-5.8	2790	-6.5	1770	3120
10-11	1413	-8.5	617	-30.9	2445	-10.5	1490	-46.6	1731	2413

Source: Agricultural statistics of Pakistan 2011-12

Table 2: Variety-wise and total rice exports from Pakistan during 2001-11

Year	Rice (all) Quantitiy (Million tons)	Rice (all) M. Rs.	Basmati M. tons	Basmati M. Rs.	Non-Basmati M. tons	Non-Basmati M. Rs.
2001-02	2	27510	1	15856	1	11653
2002-03	2	32433	1	21077	1	11356
2003-04	2	36535	1	24284	1	12251
2004-05	3	55392	1	26074	2	29319
2005-06	4	69325	1	28714	3	40611
2006-07	3	68286	1	33733	2	34553
2007-08	3	117088	1	68232	2	48857
2008-09	3	154763	1	83253	2	71510
2009-10	4	183370	1	71770	3	111600
2010-11	4	184675	1	82314	3	102360

Source: Agricultural statistics of Pakistan 2011

Table 3: Equality of variance test and distance between domestic market pairs

Market pairs	Equality of Variance /SD (1994-2011)	Distance (Km)
Rawalpindi – Peshawar	Yes	183
Hyderabad –Sukhar	No	323
Quetta – Sukhar	No	399
Sukhar – Multan	Yes	468
Multan – Rawalpindi	No	548
Quetta – Multan	Yes	625
Multan – Peshawar	No	689
Quetta– Hyderabad	No	721
Hyderabad –Multan	No	781
Quetta – Peshawar	No	846
Sukhar – Peshawar	No	884
Quetta – Rawalpindi	Yes	902
Sukhar – Rawalpindi	No	1012
Hyderabad – Peshawar	No	1206
Hyderabad – Rawalpindi	No	1325.1
Average–International market	No	

Table 4: Standard deviations of logarithmic price returns using monthly data during 1994-2011

Years	Peshawar	Rawalpindi	Multan	Sukhar	Hyderabad	Quetta
1994-1999	0.044	0.034	0.043	0.056	0.017	0.033
2000-2005	0.033	0.039	0.049	0.043	0.035	0.028
2006-2011	0.072	0.081	0.092	0.104	0.057	0.073
1994-2011	0.052	0.051	0.064	0.071	0.039	0.048

Table 5: ARCH-LM test on price returns in the domestic rice markets in Pakistan

Year	Thailand	Peshawar	Rawalpindi	Multan	Sukhar	Hyderabad	Quetta
Skewness	1.0	0.9	7.6	0.8	0.6	0.4	0.8
Kurtosis	2.9	2.6	2.6	2.8	2.5	2.2	2.8
ARCH- LM[a]	15.3	5.5	2.9	30.1	26.0	2.6	12.9

Source: Author's calculations

Notes: [a] All the coefficients are significant at 1% level of significance except for Rawalpindi and Hyderabad which are significant at 10% level of significance

Table 6: ARCH/GARCH models with lagged dependent variable, AR (1); Ljung-Box (3 lags) and ARCH-LM (3 lags) tests' statistics for standardized model residuals

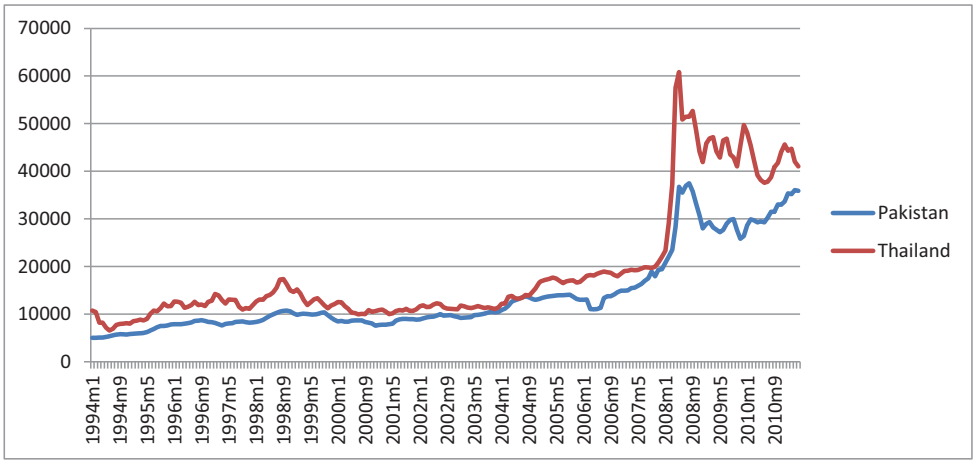
DlnP	Thailand	Hyderabad	Sukhar	Multan	Rawalpindi	Peshawar	Quetta
Constant	0.005	0.009[a]	0.01[a]	0.009[b]	0.01[a]	0.009[b]	0.01[a]
AR(1)	0.33[a]	0.23[a]	0.21[a]	0.38[a]	0.48[a]	0.29[a]	0.23[a]
ARCH (1)	0.15	0.17[c]	0.20[b]	0.32	0.72[c]	0.21	0.97[a]
GARCH(1)	0.43[b]	0.81[a]	0.72[c]	-	-	0.51[a]	-
Constant	0.0003	0.00006[c]	0.0004[b]	0.003[a]	0.001[a]	0.0006[a]	0.0006[a]
ARCH(2)	0.28[b]						
Ljung-Box(3)	4.95[c]	1.22	0.96	2.62	2.19	0.06	3.00
ARCH-LM(3)	4.25	0.49	0.77	1.20	0.13	1.12	0.90

Notes: [a]/[b]/[c] statistically significant at the 1%, 5%, and 10% levels, respectively

Table 7: Time-varying conditional correlations of logarithmic price returns in domestic rice markets in Pakistan

Market pairs	Average Conditional Correlation	Distance (km)
Rawalpindi – Peshawar	0.17	183
Hyderabad –Sukhar	0.09	323
Quetta – Sukhar	0.18	399
Sukhar – Multan	0.29	468
Multan – Rawalpindi	0.28	548
Quetta – Multan	0.20	625
Multan – Peshawar	0.24	689
Quetta– Hyderabad	0.19	721
Hyderabad –Multan	0.14	781
Quetta – Peshawar	0.16	846
Sukhar – Peshawar	0.18	884
Quetta – Rawalpindi	0.11	902
Sukhar – Rawalpindi	0.23	1012
Hyderabad – Peshawar	0.09	1206
Hyderabad – Rawalpindi	0.05	1325

Figure 1: Rice prices in Pakistan's domestic (average) and international markets (Rupees/ton)



Note: Thailand's prices were converted into Pakistan's rupees before estimations of rolling standard deviations.

Figure 2: Logarithmic price returns in Pakistan's domestic (average) and international rice markets

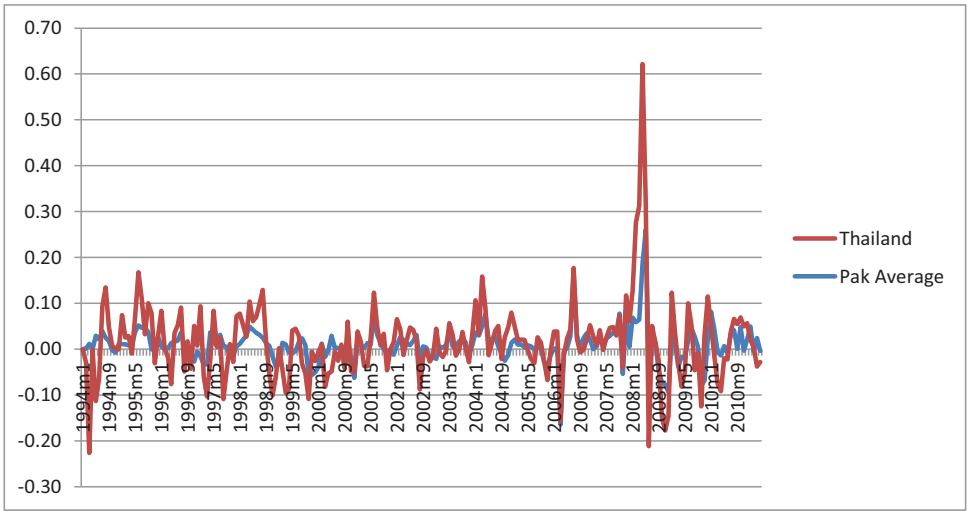
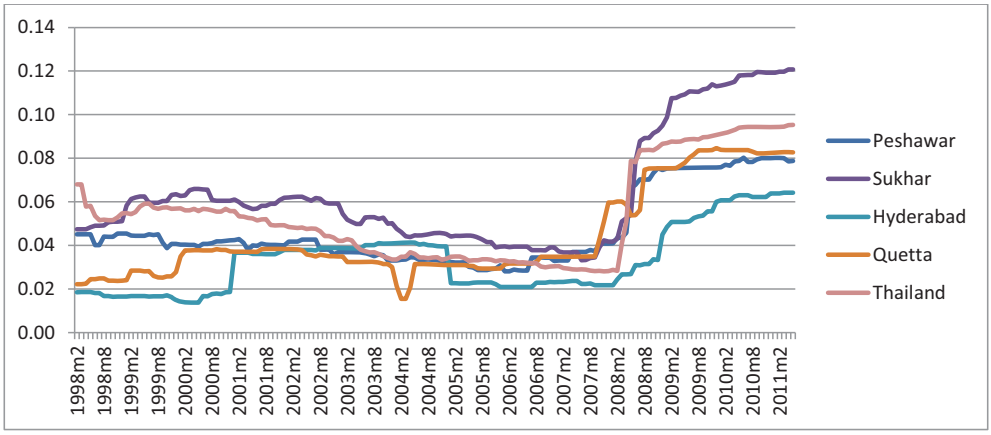
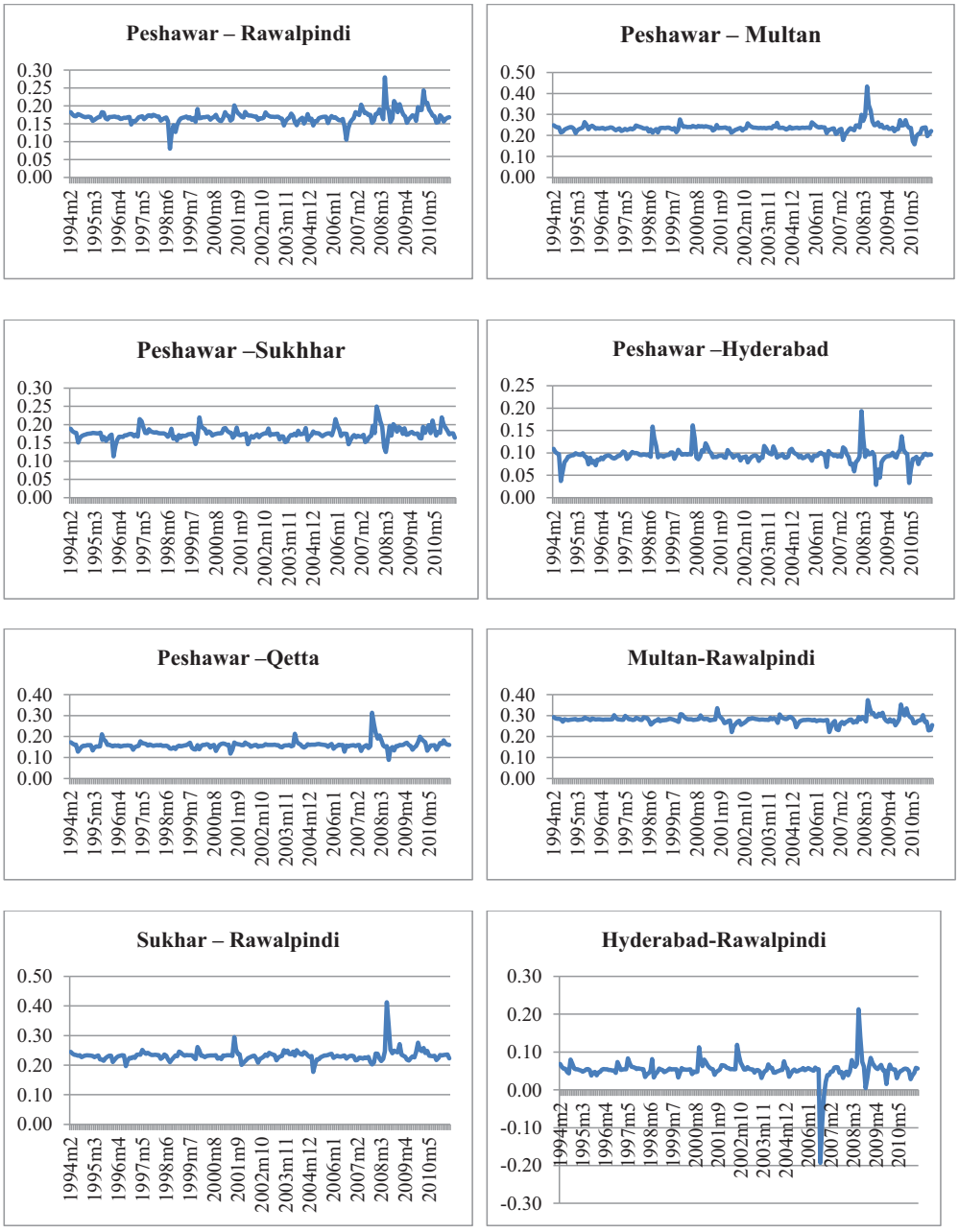


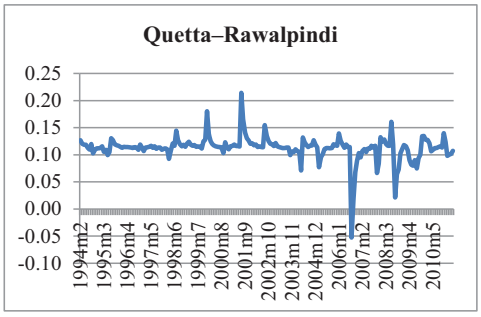
Figure 3: Standard deviations of logarithmic price returns in Pakistan's domestic and international rice markets over 48-month rolling windows during 1994-2011



Note: Thailand's prices were converted into Pakistan's rupees before estimations of rolling standard deviations.

Figure 4: Conditional correlations between rice market pairs in Pakistan




Quetta–Rawalpindi
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
1994m2
1995m3
1996m4
1997m5
1998m6
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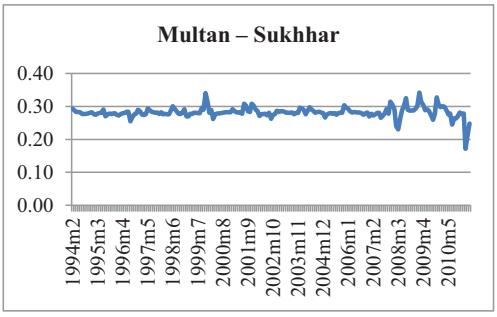
2010m5


Multan – Sukhhar
0.40
0.30
0.20
0.10
0.00
1994m2
1995m3
1996m4
1997m5
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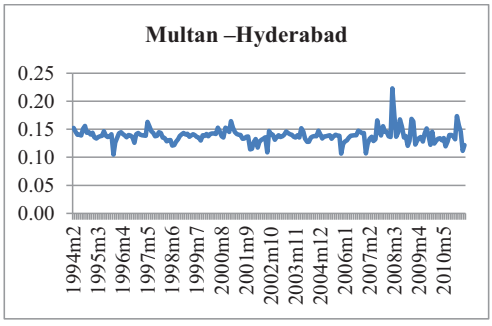
2009m4
2010m5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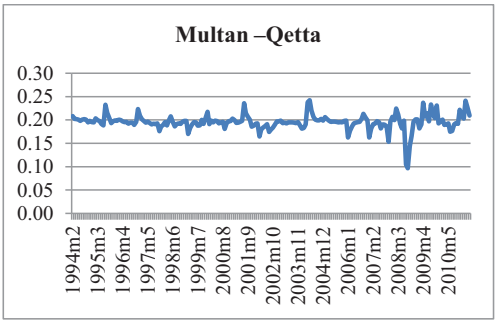
Multan –Qetta
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1994m2
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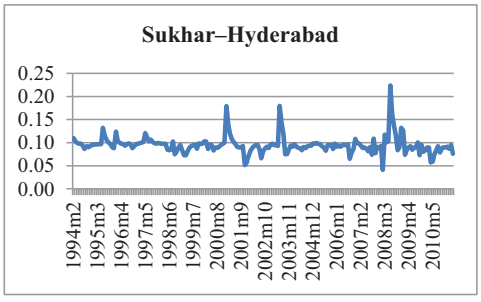
Sukhar–Hyderabad
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0.10
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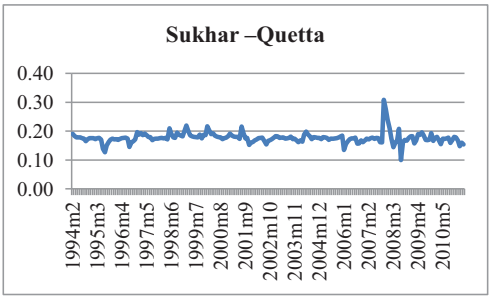
Sukhar –Quetta
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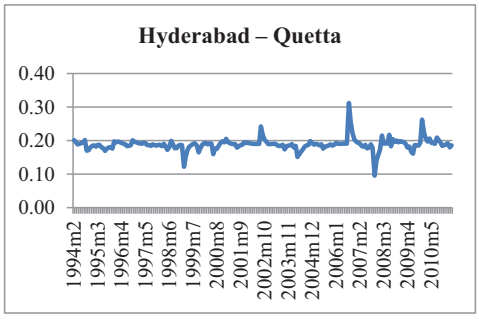
Hyderabad – Quetta
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2003m11
2004m12
2006m1
2007m2
2008m3
2009m4
2010m5

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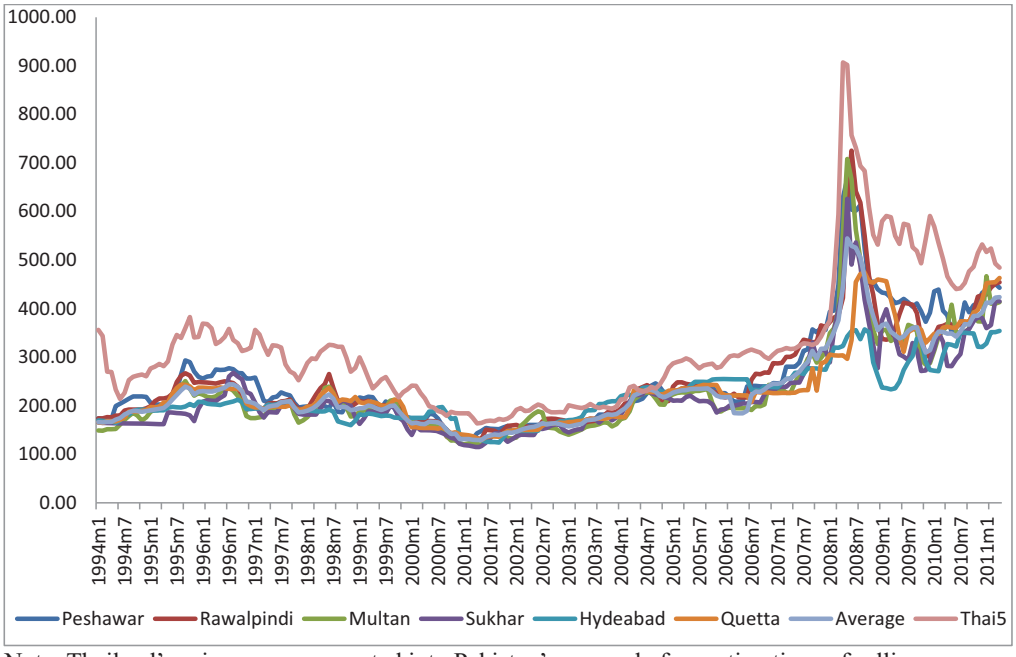
Appendix

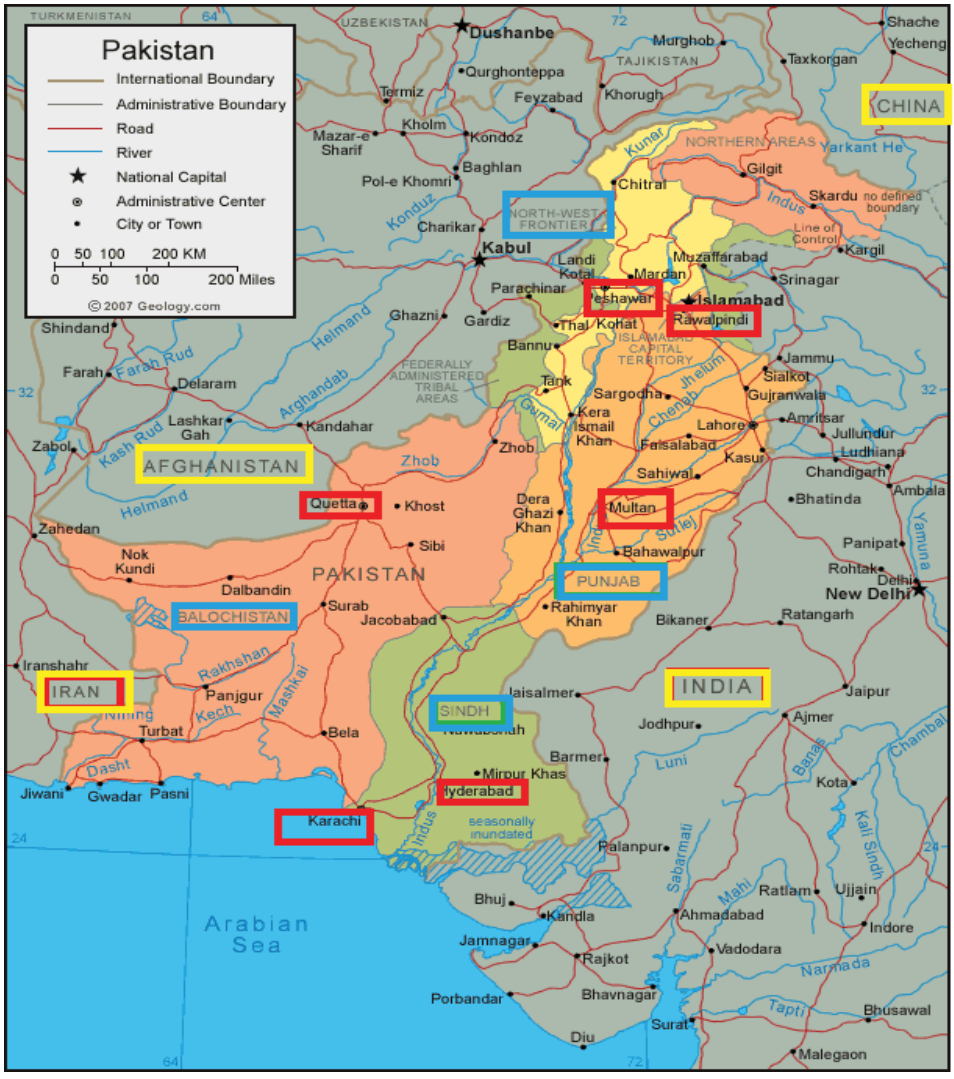
Figure 5: Rice Prices in the domestic and international market of rice (Rs/ton)



Note: Thailand's prices were converted into Pakistan's rupees before estimations of rolling windows

Figure 6: Map of Pakistan showing provinces and their capitals and selected markets in this study

Figure 7: Detail map of Pakistan showing various cities and road networks.



Note: Red highlights are the major cities while blue and yellow represent the provinces and neighboring countries of Pakistan respectively. Red connecting lines are the roads.

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Burhan Ahmad was born in Faisalabad, Pakistan in 1979. He holds a Bachelor degree in Agricultural sciences with Agricultural Economics as a major subject and Master's degree in Agricultural Economics from the University of Agriculture, Faisalabad, Pakistan (2001; 2003).

This dissertation is comprised of an introduction and four research articles. Overall objective of the dissertation is to study aspects of economic growth and development in Pakistan that have been pursued through enhancing commodity-specific exports, attracting foreign investment and improving the functioning of commodity markets.

Article 1 investigates the factors affecting commodity exports and identifies markets that have unexploited export potential. Rice exports from Pakistan during 1991-2010 are taken as the example and studied using panel data and techniques. It is found that Pakistan's economic growth, importers income, export prices, specialization, the currency exchange rate and transactions costs are the major factors affecting rice exports from Pakistan. A high unexploited export potential is also found in 49 export markets out of the 92 countries.

Article 2 measures the economic and institutional determinants of Foreign Direct Investment (FDI) inflows into Pakistan and answers why FDI has been low and uneven despite investment-friendly policies during 1996-2010. Pakistan's market size, governance, infrastructure, human capital, favorable business environment and income and governance of the foreign investors are the major factors responsible for attracting foreign direct investment in Pakistan. Low economic growth, bad governance, and a lack of skilled human capital are possible reasons for low and variable net FDI inflows.

Article 3 answers the question whether commodity markets such as rice are integrated domestically and with the international markets. It also examines the effects of government policies on the extent of market integration employing time series data and techniques. It is found that Pakistan's domestic markets are integrated domestically and with the international markets. The price support policy abolition seems to have contributed to greater domestic integration, while the subsequent export policies seem to have decreased the extent of Pakistan's integration with the international markets.

Article 4 examines the spatial differences in volatility across regional rice markets of Pakistan using time series data and techniques. Volatility clustering is found in all markets. Volatility and its persistence differ spatially reflecting differences in infrastructure that make some regions more exposed to risk. A positive association of volatility across markets is found, and its degree is reviewed in light of market geography and infrastructure.

Roberto J. Garcia is Burhan's main supervisor

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