RELATIVE PRICE CONVERGENCE AMONG PAKISTANI CITIES: DOES THE HARROD-BALASSA-SAMUELSON HYPOTHESIS HOLD?

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AUTHORSHIP STATEMENT

I Rubina Ilyas solemnly declare and affirm on oath that I myself have authored this M.Phil. Thesis with my own work and means, and I have not used any further means except those I have explicitly mentioned in this report. All items copied from internet or other written sources have been properly mentioned in quotation marks and with a reference to the source of citation.

Rubina Ilyas

Dedicated to my beloved

Mother

Whose prayers for me, were what sustained me thus far

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List of Abbreviations

ADF	Augmented Dickey Fuller
CPI	Consumer Price Index
GLS	Generalized Least Squares
HBS	Harrod Balassa Samuelson
IPS	Im-Pesaran-Shin
LLC	Levin-Lin-Chu
LOP	Law of One Price
OLS	Ordinary Least Squares
PPP	Purchasing Power Parity

Abstract

This study examines the price dynamics across 17 cities within Pakistan. Considering monthly disaggregated goods prices, the convergence behavior among tradable, non-tradable and energy goods is examined. Using panel econometric methods the results show overwhelming evidence of mean reversion of relative prices among cities. Varying across items, the speed of convergence is only a few months or less. However the results do challenge some of the previous findings as the services which are considered as non-tradable items also reject the null of unit root with half-lives of less than a year. These results support the conjecture that intra-national prices converge at a faster rate as compared to international prices. Greater tendency of convergence towards Law of One Price implies high integration of Pakistani markets or perhaps low degree of specialization and market differentiation.

Key Words: Pakistan, Law of One Price, Market Integration, Price convergence, Half Life

Appendix

Table A.1 List of Cities

ID	Cities
1	Islamabad
2	Rawalpindi
3	Gujranwala
4	Sialkot
5	Lahore
6	Faisalabad
7	Sargodha
8	Multan
9	Bhawalpur
10	Karachi
11	Hyderabad
12	Sukkher
13	Larkana
14	Peshawar
15	Bannu
16	Queta
17	Khuzdar

Table A.2 List of Products

Category	Description	Unit
Storable Goods	WHEAT	Kg
	RICE BASMATI	Kg
	MASOOR PULSE WASHED	Kg
	MOONG PULSE WASHED	Kg
	MASH PULSE WASHED	Kg
	SUGAR	Kg
	SALT POWDERED	Kg
	RED CHILLIES	Kg
	LAWN	Meter
	SHIRTING	Meter
	WASHING SOAP NYLON	Cake
Meat, fresh produces, dairy products, and other perishable food items	CHICKEN (FARM)	Kg
	BEEF	Kg
	MUTTON	Kg
	EGG HEN (FARM)	Dozen
	BREAD PLAIN MID.SIZE	Each
	MILK FRESH	Liter
	POTATOES	Kg
	ONIONS	Kg
	TOMATOES	Kg
	BANANAS	Dozen
	CURD	Kg
	GARLIC	Kg
Services and other non-tradable items	Doctor clinic fee	Each
	Carpenter	Per day
	Mason	Per day
	Labor	Per day
	Plumber	Per day

Table A.3 Summary Statistics Of Relative Prices

PRODUCT	Mean	Median	Maximum	Minimum	Std.Dev.	Skewness	Kurtosis	Observations
Wheat	-0.0017	-0.00374	0.819998	-0.20897	0.035043	4.496301	130.5538	2448
Rice	-0.0018	-0.00265	0.320394	-0.13813	0.040447	0.06304	4.293814	2448
Masoor pulse	-0.0009	-0.00016	0.096004	-0.21346	0.029228	-0.42559	5.041524	2448
Moong pulse	-0.0013	-0.00185	0.149946	-0.13229	0.03377	0.166025	3.569952	2448
Mash pulse	-0.0021	0.002444	0.19158	-0.15219	0.043093	-0.19757	3.347516	2448
Chicken	-0.0021	-0.00543	0.206518	-0.19255	0.042606	0.663182	4.62083	2448
Beef	-0.0013	-0.00372	0.257299	-0.14408	0.033746	0.612275	5.559395	2448
Mutton	-0.0021	0.000457	0.097659	-0.83418	0.045505	-3.69135	57.48919	2448
Egg hen	-0.001	-0.00203	0.243128	-0.33586	0.029448	-0.35944	17.51182	2448
Bread	-0.0018	0.002948	0.313545	-0.15516	0.039907	-0.48186	5.362108	2448
Sugar	-0.0002	-0.00119	0.102158	-0.19223	0.013642	-0.47657	26.02264	2448
Milk fresh	-0.0037	-0.00491	0.847939	-0.27154	0.05439	1.045261	27.99372	2448
Curd	-0.0047	-0.01705	0.1855	-0.14211	0.063341	0.554611	3.13985	2448
Potatoes	-0.0094	-0.01906	0.279237	-0.28928	0.089655	0.311032	2.814511	2448
Onions	-0.0073	-0.01151	0.266613	-0.31081	0.078834	0.377419	3.849279	2448
Tomatoes	-0.0102	0.001938	0.276805	-0.37817	0.096259	-0.59079	3.56286	2448
Bananas	-0.0128	-0.01077	0.28346	-0.89301	0.10569	-0.11898	4.847832	2448
Salt Powder	-0.0124	0.002402	1.069266	-0.6351	0.104657	-0.76462	10.67683	2448
Red chilies	-0.0034	0.003915	0.192861	-0.60569	0.057956	-2.84159	20.73064	2448
Garlic	-0.0057	-0.00899	0.302924	-0.32471	0.069881	0.277768	4.396012	2448
Lawn	-0.0104	0.019988	0.203393	-0.36339	0.098323	-0.8415	3.098425	2448
Shirting	-0.0078	-0.011	0.697164	-0.29438	0.082486	-0.19596	5.644004	2448
Washing Soap	-0.0131	-0.02568	0.3388	-0.24258	0.106309	0.126394	2.338071	2448
Doctor fee	-0.0205	-0.02865	0.587466	-0.36109	0.128444	0.726637	4.503515	2427
Carpenter	-0.0067	0.001071	0.170015	-0.35438	0.077707	-0.39525	2.911885	2427
Mason	-0.0036	0.001146	0.138484	-0.28633	0.056812	-0.46232	3.823714	2427
Labor	-0.0084	0.000731	0.308844	-0.25092	0.086099	-0.18594	2.747847	2427
Plumber	-0.0054	-0.00485	0.160991	-0.56683	0.069542	-0.39367	4.365118	2218

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Chapter 1

INTRODUCTION

1.1. Background

In recent literature the issue of Price level Convergence has been subject to enormous attention. Price level convergence is the name given to the converging behavior of the prices of identical goods towards a similar price. Price convergence studies are ostensibly an empirical exercise that tests for the economic theory of Law of One Price. Even after having controlled many factors as trade barriers, exchange rate volatility etc. which are present on the international level, testing for price convergence on the intranational level (within the same country) failed to coincide with The Law of One Price (LOP). The question still arises till date, why do prices of same goods differ across regions, cities and even adjacent markets.

The whole concept of price convergence comes from the theory of Purchasing Power Parity (PPP), a simple empirical proposition which submits that national prices should be equal as soon as they are converted to the same currency. In 1970's most findings supported the existence of PPP (Frankel, 1976). However, during 1980's and onwards many economists came to the conclusion that PPP is only a long run perception as the deviations in the short run are large and volatile. By using longer time series data they found that deviations from the PPP were persistent (Frankel and Rose 1986, Wu 1986, Abuaf and Jorion 1990, Wei and Parsley 1995, MacDonald 1996, Papell 1997, Lothian 1997, O'Connell and Wei 2002). The speed with which the deviations converged was measured by "half-life". According to Chmelarova and Nath (2010) half-life is the name given to the time required by a deviation from PPP to dissipate by one half.

The PPP deviations were found to die out with a half-life of three to five years (Kenneth Rogoff 1996).

Kenneth Rogoff observed that even for highly traded homogeneous goods, the price differential volatility was surprisingly large. These results gave rise to the concept of PPP puzzle which states that how can one reconcile the enormous short term volatility of real exchange rates with the extremely slow rate at which shocks appear to damp out? (Kenneth Rogoff 1996) There were multiple reasons found that explained the PPP puzzle[1], mainly nominal exchange rate volatility, presence of trade barriers between countries and transportation cost (Knetter 1994).

The most commonly discussed factors that impede convergence are transportation costs (Dumas 1992), information costs, trade barriers (Knetter 1994), non-tariff barriers, pricing to market and market segmentation (Krugman, 1987, Dornbusch, 1979, Haskell and Wolf, 2001), presence of non-traded goods (goods that cannot be sold at locations distant from where they are produced) in the consumer basket (Balassa and Samuelson 1964), product differentiation, inclusion of value added taxes in some countries, different consumer basket, different factor endowment, differences in profit margins due to competition, failure of nominal exchange to adjust to relative price-levels shocks and sticky nominal price-level (Rogoff 1996, Cecchetti, et.al 2002 & Morshed, et.al, 2009).

The frequent failure of the PPP led to investigations on the Law of One Price (LOP). LOP constitutes the basis of the theory of PPP with the assumption of no arbitrage and exchange rate fluctuations. According to the LOP, the prices of identical products in the same currency should be identical in all locations. The LOP plays a significant role in macroeconomic models. With

[1] Since short term exchange rates are highly fluctuating, the PPP puzzle states that if the exchange rates are so volatile why it takes so long for them to converge.

the use of data of a city or province within a country the “intranational price behavior” was examined.

Recently engaging the multivariate tests, researchers have found that relative prices within the same country are mean reverting. Mean reversion is a theory which stats that the prices may deviate from the mean or average after a shock hits but will move back towards the mean or average eventually. In presence of mean reversion or price convergence, prices do differ but after an exogenous shock prices tend to converge towards a mean value. This mean or average can be a historical average of the prices. If there is a deviation it tends to dampen out with the passage of time (Cecchetti, Sanora and Mark, 2000, Chen and Devereux, 2003, Morshid, Ahn and Lee, 2005, Nath and Sarkar, 2009). Later selection of numeraire (bench mark) city was also considered to affect the convergence rate (Chmelarova and Nath, 2010).

The price index at intranational level is expected to be homogeneous because within a country, the trade barriers and exchange rate volatility are not present. However, these two factors cannot capture price dispersion entirely (Engel and Rogers, 2001). On the other hand, since the Consumer Price Index (CPI) includes non-traded goods as well, the presence of these goods may also result in divergence from LOP. Balassa and Samuelson have used services as non-traded items as they consider labor to be perfectly immobile. According to them another factor that hampers prices to converge is the difference in productivity of growth among sectors. Productivity growth is the rate at which goods and services are produced i.e. output per unit of labor. The internal price structure of a country can be altered if there are differences in the growth of productivity of the two sectors i.e. tradable goods sector and non-tradable goods sector. This means that differences of productivity growth of the two sectors will lead to inflation differentials within a country known as the “Harrod-Balassa-Samuelson effect”. The productivity

growth in the tradable sector causes an increase in general wages. Due to slower productivity development in the non-tradable sector, the non-traded goods prices will increase (Manuela NENNA, 2001). Furthermore, illegal trade has also been considered as a hindrance for convergence (Sharif et al. 2000).

Transportation costs also affects the rate of convergence by causing the relative prices between adjacent regions to converge quickly as compared to the regions that are far away, as regions that are nearby face low costs while moving goods between them . Krugman and Obstfeld (2009) consider transportation cost and market segmentation as sources of divergence from PPP. More recent studies as by Natalie Hegwood and Hiranya K. Nath (2012) consider structural breaks as a source to slow the speed of convergence. They found that by accounting for structural breaks the convergence rate is much higher than that estimated by previous panel studies which do not account for structural break.

Examination of convergence of relative prices provides an important insight of market integration reflecting how changes in one market are transmitted to another (Fan and Wei, 2002 and Na li, 2006). Richardson, 1978 argues that LOP is a test of market integration. Market integration is basically an indicator which explains how well different markets are related to each other. It occurs when prices of related goods among different markets follow similar patterns over a long time and provides important information on the efficiency of markets. The government uses such information to decide the extent to which it should promote market development.

Market integration is of three types, inter-temporal, vertical and spatial. Inter- temporal relates to the arbitrage process across periods, while stages in marketing and processing channels are related to the vertical integration. Spatial integration is concerned with the integration of spatially

distinct markets. If price changes in one market are completely transmitted to another market then these markets are said to be spatially integrated (Goodwin and Schroeder, 1991).

The overall market performance has been widely analyzed by the spatial market integration of agricultural products (Faminow and Benson, 1990). When markets are spatially integrated, the competition among arbitragers will guarantee a unique equilibrium where the market prices differ by no more than the transaction and transportation cost. Sexton, et al. (1991) suggests that spatial market integration is an indication of effectiveness of arbitrage, competitiveness and efficiency of pricing.

In developing countries like Pakistan, efficient functioning of market is subject to several impediments such as difficulties in evaluating market information, government monopoly over marketing system, insufficiency of transportation infrastructure, restriction on movement of goods between regions, price fixing etc. In presence of such hurdles, markets will not be well integrated which could distort the price signals leading to inefficient allocation of resources (Tahir and Riaz, 1997).

The economy of Pakistan largely depends upon the agricultural sector which contributes about 21 percent to the GDP. The food consumer price index constitutes 40 percent of the overall CPI (Janjua, 2005). Market integration of agricultural products is of massive importance due to its potential application in policy making. The high degree of market integration means that the markets are competitive and there is no need of costly govt. intervention to enhance the market efficiency. Due to the transmission of incentives across the marketing chain, market integration leads to price stabilization. If the markets are highly integrated government will maintain stable prices in all the markets by stabilizing them in the key market. Arbitrage forces will ensure

stabilization of prices in other markets. Thus, market integration reduces the cost of stabilization immensely.

Even though the literature on market integration is limited in case of Pakistan, studies reveal that the markets are well integrated. Most studies are confined to food/ agricultural products. Lohano, Mari and Memon (2005) analyzed the onion market integration in four regional markets i.e. Hyderabad, Quetta, Lahore and Peshawar for the period of 1979-2004. Unit root test showed that prices were stationary in each location and results of the error correction model revealed that the onion markets are spatially integrated. Further in 2006 Mushtaq, et al. empirically tested the degree of integration in rice markets of Punjab by using the LOP framework and Cointegration analysis. Six major markets of Punjab i.e. Lahore, Gujranwala, Multan, Rawalpindi, Sargodha and Rawalpindi were analyzed over the period of 1995-2003. Results indicated that the rice markets are strongly integrated and converge to long run equilibrium. Later other food markets as Wheat, Maize, Apple, Mango and Gram were also found to be integrated among Pakistani markets (Zahid, Qayyum and Malik, 2007, Mukhtar and Javed, 2007, Mushtaq and Dad, 2008, Ghafoor, et al. 2009, Hussain, et al. 2010).

Apart from individual products the overall CPI also provided evidence for spatial correlation. Recently convergence of relative prices between cities has been tested as a measure of market integration. Mohsin and Gilert (2010) using CPI data of 35 cities over the period of 2001-2008, tested the relative price convergence by keeping Lahore and Karachi as the numeraire. The estimates of Spatial GLS revealed that the price shocks die out in a period of less than 5 months. They found that cities were more spatially associated with Lahore than with Karachi.

Looking at the previous findings we can conclude that food markets are well integrated among Pakistani cities, but do all the components of the CPI behave in the same way? Are the market

for services (non-traded items) also well integrated among the Pakistani cities as the market for consumer products?

1.3 Significance of Study

Relative price convergence among cities within the same country has gained much importance over the years mainly for two reasons. Firstly, factors causing the breakdown of PPP like fluctuations in nominal exchange rate, trade barriers, heterogeneous baskets of consumption which are used in the construction CPI are not significant while dealing with the prices of the same country. So the deviation from the LOP can be better explained by using city wise price data. Secondly, an examination of price differentials across cities is useful to explain provincial/regional growth. The relative price dynamics imply differences in inflation rates between cities. Since the inflation rate determines the level of real wages as well as the real interest rates, so the movements in the relative prices cause differentials in the real wage rates and real interest rates between cities, following influences on the direction of labor flow and capital flow respectively.

Pakistan being a developing as well as a high inflation country (at least after 2005) is expected to provide evidence for PPP Hypothesis. According, to Inflation Monitor, State Bank of Pakistan (2011), the overall consumer price index (CPI) inflation rose to 13.2% on YOY basis till March, 2011. The city-wise inflation level at the major cities indicates that the inflation in Peshawar and Lahore is highly persistent (existing for a long or longer than usual time). Out of 35 cities in the CPI, 23 cities showed higher inflation than the overall inflation rate (Inflation Monitor, State Bank of Pakistan 2011). The geographic location of Pakistan is also of great significance as its entire provinces share an international border like Punjab and Sindh with India, Khyber

Pukhtunkhwa with Afghanistan and Baluchistan with Iran, Afghanistan and China. Across these boarders there is some evidence of illegal trade which could lead to price divergence and inflation across cities within the country (Mohsin and Gilbert, 2010 and Sharif, et al. 2000 and Khan, 2005).

The purpose of this study is to assess the market integration among Pakistani cities. Previous studies have focused on the convergence behavior of aggregate prices across different cities in Pakistan. Since the proper functioning of a market economic system requires that the prices for a homogenous good eventually converge across different markets this empirical test can serve as a direct check on how well the market system performs in Pakistan. Taylor (2001) has demonstrated that convergence can be underestimated if researchers use low frequency data. The use of overall CPI is subject to aggregation bias which results in long estimated half-life. This study uses disaggregated monthly data that is more frequent than the quarterly or annual data fixing for the aggregation bias caused by use of low frequency data. It also corrects for the Nickell bias which causes the serial correlation coefficient to bias downwards in small samples.

In addition this study examines the effect of non-tradable goods on price differentials. Although the "*Harrod-Balassa-Samuelson effect*" has been tested for a number of developed countries but as we know that there is a great difference between economic conditions across developed and developing countries like Pakistan, those results cannot be generalized to draw conclusion in our case. To capture this effect the CPI goods are segregated into tradable sector and non-tradable sector.

1.2 Objectives

Keeping in view all of the above discussion it is much needed to determine the factors which are not much explored in previous research related to Pakistan, mainly the role of non-tradable goods in relative price dynamics. Following are the main objectives of this study:

1. To investigate the relative price convergence among different cities in Pakistan.
    - To examine whether commodity prices converge across Pakistani cities.
    - To examine commodity wise speed of convergence among Pakistani cities.
2. To study the convergence behavior among tradable and non-tradable goods, whether speed of convergence in the case of tradable goods is higher than non-tradable goods.
3. To examine the impact of distance on intercity price differentials.

1.4. Organization of the Study

Chapter 2 deals with the literature review, chapter 3 explores the theoretical model, while chapter 4 discusses the data and estimation techniques. The estimated results are reported in chapter 5 and chapter 6 deals with the conclusion derived from the estimated results.

Chapter 2

REVIEW OF LITERATURE

This chapter provides detailed overview of literature on price convergence. Study after study, there is enormous literature that checks the deviations from LOP within a country and across countries. However different dimensions have been used to gauge price convergence. The vast literature has been segregated on the basis of these dimensions as follows:

2.1 Price Convergence across Countries

At international level the study of Law of one price and the PPP has a long history. Here it is divided into two main groups on the basis of nature of data.

2.1.1 Data

Price dynamics have been tested using micro as well as macro data. Here micro data refers to the individual goods prices while the macro data deals with the aggregate prices of goods.

2.1.2 Micro Data

Studies dealing with micro data focused either on individual good or a subset of goods in a CPI basket. *Cumby* (1996) examined the deviations from Big Mac parity using the prices of Hamburgers. He found that the deviations were temporary with a half-life of 1 year. *Crucini, Telmer and Zachariadis* (1998) used retail prices for a broad group of goods and services for the European Union countries. They found that product heterogeneity plays a significant role in price dispersion. Again in 2001, they characterized factors that caused dispersion as tradability, non-traded inputs into production, brand differentiation and price discriminations across locations.

Following similar pattern *Haskel and Wolf (*2001) examined absolute prices of more than 100 identical goods produced by IKEA for 25 countries. Their findings were in accordance to mean reversion. *Crucini and Shintani* (2004) working on similar lines used prices of micro-panel of 270 goods from 71 countries and 245 goods from 13 U.S. cities. The half-life of deviation was about 1 year or less.

Goldberg and Verboven (2004) measured price dispersion by means of car prices in Europe. They identified three potential sources causing international price differentials: costs, import quota constraints and difference in markup due to price elasticities. Strong bias for domestic bands in Italy derived the prices high. While in U.K., better equipped cars became the source of high prices. The half-life was estimated to lie in the range of 1.3 to 1.6 years. Emphasizing the role of branding the price dispersion in European countries was again investigated by *Imbs, Mumtaz, Ravn and Rey* (2009) using a unique data set of television prices. Quality of the product, exchange rate volatility in accordance to border effect and perception about brands were found to be creating international price volatility. Their results showed that countries within EMU displayed sizably less price dispersion than countries outside the monetary union.

Burstein and Jaimovich (2008) found evidence of large volatility in relative prices of internationally traded products. At the level of individual products, international relative prices were found to be roughly 3 to 4 times as volatile as the U.S.-Canada nominal exchange rate at quarterly frequencies. They came to the conclusion that border played a significant role by segmenting the competitors across countries.

2.1.3 Aggregate Data

Both distance and border matters for relative price variability. *Engel and Roger (1996*) examined the behavior of price deviations across borders using CPI data for 14 categories of consumer prices of Canadian and U.S. cities. The variation of price was much higher for cities located in different countries than for two equidistant cities in the same country. Meaning, the "border effect" led to the failure of LOP. The border coefficient was measured to be 75,000 miles.

The border effect research has been further extended by *Engel &Rogers* (2000, 2001a, 2001b), *Parsley & Wei* (2001), *Depken & Sonora* (2002), *Cheung & Fujii* (2005), *and Crucini et al.* (2005). The border effect estimated with price data was significantly large. Exchange rate variability, unit shipping cost and distance accounted for international market segmentation.

The study by *Morshed* (2002) showed that distance and border played a significant role in price variability between Bangladesh and India using disaggregated data for 5 Bangladeshi and 19 Indian cities. They came to the conclusion that exchange rate variability and presence on nontraded goods in CPI are not able to explain the large border effect in developing countries.

Later in 2006, *Yin-Wong Cheung and Kon S. Lai* re-evaluated the border effect using decomposition of relative price volatility. There were mainly two reasons identified for the occurrence of border effect: (a) sticky prices accompanied with fluctuating exchange rates (b) cross border relative prices are driven by dissimilar, as opposed to common shocks than are within-country relative prices.

Recently, *Gorodnichenko, Yuriy, and Linda L. Tesar (2009)* argued that the border effect is entirely due to the heterogeneity in the distribution of within-country price differentials across countries named as the "country heterogeneity effect". So difference in price distribution within countries causes the price variations across borders. Adjusting for cross-country heterogeneity

they estimated two border coefficients. From the U.S. perspective the border distance was 47km and from the Canadian perspective it was found to be 108 million km. However, the impact border effect could not be completely identified as the coefficients reflected a combination of the border effect and the cross-country heterogeneity effect on trade prices.

2.2 Price Convergence Within countries

The issue of price convergence within a single country has gained massive attention over time. The convergence rates within single economy are substantially higher than across borders. The vast literature has been summarized as follows:

2.2.1 Segregation of commodities

Many researchers have studied convergence by dividing the commodities in different groups. *Parsley and Wei* (1996) decomposed the whole set of 51 goods and services into 2 groups of tradable goods (41) and non-tradable goods (10 mostly services). Further they classified the tradable category into perishable goods and nonperishable (storage goods). The perishables goods included dairy products, fruits and vegetables. They found that the tradable goods converge towards parity with a high speed. For fried chicken and corn flakes the half-life of the deviation was estimated to be four to five quarters. While for non-tradable goods (services) the half-life was fifteen quarters. They also concluded that convergence rate for far away locations, was slower. They also corrected the data for possible measurement error and tax differentials, but their conclusion wasn't affected.

2.2.2 Monthly data

Adopting the same approach *Wei and Fan* (2002) used high frequency monthly data instead of quarterly data and estimated convergence in case of Chinese economy. They grouped 86 products into four categories (i) Agricultural products (26) (ii) Industrial products (32) (iii) Other consumer products (16) and (iv) Services (12). Prices for almost all the products in the dataset converged. Using high frequency data the results were consistent with theoretical study by Taylor (2001), in which he purposed that failure to use high frequency could cause a bias and lead to non-convergence.

Li and Haung (2006) examined the dynamics in 42 province-level indices along with wage and unemployment rate within Canada. The average speed of convergence of the CPI subgroups was found to be less than half a year fluctuating across CPI items. They found no market segmentation in case of labor and capital as well.

Lee and Habibullah (2008) assessed the market integration within Malaysia using disaggregated monthly prices of various types of goods and services. They checked the stationarity of prices among three provinces/states: Peninsular Malaysia, Sabah and Sarwak. They divided the goods and services in nine groups and tested for the existence of Harrod-Balassa-Samuelson effect. It was found that the convergence rate for the tradable category was much higher than for the non-tradable category, having a half-life of 1-2 years. While in case of non-tradable goods the half-life was computed to be10 years.

Lan and Sylwester (2010) used 2 estimation methods to examine the price divergence in China. For examination of individual goods they used the fixed effect method. While for the examination of all the products simultaneously included in the panel they used the mean group

estimation specification. For the individual goods the half-life was 2.95 months while with the mean group estimator implied a half-life of 1.72 months.

2.2.3 Pair-wise Approach

To overcome the problems of heterogeneity and cross sectional dependence across city pairs a new technique was used. *Ghauri, Qayyum and Arby* tested the convergence of relative prices across 35 cities of Pakistan using the technique suggested by *Pesaran* (*Pesaran* (2004) purposed a pair wise approach to test output convergence that took N/N-2 possible pairs of log per capita output deviations across N economies). By using such a method the problem of arbitrary benchmark was also solved. A dataset of 92 commodities was divided into two groups i.e. food group which included 40 items having weight of 40.34 percent and non-food group including 52 items weighing 59.66 percent. There were 595 relative price pairs out of which 33 percent belonged to the same province. The speed of convergence for the food group was 3 months while, for non-food group it was 20 months. As a result the speed of convergence for the whole basket of goods was 8 months. They also examined the dynamics of relative prices within and across provinces and concluded that distance along with location accounts for dispersion.

Testing bilateral price-level convergence by using the similar technique *Yazgan and Yilmazkuday* (2010) found strong evidence supporting convergence among 52 U.S. cities. The convergence rate was much quicker as compared to the previous studies on price convergence among U.S. cities. The half-life for all types of goods was 1.64 quarters. Traded goods showed a faster convergence with half-life of 1.37 quarters of perishable goods, while non-traded goods had a slower rate of convergence with half-life of 2.75 quarters.

Mohsin and Gilbert (2010) studied the convergence of relative prices among 35 Pakistani cities checking for spatial correlation. The average half-life was estimated to be 5 months using GLS and 6 months using OLS keeping Lahore and Karachi as the numeraire cities but in case of individual cities it varied from 1.3 months to 68 months. Pakistani cities were found to be more spatially associated with Lahore than with Karachi as the half-life of a price shock with Lahore as the numeraire city was lower than with Karachi as the numeraire.

Nenna (2001) studied the presence of Harrod-Balassa-Samuelson effect in the divergence of relative prices across Italian cities. By choosing Rome as the numeraire city he found that the relative prices are mean reverting but the convergence rate was very slow. They gave two explanations for the persistence of deviation, arbitrage impediments and HBS effect. The prices of tradable goods, non-tradable goods and relative prices were stationary with a deterministic trend but the level of persistence was high. The deviations from LOP were more persistent in case of non-tradable goods. The half-life in case of non-tradable goods was estimated to be 10.79 years while for tradable goods it was 9.16 years. While for the average CPI it was 6.51 years.

2.2.4 Aggregate Price Index

Cecchetti, Mark and Sonora (2000) examined convergence of price levels among the cities of the United States. They suggested that monetary policy makers are concerned with aggregate inflation instead of individual commodity prices, so they focused on the behavior of aggregate price indices. They tried to get an insight of the price dispersion in the European Union by studying the price behavior in the U.S. cities. They used a large sample of 78 years and the estimated half-life of convergence was approximately 9 years. The deviations were found to be persistent. They suggested three reasons that could slow down the speed of inter-city price

convergence: transportation cost, non lineraties causing lower adjustment to smaller shocks than to large ones and presence of non-traded goods in the overall CPI.

Further in 2007, *Nath and Sarkar* extended the work of *Cecchetti* by correcting for the time aggregation bias and small sample bias. The estimated half-life was 7 years only two years shorter than the one estimated previously.

Using the aggregate price index data *Fan, Ma and Wei* (2007) examined the market integration in China. Extending the study by *Cecchetti, Mark and Sonora* they tested whether price convergence follows a linear pattern by applying a nonlinear unit root test by *Kapetanios, Shin and Snell* (2003). They found strong evidence for convergence among 36 major cities of China. In case of linear convergence the half-life was about 6 to19 months while in nonlinear case it was 6.6 to 24 months.

Morshid, Ahn and Lee (2005) examined the price dynamics in 25 Indian cities using a Cointegration technique to derive the common trend. They found that common trends were closely related to the overall CPI. They decomposed the effects of a shock into common trend effect and stochastic trend effect. Using impulse response functions the rate of convergence to the stochastic trend was found to be around 3 months.

2.2.5 Actual Prices

Cheung and Fujii (2008) used actual prices instead of price indexes and examined the product specific distribution of LOP deviations across 67 Japanese cities for 86 consumer products. Their results contradicted the findings by *Crucini and Shintani* of tradability enhances convergence. The deviations from LOP displayed a nonlinear trends that were not linearly related to the products tradability. Average deviation of the Japanese products from LOP was found to be 10%.

Iregui and Otero (2008) tested the LOP in food market in case of Colombian cities using disaggregated data of food products. Little evidence of convergence was found using the univariate KPSS test. However, when the cross sectional dependence was allowed in a panel context, by the use of a large data set of thirteen cities and fifty four food items, the Hadri test provided evidence of market integration in case of food market.

The analysis by *Ceglowski* (2003) provides evidence that inter-city price differentials in Canada are significantly affected by provincial borders even though the effects of distance are controlled for. However the retail prices do converge to parity in the long run. The short run deviations were found to have half-lives of less than a year. They gave a number of reasons creating the provincial border effects including provincial tax differences, provincial trading networks and geography. Their analysis led to the conclusion that there is a positive link between distance and price disparity suggesting that price effects of distance cannot be entirely captured by intercity measures.

2.2.6 Structural breaks:

"*Structural change is pervasive in economic time series relationships, and it can be quite perilous to ignore. Inferences about economic relationships can go astray, forecasts can be inaccurate, and policy recommendations can be misleading or worse."*

Bruce Hansen, 2001.

Sanora (2009) examined the behavior of relative prices across 19 U.S. cities with the help of a unit root test process. With the incorporation of structural breaks, he found that the mean half-life falls in the range of 1.74 to 2.96 years.

Basher and Silvestre (2010) reexamined price convergence among U.S. cities accounting for the structural breaks in the data. 5 breaks were incorporated: 1929 Great Depression, World War II, Collapse of Bretton Wood system 1971, the oil shocks 1973 and 1979, the great moderation and the early 1990's economic crisis. They performed a pair-wise analysis to compute the half-life estimates. The median half-life of convergence was estimated to be in the range of 1.5 to 2.6 years.

Hegwood and Nath (2012) further examined the price index convergence among the 17 major U.S. cities. Their results indicated convergence among cities by allowing for structural breaks, a single endogenously determined in the year 1985 and two breaks in 1943 and 1990. Their results gave a half-life of 2.8 years after correcting the bias for small sample and time aggregation, allowing for 2 breaks. This speed of convergence was found to be 74 percent faster than that estimated without involving a bias correction and structural break.

2.2.7 PANIC Approach

Bai and Ng (2004) gave the approach of panel analysis of non-stationarity by decomposing each series of the panel in the idiosyncratic and common component. The unit root test hypothesis is tested separately for both components in this analysis.

A few studies have examined the price convergence using this technique. *Das and Bhattacharya* (2004) tested the stationarity of prices across Indian regions by decomposing each series into a set of common and idiosyncratic components. Both were found to be stationary. However, the price shocks in the idiosyncratic factor were found to be more persistent than the ones in the common factor.

Dreger and Kosfeld (2007) explored the price index convergence in 439 German districts. The non-stationarity was found to lay in the common component. There were two explanations given

for this outcome, one was the west-east segregation in consumer prices and second was the price difference between urban and rural regions.

Chmelarova and Nath (2009) explored weather the choice of numeraire city matters for price convergence using the same approach. They used annual data of Consumer Price Index for 17 U.S. cities and found strong evidence of convergence in relative prices keeping Atlanta, Chicago and Los Angeles as the numeraire city. They estimated the half-life with different numeraire cities to investigate the implication of the choice of numeraire city. These estimates varied depending on the choice of numeraire city. Keeping some cities as numeraire stationarity was found to be in the common factor, while for others it was found in the idiosyncratic factor. Their results suggested that the choice made for the selection of the bench mark city plays an important role in the dynamic behavior of relative prices.

2.3 Summary and conclusion

After having analyzed the work done so far on price convergence in case of Pakistan, it can be concluded that the research is limited to the similar kind of data used to test for price convergence. In case of Pakistan mostly CPI data has been used to study the deviations from the Law of one price. Ghauri, Qayyum and Arby (2013) have used the sub groups of the CPI; however the individual items have not been tested separately for the rate convergence. Due to the differences in the transport cost, tradability or market competition the rate of convergence is not the same for all the items. Imbs et al. (2005) showed that using aggregate prices cause the speed of convergence to bias downward.

Moreover the prices of services as well as energy goods have been ignored in analysis of the price dynamics. As the services and energy goods also constitute a part of the Consumer Price Index, their prices will also affect the convergence behavior of the CPI. So their individual prices should be analyzed separately. Services are termed as non-traded items on the international level. Studying their price dynamics will help us to examine how the non-tradable goods affect the price convergence among Pakistani cities. Research including the non-traded items mostly services has been done in developed economies ignoring the emerging and transiting economies, hence the results of these studies cannot be generalized to our economy.

Chapter 3

Theoretical Background

3.1. Law of One Price

The LOP states that:

"In the absence of frictions such as shipping costs and tariffs, the price of a commodity expressed in a common currency is the same in every country" (A.Moosa, 2003). The LOP can be expressed as:

$$P_i = SP_i^* \qquad (3.1)$$

Where P is the domestic price of the i_{th} commodity and its foreign price is P_i^*. S is the exchange rate which is defined as the number of units of domestic currency per unit of foreign currency. The driving force behind the LOP is the commodity arbitrage. Arbitragers tend to equalize the price of a commodity by buying it from a market where it is cheap and selling it at a place where its price is high.

3.2. Purchasing Power Parity

LOP forms the basis of the PPP assuming no arbitrage and no exchange rate fluctuations. Basically the PPP is a generalization of the LOP. The idea of PPP was instigated in the school of Salamanca during the 16^{th} century. It was developed in the modern form by Gustav Cassel. The theoretical debate on PPP started in the beginning of the 20th century and the conceptual idea was born even earlier (Taylor and Taylor, 2004). According to PPP, the aggregate prices across countries should be the same once converted to the same currency. While the LOP takes prices on the individual level, PPP determines the relationship the exchange rates and general price

levels at a specific time. The difference is that the concept of LOP considers the actual prices while PPP considers index of prices for different goods. PPP assumes that the LOP holds for every single commodity. If the LOP holds for every commodity in the reference basket of countries then PPP holds automatically. However, advocates of the PPP theory claim that for the confirmation of PPP in the long run it is not necessary for the Law of One Price to hold.

PPP stresses that even if there is a failure of LOP to hold, the purchasing power of currencies in all the countries tend equalize due to the economic forces. When the prices of goods and services become high in one country relative to other countries it causes the demand for its products and currency to fall, causing the prices and exchange rate to revert back to the PPP. The reverse happens in case if the prices are relatively cheap.

3.2.1 Absolute PPP

The absolute or strict PPP "equates the national price level in two countries expressed in a common currency at a particular rate in such a way that the purchasing power of one unit of currency would be the same in the two countries" (Hakkio, 1992). To align the relative prices of goods in a common basket by quoting them in the same currency the absolute version of PPP depends on a world economy that is perfectly competitive.

. For n commodities the PPP can be expressed as

$$\sum_{i=1}^{n} w_i P_i = S \sum_{i=1}^{n} w_i^* P_i^* \qquad (3.2.1)$$

Where w_i is the weight of the i_{th} commodity in the domestic price level and w_i* is its weight in the foreign price level. If the weights assigned to the identical commodities are same across countries then the equation becomes:

$$P = SP^* \qquad (3.2.2)$$

Here P and P* are in terms of general price levels rather than prices of individual commodities. The absolute PPP assumes that in the absence of all the resistances the prices of goods present in the common basket of two countries will be equal when converted to the same currency. But, the problem with the absolute PPP is that it may not hold accurately due to transportation costs, imperfect information, exploiting tariffs (or quotas), different years being taken as base and different price index weights (*Hakkio,*1992). Mostly while testing PPP the consumer price indices is used which include the sale tax or value added taxes and these taxes lead to the failure of absolute PPP (*Jenkins*, 1997).

3.2.2 Relative PPP

The relative PPP is an implication of the absolute PPP. It states that the percentage change in the exchange rate between two currencies over any period equals the difference between the percentage changes in national price levels. So the Relative PPP expresses the Absolute PPP in terms of changes in prices and exchange rates. It asserts that the changes in prices and exchange rates are such that the purchasing powers of the currencies remain the same. The relative PPP relaxes some of these restrictions and works smoothly as compared to absolute PPP. The absolute PPP requires the real exchange rate to be equal to one, while the relative PPP doesn't impose such restriction on the real exchange rate and requires only the changes in the relative prices to be proportional to the changes in the nominal exchange rates (*Pilbean, K. Book, Oskooee and Brooks* 2006 and *Zdareck* 2010). Many economist favor to test relative PPP as it is less restrictive.

$$S_t/S_0 = (\sum_{i=1}^{N} \alpha_{it} P_{it} / \sum_{i=1}^{N} \alpha_{i,0}^{*} P_{i,0}^{*}) \div (\sum_{i=1}^{N} \alpha_{it}^{*} P_{it}^{*} / \sum_{i=1}^{N} \alpha_{i,0}^{*} P_{i,0}^{*}) \qquad (3.2.3)$$

Where the relative changes in the nominal exchange rate are proportional to the ratio of relative change in domestic price level to relative change in foreign price level.

3.3 Balassa Samuelson Hypotheses

Bella Balassa and Paul Samuelson (1964) identified a significant factor which causes flaws in the PPP. According to Balassa Samuelson hypothesis productive countries or advance economies suffer from higher price levels. Difference in inflation among countries results from productivity differential between non-traded and traded goods sector. Earlier in 1933, Harrod had also argued that the non-tradable items were a major source causing deviations from the PPP. The basic idea behind Balassa Samuelson proposition is that wages and price levels are higher among developed countries. Spillover effects from trade when less developed countries start trade with developed countries causes wage and productivity of less developed countries to rise in tradable goods sector due to stronger convergence of productivity levels among the traded goods sector. While labor mobility between sectors leads to rise in wages of non-traded good sector of catching up economies to avoid worker flight from non-traded product sector, hence slower productivity growth and higher wages in this sector leads to increase in overall price level causing rise in overall inflation. Thus as less develop country start trade with a developed country then after trade less developed economy experiences higher inflation rate.

Balassa and Samuelson also examined the impact of PPP deviations on inter country incomes. They empirically showed that the real price structure is correlated to the per capita income. They concluded that low per capita income of a country implies low domestic prices of services.

Samuelson and Balassa showed that the internal price structure within a country is altered due to the difference in productivity growth of the two sectors i.e. tradable goods sector and non-tradable goods sector. The relative price dynamics of non-tradable goods reflect deviating trends of productivity in the two sectors.

3.4 The Balassa Samuelson Model

Balassa made the assumption of a two country, two commodity world with one scarce factor labor and constant technology. To illustrate the basic proposition of Balassa Samuelson model we present the model in a more generalized setting as by Asea and Corden (1994), extending the model for multiple factors of production and adjusting it for a single country.

Consider a small open economy having two factors of production labor and capital. Both are perfectly mobile within a country whereas internationally, only capital is mobile. At full employment:

$$L = L_T + L_N \qquad (3.3.1)$$

Where, L_T shows the labor in tradable sector and L_N is the labor in the non-tradable sector.

The output in the tradable sector is given as:

$$Y_T = \theta_T + K_T^{\beta_T} L_T^{\alpha_T} \equiv \theta_T L_T f(k_T) \qquad (3.3.2)$$

While in the non-tradable sector it is given as:

$$Y_N = \theta_N + K_N^{\beta_N} L_N^{\alpha_N} \equiv \theta_N L_N f(k_N) \qquad (3.3.3)$$

Here Y_T = Output in the tradable sector,

Y_T = Output in the non-tradable sector,

$$k_T \equiv \frac{K_T}{L_T}, \quad k_N \equiv K_N / L_N$$

and θ_T θ_N are productivity parameters.

The interest rate of the world is taken as given which is the marginal product of capital in each sector.

$$i = \theta_T \beta_T k_T^{(\beta_T - 1)} \quad (3.3.4)$$

$$i = s\theta_N \beta_N k_N^{(\beta_N - 1)} \quad (3.3.5)$$

where $s = P^N/P^T$ (relative price of the non-tradable goods).

Solving equation (3.3.5) for capital-labor ratio in the tradable sector gives us:

$$k_N = \left(\frac{s\theta_N \beta_N}{i}\right)^{\frac{1}{1-\beta_N}} \quad (3.3.6)$$

Assuming linear homogeneity, the wage rate in the tradable sector can be given as:

$$w = \theta_T\{f(k_T) - f'(k_T)k_T\} \quad (3.3.7)$$

$$= \theta_T(1 - \beta_T)k_T^{\beta_T} \quad (3.3.8)$$

Solving for k_T from equation (5) and substituting in equation (8) gives us:

$$w = (1 - \beta_T)\left(\frac{\theta_T \beta_T}{i}\right)^{\frac{\beta_T}{1-\beta_T}} \quad (3.3.9)$$

Equation (3.3.8) clearly shows the wage rate in a small open economy is determined by the productivity of the factors in the tradable sector. The relative prices for the non-tradable goods can be derived by solving equation (3.3.3), (3.3.5), (3.3.8) and (3.3.9).

$$\hat{s} = \alpha_N \hat{w} - \hat{\theta}_N$$

$$\hat{s} = \frac{\alpha_N}{\alpha_T}\hat{\theta}_T - \hat{\theta}_N \quad (3.3.10)$$

Here hat above the variables denotes the percentage change of the variables. Equation (10) shows the relative prices in the non-tradable sector depends upon the difference of productivity between the two sectors of tradable and non-tradable items. An increase in θ_T holding θ_N constant will cause an increase in the real wage leading to a rise in the relative prices of non-tradable items.

3.5 Summary

So the Balassa-Samuelson model may be summarized as:

i. The differences in productivity of the two sectors of tradables and non-tradables determine the relative prices of the non-tradable within a country.
ii. The relative price differentials of the non-tradable items cause deviation from the Purchasing Power Parity.

Both Balassa and Samuelson refer to the non-traded goods as services as they consider labor to be perfectly immobile. For testing the Harrod-Balassa-Samuelson effect within Pakistan we are also going to include the prices of energy goods in the non-tradable items along with the prices of individual services. We will examine whether their prices diverge across the cities in Pakistan and how the price dynamics of the non-traded items effect the deviations from the LOP.

Chapter 4

DATA AND METHODOLOGY

This chapter provides the analytical framework for empirical testing of the objectives formulated in chapter 1.

4.1. Data and Sample Selection

The data employed is taken from Monthly Bulletin of Statistics published by Government of Pakistan, Statistics division, Federal Bureau of Statistics. Monthly city wise data[2] on prices of individual commodities and services from the period 2001-2013 is used. These individual commodities are selected from the monthly Sensitive price index (SPI) through three criteria's i.e. for each commodity, wide coverage in terms of availability across cities and time, variation in the degree of tradability of the commodities and homogeneity of the commodities over time as in Parsely and Wei, 1996. The services data is taken from the Consumer Price Index (CPI).The cities are selected according to the criteria used in SPI acquired from the monthly statistical bulletin of federal bureau of statistics. For the analysis monthly data is used as it is considered to be a high frequency data and results are to a great extent accurate in the context of objectives (Fan &Wei, 2006 and Wimanda, 2009, Taylor, 2001).We have taken all those commodities which are highly used in the private consumption representing higher weights in the consumer expenditure and their prices are sensitive to shocks. The commodities and services are categorized as tradable and non-tradable goods (as in Parsely and Wei, 1996). Tradable goods are further categorized as perishable and non-perishable goods while the non-tradable goods. We

[2] Excluding the products, services and energy good prices whose prices completely converged among all the cities.

are not using the consumption basket. This data covers the monthly price information for 23 products and 5 services of 17 cities for the period of July 2001 to June 2013. The list of cities, products, services and energy goods is given in the Appendix table A.1 and A.2. All the product definitions in the data are specific and stable over time.

Briefly our sample contains prices of 12 perishable goods (chicken, beef, mutton, eggs, bread, milk, potatoes, onions, tomatoes, bananas, curd and garlic), 11 storage goods (wheat, rice, masoor pulse, moong pulse, mash pulse, sugar, salt, red chilies, lawn, shirting and washing soap) and 5 services (doctor, carpenter, mason, labor, plumber). The commodities and services whose prices completely converged to the mean prices (relative prices turned out to be zero), are excluded from the sample as testing convergence for these items is meaningless.

To investigate whether the distance which is a proxy for the transportation cost has any effect on the relative price convergence, we follow Engel and Rogers (1996), Parsely and Wei (1996), Cecchetti, et.al (2002) and Das and Bhattacharya (2004). The data for distance is taken from the site of Distance calculator of Pakistan. The distance used is the air distance in kilometres of city i from the numeraire city. Lahore and Karachi are kept as the numeraire cities. Lahore is the capital of Punjab and is considered as the central market for agricultural products. On the other hand Karachi is the capital of Sindh and is considered as the center of industrial and economic activity. Proportion of income tax collected from Karachi is the highest among all the cities. Both these are considered as the urban commercial centers with the highest populations.

4.2. Technique of Estimation

Price convergence is commonly examined by the application of a unit root test to check whether the series of relative prices are stationary. The time series of the relative prices is stationary if the unit root hypothesis is rejected. If the unit root hypothesis is not rejected it implies that the

relative prices follow a random path. The unit root test for a single time series as the Augmented Dickey Fuller (ADF) has low power in the sense that it is difficult to reject the unit root null when in fact it's false.

Levin, Lin and Chu (2002) provided statistical foundations for panel unit root test by multivariate generalizations of the ADF test. They revealed that by using panel unit root tests the power of the test is significantly increased. However, the Levin-Lin-Chu (LLC) imposes a cross section restriction on the first order autocorrelation coefficients. Correcting for this limitation Im, Pesaran and Shin (2003) put forward a unit root test that allowed the autocorrelation coefficients to differ across panel members.

As in the study of *Cecchetti, Mark and Sanora (2000)* we apply the panel unit root tests, LLC followed by the IPS test.

4.2.1. Relative Prices

In our empirical work, price variability is measured by the log price difference between a city's price for a specific product and the mean price of that product over all cities at a point of time. We calculate the relative prices for each city as:

$$r_{ist} = p_{i,s,t} - \hat{p}_{i,s,t} \qquad (4.2.1)$$

Where, r_{ist} is the log relative price in city 'i', $p_{i,s,t}$ is the logarithm of price of commodity 's' in city 'i' and $\hat{p}_{s,t}$ is the logarithm of the mean price of commodity 's' over cities in period 't'.

4.2.2. Levin-Lin-Chu test (LLC)

The Levin-Lin-Chu (2002) test simultaneously analyzes the stationarity of the relative prices across the cities. The test is based on the following equation:

$$\Delta \boldsymbol{r}_{i,s,t} = \boldsymbol{\alpha}_{i,s} + \boldsymbol{\theta}_t + \boldsymbol{\beta}_s \boldsymbol{r}_{i,s,t-1} + \sum_{j=1}^{k} \boldsymbol{\gamma}_{s,j} \Delta \boldsymbol{r}_{i,s,t-j} + \boldsymbol{\varepsilon}_{i,t} \qquad (4.2.2)$$

Where $\alpha_{i,s}$ is the city-specific constant that controls for the non-time dependent heterogeneity across cities and θ_t is the common time effect. γ_{ij} are the lag coefficients in the process characterizing r_{ist}, $\beta_i \equiv \rho_i - 1$ and $\rho_i \equiv \sum_{j=1}^{k} \gamma_{ij}$. Panel data analysis gives the advantage of accounting the two effects simultaneously. α_i reflects the heterogeneity across cities that is due to the income level and sales tax differences , while macroeconomic shocks that determine cross-sectional dependence in relative prices are captured by the common time effect.

The null hypothesis that each series contains a unit root is tested against the alternative of mean convergence.

Ho: $\beta i=\beta=0$

H_1 : $\beta i=\beta < 0$

Our analysis is based on the t-statistic provided by the LLC test. The number of lags for equation (1) is determined by using Modified Schwarz Information Criterion (MSIC) developed by Ng and Perron (2001)[3] on product by product basis for each product and city series.

4.2.3. Estimation of Half -life

The speed of convergence of the relative price behavior of the goods and services can be measured by half-life. Half-life is the time required for a divergence from PPP to dissipate by one half. If $\beta i \geq 0$, it means that that the deviations of the price differential $r_{is,t}$, of product 's' are persistent. If the value of βi is negative as well as significant it will imply that the prices converge. The value of βi defines the speed of convergence. The half-life for product 's' is calculated as :

$\boldsymbol{h(\rho)} = -\ln(2)/\ln(1+\beta_s)$.

Here, h (ρ) is the half-life.

[3] Ng and Perron (2001) gave a new methodology for the selection of lags for an AR variable in the presence of negative moving average errors.

4.2.4. Im-Pesaran-Shin test (IPS)

The IPS test extends the LLC test by allowing for heterogeneity in the value of β under the alternative hypothesis. The IPS test has more power than LLC according to Bowman (1998) and Maddala and Wu (1997). The test is bsed on the following equation:

$$\Delta \boldsymbol{r}_{i,s,t} = \boldsymbol{\alpha}_{i,s} + \boldsymbol{\theta}_t + \boldsymbol{\beta}_{i,s}\boldsymbol{r}_{i,s,t-1} + \sum_{j=1}^{k} \boldsymbol{\gamma}_{s,j}\Delta \boldsymbol{r}_{i,s,t-j} + \boldsymbol{\varepsilon}_{i,t} \qquad (4.2.4)$$

As in the LLC test, all our ADF specification includes constant terms to capture city specific fixed effects (city specific transportation cost and wage cost) and the common time effects. The IPS differs in the treatment of β_i under the alternative hypothesis, with H_1: $\beta_i < 0$ for some i. The number of lags for each product and city series is determined by using MSIC on a city by city and product by product basis.

Im, Pesaran and Shin designed the following t statistic:

$$Z = \sqrt{(t - E(t)/\sqrt{VAR(t)}}$$

Where t is the t-statistic and $t=(1/N)\sum_{i=1}^{N} t_i$; E(t) and VAR(t) are the mean and variance of t respectively.

The half-life is calculated as:

$$\boldsymbol{h(\rho) = -ln(2)/ln(1 + \beta_s)},$$

Where β_s is the average of all the Beta's across cross sections, $\beta s = \frac{1}{N}\sum_{i=1}^{N} \beta_{i,s}$.

4.3 Impact of distance on price differentials

Price differences between cities could be due to the transport costs. To analyze the impact of transport cost on the price deviations previous studies as Engel (1993), Engel and Rogers (1996), Parsley and Wei (1996), Cecchetti et al (1998) and Das and Bhattacharya (2004) all have used

distance as a proxy for the transport cost. We have also approximated the transport cost by distance from the numeraire city i.e. Lahore and Karachi. Lahore is the capital of Punjab and is considered as the central market for agricultural products. On the other hand Karachi is the capital of Sindh and is considered as the center of industrial and economic activity. Proportion of income tax collected from Karachi is the highest among all the cities. Both these are considered as the urban commercial centers with the highest populations.

Keeping Lahore and Karachi as the numeraire and using distance as the independent variable, we check the impact of distance by running the following regressions:

$$s.d.\left(r_{i,s,t}\right) = \beta \ln(distance) + dummies \quad (4.3.1)$$

$$\bar{r}_{i,s,t} = \beta \ln(distance) + dummies \quad (4.3.2)$$

Where $s.d.\left(r_{i,s,t}\right)$ is the price differential variability, measured by taking the standard deviation over time of the price differentials, $\bar{r}_{i,s,t}$is the mean absolute price differential that is calculated by taking the mean of the absolute relative prices ($\left|\ln\left(p_{i,s,t} - p_{j,s,t}\right)\right|$) over time and natural log of distance and product dummies are used as the independent variables. Here city "j" is the numeraire city. The product dummies are used to differentiate among the three groups of perishable, storage and non-tradable goods.

Chapter 5

EMPIRICAL RESULTS AND DISCUSSION

This chapter presents the empirical results. Stationarity for 23 products and 5 services of 17 cities is examined for the period of July 2001 to June 2013. The analysis is divided into three parts, section 5.1 deals with the data description, empirical results related to panel unit root tests are presented in section 5.2 and 5.3 presents the estimates of speed of convergence.

5.1. Data Description

It is important to see the nature of the data before carrying out panel estimations.

5.1.1 Summary Statistics

Summary statistics of the price differentials for the individual commodities and services is given in Appendix table A.3. Our benchmark is the cross sectional mean of prices over the cities. The natural benchmark for the relative prices ($\ln(p_{i,s,t} - \hat{p}_{i,s,t})$) is zero. However, the price differentials may differ from zero due to the obstacles in the arbitrage of goods and services.

According to Engel and Rogers (1994) and Parsley and Wei (1995) these price differentials are due to the arbitrage cost between cities. As the transportation cost increases the price differentials also tend to increase. They have approximated the transport cost by distance. It means that the transportation cost not only affects the variability of the price differentials but also the mean absolute deviation (mean over time).

Following Parsley and Wei we have defined the price differential variability as the standard deviation of the relative prices ($s.d.(r_{i,s,t})$) over time and mean absolute price differential as the

mean of the absolute relative prices ($\left| \ln(p_{i,s,t} - p_{j,s,t}) \right|$) over time. We take two cities Lahore and Karachi as the benchmarks.

Table 5.1 Summary Statistics keeping Lahore as the numeraire

Variability of Price Differentials	**Mean**	**Standard Deviation**	**Observations**
Perishables	0.044	0.029	192
Non-Perishables	0.047	0.032	175
Services	0.109	0.083	115
Mean Absolute Price Differentials	**Mean**	**Standard Deviation**	**Observations**
Perishables	0.060	0.039	192
Non-Perishables	0.059	0.051	175
Services	0.154	0.114	115

Taking Lahore as the numeraire city services have the highest variability of the intercity price differential among the three groups and also the highest mean price differential. We again check the variability of price differentials and mean absolute price differentials by taking Karachi as the numeraire city. Table 5.2 shows that perishables and storage goods display more variability of relative prices than services. However services have the highest average absolute differentials.

Parsley and Wei have linked the average price differentials and variability of price differentials with the cost of arbitrage activities. We therefore, examine the impact of distance on the intercity price differentials.

Table 5.2 Summary Statistics keeping Karachi as the numeraire

Variability of Price Differentials	Mean	Standard Deviation	Observations
Perishables	0.12	0.071	192
Non-Perishables	0.12	0.072	175
Services	0.11	0.074	115
Mean Absolute Price Differentials	**Mean**	**Standard Deviation**	**Observations**
Perishables	0.18	0.117	192
Non-Perishables	0.16	0.138	175
Services	0.19	0.153	115

5.2 Impact of distance on price differentials

The impact of distance is analyzed through cross-sectional regressions of the variability of price differentials and mean absolute price differentials on the log of distance and log of distance squared. Table 5.3 shows that the distance among the cities has a positive relation with the variability of price differentials for all the three categories of perishables, non-perishables and services with Lahore as the numeraire city. The impact of distance is the greatest in case of the non-tradable services. The mean absolute price differentials also show a positive relation with the distance. It means there is a linear relation between the price differentials and the distance among the cities.

Table 5.3 Impact of distance on price differentials keeping Lahore as the numeraire

Variability of Price Differentials			
	Perishables	**Non-Perishables**	**Services**
ln(Distance)	0.010	0.011	0.013
Std.Error	(0.002)	(0.002)	(0.002)
Product dummies	Yes	Yes	Yes
R^2	0.66	0.64	0.65
Std. Error of regression	0.0322	0.0330	0.0322
Number of observations	192	175	115
Mean Absolute Price Differentials			
	Perishables	**Non-Perishables**	**Services**
ln(Distance)	0.017	0.013873	0.010659
Std.Error	(0.002466)	(0.002)	(0.001)
Product dummies	Yes	Yes	Yes
R^2	0.53	0.52	0.54
Std. Error of regression	0.0543	0.0547	0.0538
Number of observations	192	175	115

Now keeping Karachi as the numeraire Table 5.4 shows the distance has a positive relation with the mean absolute price differentials but the relation turned out to be insignificant in case of variability of price differentials. We therefore conclude that the transport cost also plays a role in the divergence of prices.

Table 5.4 Impact of distance on price differentials keeping Karachi as the numeraire

Variability of Price Differentials			
	Perishables	**Non-Perishables**	**Services**
ln(Distance)	-0.001	0.0007	-0.0006
Std.Error	(0.00426)	(0.00413)	(0.0043)
Product dummies	Yes	Yes	yes
R^2	0.55	0.55	0.55
Std. Error of regression	0.0481	0.0481	0.0481
Number of observations	192	175	115
Mean Absolute Price Differentials			
	Perishables	Non-Perishables	Services
ln(Distance)	0.032	0.0341	0.0278
Std.Error	(0.032)	(0.0094)	(0.0037)
Product dummies	Yes	Yes	yes
R^2	0.44	0.45	0.44
Std. Error of regression	0.1007	0.1000	0.1010
Number of observations	192	175	115

5.2. Panel Unit Root Tests

In this section, it is firstly tested whether the relative price series contains a unit root, i.e. series containing a stochastic trend making them diverge from one another. As the results indicate convergence of the relative prices towards the cross-sectional means, we turn to the issue of rate of convergence.

Instead of using any city or province as a benchmark we are using the cross-sectional averages, since movements in a numeraire province or city will be absorbed into the common time effect. Hence panel analysis makes it unnecessary to select a numeraire (Cecchetti, Mark and Sanora, 2002).

5.2.1 Levin-Lin-Chu Test results

Table.1 presents the regression result on an item by item base. According to Levin-Lin-Chu, the critical values for t=100, N=10 (nearest to our panel) at 1%, 5% and 10% are -2.48, -1.81 and -1.44 respectively. The point estimate of beta was found to be negative in all cases. Results show that majority of the items (29 out of 30) reject the unit root null supporting the law of one price within Pakistan. The only item that shows non stationary results is Shirting. Doctor, Carpenter, Mason, Labor and Plumber among the services turn out to be first difference stationary. Among the tradable goods 8 perishable goods (Chicken, Beef, Egg, Milk, Potatoes, Onions, Tomatoes, and garlic) and 3 storage goods (Wheat, Red chilies Sugar) were found to be level stationary. While the rest were first difference stationary.

Including trend along with intercept, all the services turned out to be first difference stationary. Among the tradables Rice, Masoor, Moong,Mash, Bread, Curd, Lawn and Washing Soap were

first-difference stationary while the rest were level-stationary. Shirting remained to be non-stationary.

Table 5.5: Results based on Levin-Lin-Chu (LLC) Test

	Individual intercept (Level)		**Individual intercept** (First Difference)		**Intercept and trend** (Level)		**Intercept and trend** (First Difference)	
Item	**LLC t-stat**	**P-value**	**LLC t-stat**	**P-value**	**LLC t-stat**	**P-value**	**LLC t-stat**	**P-value**
Doctor	4.13504	1	-13.4169	0	4.36913	1	-14.2177	0
Carpenter	-0.04233	0.4831	-9.12191	0	-0.77992	0.2177	-8.38318	0
Mason	-1.12439	0.1304	-5.60296	0	-1.06312	0.1439	-3.84103	0
Labor	0.65776	0.7447	-11.552	0	1.09687	0.8637	-11.5634	0
Plumber	-0.24739	0.4023	-14.1808	0	0.61762	0.7316	-14.639	0
Wheat	-5.10021	0			-4.90685	0		
Rice	-0.97145	0.1657	-7.88577	0	-0.78059	0.2175	-7.05482	0
Masoor	-1.51463	0.0649	-10.2455	0	-1.10226	0.1352	-9.54781	0
Moong	-0.92852	0.1766	-6.51323	0	-0.37152	0.3551	-5.39299	0
Mash	-0.32275	0.3734	-9.09603	0	0.79556	0.7869	-8.43936	0
Chicken	-5.12149	0	-11.6244	0	-7.58357	0		
Beef	-2.36228	0.0091	-8.87307	0	-2.41213	0.0079		

Table 5.5: Continued…

	Individual intercept (Level)		**Individual intercept** (First Difference)		**Intercept and trend** (Level)		**Intercept and trend** (First Difference)	
Item	**LLC t-stat**	**P-value**	**LLC t-stat**	**P-value**	**LLC t-stat**	**P-value**	**LLC t-stat**	**P-value**
Mutton	-1.61	0.053	-10.81	0	-1.65	0.049		
Egg	-8.96	0	-0.92	0.17	-11.02	0		
Bread	0.01	0.506	-11.65	0	1.09	0.86	-11.5939	0
Sugar	-9.81	0	-9.60	0	-11.66	0		
Milk	-4.70	0	-8.11	0	-6.44	0		
Curd	0.003	0.501	-5.45	0	0.94	0.82	-4.25471	0
Potatoes	-8.63	0	-6.100	0	-8.29	0		
Onions	-10.47	0	-5.70	0	-11.54	0		
Tomatoes	-9.98	0	18.58	1	-10.92	0		
Bananas	-10.10	0	-9.35	0	-12.15	0		
Salt	-3.408	0.00	-17.78	0	-5.301	0		
Red chilies	-13.62	0	-17.84	0	-19.69	0		
Garlic	-5.15	0	-6.79	0	-5.05	0		
Lawn	2.34	0.99	-7.93	0	0.66	0.74	-7.16518	0
Shirting	1.35	0.91	14.93	1	2.68	0.99	18.9156	1
Washing soap	2.69	0.99	-1.68	0.045	2.91	0.99	-0.07473	0.4702

5.2.2 Im-Pesaran- Shin Test results

Looking at table.2 it is clearly evident that the Im-Pesaran-Shin test has significantly increased the power to reject the unit root hypothesis in comparison to the Levin-Lin-Chu test. The goods as well as the services and energy goods converge to the LOP. Shirting that possessed unit root for LLC also converged towards the mean using IPS. It is observed that all of the items are level stationary. It means there is no evidence of a stochastic trend in the relative prices of the cities.

Table 5.6: Results based on Im-Pesaran-Shin (IPS) Test

	Individual intercept (Level)		**Individual intercept** (First Difference)		**Intercept and trend** (Level)		**Intercept and trend** (First Difference)	
Item	**IPS w-stat**	**P-value**	**IPS w-stat**	**P-value**	**IPS w-stat**	**P-value**	**IPS w-stat**	**P-value**
Doctor	0.43	0.003			0.71	0		
Carpenter	-1.61	0.002			-2.40	0.0081		
Mason	-3.93	0			-2.97	0.0015		
Labor	-2.46	0.0068			-2.20	0.0138		
Plumber	-2.92	0.0017			-2.50	0.0061		
Wheat	-10.51	0			-8.756	0		
Rice	-5.44	0			-5.054	0		
Masoor	-6.61	0			-6.940	0		

Table 5.6: Continued…

	Individual intercept (Level)		**Individual intercept** (First Difference)		**Intercept and trend** (Level)		**Intercept and trend** (First Difference)	
Item	**IPS w-stat**	**P-value**	**IPS w-stat**	**P-value**	**IPS w-stat**	**P-value**	**IPS w-stat**	**P-value**
Moong	-7.09	0			-6.22	0		
Mash	-4.93	0			-3.847	0.0001		
Chicken	-9.176	0			-9.28	0		
Beef	-5.94	0			-5.79	0		
Mutton	-7.11	0			-6.39	0		
Egg	-16.41	0			-16.77	0		
Bread	-4.41	0			-3.99	0		
Sugar	-12.45	0			-12.30	0		
Milk	-6.047	0			-5.751	0		
Curd	-3.295	0.0005			-2.548	0.0054		
Potatoes	-21.80	0			-22.72	0		
Onions	-16.57	0			-16.23	0		
Tomatoes	-19.37	0			-20.16	0		
Bananas	-12.30	0			-12.59	0		
Salt	-5.735	0			-6.514	0		
Red chilies	-19.65	0			-21.46	0		
Garlic	-9.109	0			-7.833	0		
Lawn	-0.556	0.008			-1.415	0		
Shirting	-0.434	0.001			0.6173	0		
Washing soap	1.2774	0.003			1.2786	0		

5.3 Speed of Convergence

As it is evident that relative prices do converge across cities, we now move on to check the speed of convergence based on the persistence parameter (ρ_i). For the IPS ρ_i differs across cities so the average of all the ρ_i across cities is taken. We have used Nickell's (1981) formula[4] to adjust the estimated panel ρ to correct for the bias due to small samples. For IPS we have used the average of the bias adjusted ρ_i's.

The Levin-Lin-Chu test is considered to be a low power test which is biased towards the null of unit root. Most of the items were first difference stationary using the LLC test while for the IPS test all turned out to be level stationary. Hence we use the results of the IPS to calculate the speed of convergence. Using the IPS test Shirting also converges with a half-life of 0.74 months. The half-life's for services range 1.1 months (Mason) to 6.6 months (Doctor Clinic fee). Excluding Doctor Clinic fee the other services converge at a rate of less than 3 months. The half-life for the tradable goods range from 0.22 months (Eggs) to 2.8 months (Bread). 5 out of 10 storage goods (Wheat, Sugar, Salt, Shirting and Washing Soap) revert to the mean even earlier than a month. While the rest of the storage goods (Rice, Masoor, Moong, Mash, Red chilies and Lawn) have a speed of less than three months. The perishable items have a speed of less than two months with eight items (Chicken, Eggs, Milk, Curd, Potatoes, Onions and Tomatoes and Bananas) having convergence rate of less than a month. Among which Bread has the slowest speed of adjustment (approximately 3 months). The mean half-life of the services is 2.3 months. While the mean half-life of storable goods is 1.2 months and that of the perishable goods is 1

[4] $p\lim_{n\to\infty}\rho-\rho=\frac{(A_tB_t)}{C_t}$, where A_t= -(1+ρ)(T-1), $B_t = 1-\frac{\left(\frac{1}{T}\right)(1-\rho^T)}{(1-\rho)}$ and $C_t = 1-2\rho(1-B_{t)}/\{(1-\rho)(T-1)\}$

month. We see that the tradable goods have a faster speed of adjustment than the services. Our results coincide with the findings of Na Li (2006), who found that services are also mean reverting with a high speed of convergence.

Our estimate of the mean half-life of the services is 2.3 months which is far less than that estimated by Parsley and Wei (1996). They argued that the deviation converge within the border of the U.S. with a half-life of 5 years. Ceglowski (2003) also got a similar result of convergence rate while testing for retail prices in Canada.

Moreover, our results confirm the findings of *Cheung and Lai* (2000) and *Crucini and Shintani* (2008). They suggested that the speed of convergence is higher in case of developing countries than the developed countries.

Looking at the convergence behavior of the twenty eight items by using both tests we see that although the convergence rates are different for various items, however none of the items take a year or more to revert to their mean prices. It means the deviations from the LOP are very minor and short lived.

Individual testing of items which are components of the CPI, gave half-life estimates which are smaller than that for overall CPI. The average speed of convergence for 28 items is found to be 1.5 months which is consistent with the findings of Mohsin and Gilbert (2010). They found that the speed of convergence of the overall CPI is less than 5 months for the overall CPI basket. Our estimated half-lives are far less than that of estimated by Ghauri, Qayyum and Arby (2013) which is 8 months for the overall CPI basket.

Table 5.7: Estimates of convergence rates by IPS

Category	Im-Pesaran-Shin						
	Item	**β**	**t-stat**	**ρ**	**Half life**	**Adjusted ρ**	**Adjusted Half-life**
Services and Other non-tradable items	**Doctor clinic fee**	-0.024	-12.4***	0.975	28.018	0.899	6.576
	Carpenter	-0.257	-13.6***	0.742	2.325	0.732	2.231
	Mason	-0.460	-13.7***	0.539	1.122	0.525	1.075
	Labor	-0.265	-15.8***	0.734	2.242	0.642	1.564
	Plumber	-0.213	-13***	0.786	2.893	0.780	2.801
Storable Goods	**Wheat**	-0.578	-7.5***	0.421	0.802	0.162	0.381
	Rice	-0.330	-3.7***	0.669	1.730	0.583	1.287
	Masoor	-0.250	-14.3***	0.749	2.400	0.692	1.888
	Moong	-0.211	-4.28***	0.788	2.924	0.737	2.277
	Mash	-0.320	-9.5***	0.679	1.794	0.614	1.421
	Sugar	-0.543	-4.2***	0.389	0.883	0.207	0.440
	Salt powdered	-0.701	-8.9***	0.745	0.573	0.297	0.571
	Red chilies	-0.215	-4.7***	0.657	2.848	0.729	2.201
	Lawn	-0.336	-12.4***	0.332	1.688	0.563	1.210
	Shirting	-0.435	-12.3***	0.819	1.211	0.391	0.739
	Washing soap	-0.503	-14.4***	0.456	0.989	0.435	0.834

Note: Critical values at 1%, 5%, and 10% are -2.48, -1.81 and -1.44 respectively. (***) indicates 1% Significant level, (**) 5% significant level, and (*) 10% significant level.

Table 5.7: Continued…

Category	Item	Im-Pesaran-Shin β	t-stat	ρ	Half life	Adjusted ρ	Adjusted Half-life
Meat, fresh produces, dairy products, and other perishable food items	**Chicken**	-0.610	-8.2***	0.577	0.735	0.231	0.473
	Beef	-0.254	-11***	0.586	2.361	0.685	1.838
	Mutton	-0.342	-3.8***	0.588	1.655	0.579	1.268
	Egg	-0.667	-11***	0.491	0.628	0.040	0.216
	Bread	-0.180	-13.2***	0.561	3.489	0.779	2.77
	Milk fresh	-0.422	-4.7***	0.281	1.261	0.414	0.785
	Curd	-0.413	-12.4***	0.298	1.299	0.498	0.994
	Potatoes	-0.411	-5.1***	0.784	1.308	0.421	0.801
	Onions	-0.508	-5.7***	0.727	0.977	0.243	0.490
	Tomatoes	-0.573	-8.6***	0.663	1.200	0.215	0.451
	Bananas	-0.718	-6.2***	0.564	0.547	0.265	0.522
	Garlic	-0.272	-2.9***	0.496	2.177	0.639	1.548

Note: Critical values at 1%, 5%, and 10% are -2.48, -1.81 and -1.44 respectively. (***) indicates 1% Significant level, (**) 5% significant level, and (*) 10% significant level.

Chapter 6

CONCLUSION AND IMPLICATIONS

6.1. Conclusion

Lately with the increasing awareness of the role of market integration in the foundation of economic discipline, relative price convergence has received immense attention. Strong competitive forces along with market information guarantee the convergence of prices. Motivated by the recent wave of studies, we empirically examine the convergence behavior of individual goods along with services within Pakistan.

This study analyzes the price dynamics across 17 cities of Pakistan. A sample of 28 items, 23 tradable goods and 5 non-tradable services for the period of 2001 to 2013 are taken. By adopting a similar approach to that of *Parsley and Wei (1996*), we found that relative price do converge for all the products in our data set. However, our convergence rate is much higher than their findings.

First part of the study focuses on the disaggregated prices to check for the deviations from the Law of One Price. In this regard three panel unit root tests were applied to check for the non-stationarity of the relative prices. Not only do the results of this study complement the previous findings but also gave new conclusions. Analyzing the relative prices on product basis, the LOP proved to be authentic in both cases of tradable and non-tradable goods. Only one item out of twenty eight shows non-convergence using Levin-Lin-Chu test while, the Im-Pesaran-Shin gave evidence of convergence for all the 28 items. Moreover, testing price convergence with such high frequency data supports the LOP with higher speed of convergence. Our results seem to be

consistent with *Taylor (2001)*, he claimed in his theoretical study that non- convergence could be the consequence of using low frequency data while testing price convergence.

Second part of the study focuses on the rate of convergence of the individual items. The results suggest a remarkably fast convergence towards the Law of One Price. 15 items out of 28 converged with the speed of less than a month. Only 1 item (Doctor) has a speed of convergence of about half a year while, the half-life of the rest of the items is observed to be less than 3 months. It implies that price differentials for items that are termed as "non-tradable" in the international context do not deviate from zero indefinitely.

Our results coincide with the previous findings of price convergence within Pakistan. Convergence was not only found in individual commodity markets (Zahid, Qayyum and Malik, 2007, Mukhtar and Javed, 2007, Mushtaq and Dad, 2008, Ghafoor, et al. 2009, Hussain, et al. 2010), Mohsin and Gilert (2010) and Ghauri, Qayyum and Arby (2013) also found converging behavior of aggregate prices (CPI). Our estimate of speed of convergence for 28 items is 1.5 months which is consistent with the findings of Mohsin and Gilert (2010). They found that the speed of convergence of the overall CPI is less than 5 months for the overall CPI basket. Whereas, Ghauri, Qayyum and Arby (2013) found that the half-life for the overall is 8 months for the overall CPI basket.

Though our study does not provide a complete picture on the integration and segregation of Pakistan's local market, but these findings imply that Pakistan's agriculture, labor and energy market is highly integrated.

Our results confirm the findings of *Cheung and Lai* (2000) and *Crucini and Shintani* (2008). They suggested that the speed of convergence is higher in case of developing countries than the

developed countries. This difference can be attributed to the low level of specialization, market concentration and market differentiation in the developing countries which could also be a potential for mean reversion. Considering these possibilities, the examination of the effect of market structure on price convergence could be an avenue for future research within Pakistan.

Furthermore LOP is known to hold quite well in case of high inflation countries (Frenkel 1978, Ball and Mankiw 1994). Cheung and Lai (2000) have shown that government spending and inflation play a vital role in the convergence to LOP. They argue that if price dynamics are dominated by monetary shocks, Parity reversion is expected to prevail. The average annual rate of inflation in Pakistan during the sample period is 9.12% (Inflation Monitor, State Bank of Pakistan 2013). Thus high inflation in Pakistan could also explain for such short half-lives. Furthermore we also observe that items taken from the sensitive price index (tradable goods) have a faster speed of convergence as compared to those (services) that are taken from the CPI. As the sensitive price index is more responsive to shocks, this could result in a faster speed of convergence. Since, LOP is also tested to check if the markets within a country are integrated, our results suggest that the market is closely integrated in Pakistan with small regional differences.

6.2. Implications of the Study

- The linear relation between the price differentials and the distance among the cities implies that the transport cost does affect the converging behavior of prices. Hence, better infrastructure and easy means of transport will ensure to minimize the inflation differentials within cities.
- Our results suggest that the rate of convergence of the non-tradable services is lower as compared to the tradable goods. So the service prices may also be a reason for the

inflation differentials among cities. When formulating anti-inflationary policies it has to be considered which component of the CPI is leading to such differentials.

- As our results show that the markets in Pakistan are highly integrated government can maintain stable prices in all the markets by stabilizing them in the key market.

6.3. Direction for Future Research

Keeping in view the findings of this research, it would be worthwhile to suggest following ideas to the future researchers:

- Higher frequency data such as weekly data can also be used to test for the converging behavior of goods.
- The examination of the effect of market structure on price convergence could be an avenue for future research within Pakistan.