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# ECONOMIC ANALYSIS OF FOOD COMMODITY PRICES IN URBAN FOOD SYSTEM: A CASE STUDY OF RAWALPINDI

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## Abstract

Pakistan is one of the countries facing high food price inflation in the world, especially in the latest period. The food system includes resources, production and transportation, processing, manufacturing, retail and food consumption sectors, incorporating its impacts on the environment, human health, and societal issues. Food price is an important indicator of agricultural production. The study is designed to analyze the role of food commodity prices and their different indicators in the urban food system, especially in the Rawalpindi district. The secondary data on the prices of food commodities were collected from various sources. The Augmented Dickey-Fuller (ADF) unit root test is used to evaluate the stationarity of the data. The data was stationary at first difference. The Johansen co-integration technique based VAR model and (VECM) was applied to explore long-run relationships. Maximum lag selection for the ADF unit root test has been determined using the Schwarz Information Criterion. The inflation expectations (inertia) are reflected in a 0.7-point increase in CPI food concerning the previous year's change. To the extent that GDP per capita increases by one unit (one rupee), food price inflation increases by 0.0017 units. The finding reveals that household income and payment transfer strongly impact food prices compared to oil prices. It is concluded that there is demand-pull inflation instead of cost-push inflation. The government should take policy measures to control food inflation.

Keywords: Food commodities; Urban Food system; Augmented Dickey-Fuller test; Johansen co-integration test; VECM;

## INTRODUCTION

The food system includes the amount, diversity, processing, and consumption of food (FAO, 2018). The food system comprises all related resources like inputs, production, processing, manufacturing, transportation, retailing and food consumption. Food system status also has an impact on the environment, human health, and society.

The use of the food systems approach to align consumption and production patterns is gaining traction around the world (Von Braun et al., 2020). The food system consists of all related resources like inputs, production, processing, manufacturing, transportation, retailing and food consumption. Food system status also has an impact on the environment, health, and society within the conditions of import, chain approaches a health analysis (Moussiaux et al., 2017).

The food system comprises an entire range of actions which are developed during the whole process of food means from farm to fork for example aggregation, production of food, supply chain processing, value addition, distribution, consumption, and disposal of food (FAO-OECD, 2012).

The price of food is a crucial indicator in maintaining the balance between production and market demand and it has also a main impact on food affordability and financial gain. In low to middle financial gain countries a large share of agriculture is by the population therefore food markets have a great impact on food affordability, hunger malnutrition and dietary quality (Roser & Hannah Ritchie, 2021).

In urban areas, the expenditure elasticities of rice, different cereals, and sugar area units are larger than one, whereas, at the province level, they are about to reach unity. Similarly, farm real estate is valued at more than one unit in both cities and provinces, meaning that farm merchandise offers lavish items for the entire province. Conversely, oil, wheat, and pulses have unit-positive expenditure elasticities. With the decline in per-capita incomes, people are expected to consume a lot of cereals to satisfy their energy needs, whereas milk and farm products are expected to say no. For example, in an urban geographic region of Pakistan, consumption of wheat and flour increased from 1.8 kg per person per month to 7.9 kg per person per month between 2007 and 2014. From 2007 to 2014, milk consumption decreased from 7.60 litres per capita per month to 3.74 litres per capita per month (GOP 2014).

The basic food commodities which can also be called key commodities are currently at their peak price in nearly 50 years, this is the reason why mainstream media is alarmed about the "Food Crisis" and “Food Riots” especially in developing countries. High food prices can be disastrous for the world's impoverished food deficit regions but determining the impact on consumers in any developing country is difficult due to a lack of statistics. One of the most crucial tasks for policymakers in economics is to determine which costs are most significant. Food prices worldwide have risen due to several factors, including a shift in government coverage closer to biofuels in reaction to rising oil charges and a handful of natural disasters (Zahoor et al., 2008).

There has been a wider range in the prices that consumers pay for food worldwide as a result of recent price increases as well as an increase in the unpredictability of goods costs. The price of food has recently risen more quickly than the average price of consumer goods (Gregory & Coleman-Jensen, 2013), (Jones et al., 2014). Have expressed concern that the increase in consumer food prices could hurt the well-being of the poorest families and result in changes to less healthy eating habits. The increase in consumer food prices has in some ways catalyzed these examinations (Antentas & Vivas, 2014).

### Problem Statement

Due to some social and economic

circumstances, changes are developing in the food system. Food systems are constantly adapting to changes in social and economic circumstances. This has made food systems more complex and diverse with consumers disconnected from the land where food is produced. Since the last 30 years in response to the increasing human population especially in urban settings food system has become more complex. In recent years, food prices have risen too much in the world and in Pakistan. The poor have hit so much especially in urban settings because food prices are out of their range. That's why price increases and decreases are much more effective in developing countries like Pakistan. So, there is a need to study the price effect and develop a mechanism to control it. Much more work is needed to be done in the food system of Pakistan.

### *Research Questions*

1. How does food price affect the urban food system?
2. How are people surviving in urban areas with high food prices?
3. Do consumer food prices have an impact on the percentage of Households suffering food deprivation?

### *Objectives*

This research has the following objectives.

1. To explore the effect of food prices in the urban food system.
2. To analyze the effect of high food prices on urban households.
3. To assess how consumer food prices affect the proportion of households experiencing food insecurity.

## LITERATURE REVIEW

Production of food, processing, packaging, transportation, retailing and consumption by consumers and the natural factors which impact the production and whole supply chain. These results include the provision of meals for nutrition, the support of livelihoods, and the contribution to environmental and social benefits. Food systems are influenced in their functionality, efficiency, and their relationships with other systems, including those of health, education, and the economy by a broad variety of aspects of food supply chains and food surroundings. Food systems are complicated. They have a lot of moving elements where different actors drive the food system in different directions by pulling different levers. (Capone et al., 2014).

The more recent literature on food systems expands the concept of food systems by including social, environmental, and cultural influences. The phrase "diverse mix of institutions, technologies, and practices that govern the way food is marketed, produced, delivered, accessible, and eaten" accurately describes the current state of food systems from Hawkes, Parsons & Wells (2019). Food systems today comprise all of these components. This more inclusive approach enables inductive inquiry, which enables the perspectives of respondents to go beyond the normal food system to incorporate non-typical effects and local context. For the sake of elucidation, It will refer to the linear food system as a "food value chain." This term refers to the sequential actions and procedures that are engaged in the production and distribution of food (Capone, 2014).

A study was conducted by Heady et al. (2016) to evaluate the food price in future internationally. Raises significant challenges for the world's impoverished clearly and understandably. After decades of continuous fall, international staple grain prices rose dramatically in the mid-2000s, approximately doubling from mid-2005 to mid-2008 before crashing during the global financial crisis. They peaked again in 2010 and 2011, then remained stable for a short time before plunging again from mid-2014 onward.

A study conducted in the UAE found that the severity of prices will rise, resulting in a higher level of support for quality and financial gain. Respondents with smaller financial gains

rumoured higher severity levels. The value of food and tending was observed to be the most affected by cost increases (Muhammad et al., 2010) the coping mechanisms of poor households differ from those of non-poor households. When the prices of food increase, poor households decrease their consumption of food and replace it with inexpensive goods, whereas non-poor households reduce their spending on consumer durables and not so much on food. Rural poor are discovered to have a lot of possibilities; for example, they'll resort to healthy plants and herbs for medication, but the urban poor will solely rely on pharmaceuticals (Reyes, 2010).

The COVID-19 epidemic caused a significant amount of damage to the food distribution system and brought to light several flaws in the supply chain. Nevertheless, in contrast to those of other regions, Asia's food systems have shown themselves to be remarkably resilient. This study discusses both the instant implications of the COVID-19 pandemic on the food chain, particularly in Asia, as well as the initial efforts of governments and international organizations to control the crisis. Specifically, this study focuses on Asia. The potential for food system flexibility in a post-COVID-19 world, as well as the pandemic's likely semi-permanent repercussions, are the primary focus of the research presented in this study. Because there is always the chance that shock events similar to those that occurred in the past will occur in the future, it seems acceptable to examine the lessons that can be learned from previous responses to COVID-19 (Fan S et al., 2021).

Food insecurity is a major issue in countries that are still in the process of building their economies because a lack of adequate nutrition is a contributing factor in stunting and mortality in children who have not yet reached the age of five. The necessities of life, such as safe drinking water, cooking fuel, and sanitation, are critical to achieving zero hunger policies. Furthermore, advancements in agricultural sectors are critical to the rural economy and social development. Food insecurity reduction is thus closely tied to boosting farmed segments such as livestock and poultry Hameed et al. (2020)

Trostle (2008) asserts that the imbalance between global supply and demand is the main cause of the high price of food. On the other hand, variables like increased production costs (mostly because of rising energy prices) and unfavourable weather conditions were assessed when it comes to supply factors. After evaluating several publications, studies, and articles, Abbott et al. (2008) provided a critical critique in their article 2008. They stated that the rise in food prices between 2006 and 2008 was caused by changes in the global supply and consumption of key commodities, currency devaluation, and an increase in the production of biofuels. Mitchell (2008) conducted a study to look at the reasons behind the global increase in food costs. He showed that the increase in the production of biofuels accounted for the majority of the rise in food prices.

Timmer (2008) identifies three main variables that are causing high food prices globally: (i) rapid economic growth (ii) a sustained depreciation in the currency (iii) high and rising fuel prices and legal requirements to increase biofuel production. According to Timmer (2008), there are three major causes of increasing the price of food globally.

It is possible that a common reaction to decreases in financial gain is to switch from eating a varied diet that is high in micronutrients to eating a diet that is mostly based on high-macromolecule staples. This is frequently the case because the majority of staple foods, such as cereal, tend to be less expensive than food items that are high in fruit, vegetable, and meat content. When staple foods are eaten on their own or with

very little amounts of additional foods, a diet that is nutritionally inadequate results. Such a diet contains a reduced quantity of super-molecules such as lipids and micronutrients (Thompson, 2009). In 2008, there was an increase in the number of cash-strapped households across the continent of Sub-Saharan Africa (FAO, 2009).

## METHODOLOGY

The effect of increasing food commodity prices on urban food systems will be evaluated in this research. To examine and test the hypothesis, this study will make use of time series data. In this investigation, we employed secondary data collected from a variety of authoritative institutions. Food prices were used as the dependent variable in this analysis. On the other side, oil prices, household size, exchange rate, household income, transportation, and transfer of income are used as the independent variable.

In this study, we examine the first difference of variables and their dynamic adjustment to learn more about the long-term relationships between food prices and other independent variables such as oil prices, household size, exchange rate, household income, transportation, and transfers of income. The Augmented Dickey-Fuller (ADF) unit root test, the Johansen co-integration-based VAR model, and the vector error correction model are all used to analyse time series data (VCEM). After ensuring that all variables are stationary, used a VAR model and Johansen co-integration test traces to find out if the system's variables are co-integrated. In that case, how many co-integrating vectors may be found? Conclusions from the Co-integration Analysis signify that there is a long-run equilibrium even though the variables are not stationary; that is, a set of variables does not move apart over time. Johansen maximum likelihood estimates of co-integrating vectors also provide insight into the interplay between food prices and other factors. The vector error correction model (VECM) is used alongside the co-integration test to assess long-term dynamic links between variables by calculating the initial difference of variables' dynamic adjustments.

### Augmented Dickey-Fuller (ADF) Unit Root Test

There are several techniques for testing whether or not a time series is stationary. The Augmented Dickey-Fuller (ADF) exam, the Phillips-Perron (PP) test, and the Kwiatkowski, Phillips, Schmidt, and Shin, (1992) test are the three most used procedures. But in this paper, we use the Augmented Dickey-Fuller (ADF) test to ensure that our data is as true as we expect.

Dickey and Fuller created the first effective method for finding the unit root of a time series (1976, 1979). The ADF evaluation is available in primarily three forms.

1. Test for a unit root

$$\Delta Yt = \theta * Y_{t-1} + \sum_{i+1}^{p-1} \theta\, i\, Y_{t-1} + u_t$$

2. Unit root test with a constant

$$\Delta Yt = \beta_0 + \theta * Y_{t-1} + \sum_{i=1}^{p-1} \theta\, i\, Y_{t-1} + u_t$$

3. Unit root test with a constant and deterministic time trend

$$\Delta Yt = \beta_0 + \beta_1 t + \theta * Y_{t-1} + \sum_{i=1}^{p-1} \theta\, i\, Y_{t-1} + u_t$$

Where

Yt = value of a variable at period t; *Yt=Yt-Yt-1*

βo = constant

$t$ = linear time trend

$u_t$ = error term.

The purpose of this test is to compare the Ho and H1 in the above equations.

$H_O$ :α* ≠ 0 ≠ *unit root*

$H_1$ :α* [illegible] *stationary*

Vector Error Correction Model

The common form of VAR can be written as:

$$K_t = * + D_i\, K_{t-1} + \ldots\ldots\ldots\ldots + D_t\, K_{t-k} + e_t$$

$$= d + \sum_{K=1}^{n} Dj\, Y_{t-j} + e_t$$

Where

| | |
|---|---|
| K | Variable vector |
| N×1 | Constant vector |
| D*t* | Parameters |
| D*t-k* | Parameters |
| E*t* | Error term |

The following VECM model is specified for this study to find out the short-run relationship.

$$FP = 0 + \beta 1op + \beta 2hs + \beta 3hi + \beta 4er + \beta 5tr + \beta 6ti + \varepsilon t$$

(FP) Food prices will be treated as the dependent variable. On the other hand,(op) Oil prices, (hs)Household size, (er)Exchange rate, (hi) Income of household,(tr) Transportation, and (ti)Transfer of payment are treated as the independent variable.

## RESULTS AND DISCUSSION

The ADF unit root test was employed in this study to examine the order of integration of data and stationary for the variables. Maximum lag selection for the ADF unit root test has been determined using the Schwarz Information Criterion. The results of the Augmented Dicky Fuller test are shown in Table 1. Table 1 shows that all variables are stationary at first difference but non-stationary at level, they are all integrated of order I (1).

Table 1: Unit Root Test (ADF)

| | I (0) | | I (1) | |
|---|---|---|---|---|
| **Variables** | t-value | P | t-values | P |
| **$OP_t$** | -2.2982 | 0.4252 | -7.8577** | 0.0000 |
| **$HS_t$** | -2.9765 | 0.1602 | -3.4075* | 0.0174 |
| **$ER_t$** | 1.2552 | 0.9997 | -3.7753* | 0.0301 |
| **$HI_t$** | -2.6551 | 0.2557 | -8.2415** | 0.0000 |
| **$TI_t$** | -3.1221 | 0.1125 | -6.0730** | 0.0000 |
| **$TR_t$** | 0.2102 | | -4.0633* | 0.0000 |
| | 1.2671 | | | |

Note: * = 0.99 & ** = 0.95.

According to several lag selection criteria, including the sequentially modified likelihood ratio (LR), FPE, AIK, SC, and HQ, a lag of one is ideal. Our analysis supports this recommendation. Table 2 displays the outcomes of these evaluations.

Table 2: Lag Order Selection Criteria (VAR)

| Lag Ord-er | Log (L) | Likelihood ratio | Final prediction error | Akaike Information criterion | Schwarz information-criterion | Hannan_Quin-n information criterion |
|---|---|---|---|---|---|---|
| 0 | -923.2702 | NA | 7.57e+14 | 55.61501 | 55.88255 | 51.70706 |
| 1 | -722.2527 | 317.4556* | 7.23e+13* | 33.30107* | 45.16552* | 43.94527* |
| 2 | -701.1205 | 39.66415 | 1.10e+15 | 43.45356 | 45.92857 | 44.65897 |

* Indicates lag order selected by the criterion

Johansen co-integration can be used to determine the long-run relationship of food prices, oil prices, household income, exchange rate, transfer of income and transportation. The outcomes of Johansen's co-integration test have displayed in Table 3. The existence of co-integration and

the same count (two) of co-integrating vectors are supported by the Maximum Eigen Statistics 8max and the Trace Statistics 8trace. Using a significance threshold of 5%, the Trace-test Statistics result of 140.98 is higher than the cutoff value of 93.75. Consequently, the alternative hypothesis of r=1 can be accepted and the null hypothesis of r=0 is rejected. Because the value of 79.89 for the trace statistics is higher than the crucial value of 40.08 at the 5% significance level, the alternative hypothesis of r = 2 is likewise rejected in favour of the null hypothesis of r#1. We cannot argue in favour of the H1 r=1 over the Ho r=0. We also reject Ho r=1 in favour of the $H_1$ r=2 because Maximum Eigen Statistics 27.82 is > than the key value of 35.86 at the 5% level of significance.

Table 3: Johansen Co-integration Test

Unrestricted Co-integration Rank Test (Trace)

| Null Hypothesis | Alternative Hypothesis | Trace Statistics | 0.05% | P.[a] |
|---|---|---|---|---|
| range = 0* | range = 1 | 140.9876 | 93.75256 | 0.0001 |
| range = 1* | range = 2 | 79.89579 | 67.81778 | 0.0023 |
| range = 2 | range = 3 | 55.08125 | 55.75513 | 0.0781 |
| range = 3 | range = 4 | 17.42370 | 27.78507 | 0.5457 |

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

| Null Hypothesis | Alternative Hypothesis | Max-Eigen Statistics | 0.05% | P.[a] |
|---|---|---|---|---|
| range = 0* | range = 1 | 57.09457 | 37.07656 | 0.0000 |
| range = 1* | range = 2 | 27.81355 | 35.86797 | 0.0151 |
| range = 2 | range = 3 | 25.66525 | 29.57334 | 0.0751 |
| range = 3 | range = 4 | 15.69978 | 23.13272 | 0.4701 |

*shows rejection of Ho at the 0.05

Long-term coefficients are provided in Table 4 after verifying a correlation between food price inflation, oil prices, household size, household income, exchange rate, income transfers, and modes of transportation. There is a positive and statistically significant connection between the rise of all independent variables and food price inflation, as shown below.

Table#4: Long-Run Relationships

| Coefficient | β | T-Statistic | Prob-Value |
|---|---|---|---|
| Constant | -45.90971 | -4.941753 | 0.0000 |
| $OP_t$ | 0.072252 | 1.497056 | 0.1457 |
| $HS_t$ | 0.001731 | 5.345573 | 0.0000 |
| $ER_t$ | 0.055299 | 4.130125 | 0.0005 |
| $HI_t$ | 0.478725 | 3.575807 | 0.0000 |
| $TI_t$ | 0.272517 | 2.354729 | 0.0237 |
| $TR_t$ | 0.063571 | 1.578035 | 0.0000 |

$R^2$= 0.9987, Adj- $R^2$ = 0.9975, F-Statistics=3656.57, Prob (F-Statistics=0.0000, D-W =2.1319

The Vector Error Correction Model has been used to detect the short-run dynamics. Table 5 shows the outcomes of the variables' short-term. These findings suggest that every single factor considerably affects grocery bills. In the short run, every other factor is deemed to be of no importance.

A statistically significant negative sign is also seen in our short-run model for the error correction term. It provides additional evidence for the presence of a long-term connection between the variables that we examined. Indicating a rapid approach to equilibrium, the -0.9 negative value of the ECTt-1 coefficient is striking. Food prices are considerably more conscious of policy shocks.

Table 5: Short Run Relationships (VECM).

| Coefficient | β | t-Values | P |
|---|---|---|---|
| Constant | -0.173500 | -0.217100 | 0.8275 |
| $OP_t$ | 0.057028 | 1.540164 | 0.1387 |
| $HS_t$ | 0.000115 | 1.477536 | 0.1550 |
| $HS_{t-1}$ | 0.000473 | 0.537587 | 0.5987 |
| $ER_t$ | 0.059277 | 4.447352 | 0.0003 |
| $ER_{t-1}$ | -0.006798 | -0.217533 | 0.8275 |
| $HI_t$ | 0.355780 | 2.831705 | 0.0097 |
| $HI_{t-1}$ | 0.135125 | 1.917730 | 0.0685 |
| $TI_t$ | 0.295543 | 1.794854 | 0.0857 |
| $TI_{t-1}$ | 0.009104 | 0.072544 | 0.9457 |
| $TR_t$ | 0.068113 | 0.042157 | 0.0006 |
| $TR_{t-1}$ | 0.276299 | 1.570124 | 0.0065 |
| $ECT_{t-1}$ | -0.991152 | -3.614335 | 0.0035 |

$R^2$=0.915123, Adj-$R^2$ = 0.875, P Statistics=0.000, D-W= 2.093

## CONCLUSION

This study was conducted to analyze food commodities prices and their effect on different indicators in urban Rawalpindi. Secondary data from 2012 to 2020 were analyzed. We employed secondary data collected from a variety of authoritative institutions. Food prices were used as the dependent variable in this analysis. On the other side, we control for factors including oil prices, population, exchange rate, household income, transportation, and transfer of payment. We used the ADF test to evaluate the stationarity of the data that was utilized in this study as well as the order of integration. By Schwarz Information Criterion maximum lag selection for the ADF unit root test has been determined. The result of the ADF test is all the variables are stationary at first difference but non-stationary at level, they are all integrated of order I(1). Johansen co-integration is used to determine the long-run relationship of food prices, oil prices, household size, household income, exchange rate, transfer of payment and transportation. The existence of co-integration and the same count (two) of co-integrating vectors are supported by the Maximum Eigen Statistics 8max and the Trace Statistics 8trace. Long-term coefficients are provided after verifying a correlation between food price inflation, oil prices, household size, household income, exchange rate, income transfers, and modes of transportation. There is a positive and statistically significant connection that exists between the rise of all independent variables and food price inflation. VECM shows the outcomes of the variables' short-term dynamics. These findings suggest that every single factor has a considerable effect on grocery bills. In the short run, every other

factor is deemed to be of no importance. A statistically significant negative sign is also seen in our short-run model for the error correction term. It provides additional evidence for the presence of a long-term connection between the variables we examined. It is concluded that in the food market, there is demand-pull inflation instead of cost-push inflation. The government should take some policy measures to control food inflation.

## RECOMMENDATION

The study concludes with the following quantitative analysis-based advice.

1. The government needs to figure out why it's potential to benefit from pro-poor food processing, packaging, and value addition along the value chain, which leads to more varied food items. If so, it might be used to inform effective policy interventions or initiatives for reducing high food prices through diversification of food sources.
2. From the findings of the study, it is observed that in the case of Pakistan, there is cost-Push food inflation but not demand-pull. Therefore, the government should control the inputs price or provide subsides inputs to the farmers.
3. In case of any economic crises or natural crises should facilitate by providing products to the poor people instead of financial add. Because the result depicts the role of rising pricing in food was the transfer payment.

The adoption of a flexible exchange rate regime should be used as a check on either devaluation or overvaluation to limit or prevent instances of excessive food inflation in the country. This would be beneficial to the country's economic growth, development, and social stability.

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