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Measuring Availability of Resources: A Case Study of Selected CPI Items in Pakistan

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Abstract: It is widely believed that resources are becoming scarcer, and measuring their availability is crucial for efficient allocation. This study measures the availability and affordability of essential items in Pakistan before and after COVID-19. Time Price, Price Elasticity of Population (PEP), and Simon Abundance Index (SAI) are calculated to analyze thirty-nine items from Pakistan's CPI basket. The findings reveal that from 2006 to 2018, the Time Price decreased for almost all items, indicating increased affordability and resource abundance relative to population growth. However, the COVID-19 pandemic significantly increased the Time Prices of essential commodities, making them less affordable and less abundant. Policymakers are advised to adjust wages to maintain purchasing power and to adopt resilient strategies to ensure Pakistan is well prepared for such crises.

Keywords: Resource abundance, time price, Simon abundance index, inflation measurement, COVID-19 impact, Pakistan.

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1. Introduction

Natural resources have a positive impact on a country's growth and development, both socially and economically (Hodor & Clodnitchi, 2021). Resources become scarce when demand exceeds supply, leading to the depletion of available stocks. This imbalance often results in rising costs, making essential resources less accessible to lower-income groups. Consequently, such scarcity can contribute to unsustainable growth and widening economic inequality.

The relationship between population growth and resource availability has long been debated among economists, demographers, and environmentalists. Classical pessimists such as Malthus (1798) and Ehrlich (1968) argued that population growth has a negative effect on economic growth and resource availability, resulting in declining living standards. In contrast, Julian Simon (1996) presented a more optimistic view, arguing that the stock of human knowledge, innovation, and technological progress always finds solutions to human problems. He further argued that scarcity is only a short-run phenomenon, and in the long run, market mechanisms transform potential scarcity into greater abundance. According to him, population growth provides not only additional consumers but also more problem-solvers, making resources more effectively available over time.

Building on Simon (1996), Tupy and Pooley (2022) developed new analytical concepts to measure the scarcity and availability of resources. In their book Superabundance, they challenge the traditional belief that population growth inevitably leads to resource scarcity. Instead, their findings reveal that, over time, most resources are becoming more abundant despite population growth, a phenomenon they term 'superabundance'.

To operationalize Simon's idea that scarcity is only a short-run phenomenon and that, in the long run, the prices of most items eventually fall, Tupy and Pooley developed the concepts of Time Price, the Simon Abundance Index (SAI), and the Price Elasticity of Population (PEP). The Time Price is the time a worker has to spend to buy a unit of a good or

service. Because time is a universal unit, it can be used to compare the prices (in terms of time spent) of a wide range of commodities. For example, the time needed to earn enough to buy a day's supply of rice in India reportedly fell from about seven hours in 1960 to less than one hour today (Tupy & Pooley, 2022).

Building on the concept of Time Price, they further developed the Simon Abundance Index (SAI) to quantify changes in global resource abundance by combining variations in Time Prices with population growth. Their results show that between 1980 and 2024, the average Time Price of 50 basic commodities fell by about 70.4%, while the world population rose by 82%, indicating that resources became substantially more affordable over time despite the increase in global population. Similarly, the results for the Price Elasticity of Population (PEP), which measures the percentage change in Time Price per percentage change in population, show a greater decrease in Time Prices than the increase in population at the global level.

This study uses the innovative measures Time Price, SAI, and PEP to assess the availability of essential CPI items in Pakistan across two distinct periods: pre-COVID (2006–2018) and COVID/post-COVID (2019–2022). This approach offers a new perspective on inflation and scarcity in Pakistan and tests whether global patterns of falling Time Prices and rising abundance also hold in a developing country like Pakistan.

2. Literature Review

Generally, people believe there is a negative relationship between population growth and resource availability. However, this pessimistic view was challenged by Julian Simon (1996) in his book 'The Ultimate Resource 2,' in which he stated that humans, in general, are builders, not destroyers, of resources. He believed that over time, resources become less scarce in an economic sense due to innovation and improvements in technology. He laid the foundation for all later work measuring the scarcity of resources through different and innovative methods.

Based on his ideas and work, Pooley and Tupy (2021) developed the concepts of time price, price elasticity of population, and the Simon Abundance Index. Their results show that over the past 40 years, the value of SAI has reached 618 (base year 1980 = 100). This suggests that global resource abundance has doubled approximately every 14 years and has

grown at a compound annual growth rate of around 5%. They discovered that abundance is expanding faster than population growth, a phenomenon known as "Superabundance," which is what mankind is currently experiencing.

Later, Pooley (2024) calculated the time price of gasoline in the USA by collecting nominal gasoline price data from the Bureau of Labor Statistics and average hourly earnings. According to his research, the average time spent paying for a gallon of gasoline has been 6.34 minutes since 2013. During the COVID-19 lockdown, when demand was stifled in April 2020, the lowest time price was 3.75 minutes. In June 2022, when supply and demand were moving in opposing directions, the price reached its maximum at 9.43 minutes. The trend line predicts that the time price will continue to fall, indicating a rise in the supply of gasoline. In September 2023, US crude oil output reached a record high of 13.21 million barrels per day. This represented a 88.7% increase from 7 million barrels per day in January 2013. With more than half of the world's wells, the United States is the world's top producer of natural gas and crude oil.

Similarly, Pooley (2023) demonstrated that, for key consumer goods such as gasoline, airfare, and food items, nominal prices declined relative to wages, resulting in measurable improvements in personal abundance.

Many researchers also examine the impact of COVID-19 on inflation and resource availability. A study by Younis et al. (2023) conducted a systematic review of the literature to analyze the impact of COVID-19 on supply chain disruptions. They divided the literature into two groups. The first group of studies found that the pandemic has resulted in disruptions to the global supply chain, while the second group found that it has created many new business opportunities, such as in transportation, pharmaceuticals, and container shipping.

In Pakistan, a study by Shafi et al. (2020) highlighted the impact of COVID-19 on micro, small, and medium-sized enterprises (MSMEs). By collecting data from 184 MSMEs, the study found that most businesses were severely affected by reduced demand, supply chain disruptions, and lower profit rates. For example, the textile and apparel industry was badly affected by the lockdown, and the agriculture sector was affected by the unavailability of labor and transport. Similarly, small businesses such as clothing, shoes, food, and electronics were also affected by the lockdown

during Ramadan and by the additional cost of safety measures, such as buying masks, gloves, and sanitizers.

Using a demand-system approach, Hayat (2023) also analyzed household food consumption patterns and found that as the prices of staple foods increased, households tended to buy cheaper products, indicating declining affordability and nutritional quality.

Headey et al. (2024) argue that tracking only food prices doesn't fully capture how affordable diets are. They suggest a food wage index that compares the wages of unskilled workers with food prices or the cost of a healthy diet. This index helps show how inflation reduces people's real buying power.

Lee et al. (2013) further strengthen this analytical direction by presenting a comprehensive framework for assessing food prices and diet affordability, emphasizing the importance of linking diet costs to household income. Taken together, these studies provide empirical evidence and methodological guidance for the present analysis of Pakistan, offering tools to evaluate how inflation affects resource availability, affordability, and overall household welfare beyond conventional price indices.

Overall, the literature shows that traditional CPI or nominal price measures often signal high inflation and deteriorating affordability. However, when we incorporate changes in wages, hours worked, and population, the results for many essential items show a trend of increasing availability. This study aims to fill a gap in the literature in Pakistan by applying the concepts of time price, SAI, and PEP to measure the affordability of necessary items in Pakistan.

3. Materials and Methods

3.1 Data Sources

The data on average hourly wages (total skilled workers) were retrieved from the International Labor Organization (ILO). The data on commodity prices were taken from the Pakistan Bureau of Statistics (PBS) and the China Economic Information Center (CEIC). The population data were taken from the World Bank.

3.2 Selection of Commodities

The CPI basket in Pakistan comprises twelve categories. Due to data limitations, thirty-nine representative items were selected, covering essential food products (protein sources, dairy, and basic cooking ingredients), household and personal care goods (shirting fabric, soaps), energy items (kerosene, petrol, gas charges, and firewood), footwear for men and women, and basic communication expenses such as local call fees.

3.3 Methodology

This study follows the methodological framework developed under the Simon Project at the Cato Institute (Pooley & Tupy, 2018). Specifically, it applies the concepts of Time Price, Price Elasticity of Population (PEP), and the Simon Abundance Index (SAI) to assess the scarcity or abundance of selected CPI items in Pakistan.

Time Price (TP)

Time-price is the amount of time an average human must work to earn enough money to buy a commodity. Money prices can be converted to Time Prices by dividing the money price by hourly income. Time Prices in this study are expressed in minutes.

$$TP = \frac{Price\ of\ a\ commodity}{Hourly\ wage} \times 60$$

Percentage Change in Time Prices (%ΔTP)

Percentage change in Time Price (%ΔTP) provides more valuable information than individual TP. It indicates whether resources are becoming easier or harder to obtain in terms of work time, with a negative %ΔTP reflecting greater abundance and a positive %ΔTP indicating increased scarcity.

$$\%\,\Delta\ in\ TP = \left(\frac{TP_{final\ year} - TP_{Initial\ year}}{TP_{Initial\ year}}\right) \times 100$$

Price Elasticity of Population (PEP)

The concept of elasticity is used to estimate the sensitivity of changes in TP to changes in population. PEP produces a coefficient that can

be interpreted as a measure of abundance. If the PEP value is positive, the TP of commodities increases in response to population growth. If the PEP value is negative, the TP of commodities declines in response to population growth.

$$PEP = (\%\ Change\ in\ Time\ Price) \div (\%\ chagne\ in\ Population)$$

Abundance Multiplier

The Abundance Multiplier indicates the number of units of a resource that can be purchased with the same amount of working time at different points in time. The multiplier shows how much more or less abundant a resource has become from the perspective of an individual over time. It is the ratio of the start-year TP to the end-year TP.

$$Multiplier = \text{start year TP}/\text{end} - \text{year TP}$$

As long as the multiplier is greater than 1, personal resource abundance is increasing.

Simon Abundance Index

The Simon Abundance Index (SAI) measures the change in the abundance of a resource over a period. SAI compares the change in commodity resource abundance to the change in population.

$$SAI = (1 + \%\ change\ in\ Abudance\ Multiplier) \times (1 + \%\ change\ in\ Population) \times 100$$

A rising SAI indicates that resources are becoming more abundant, as fewer work hours are needed to purchase them—reflecting gains in technology, productivity, and efficiency. Conversely, a declining SAI suggests increasing scarcity, as more work time is required to afford the same resources.

4. Results and Analysis

4.1 Trends in Time Price

Nominal price data show that prices for most commodities have consistently increased over the study period. Prices for some items, especially food items such as wheat, vegetable ghee, beef, mutton, and curd, increased during and after COVID. Prices for other essential items,

such as shirting, also increased, along with petrol and gas prices. In addition to global factors, domestic factors such as rising energy prices, power shortages, government policies, and economic and political instability played a major role in rising inflation measured in nominal terms. However, if we measure resource availability using Time Prices, we find a different picture. Table 1 presents the Time Price and the percentage changes in Time Price for thirty-nine items during the years 2006-2018 and 2019-2022 for total skilled workers.

Table 1: Time Price and Percentage Change in Time Price

Items	Time Price				Percentage Change in Time Price	
	2006	2018	2019	2022	2006-18	2019-22
Wheat/Kg	31.53	24.45	22.82	26.36	-22.44	15.49
Veg. Ghee/Kg	157.89	100.56	89.94	236.72	-36.31	163.20
Sugar/Kg	75.17	37.18	39.04	37.96	-50.54	-2.76
Gur/Kg	93.50	53.28	56.51	56.49	-43.02	-0.04
Fresh Milk/Lt	61.16	53.89	49.47	56.03	-11.88	13.26
Basmati Rice/Kg	50.90	47.73	44.88	49.73	-6.24	10.82
Rice Irri 6/Kg	37.24	32.02	32.47	36.52	-14.03	12.46
Basmati Rice: Broken/Kg	46.77	44.78	43.99	50.19	-4.27	14.09
Masoor Pulse/Kg	104.43	73.59	68.07	120.52	-29.53	77.05
Moong Pulse: Washed/Kg	109.70	73.41	90.29	76.74	-33.08	-15.02
Mash Pulse/Kg	122.76	102.46	94.48	131.19	-16.54	38.86
Gram Pulse/Kg	72.20	73.79	69.92	86.76	2.19	24.09
Beef with Bone/Kg	247.89	216.61	228.03	284.74	-12.62	24.87
Mutton: Goat/Kg	468.91	472.50	471.73	591.28	0.77	25.34
Farm Chicken/Kg	153.32	98.71	91.28	109.31	-35.62	19.76
Farm Eggs Hens/Dozen	81.37	64.10	47.03	79.50	-21.22	69.05
Cooked Beef Plate/Each	60.49	63.06	67.56	83.71	4.25	23.92
Cooked Dal Plate/Each	36.31	36.55	35.42	41.37	0.66	16.79
Banana/Dozen	65.38	50.35	62.84	83.38	-22.99	32.69
Potato/Kg	42.18	21.06	17.61	21.27	-50.08	20.78
Dry Onion/Kg	27.89	30.19	29.05	34.39	8.25	18.36
Curd/Kg	65.85	61.60	58.21	63.62	-6.45	9.30
Tomato/Kg	45.20	37.04	26.27	34.38	-18.04	30.89
Mustard Oil/Kg	154.76	114.28	107.57	228.36	-26.16	112.30
Tea Prepared/Cup	13.39	13.19	13.19	15.75	-1.47	19.40
Rock Salt/Kg	9.14	6.90	6.84	5.50	-24.56	-19.64
Red Chilies /Kg	925.75	434.30	385.23	612.62	-53.09	59.03
Gents Shoes: BATA/Pair	693.74	372.17	330.12	302.51	-46.35	-8.36
Ladies Shoes: BATA/Pair	9.63	9.65	8.91	9.05	0.21	1.61
Firewood/Kg	1.44	1.40	1.36	1.67	-2.39	23.04

Items	Time Price				Percentage Change in Time Price	
	2006	2018	2019	2022	2006-18	2019-22
Matches Box/Each	17.94	16.40	17.31	38.40	-8.58	121.86
Washing Soap/Cake	32.32	25.27	22.65	27.71	-21.82	22.37
Lifebuoy Soap/Cake	144.69	108.85	104.89	121.86	-24.77	16.18
Shirting/M	33.02	26.14	24.92	74.36	-20.83	198.39
Bread Plains/Each	83.97	61.35	72.23	71.34	-26.94	-1.23
Kerosene/L	128.10	50.14	62.68	94.33	-60.86	50.48
Petrol Super/L	204.36	79.96	79.96	61.27	-60.87	-23.37
Gas Charges/MNBTU	5.36	2.45	2.56	0.77	-54.33	-69.77
Local Call Chargers/Call	31.53	24.45	22.82	26.36	-22.44	15.49

Source: *Authors' o*wn Calculations

The results show that the Time Price of various food items declined significantly between 2006 and 2018. Important products such as wheat dropped by 22.44%, sugar by 50.54%, gur by 43.02%, bananas by 22.99%, and vegetable ghee by 36.31%, suggesting improved real wage growth or productivity. These findings align with global evidence that falling time prices reflect technological advancement, economic growth, and relatively faster wage increases than commodity prices (Pooley & Tupy, 2018; Tupy & Pooley, 2022).

In contrast, the period following the pandemic saw increases in the time prices of many food items, such as vegetable ghee, edible oils, pulses, meat, and dairy products. This reversal can be attributed to government lockdown policies during COVID, which led to job losses, higher international commodity prices, domestic inflation, and a decrease in the value of the Pakistani currency. However, despite the pandemic, a few items, including sugar, moong pulse, petrol, and gas, registered stable or lower time prices due to subsidies or global price corrections.

Overall, while the pre-COVID period saw rising abundance, the period after COVID underscored the economy's vulnerability to global shocks and domestic inflationary pressures.

4.2 Trends in Price Elasticity of Population and Simon Abundance Index

The trends in PEP and SAI are analyzed using the calculations presented in Table 2. A positive PEP indicates rising TP with population growth, whereas higher SAI values indicate greater abundance that keeps pace with population expansion.

Table 2: Price Elasticity of Population and Simon Abundance Index

Items	Price Elasticity of Population		Simon Abundance Index	
	2006-2018	2019-2022	2006-2018	2019-2022
Wheat	-0.96	2.77	159.10	91.43
Veg. Ghee	-1.55	29.20	193.75	40.12
Sugar	-2.16	-0.49	249.50	108.58
Gur	-1.84	-0.01	216.56	105.63
Fresh Milk	-0.51	2.37	140.04	93.23
Basmati Rice	-0.27	1.94	131.61	95.28
Rice Irri 6	-0.60	2.23	143.53	93.89
Basmati Rice: Broken	-0.18	2.52	128.90	92.55
Masoor Pulse	-1.26	13.79	175.12	59.64
Moong Pulse	-1.41	-2.69	184.40	124.25
Mash Pulse	-0.71	6.95	147.84	76.04
Gram Pulse	0.09	4.31	120.75	85.09
Beef: Cow or Buffalo with Bone	-0.54	4.45	141.21	84.56
Mutton: Goat	0.03	4.53	122.46	84.24
Farm Chicken	-1.52	3.53	191.67	88.17
Farm Eggs Hens	-0.91	12.36	156.64	62.46
Cooked Beef Plate	0.18	4.28	118.37	85.21
Cooked Dal Plate	0.03	3.00	122.58	90.41
Banana	-0.98	5.85	160.23	79.58
Potato	-2.14	3.72	247.19	87.42
Dry Onion	0.35	3.28	113.99	89.21
Curd	-0.28	1.66	131.90	96.60
Tomato	-0.77	5.53	150.56	80.67
Mustard Oil	-1.12	20.09	167.10	49.74
Tea Prepared	-0.06	3.47	125.24	88.43
Rock Salt	-1.05	-3.51	163.56	131.39
Red Chilies	0.04	-4.09	122.37	136.90
Gents Shoes: BATA	-2.27	10.56	263.03	66.40
Ladies Shoes: BATA	-1.98	-1.50	230.02	115.23
Firewood: Kikar or Babul	0.01	0.29	123.14	103.92
Matches Box	-0.10	4.12	126.41	85.82
Washing Soap	-0.37	21.80	134.98	47.59
Lifebuoy Soap	-0.93	4.00	157.83	86.29
Shirting	-1.06	2.89	164.02	90.89
Bread Plains	-0.89	35.50	155.86	35.39
Kerosene	-1.15	-0.22	168.89	106.90
Petrol Super	-2.60	9.03	315.25	70.17
Gas Charges	-2.60	-4.18	315.37	137.80
Local Call Chargers	-2.32	-12.48	270.17	349.30

Source: Authors' own Calculations

4.2.1 Analysis of Price Elasticity of Population

The PEP measures changes in Time Price of goods relative to changes in population size. As shown in Table 2, almost all items have negative PEP values from 2006 to 2018, indicating that they are becoming more affordable over time despite population growth. This suggests possible gains in productivity, improved distribution systems, and a steady supply of essential goods. For example, the PEP values for wheat (-0.96), sugar (-2.16), and vegetable ghee (-1.55) show that the percentage decrease in time prices was greater than the percentage increase in the country's population. These findings confirm Simon's (1996) prediction that, despite population growth, the real prices of most items tend to decline in the long run.

However, results since the start of the pandemic show increases in the PEP values of many items. For instance, wheat's PEP rose from □0.96 (2006–2018) to 2.77 (2019–2022), vegetable ghee from □1.55 to 29.20, mutton from 0.03 to 4.53, and sugar from □2.16 to □0.49, showing a greater increase in the TP relative to population growth. These results are consistent with earlier findings showing a rise in TP after the pandemic, driven by a depreciated Pakistani rupee and inflationary pressures, particularly for imported items such as edible oil and petroleum. However, not all goods followed this pattern. Commodities including sugar (-0.49), gur (-0.01), and local call charges (-12.48) showed relatively stable markets, possibly due to domestic availability and substitution effects. Energy-related items like kerosene (-0.22) and gas charges (-4.18) showed even greater negative values, reflecting state price controls or subsidies.

4.2.2. Analysis of Simon Abundance Index

SAI measures the abundance of resources relative to population growth, with a base value of 100 in 2006. Any value greater than 100 indicates an improvement in resource abundance, meaning that, on average, people would be able to buy more goods and services with the same amount of work they did in the past (1980).

The results show a sharp increase in the abundance of many items from 2006 to 2018, including sugar, potatoes, petrol super, gent's shoes, and gas charges, driven by stable global prices, technological advancements, and improved agricultural yields. Some items, including wheat, vegetable ghee, and fresh milk, have moderate SAI values. A few

goods, such as mutton, gram pulse, and cooked beef plate, show relatively low SAI values due to limited production and higher input costs.

On the contrary, a general decline in abundance is evident after the pandemic. Wheat dropped from 159.10 to 91.43, vegetable ghee from 193.75 to 40.12, and washing soap from 134.98 to 47.59. Essential food and household items thus became scarcer relative to population growth. In other words, after the pandemic, people were able to obtain smaller quantities of these goods even when working the same amount as before COVID-19.

Some exceptions remain, for instance, the SAI values for sugar (108.58), gur (105.63), and rock salt (131.39) were retained or even improved post-pandemic, reflecting resilience due to domestic availability. Items related to energy and services, such as local call charges (349.30), also showed substantial improvements in SAI, reflecting expansion of digital infrastructure during COVID.

Overall, these results align with global values for abundance indicators and show a greater abundance of essential items in Pakistan, despite the increase in population.

5. Conclusion and Recommendations

This study applies the innovative concepts of Time Price, Price Elasticity of Population, and the Simon Abundance Index to assess the affordability and abundance of key CPI items in Pakistan across two distinct periods: pre-COVID (2006–2018) and COVID/post-COVID (2019–2022). Between 2006 and 2018, the time prices of staples, meat, dairy products, and energy declined significantly for total skill level workers, indicating increased accessibility and affordability for workers in Pakistan. Essential household commodities, clothing, and footwear also showed notable decreases in TP during this period, suggesting that individuals had to spend less time to afford these items. Similarly, the results of the PEP and the SAI show a greater decrease in TP than the increase in population. This means that workers in Pakistan can afford a larger quantity of goods with the same effort they used to put in in 2006.

However, results for all these indicators show a reversal, with rising TP and declining abundance after the pandemic, driven by various domestic and international factors. Overall, considering the entire study

period, the findings support Julian Simon's view that population growth does not create resource scarcity. Rather, in the long run, humans always come up with novel solutions and innovative ideas that solve the problem of scarcity, which exists only in the short run. The study also highlights the importance of measuring inflation and resource availability through new indicators that incorporate both wages and prices simultaneously.

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