



Global Shocks and Local Impacts: A CGE Analysis on the Impact of COVID-19 and Russia-Ukraine Conflict on Pakistan's Wheat Sector

Naveen Tahir

*Ph.D. Scholar, Department of Economics (S3H), National University of Sciences & Technology (NUST), Islamabad,
naveen.phde18s3h@student.nust.edu.pk*

Ashfaque Hasan Khan

*Director General NUST Institute of Policy Studies (NIPS), National University of Sciences & Technology (NUST),
Islamabad,
ahkhan@s3h.nust.edu.pk*

Abstract

Wheat is one of the most important and vital sectors of Pakistan adding around 2% to the country's GDP growth each year. The crop has been in turmoil for the past four years. The primary drivers of this turmoil are the COVID-19 pandemic and the Russia-Ukraine conflict, which have impacted wheat production. The current study employs a Computable General Equilibrium (CGE) model focusing on the individual and combined effects of these two global shock scenarios. The study initiates by exploring the baseline scenario which assumes that there is no existence of Covid-19 or Russia Ukraine Conflict, then the results are calculated firstly for the productivity loss due to pandemic and then due to the Russian Ukraine conflict. Finally, both the productivity shocks are combined to study the shared effect of both the losses. The results indicate that the sector has experienced a significant loss, with spillover effects on its subsidiaries, including flour mills, bakery and confectionary industries, animal feed industries, and processed food industries. The labor and export markets shocks are also simulated highlighting the loss in both sectors attributing to disrupted supply chains and restrictions in covid nineteen and high dependency on Ukraine and Russia wheat imports. Welfare analysis has also been done for all the four scenarios to capture the welfare losses faced in the previous 4 years and the results are compared to the baseline scenario to compare the damage. To mitigate these losses, two policy scenarios are proposed: an expansionary fiscal policy and increased subsidies, followed by increased tariffs and a shift towards locally produced wheat instead of relying on imports.

Keywords: Wheat, food insecurity, CGE Model, Covid-19, Russia-Ukraine Conflict



Introduction

Background

The past half of the decade is marked as the historic time of the global crisis. The world was shocked to the crux of its matter by Covid 19 and Russia Ukraine Conflict. It turned the concept of certainty upside down and no one had a clue what would happen the next day. Covid 19 was brought to the attention from all around the world, making it a global disaster. Countries were locked down in houses making social contact zero, strict restrictions were placed pushing the global economic engine to a halt. Such a situation had never been envisioned or imagined. More than 760 million cases were reported globally. (Sohrabi et al., 2020) World Health Organization (WHO) declared a global emergency, as the death toll crossed 6.8 million globally. The GDP contracted to 3.5% in 2020 over the world which is considered one of the worst years in history even surpassing the shrinkages recorded over the great depression of 1935. Unemployment rates witnessed the peak increasing up to 25% globally and 15% in Pakistan. Millions of jobs were lost, (Kalkavan et al., 2021) recorded working hours decreased to 14% in the lower income countries. International Monetary fund (IMF) recorded the rise in public debt to 97% of the GDP for the developing countries to finance the fiscal stresses faced due to increased government expenditure in the form of various supportive programs and health services. (UNL et al., 2022) There was global food shortage and scarcity due to the pandemic, only in the year of 2020, the global food insecurity escalated by 320 million people. (Paslakis et al., 2021). To counter off the damage done, vaccinations were effectively administered, making up to 70% of the global population vaccinated with at least a single dose. (Patel et al., 2021)

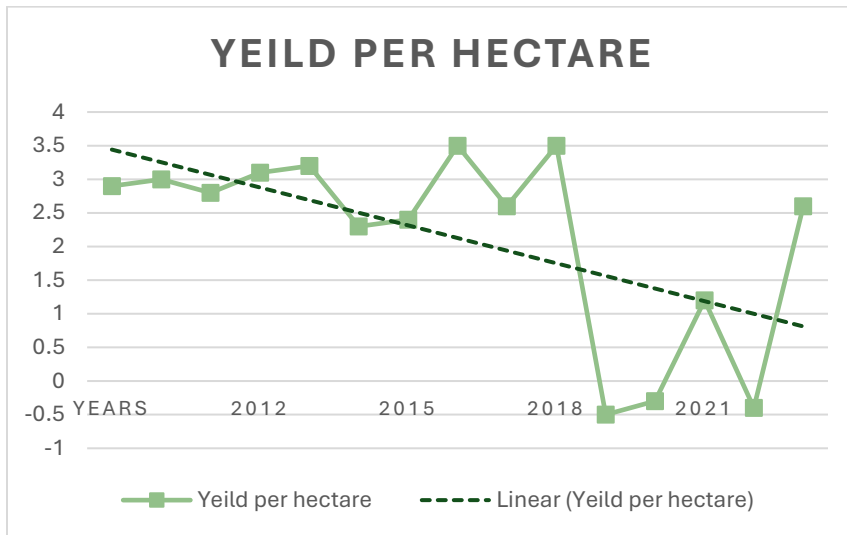
The world was barely making a recovery from this humongous disaster, yet again it was struck by another global calamity in the form of Russia Ukraine Conflict, making this retrieval again a very challenging process.(Zayukov et al., 2020) More than 11,000 deaths were recorded, and more than 20,000 casualties were recorded due to the conflict in Ukraine. (Lin et al., 2023)

Pakistan was a major sufferer in both these tragedies. Pakistan lost lives, livelihoods and had record food scarcity statistics in years marking between 2020 and 2023. The incomes of the households have drastically fallen, unemployment rates increased by 30% in 2020-2021. While more than 30% of the total households faced food insecurity, in which 43% of the total geographical area of the country went to severe food crisis in these two calamities. Analyzing the country's situation, the major shortage faced was due to the wheat shortage. Pakistan is a heavily

wheat dependent country and even being a wheat grower, the country still imports more than 3.5 million tons of wheat every quarter of the year. (Ahmed et al., 2021). The latest statistics recorded that in 2022, Pakistan produced approximately twenty-seven million metric tons of wheat, while the demand for wheat consumption was around twenty-nine million metric tons. Hence, the demand gap was covered by importing around three million metric tons of wheat (Erenstein, 2022). This implies that Pakistan is unable to meet its local demand and must bridge the shortfall of wheat via importing.

Figure 1 below shows the percentage change in the yield per hectare for wheat over the past 14 years. The downward linear trend can be observed. As seen, the graph takes a huge downward dip in the year 2020 and since then the situation continues to worsen for Pakistan which is one of the major causes of the food insecurity caused in Pakistan.

Figure 1
 Percentage change in the yield per hectare for wheat



Source: (Author's own calculations)

Summarizing the above discussion and statistics mentioned, wheat is the highlight for the study, and it becomes imperative to see the impact of wheat loss due to the pandemic and conflict. In the past few years, as seen food insecurity is one of the primary key factors hindering the developing economies like Pakistan from achieving the desirable growth rates. Pakistan is a food scarce country, and numerous studies are conducted in this matter. Research done by (Beckman et al., 2021), (Dube, 2022) and (Iqbal, 2020) explored the food insecurity and how to combat the issue in developing countries of Asia and specifically for India and Pakistan. Moreover, some



studies employed various modelling techniques including the Computable General Equilibrium (CGE) (Laborde et al., 2020) Modelling and Dynamic Stochastic General Equilibrium Modelling (DSGE) (Nguyen et al., 2022), macroeconomic modelling etc. (Kovacs et al., 2021) to achieve the results.

All the above studies highlighted the issue and did not focus on the solution and wheat was discussed as a sector only, but the current study focuses on wheat as a factor of production, as an input in the production function, as an employer for labor market and therefore sees the impact on its subsidiary sectors as well including the flour mills, processed food industries, animal feed industries, and baking and confectionary industries. A CGE model for Pakistan is developed and the model allows for the disaggregated shocks to the above-mentioned sectors. None of the previous studies have developed a model which highlights the dual Covid 19 pandemic and Russia Ukraine Conflict shock and simultaneously simulates the impact of both the shocks on Pakistan's major sector of staple food. The model also brings novelty by contributing the policy shocks and attempting to reverse by simulating the fiscal policy shocks for Pakistan.

Moreover, as Pakistan is a wheat growing and exporting country as well. The impact on wheat exports has also been captured. Lastly the focus is on gaining the welfare back lost via the two misfortunes and what should be the adequate government responses and policy recommendations to correct the matter. Hence, the innovation in the study lies in its simulation techniques, and the solution-oriented policy shocks to cure the matter.

Research Objectives

The paper addresses the following research questions.

1. What is the loss on the wheat and its subsidiary sectors in Covid-19?
2. What is the loss on the wheat and its subsidiary sectors in Russia and Ukraine Conflict?
3. What is the combined loss of both these global crises?
4. What is the loss of wheat export market in the above-mentioned three scenarios?
5. What is the loss of wheat labor market in the above mentioned three scenarios?
6. Where is inflation headed to in the in the above mentioned three scenarios?
7. What is the welfare gain/loss in the above mentioned three scenarios?
8. What are the government responses to correct the losses incurred through various shocks?



These research questions are then used to identify the losses in various wheat related sectors, export market and labor market. The whole agenda behind looking for a solution for these questions is to provide accurate government responses and certain policy implications which if implied can bring phenomenal results.

To obtain the solution for above research questions CGE modelling technique is used and multiple simulations are done with four designed scenarios including the baseline scenario, the Covid-19 shock scenario, the Russia Ukraine Conflict scenario and lastly the combined effects of both these shocks. Consequently, the results conclude that the loss have been incurred and they can be reversed with increased subsidies and tariff adjustments with further relevant policy measures if effectively applied.

The paper is divided in the following order the first and above sections of the study shed light on the background and the importance of the matter, followed by the literature review section. The third section covers methodology followed by the results and the policy recommendations section.

Literature Review

Wheat is an integral part of the world's daily diet and nutritional value. Around 90% of the world's population consumes wheat in one form or the other. (Ahmed et al., 2021) Regions including Asia, Europe, middle east, Africa, America widely consumes wheat as a staple food. (Igrejas & Branlard, 2020) Wheat is enriched with all the required body nutrients including vitamins and minerals like iron and magnesium. It also contributes to the major macros of an individual's diet plan. (Hegsted, 1954)

Wheat can be consumed directly in the form of processed flour, but it also offers diversity in the food production spectrum. Wheat is used to make pastas, bakery items, noodles, confectionary, varieties of breads etc. (Bushuk & Rasper, 1994). Moreover, wheat is not only famous among humans, but it is widely used for animal feed as well. (Tripathi et al., 2007) Furthermore, Wheat carries an immense economic importance, and it is considered an economic crop. Wheat is grown in several types of fertile soils, and it is a resistive crop able to grow in different climate conditions. (Porter & Gawith, 1999) Wheat is a source of livelihood for millions of farmers worldwide. Around 84% of Pakistan's farmer population are wheat growers and around 8.3 million households' family is dependent on wheat farming. These enormous numbers make



wheat as the most harvested crop of Pakistan with the highest demand as staple food when compared to the rest of the crops grown around the country. (Amin et al., 2014)

Wheat growth in Pakistan was consistent in the earlier decade of 2010s, by the end of decade when Covid-19 emerged as global pandemic, wheat supply drastically fell. As the international borders closed with local supply chain disruptions, shortage of wheat and its related products was not seen on the store food shelves. Even the most basic forms used like white and bran bread, rusk, cake rusk were seen missing from the shops. (Ubaid-ur-Rehman et al., 2021) explored in his study that Pakistan faced many food insecurity challenges in the form of availability of basic food items during the Covid-19 due to the strict supply chain restrictions, local and international borders closure played a leading role in creating these disruptions.

Wheat faced shortage due to the restricted growing by the farmers during the Covid-19 era as well. Social restrictions placed worldwide and in Pakistan led to decreased working hours, loss of employment and fewer farmers working on a crop at a time. Moreover, especially in 2020, all factories were shut down including the ones producing the necessities. By the end of 2021, the factories gradually started to open up, with half of the actual employees working at a time, so social distance could be maintained. This reduced the overall production and productivity of the workers. The highest sick leave taken by the workers were recorded during the Covid-19 time. As before the vaccinations, the quarantine time was 14-21 days. This extended period of time led to workers' absenteeism from the factories and those who showed up, the quality of the production reduced as well. Accumulating all these effects, overall, the supply of the wheat and its related products drastically reduced in the Covid-19. Restaurants, bakeries, cake shops and any such food stalls selling wheat related products like burgers, shawarmas, pizzas, breads, and confectionaries were shut down during Covid-19. Many foods related stores that were opened during the pandemic were only providing the most basic supplies in the form of bread.

Covid-19 not only created a shortage of supply, but the uncertainty of food unavailability created increased demand as well. Households and individuals in Pakistan seemed to be involved in panic buying the first two years of Covid-19. Panic buying is a concept where people tend to buy more than their actual demand for that product, with the fear of the commodity being unavailable in the future. People seemed distressed and scared of the unavailability of the food resources, hence if the household requirement was one pack of bread, they bought 2-3 packs of bread to



cover up for the uncertainty. Another reason highlighted by Kazim et al (2023) for panic and bulk buying was limited number of rounds to the food stores. On average, if an individual visited a food store thrice a week on normal days, it was reduced to twice a month in Covid-19. This emphasized decreased supply and increased demand leading to another issue being raised, that was inflation.

Inflation was and is still an issue, especially if the soaring food prices are discussed. Covid-19 raised the food prices and further they sky rocketed when the Russia Ukraine conflict emerged. Pakistan is a highly import dependent country in terms of wheat. There are years where Pakistan rejoices the bumper crop, yet there are years where Pakistan faces the worst wheat crop shortages. Covid-19 had already laid the foundation for that wheat shortage, and it continued to become a threat as the country entered 2023. From the total wheat volume that is imported in Pakistan, around 87% of the wheat is imported from Russia and Ukraine. Both are the world's largest wheat producers and exporters globally. Due to the conflict faced Ukraine's crops were destroyed and only 10% of what is produced was harvested due to the clashes going on. While, on the other hand, Russia was placed under more than 160 global sanctions which prevented it from exporting the wheat crop to its trading partners. Pakistan suffered at the hands of this conflict in the form of wheat shortages. (Muhammad, 2023) Various alternates routes were defined by Russia to continue exporting including the route via Turkey, but the crops were mostly destroyed and the volume that actually reached the desired countries were not even the one tenth of the required demand. (Lin et al., 2023)

All these issues created wheat shortage and increased the wheat prices in Pakistan by multiple folds. The above literature discussed emphasizes on the food insecurity challenges and issues raised by the shortage created like unemployment and inflation, but the current study focuses on the step-by-step procedure of what the exact losses were and how the losses can be cured for Pakistan.

Research Methodology

Data Sources

The study employed the Global Trade Analysis Project (GTAP-10) database for this study. This is one of the latest forms of databases available providing data for more than 141 countries, nineteen aggregate regions, more than thirty-nine input-output tables, with more than 65 sectors coverage for each country. The data is available with five reference years with well-integrated



trade, transport, and sectoral linkages. The data was perceived, and the latest reference year of 2017 was updated and calibrated with up-to-date GDP, population, and employment datasets for Pakistan. Similarly, SAM was integrated in the database and updated with the base year used in the study as 2019. (Aguiar et al., 2019)

Computable General Equilibrium Model

A CGE model was developed with the single country (Pakistan) and all trading countries treated as rest of the world. CGE model assumes equilibrium at one point in time. (Partridge & Rickman, 2010) The role of the model is to involve each economic agent of the country. The model assumes the existence of household side, with designated production functions. The current study assumes that the households have nested consumption functions with Armington approach used. The Armington approach originates from the economist Paul Armington. He suggests that Armington functions are mostly suited to models close to real world. The Armington function assumes that there is product differentiation which varies between different regions, even the perfect substitutes would have some form of differentiation existing in them. (Alston et al, 1990) The production functions used have nested Constant elasticity of substitution (CES) functions. (Prywes, 1986). CES functions assume that any two inputs can be substituted for each other in the same ratios. The function further assumes that they are homothetic in nature, which means only the inputs can be substituted in ratios and not in absolute values. The rationale behind the CES function is that it allows for the substitution between the inputs in the function. The remaining agents include the government, and the export and imports market. Blending all the economic agents form a well cohesive effectively working economy. The major addition that the study made was in the production functions and the exports market system.

1. Let us assume.

$$W_s = F(\delta L^{-\beta} + (1 - \delta)R^{-\beta})^{\frac{-1}{\beta}} \quad (1)$$

Where, W_s = Quantity of the wheat produced/supplied

F= Total factor productivity

L = Labor

R= Rest of the factors of production



Now the model gives a negative shock due to the Covid-19 and Russia Ukraine Conflict, hence the equation becomes.

$$W_s' = F'(\delta L^{-\beta} + (1 - \delta)R^{-\beta})^{\frac{-1}{\beta}} \quad (2)$$

$$F' = F(1 - shockrate) \quad (3)$$

While ‘*shockrate*’ can be defined as the percentage reduction in the supply of wheat. This shock was consequently given to the four sectors including the flour mills, animal feed industry, baking and confectionary industry and processed food industry. Moreover, equation 1 defines the shock was also applied to the five factors of production including labor, capital, land, entrepreneurship, and natural resources. These shocks are called productivity shocks.

2. Further assume an export market for Pakistan.

3.

$$W_x = W_d(W_p, ER) \quad (4)$$

Where, W_x = Wheat Export

W_d = Wheat Demand

W_p = Wheat Prices

ER = Exchange rate

The equation explains that exports of wheat are a function of wheat demand, and it is negatively related to wheat prices exchange rate. As the wheat prices decrease demand for wheat increases abroad and as exchange rates decrease and currency depreciates again it leads to a positive impact on wheat export. (Bank, 2005) Now, if a multiplicative shock is given to the export demand as “ α ”. It can be written as:

$$\alpha = 1 - shock_rate \quad (5)$$

$$W_x' = \alpha W_d(W_p, ER) \quad (6)$$

Where; ‘*shock_rate*’ is the percentage reduction in export demand. The implantation was done via calibrating the economy and the economy was initially matched to the baseline data. It was



followed by the three different shocks which were given to the economy in the above manner explained.

Scenario Analysis

There were in total four scenarios designed to see the impact of both the global shocks. The first scenario designed was baseline scenario, followed by the Covid-19 shock, then the Russia Ukraine Conflict and lastly the combined effect.

1. **Baseline Scenario:** The baseline scenario assumes that the Pakistan is as it is when it entered 2020. Figures and values were calibrated with the condition with nonexistence of Covid -19 and Russia Ukraine conflict. This scenario assumes smooth and uninterrupted functioning of society. This further assumes stable trade figures, with steady import and export rates. The Baseline scenario assumes the results beginning from 2020.
2. **Covid-19:** The second scenario features the existence of the global pandemic and various shocks are applied to the production and consumption side. Here the shocks are applied 2020 onwards, when first case of Covid-19 was reported in Pakistan.
3. **Russia Ukraine Conflict:** The third scenario assumes the country is impacted by the conflict and various supply side and demand side shocks are applied and new results are simulated, here the shocks are applied 2023 onwards.
4. **Combined effect:** The last scenario assumes the combined effect of the Covid-19 and Russia Ukraine conflict. Here, combined production and consumption shocks are implied and new simulations are calibrated. This includes data set from 2019-2024.

Results

The results of the study overall draw attention to the research questions addressed in the beginning. Table 1 summarizes all the below explained results and highlights the losses for the four scenarios designed to show the factual and counterfactual side of the study.



Table 1
 Summary of Losses

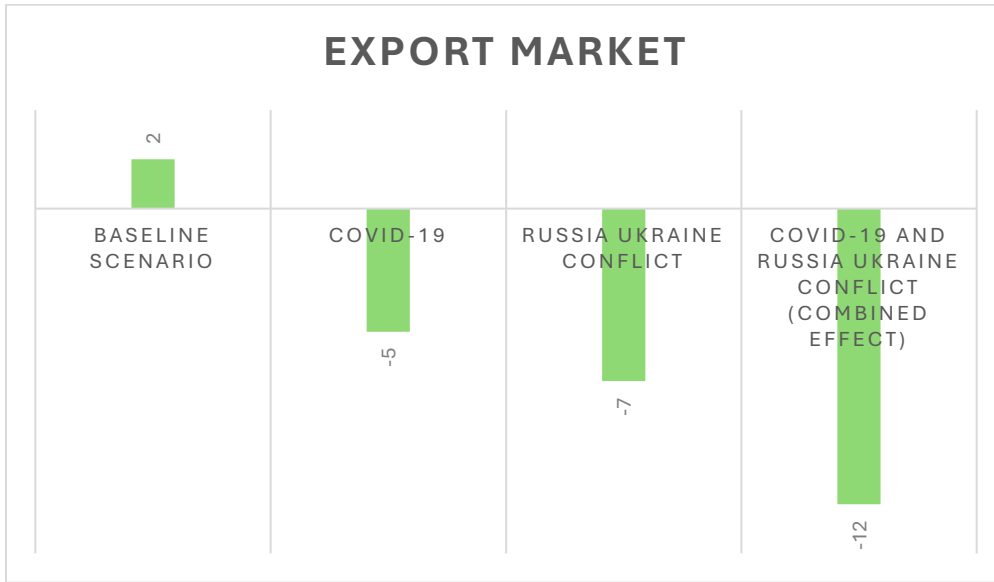
	Export Market	Labor Market	Food Processing Industry	Animal feed sector	Baking and Confectionary Industry	Flour Mills	Welfare Analysis	Inflation
Baseline Scenario	2	2.5	1.2	0.8	1.6	1.4	0.5	5
Covid-19	-5	-10	-2.5	-1.2	-0.6	-11	-5	12
Russia Ukraine Conflict	-7	-1.5	-6	-1.8	-1.5	-8	.04	25
(combined effect)	-12	-11.5	-8	-3	-2	-20	-5	37

Flour mills faced the highest loss in Covid 19 and Russia Ukraine Conflict. This subsidiary sector has high inelastic demand and flour is the form of wheat which is consumed by the masses of the country in one form or the other. Moreover, even the rest of the sectors are also dependent on the supply from flour mills. Flour mills were the highly effected sectors they directly process the imported wheat into flour, hence maximum losses were faced by this industry.

Figure 2 illustrates the results of export market results shocks under various scenarios. Under the baseline scenario, if Pakistan’s economy continued to thrive like before it was projected that the wheat export market would grow by 2%. Under the Covid-19 scenario, the wheat export market saw an export loss of 5% due to the reasons mentioned in the literature included disrupted supply chains, lockdowns, and social distancing. The results are in line with literature as calculated by (Khaliq et al., 2020). The Russia Ukraine conflict indicated a loss of an additional 7% which can be pointed towards the import dependency on Russia and Ukraine. The last scenario presents a loss of 12% which is the combined effect of both Covid -19 and the conflict. (Amin et al., 2014) (Salik, 2021) (Mazhar, 2023)

Figure 2

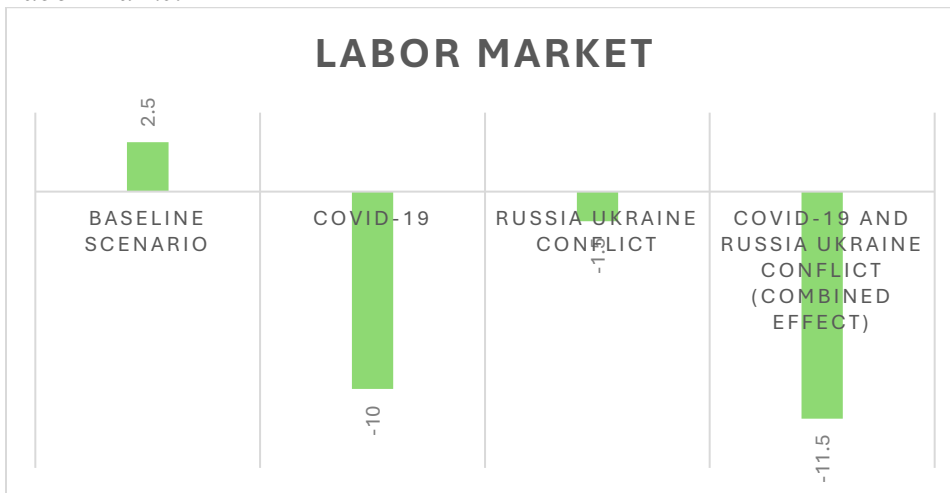
Export Market



Source: (Author's own calculations)

Figure 3 specifies the labor market losses and gains in the given four scenarios. The results simulated that in the Baseline (no Covid-19) scenario, the labor market supply witnessed a gain in the supply of labor market by 2.5% over the next few years. The second and third scenario suggest labor market supply loss of 10% and 1.5%. This loss is again accumulated and simulated for the last scenario signifying a loss of around 12%. The results are concluded by various other studies including Dissanayaka & Thibbotuwana (2021) and Arriola et al (2023).

Figure 3
 Labor Market

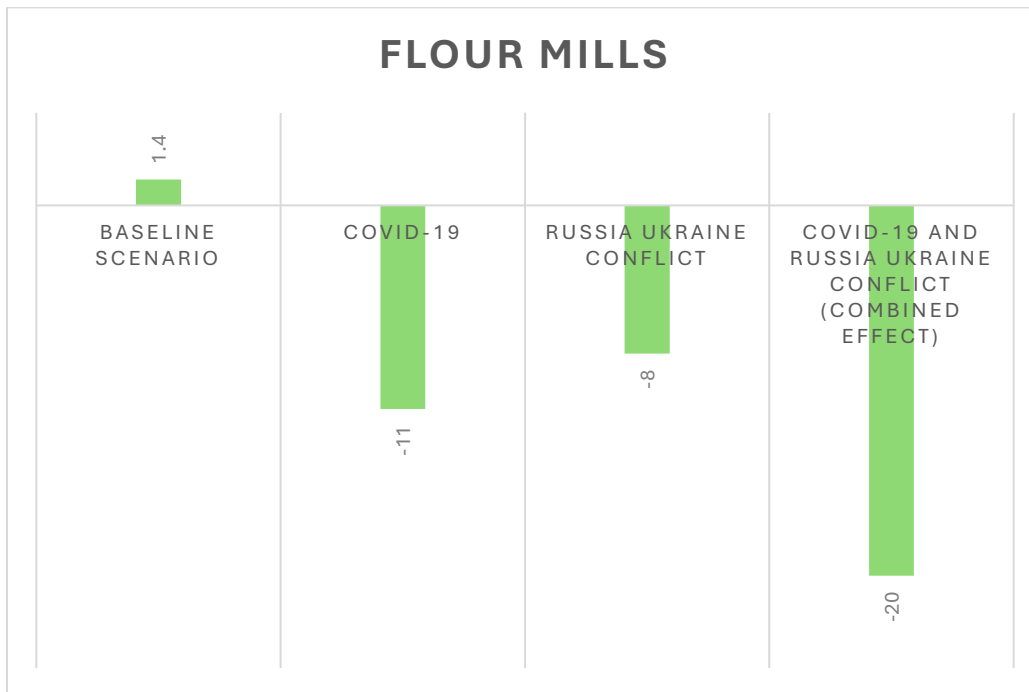


Source: (Author's own calculations)

Figure 4 presents the results of supply losses faced by the flour mills during the Covid-19 and Russia Ukraine Conflict. The baseline scenario suggests a gain in the supply of flour mills of 1.4%. The rest of the three scenarios paint a pessimistic picture. The flour mills lost 11% of their supply in Covid-19 and further loss was of 8% accumulating to a total of 20% supply loss due to the two shocks applied. (Khan, 2021)

Figure 4

Supply loss of flour mills

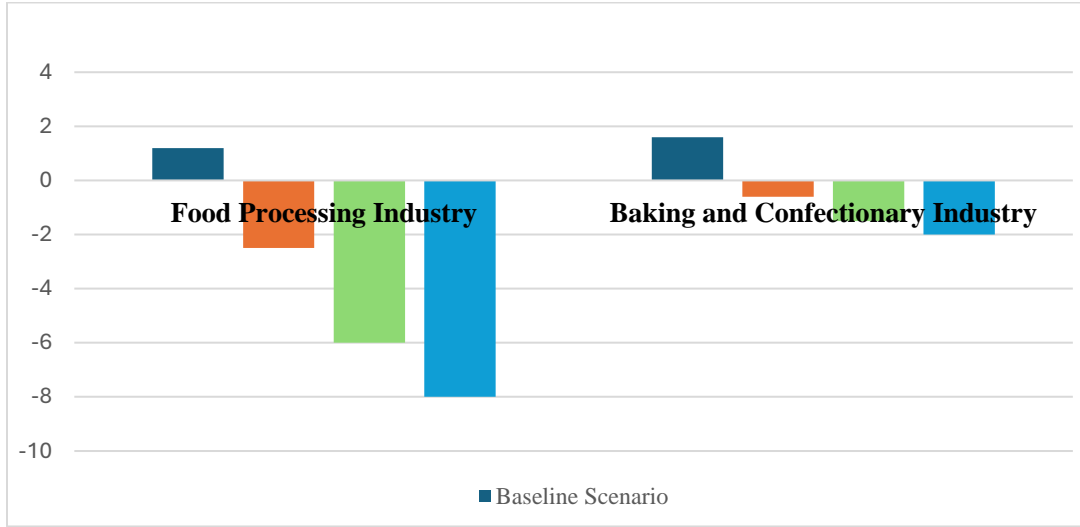


Source: (Author's own calculations)

Figure 5 indicates various losses in the three scenarios for the food processing industry and baking and confectionary industry. The main reasons for the losses can be attributed to the lockdowns and the disrupted local and international supply chains. (Khan & Tariq, 2023) implied similar findings for the Covid-19 losses. The current study focuses on the combined losses endured mounting up to 8% and 2%.

Figure 5

Supply loss in food processing and baking and confectionary industry.

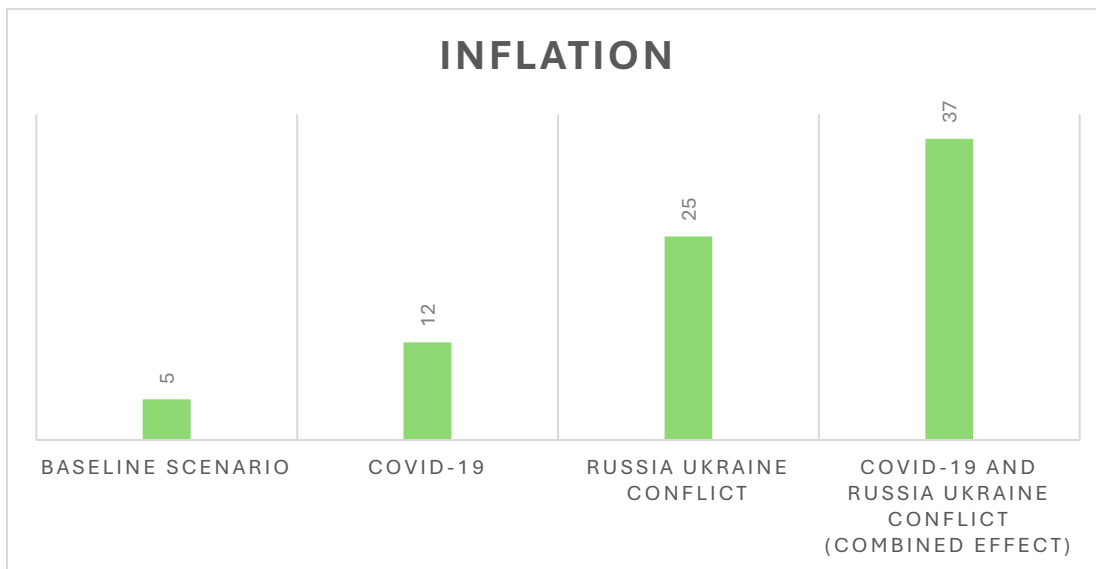


Source: (Author's own calculations)

Inflation levels have been one of the major concerns all along during this turmoil. The first scenario explains that if the Pakistan did not face any challenges, inflation would have only increased by 5% in the years 2020-2024. On the other hand, as Covid 19 and Russia Ukraine conflict raised inflation, a total of 37% increase is predicted through the results which truly reflect the current situation of Pakistan and is in line with the findings of various other authors.

Figure 6

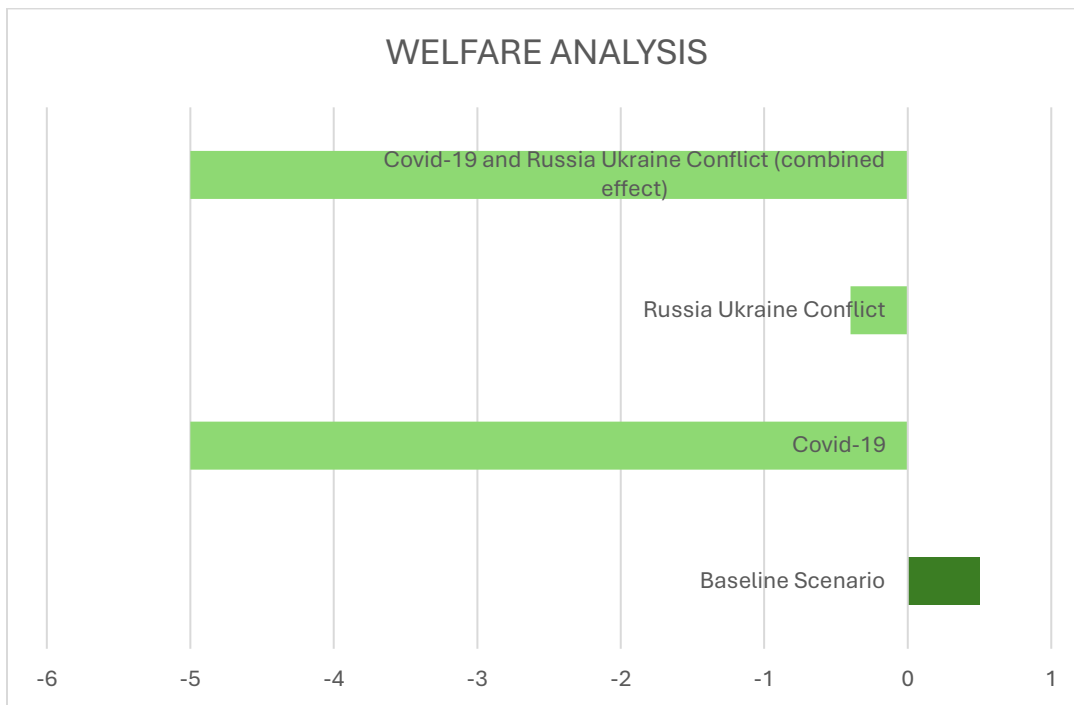
Inflation levels



Source: (Author's own calculations)

Figure 7 presents the welfare analysis results calibrated through the welfare decomposition analysis. The welfare in the study is defined through consumption and income and it is measured by how many meals per day are available to the household. The results conclude that the baseline scenario shows that there is a gain in the consumption and household welfare of the Pakistani households, whereas in the rest three scenarios the household performed poorly in terms of welfare and a combined welfare loss of around 5% can be seen.

Figure 7
 Welfare Analysis



Source: (Author's own calculations)

Figure 8 illustrates the sector-wise division of the combined losses to again summarize and emphasize the subsidiary sector losses for wheat. The overall losses show that flour mills suffered the most at the hands of both Covid-19 and Russia Ukraine Conflict accumulating to a 61% loss out of the total sector-wise losses.

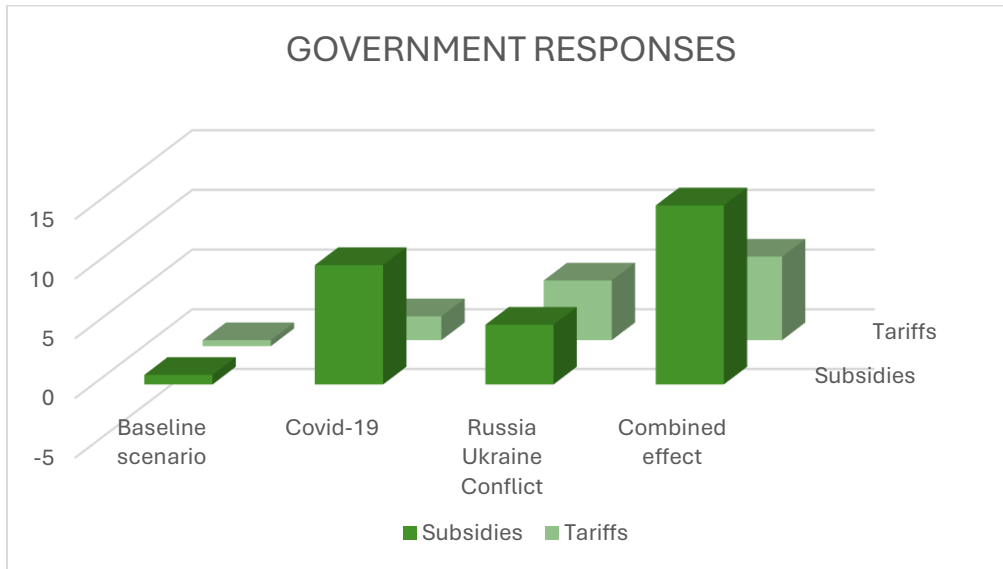
Figure 8
 Sector-wise Covid-19 and Russia Ukraine Conflict (combined effect)



Source: (Author's own calculations)

Figure 9 is the last of the results that were calculated from the various simulations run. The model was able to prove that the combined effects can be reversed if the two policy scenarios are applied to the model. The first policy response recommended by the results suggests an increase in the government subsidies of 15%. This positive increase would lead to an increase in yield per hectare for wheat, and overall production would increase. The subsidies would aid farmers and growers to use better quality seeds and enhanced growing techniques leading an increased production. Moreover, this year in 2023, a bumper wheat crop is witnessed which has led to excess supply and wheat in the form of both locally produced and imported wheat. Hence, the tariff should be increased as well as a government response. As the simulations report, the increased tariff would shift the interest of the government towards the local production and the private sectors would be discouraged to import but instead supply locally.

Figure 9
 Government Responses



Source: (Author's own calculations)

Conclusion And Future Direction

The current study is done to explore the impact on wheat due to the three scenarios designed the Covid 19, Russia Ukraine conflict and the combined effect of the two. Wheat and its subsidiary sectors were studied. The finding concludes overall losses in all four sectors of wheat. Majorly the highest loss was faced by the flour mills. Furthermore, the study explores the losses in the labor market and export market, export market again faced losses and the combined effects losses can be attributed to the disrupted international and local supply chains. The labor market also suffered in a very adverse manner; various agricultural jobs were lost (Ozden et al., 2022)

The study can be concluded by recommending various policy implications which are reinforced by the study's results as well. The most important and most crucial recommendation is the policy responses that are made by the government. The government should adopt an inward-looking trade approach. The tariff should be increased on wheat and on the other hand expansionary fiscal measures should be taken which include an increase in the subsidies and government expenditures towards the wheat producers and growers. These poor farmers are the most rightfully deserving of these subsidies, as the research above reflects the height of losses from which they have suffered.



The study uses static general equilibrium model for the single and combined shocks. The model can be further evolved along with the results if dynamic computable general equilibrium modelling is done. The study can be further expanded to various regions including the Pakistan's neighboring countries as well as the MENA region which was also highly impacted in terms of food security due to the Russia Ukraine crisis. Additional sectors can also be explored along with food security issues.

Author's Contributions: Both the authors have contributed equally towards this research paper.

Conflict of Interest: The authors declare that there is no conflict of interest.

Data Availability Statement: The data is obtained from secondary sources which can be assessed: <https://www.gtap.agecon.purdue.edu/databases/default.asp>

References

- Ahmed, J. U., Akter, S., & Majumder, K. A. (2021). Impact of COVID-19 on agricultural production and distribution in South Asia. *World Food Policy*, 7(2), 168-182. <https://doi.org/10.1002/wfp2.12032>
- Aguiar, A., Chepeliev, M., Corong, E. L., McDougall, R., & Van Der Mensbrugge, D. (2019). The GTAP database: version 10. *Journal of global economic analysis*, 4(1), 1-27.
- Alston, J. M., Carter, C. A., Green, R., & Pick, D. (1990). Whither Armington trade models? *American Journal of Agricultural Economics*, 72(2), 455-467.
- Amaglobeli, D., Gu, M., Hanedar, E., Hong, M. G. H., & Thévenot, C. (2023). *Policy responses to high energy and food prices*. International Monetary Fund.
- Amin, M., Amanullah, M., & Akbar, A. (2014). Time series modeling for forecasting wheat production of Pakistan. *JAPS: Journal of Animal & Plant Sciences*, 24(5).
- Arriola, C., Cadestin, C., Kowalski, P., Guilhoto, J. J. M., Miroudot, S., & van Tongeren, F. (2023). Challenges to international trade and the global economy: Recovery from COVID-19 and Russia's war of aggression against Ukraine. <https://doi.org/10.1787/18166873>
- Balistreri, E., Baquedano, F., & Beghin, J. C. (2022). The impact of COVID-19 and associated policy responses on global food security. *Agricultural Economics*, 53(6), 855-869. <https://doi.org/10.1111/agec.12749>
- Bank, W. (2005). World Economic Outlook. <https://doi.org/10.5089/9781616359423.081>
- Beckman, J., Baquedano, F., & Countryman, A. (2021). The impacts of COVID-19 on GDP, food prices, and food security. *Q Open*, 1(1), qoab005. <https://doi.org/10.1093/qopen/qoab005>



- Bushuk, W., & Rasper, V. F. (Eds.). (1994). *Wheat: production, properties, and quality*. Springer Science & Business Media.
- Dissanayaka, N., & Thibbotuwana, M. (2021). Sri Lanka's Agri-Food Trade: Structure, Opportunities, Challenges & Impacts of Covid-19. <http://dx.doi.org/10.22004/ag.econ.322050>
- Dube, A. (2022). Effect of Covid-19 on agriculture and food security (India).
- Erenstein, Olaf, Moti Jaleta, Khondoker Abdul Mottaleb, Kai Sonder, Jason Donovan, and Hans-Joachim Braun. "Global trends in wheat production, consumption and trade." In *Wheat improvement: food security in a changing climate*, pp. 47-66. Cham: Springer International Publishing, 2022.
- Gallagher, K., & Carlin, F. M. (2020). The role of IMF in the fight against COVID-19: The IMF Covid Response Index. *Covid Economics*, 42(19), 112-24.
- Hegsted, D. M., Trulsson, M. F., & Stare, F. J. (1954). Role of wheat and wheat products in human nutrition. *Physiological Reviews*, 34(2), 221-258. <https://doi.org/10.1152/physrev.1954.34.2.221>
- Igrejas, G., & Branlard, G. (2020). The importance of wheat. *Wheat quality for improving processing and human health*, 1-7.
- Iqbal, M. A. (2020). Ensuring food security amid novel coronavirus (COVID-19) pandemic: global food supplies and Pakistan's perspectives. *Acta Agric Slov*, 115(2), 1-4.
- Kalkavan, H., Baş, H., Ersin, İ., Eti, S., & Yüksel, S. (2021). Defining appropriate government strategies to reduce unemployment during COVID-19 pandemics. In *Management Strategies to Survive in a Competitive Environment: How to Improve Company Performance* (pp. 155-172). Cham: Springer International Publishing.
- Kazim, M., Qureshi, I. M., Sandhu, M. A. A., Ishfaq, S. R., & Hassan, A. F. (2023) Insights on Resilience and Flexibility During COVID-19 Pandemic: A Study on Wheat Supply Chains in Pakistan. 10.56976/rjsi.v5i2.137
- Khaliq, M. A., Ali, S., Kamran, A., & Qasrani, T. B. (2020). Opinion on impact of Covid-19 lockdown on agriculture, food security and livelihoods in Pakistan. *Int J Agric Biol Sc*.
- Khan, A., & Tariq, Z. (2023). Effective Marketing Strategy–Confectionery Industry of Pakistan. *International Journal of Emerging Business and Economic Trends*, 2(1), 66-101.
- Khan, M. A. (2020). COVID-19 and Pakistan's Trade. *VISITING SCHOLARS' OPINION PAPER*, 39.
- Khan, M. (2021). The COVID-19 Pandemic and Food Security in Pakistan. *Khan, Mohisn (2021). The Covid, 19*. <https://dx.doi.org/10.2139/ssrn.3896173>
- Kovács, S., Rabbi, M. F., & Máté, D. (2021). Global Food Security, Economic and Health Risk Assessment of the COVID-19 Epidemic. *Mathematics*, 9(19), 2398. <https://doi.org/10.3390/math9192398>
- Laborde Debucquet, D., Martin, W., & Vos, R. (2020). Impacts of COVID-19 on global poverty, food security and diets. <https://doi.org/10.2499/p15738coll2.134229>
- Lin, F., Li, X., Jia, N., Feng, F., Huang, H., Huang, J., ... & Song, X. P. (2023). The impact of Russia-Ukraine conflict on global food security. *Global Food Security*, 36, 100661.



- Mazhar, M. (2023). Impact of COVID-19 on Pakistan's economic development: A sector-wise analysis. *Am. J. Soc. Sci. Humanit*, 8, 73-88.
- Muhammad, A., Charlotte, F. S., Helene, M., & Mazhar, M. Y. (2023). Collateral damage? Welfare effects of the Ukraine war on Pakistan. *World Development Sustainability*, 3, 100082. <https://doi.org/10.1016/j.wds.2023.100082>
- Nguyen, T. D., Le, A. H., Thalassinou, E. I., & Trieu, L. K. (2022). The impact of the COVID-19 pandemic on economic growth and monetary policy: An analysis from the DSGE model in Vietnam. *Economies*, 10(7), 159. <https://doi.org/10.3390/economies10070159>
- Özden, C., Bulut, M., & Şen, B. (2022). Covid-19 and food security: Impact on wheat. *Turkish Journal of Agriculture-Food Science and Technology*, 10(4), 549-554. <https://doi.org/10.24925/turjaf.v10i4.549-554.4581>
- Patel, M. K., Bergeri, I., Bresee, J. S., Cowling, B. J., Crowcroft, N. S., Fahmy, K., ... & Feikin, D. R. (2021). Evaluation of post-introduction COVID-19 vaccine effectiveness: Summary of interim guidance of the World Health Organization. *Vaccine*, 39(30), 4013-4024. <https://doi.org/10.1016/j.vaccine.2021.05.099>
- Partridge, M. D., & Rickman, D. S. (2010). Computable general equilibrium (CGE) modelling for regional economic development analysis. *Regional studies*, 44(10), 1311-1328. <https://doi.org/10.1080/00343400701654236>
- Paslakis, G., Dimitropoulos, G., & Katzman, D. K. (2021). A call to action to address COVID-19-induced global food insecurity to prevent hunger, malnutrition, and eating pathology. *Nutrition reviews*, 79(1), 114-116. <https://doi.org/10.1093/nutrit/nuaa069>
- Porter, J. R., & Gawith, M. (1999). Temperatures and the growth and development of wheat: a review. *European journal of agronomy*, 10(1), 23-36. [https://doi.org/10.1016/S1161-0301\(98\)00047-1](https://doi.org/10.1016/S1161-0301(98)00047-1)
- Prywes, M. (1986). A nested CES approach to capital-energy substitution. *Energy Economics*, 8(1), 22-28.
- Tripathi, M. K., Karim, S. A., Chaturvedi, O. H., & Verma, D. L. (2007). Nutritional value of animal feed grade wheat as replacement for maize in lamb feeding for mutton production. *Journal of the Science of Food and Agriculture*, 87(13), 2447-2455. <https://doi.org/10.1002/jsfa.2942>
- Salik, K. M. (2021). Food Security Challenges in the Times of COVID-19: Need Assessment for Agriculture Sector in Pakistan.
- Sohrabi, C., Alsafi, Z., O'Neill, N., Khan, M., Kerwan, A., Al-Jabir, A., ... & Agha, R. (2020). World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). *International journal of surgery*, 76, 71-76. <https://doi.org/10.1016/j.ijssu.2020.02.034>
- Ubaid-ur-Rehman, H., Asghar, W., & Khalid, N. (2021). Food security challenges for Pakistan during COVID-19 pandemic: An overview of the response plan. *World Food Policy*, 7(1), 82-89. <https://doi.org/10.1002/wfp2.12026>
- UNL, E. B., Baquedano, F., & UNL, J. B. (2022). The Impact of COVID-19 and Associated Policy Responses on Global Food Security. <http://dx.doi.org/10.22004/ag.econ.323973>



Zayukov, I., Overchuk, V., Burdiak, V., Velykyi, Y., Butyraska, I., & Butenko, V. (2020).
Statistical data analysis of socio-economic and demographic losses of labor resources in
Ukraine.