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TITLE

FOOD SECURITY STATUS IN TIMES OF FINANCIAL CRISIS IN IRAN

Supervisor:
Prof. Maria Sassi

Student: Elham Akbari Jor

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Abstract

The 2018 financial crisis in Iran introduced unprecedented inflation into the Iranian food market, which would most definitely have an effect on the food security of the Iranian people. The study attempts to find out how the financial crisis has influenced the prices of food and the food security of households in Iran.

The impacts of the financial crisis on the average retail price of food products in Iran were investigated using interrupted time series analysis. Household food security was estimated using calculation of the share of household food expenditure. The costs of following a healthy diet based on the food pyramid were estimated.

After the financial crisis due to the limitations in international financial exchanges, a significant increase in the prices of all food groups occurred in 2018, the year after the re-imposition of sanctions and the financial crisis.

The share of food insecurity-vulnerable urban and rural households in Iran increased from 8.84% and 25.17% in 2017 to 13.64% and 33.23% in 2021, respectively. As shown, the annual average healthy diet cost for a sample Iranian family of 3.3, calculated at current prices, stands at 941,994,884 IRR (US$ 3991).

Food insecurity has increased owing to economic vulnerability in Iran after the financial crisis, and with the current status of food prices and incomes, it will be more difficult for most Iranians to follow a healthy diet. This makes Iranians more prone to chronic diseases in the near future; if this trend continues, it puts the country in danger of both a food crisis and political instability.

Keywords

Food Security, Financial Crisis, Iran, Interrupted Time Series (ITS), STATA, Consumer Price Index, Undernourishment, Food Insecurity.

Riassunto

La crisi finanziaria del 2018 in Iran ha introdotto un'inflazione senza precedenti nel mercato alimentare iraniano, che ha sicuramente avuto un effetto sulla sicurezza alimentare del popolo iraniano. Lo studio cerca di capire come la crisi finanziaria abbia influenzato i prezzi degli alimenti e la sicurezza alimentare delle famiglie in Iran.

Gli impatti della crisi finanziaria sul prezzo medio al dettaglio dei prodotti alimentari in Iran sono stati esaminati utilizzando l'analisi delle serie temporali interrotte. La sicurezza alimentare delle famiglie è stata stimata calcolando la quota di spesa alimentare delle famiglie. I costi per seguire una dieta sana basata sulla piramide alimentare sono stati stimati.

Dopo la crisi finanziaria, a causa delle limitazioni negli scambi finanziari internazionali, si è verificato un significativo aumento dei prezzi di tutti i gruppi alimentari nel 2018, l'anno successivo alla reimposizione delle sanzioni e alla crisi finanziaria.

La quota di famiglie urbane e rurali vulnerabili all'insicurezza alimentare in Iran è aumentata rispettivamente dall'8,84% e dal 25,17% nel 2017 al 13,64% e al 33,23% nel 2021. Come mostrato, il costo medio annuo di una dieta sana per una famiglia iraniana campione di 3,3 persone, calcolato ai prezzi correnti, ammonta a 941.994.884 IRR (3.991 dollari USA).

L'insicurezza alimentare è aumentata a causa della vulnerabilità economica in Iran dopo la crisi finanziaria e, con l'attuale situazione dei prezzi alimentari e dei redditi, sarà più difficile per la maggior parte degli iraniani seguire una dieta sana. Questo rende gli iraniani più inclini a malattie croniche nel prossimo futuro; se questa tendenza continua, il paese rischia sia una crisi alimentare sia un'instabilità politica.

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Chapter 1: Introduction

1.1 Background

Food security, defined as the condition where all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life, is a critical issue globally (FAO, 1996). Ensuring food security is fundamental for health, economic stability, and social well-being (FAO, 2019).

Iran, a country with a diverse economy and substantial natural resources, faces significant challenges in maintaining food security, particularly during times of financial crisis (World Bank, 2007). Economic downturns can disrupt food supply chains, increase food prices, and reduce household incomes, exacerbating food insecurity (Timmer, 2010).

1.2 Problem Statement

Several financial crises have recurrently affected Iran over the years, its food security indicators being markedly volatile. The challenge this country is facing today is constituted by a complex interaction of declining household incomes, increasing food prices, and disturbed food supply systems. Food availability, food access, utilization of food, and food stability; all these basic dimensions of food security-are vulnerable in this situation. The research problem, therefore, deals with understanding the ways in which financial crises influence food security in Iran and focuses on the main economic determinants that worsen or improve the state of food insecurity during crises.

1.3 Research Objectives

The main aim of this study will be to determine the effect of financial crises on food security in Iran. Specific objectives are listed as follows:

1. To Examine the Effect of Financial Crises on Food Prices and Availability.

2. To Identify the Important Economic Determinants Influencing Food Security during Crises.

3. To recommend policies that will help improve food security when there is an economic crisis.

1.4 Research Questions

Some of the major questions which this thesis tries to answer are:

1. The Effect of Financial Crisis on the Prices of Food in Iran

2. Due to the economic crisis, what percentage of Iranian families have fallen into food insecurity?

3. What are the projected health outcomes if the trend in food insecurity continues as it is now?

1.5 Hypothesis

The central hypothesis of this study is that, due to the increased stringency from US sanctions, this financial crisis has sharply elevated food insecurity in Iran, both through food price inflation and through reduced access to essential nutrients. It is hypothesized that this increases vulnerability among poor households to the need to become more dependent on lower-priced foods that are less nutritious and thus heighten the risk of chronic diseases.

1.5 Methodology

The methods of "FOOD SECURITY STATUS IN TIMES OF FINANCIAL CRISIS IN IRAN" were through the application of the Interrupted Time Series (ITS) analysis on the study of the impact of sanctions on food prices and food security. It checks the average retail prices of six major food groups over 60 months- January 2017 to December 2021-to determine the immediate and gradual effects of sanctions. For this, data were collected from the SCI: food production, imports, exports, and urban retail prices. In order to investigate household food security, the share of household food expenditure, and economic vulnerability, the income and expenditure surveys were estimated. For estimation, the cost of a healthy diet was considered using Iran's food-based dietary guidelines. This is an indication that escalating food prices due to the financial crisis have dramatically increased food insecurity in Iran, especially among poor households, and there is a vital need for the development of appropriate policy interventions.

1.6 Structure of the Thesis

This thesis is organized into five chapters. Following this introduction:

• Chapter 1: Introduction: Provides the background, problem statement, research objectives, research questions, hypothesis, and an overview of the methodology.

• Chapter 2: Literature Review discusses previous studies on food security in times of economic crises and the specific impacts of sanctions on food security in Iran.

• Chapter 3: Research Methodology details the data sources, tools, and analytical techniques used in this research.

• Chapter 4: Results and Discussion presents the findings and analysis based on the collected data.

• Chapter 5: Conclusion and Recommendations summarizes the research outcomes, highlighting policy implications and proposing strategies to mitigate food insecurity.

1.7 Conclusion

The chapter describes the critical nexus between financial crises, sanctions, and food security in Iran. It is in this respect that the present analysis attempts to provide an overview of how economic challenges posed by a financial crisis have reshaped food security and health outcomes in the country.

Chapter 2: Literature Review

2.1 Overview of the importance of food security

Food security is a critical issue globally, encompassing the availability, access, and utilization of food that meets the dietary needs and preferences of all individuals at all times. Ensuring food security is fundamental for health, economic stability, and social well-being. This overview highlights the significance of food security through various dimensions, including its impact on health, economic development, and social stability.

Food security is directly linked to the health and nutritional status of individuals. Adequate access to nutritious food is essential for preventing malnutrition, undernutrition, and related health issues. For instance, food insecurity can lead to deficiencies in essential nutrients, affecting physical and cognitive development, particularly in children (FAO, 2019). Food security is also crucial for economic development. A well-nourished population is more productive, which enhances economic growth and development. Conversely, food insecurity can hamper economic progress by increasing healthcare costs and reducing workforce productivity (World Bank, 2007). Ensuring food security is vital for maintaining social stability. Food insecurity can lead to social unrest, migration, and conflict. Historical evidence shows that food shortages and high food prices can trigger social and political instability, making it a key area of focus for governments and international organizations (Bellemare, M. F, 2015).

The international community, including organizations like the United Nations and the World Food Program, recognizes the importance of food security and has established goals to eradicate hunger and improve food access worldwide. The Sustainable Development Goals (SDGs) emphasize the

need for zero hunger (SDG 2), highlighting the global commitment to achieving food security (United Nations, 2015).

Financial crises pose significant challenges to food security, particularly in countries with fragile economies. Economic downturns can reduce household incomes, increase food prices, and disrupt food supply chains, exacerbating food insecurity. Research indicates that financial instability can severely impact food availability and access, necessitating robust policy responses to mitigate these effects (Timmer, C. P, 2010).

2.2 Definition of Food Security, Dimensions, and History

Providing food security for society is one of the major plans of socio-economic development in all countries. Food security is a complex, multidimensional concept, which is reflected in the commonly used definition—a condition where "… all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life" (FAO, 1996). By default, food insecurity is the failure to meet these conditions and is conceptualized along a continuum of mild to severe. From this definition, four main dimensions of food security can be identified:

- Physical AVAILABILITY of food: Food availability addresses the "supply side" of food security and is determined by the level of food production, stock levels, and net trade.

- Economic and physical ACCESS to food: An adequate supply of food at the national or international level does not in itself guarantee household-level food security. Concerns about insufficient food access have resulted in a greater policy focus on incomes, expenditure, markets, and prices in achieving food security objectives.

- Food UTILIZATION: Utilization is commonly understood as the way the body makes the most of various nutrients in the food. Sufficient energy and nutrient intake by individuals are the result of good care and feeding practices, food preparation, diversity of the diet, and intra household distribution of food. Combined with good biological utilization of food consumed, this determines the nutritional status of individuals.

_ STABILITY of the other three dimensions over time: Even if your food intake is adequate today, you are still considered to be food insecure if you have inadequate access to food periodically, risking a deterioration of your nutritional status. Adverse weather conditions, political instability, or economic factors (unemployment, rising food prices) may have an impact on your food security status.

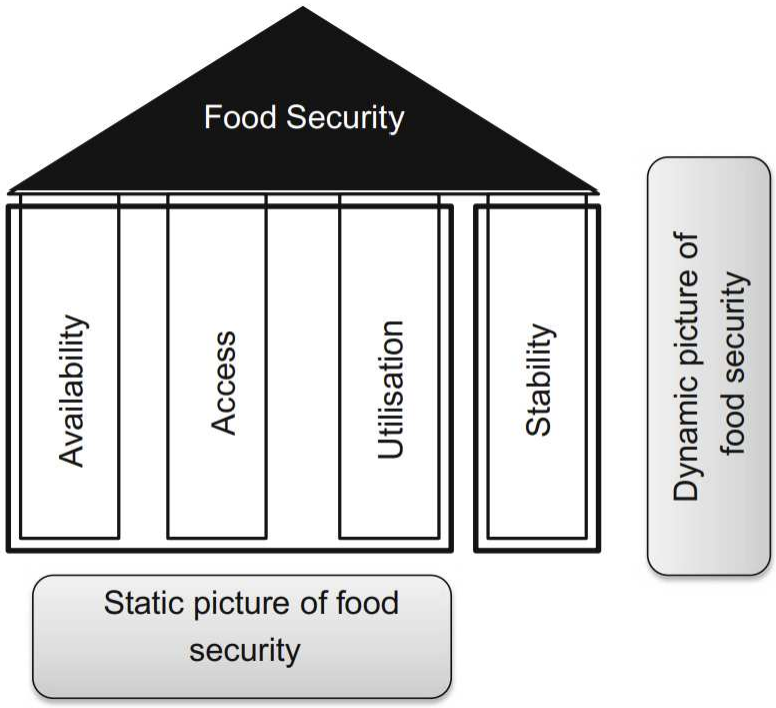

Figure 2. 1. Food security pillars and their static and dynamic nature

Source: Sassi, M. (2018). *Understanding food insecurity: Key features, indicators, and response design*. Springer. https://doi.org/10.1007/978-3-319-70362-6

The literature has introduced two dimensions of food security that have found practical applications in policy and program design and implementation: the fear or the perception that there will be not enough food to eat (Maxwell, S, 2001) and the risk that one of the three basic dimensions of food security can be disrupted. The latter is considered a cross-cutting issue: it can affect all the core pillars underpinning food security (Webb Rogers, B, P; Rogers, B, 2003) . In this respect, the following two concepts are key from a policy and programming perspective: vulnerability and resilience.

People vulnerable to food insecurity are those who are capable of maintaining an adequate level of food intake today but who may be at risk of becoming food insecure in the future (FAO, 2008).

Vulnerability refers to the full range of natural factors or to factors resulting from human activity that puts individuals or households at risk of becoming food insecure.

People are highly vulnerable to food insecurity when they are exposed to multiple shocks, when their incomes are low and uncertain, and when they own few assets (Maliro, D. D, 2011). Therefore, strengthening people's sources of income and assets reduces their vulnerability to future adverse events. These interventions are part of the resilience strategies aimed at improving the ability of people, communities, or systems affected by disasters or crises to withstand damage and recover rapidly (FAO, 2008).

Following the food crisis of 2008, research interest in resilience has increased, and many definitions have been developed. For example, according to the United Nations (UN) International Strategy for Disaster Reduction (UN, 2009), resilience is the "ability to prevent disasters and crises

as well as to anticipate, absorb, accommodate or recover from them in a timely, efficient and sustainable manner. This includes protecting, restoring and improving livelihoods systems in the face of threats that impact agriculture, nutrition, food security and food safety".

Based on the dimensions of the concept of resilience, organizations have elaborated their strategies and actions in a food security context. For example, the resilience strategy adopted by the FAO is based on enabling the environment, watching to safeguard, applying prevention and mitigation measures to disasters and crises, and preparing and responding (FAO, 2013).

The History of Food Security

The concept of food security has evolved significantly over time, reflecting changes in global priorities and understanding:

Early Focus (1970s): Initially, food security was primarily concerned with the availability of sufficient food at the global and national levels, emphasizing food production and supply (Maletta, H, 2014) The 1974 World Food Conference defined food security as the "availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices" (United Nations, 1975).

1980s-1990s: The World Bank's 1986 report "Poverty and Hunger" highlighted the distinction between chronic and transitory food insecurity (World Bank, 1986). Internationally, the 1990s saw increased efforts to integrate food security into broader development goals. The World Food Summit in 1996 was a significant event, highlighting the need for comprehensive strategies to

address both the availability and accessibility of food. The summit underscored the importance of international cooperation and the role of trade in achieving food security (Shaw, D. J, 2007).

2000s: The definition of food security expanded to include utilization, which considers the nutritional value of food and the ability of individuals to absorb nutrients. Stability, or the ability to maintain food security over time, also became a key component (Margulis, M. E, 2016). The 1996 World Food Summit defined food security as "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 1996).

In recent years, the concept of food security has further expanded to include dimensions of nutrition security, emphasizing not just the availability of food but also its quality and nutritional value. This broader understanding is crucial for addressing the complex challenges of hunger and malnutrition in the 21st century (Belugin, V, 2019).

The establishment of international organizations such as the Food and Agriculture Organization (FAO) in 1945 marked a significant step in addressing global food security. These organizations aimed to coordinate efforts to improve agricultural productivity, stabilize food prices, and provide food aid to countries in need (FAO, 1996).

2.3 Food Insecurity Typologies and Poverty

Food Insecurity Typologies According to Time

The FAO's definition of food security ("at all times") highlights the distinction between chronic and transitory food insecurity (Table 2.1). To address this issue, we must first define food insecurity. According to the (FAO, 2002), it is "a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active, healthy life". In other words, food insecurity occurs when food security is limited or uncertain.

Food security analysts have defined two general types of food insecurity:

CHRONIC FOOD INSECURITY

TRANSITORY FOOD INSECURITY

The concept of seasonal food security falls between chronic and transitory food insecurity. However, as seasonal food insecurity is of limited duration it can also be seen as recurrent, transitory food insecurity (Maxwell, S, 1996). Chronic food insecurity is long-term and persistent, occurring when people cannot meet their minimum food requirements due to poverty and lack of resources. It can be addressed with typical development measures like education and access to resources (FAO, 2003).

Chronic food insecurity can take various forms, such as limited access to food and food stocks, insufficient dietary intake throughout the year, malnutrition in young children, small-scale food purchases, and outstanding household debts. This persistent form of food insecurity can be addressed through long-term development interventions typically used to tackle poverty, including

measures to improve education, access to productive resources like credit, and access to food to enable the chronically food-insecure to enhance their productive capacity (FAO, 2008).

Transitory food insecurity is a temporary and unpredictable phenomenon, stemming from sudden declines in food availability. Addressing this type of food insecurity necessitates different interventions, including early warning systems and safety net programs (WFP, 2009).

The main cause of cyclical or seasonal food insecurity is the inadequacy of household production to sustain the household for the entire year in poverty-stricken areas with one primary growing season. Such inadequate production is associated with seasonal fluctuations in the climate, cropping patterns, work opportunities, and disease (FAO, 2008).

Table 2. 1. Food insecurity and time

Source: Sassi, M. (2018). Understanding food insecurity: Key features, indicators, and response design. Springer. https://doi.org/10.1007/978-3-319-70362-6

Typology	**Definition**
Chronic	Long-term inadequate access to sufficient food
Transitory:	Temporary inadequate access to food
– Temporary	Household entitlements affected by sudden and unpredictable shocks
– Cyclical	A regular pattern of inadequate access to food

Food insecurity arises from a diverse range of socioeconomic factors, including famine, periodic hunger, and the instability of food supplies. These factors are often linked to poverty, unemployment, inflation, illiteracy, natural disasters like droughts, and other calamities, including social problems. These variables can be both the causes and the consequences of food insecurity (Coates, J., Swindale, A., & Bilinsky, P, 2006).

A single indicator of food insecurity or food vulnerability is insufficient to assess household food insecurity (Aiga, H., & Dhur, A, 2006). Instead, a comprehensive understanding of the severity

and prevalence of food insecurity in households requires examining multiple conditions, behaviors, and experiences (Pangaribowo, E. H., Gerber, N., & Torero, M, 2013).

One of the major challenges in monitoring the extent of food insecurity is creating reliable food security indices (Bickel, G., Nord, M., Price, C., Hamilton, W., & Cook, J, 2000) (Haddad, L., Kennedy, E., & Sullivan, J, 1994). The lack of clarity surrounding the causes, specific signs, and consequences of food security can impede the development of indicators to map the prevalence of food insecurity in any country or region (Pangaribowo, E. H., Gerber, N., & Torero, M, 2013).

Food Insecurity and Poverty

Food insecurity is a cause and a manifestation of poverty (Committee on World Food Security, 2000). However, these two interrelated concepts are distinct (Clay, E., Pillai, N., & Benson, C, 1998). As the FAO definition explains, food insecurity concerns a specific vulnerability people face in accessing food. In contrast, the 1995 UN definition of (absolute) poverty describes it as a condition characterized by severe deprivation of basic human needs, including food, water, sanitation, health, shelter, education, and information. Poverty depends not only on income but also on access to services (United Nations, 1995).

Therefore, poverty describes a condition in which people are relatively short of almost every basic good and service, and they must choose between buying food items or other goods and services (e.g., clothing, medical care, education) on a daily basis.

As shown in Figure 2. 2, food insecurity and poverty are inextricably linked. Low nutrition that results from poverty leads to poor physical and cognitive development, which is the basis of a decreased ability to work. This latter condition, in turn, fuels poverty.

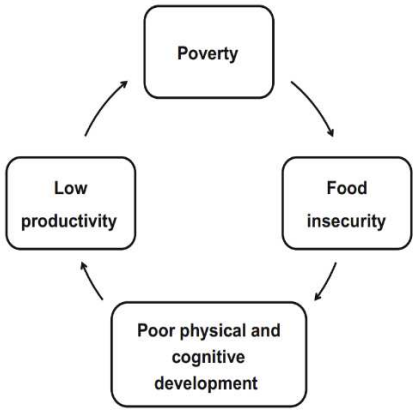

Figure 2. 2. Interdependency between food insecurity and poverty.

Source: Sassi, M. (2018). Understanding food insecurity: Key features, indicators, and response design. Springer. https://doi.org/10.1007/978-3-319-70362-6

The fact that food security is a cause, and a manifestation of poverty has important implications for action. Fighting food insecurity is "instrumental to the eradication of other dimensions of poverty" (Committee on World Food Security, 2011).

2.4 Food Insecurity, Undernourishment, Undernutrition, Malnutrition, and Hunger

Often, the terms food insecurity, undernourishment, undernutrition, malnutrition and hunger are interchangeably used loosely, although each term is a unique concept. Undernourishment is a state whereby a person is unable to take sufficient food to meet his or her daily minimum dietary energy requirements over at least one year (Food and Agriculture Organization, n.d.).

Undernourishment leads to undernutrition. Actually, undernutrition is an outcome of a chronic low food intake level and/or poor absorption of food consumed because of recurrent infectious diseases, regardless of the presence of any specific nutrient deficiency. That is to say,

undernutrition depends on both the food level of intake and health, sanitation, and care conditions. The manifestation of undernutrition includes being underweight for one's age, too short for one's age, dangerously thin for one's height, and deficient in vitamins and minerals (Food and Agriculture Organization, n.d.).

Undernutrition is one side of malnutrition. As a matter of fact, malnutrition occurs as a result of a deviation from proper nutrition, involving undernutrition and overnutrition—the former being characterized by insufficient energy, protein, and/or other micronutrients and macronutrients in relation to the need (FAO, 1999) (FAO, 2000).

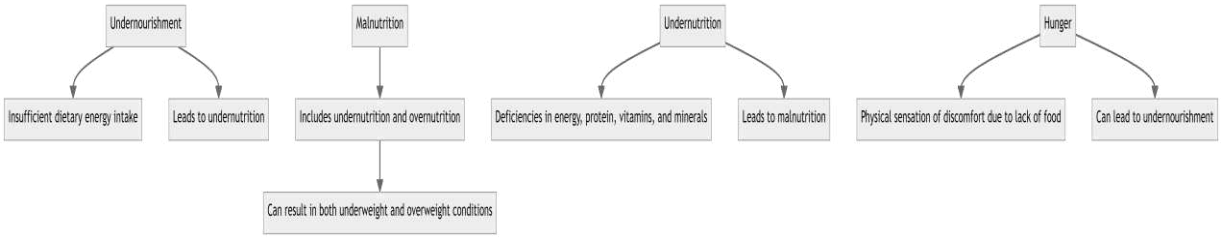

Figure 2. 3. Visual Representation of Undernourishment, Undernutrition, Malnutrition, and Hunger.
Source: Food and Agriculture Organization (FAO). (2000). The state of food insecurity in the world.

Lastly, the meaning of hunger ranges from short-term physiological discomfort to a life-threatening lack of food and an uncomfortable or painful sensation caused by insufficient food energy consumption. Hunger is referred to, in the latter aspect, as food deprivation. A hungry person is, for this reason, food insecure but not all food insecure people are hungry. Food insecurity can be determined by other causes that are ascribed to poor intake of micronutrients (FAO, 2008) (Ballard, T., Kepple, A., & Cafiero, C, 2013).

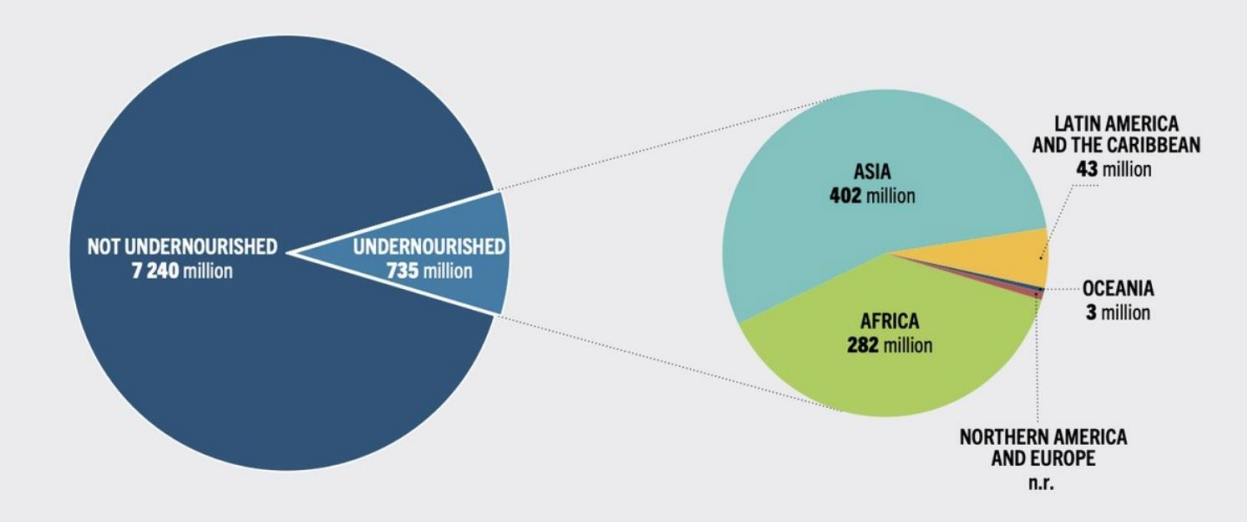

Figure 2. 4. Undernourished in the world, FAO. 2023.

n.r. = not reported,as the prevalence is less than 2.5 percent.

Source: FAOSTAT: suite of Food Security Indicators. In FAO. [Cited 12 July 2023]. www.fao.org/faostat/en/#data/FS

Figure 2.4 provides a detailed snapshot of global undernourishment in 2022, highlighting the distribution of undernourished populations across different regions, with 735 million people worldwide affected by hunger, while 7.24 billion were not undernourished. Asia was the most affected region, with 402 million undernourished individuals, representing 55% of the global total, followed by Africa with 282 million (38%), Latin America and the Caribbean with 43 million, and Oceania with 3 million. In Northern America and Europe, the prevalence of undernourishment was less than 2.5%, so it was not reported. The concentration of undernourished populations in Asia and Africa underscores the urgent need for targeted food security interventions in these regions. While the majority of the global population is not undernourished, stark regional disparities indicate uneven access to food and resources. Addressing this issue requires comprehensive strategies involving local governments, international organizations, and community initiatives to ensure access to sufficient, safe, and nutritious food for all, enabling stakeholders to better

understand the distribution of hunger and work towards sustainable solutions for global food security (FAO, 2023).

2.5 Levels of Analysis of Food Security

Food security can be analyzed at the global, national/ regional, household, or individual level (Table 2.2). Indeed, at each level of analysis, a specific policy answer is required. Besides, food security at one level does not imply food security at a lower level (FIVIMS, 2003) (Thomson, A., & Metz, M, 1996).

Food security at the global level describes a situation in which sufficient food is produced in the world (FAO, 1996) (United Nations, 2015).

National/regional food security occurs when a satisfactory balance exists between food demand and supply at reasonable prices (FAO, 2002) (World Bank, 1986). This concept describes a situation in which no major upheavals have occurred in the recent past in the food market, food availability is adequate and most of the population has access to food (Smith, L. C., & Haddad, L. J, 2000) (FAO, 2002). According to the literature, most of the population is food secure when hungry people account for less than 5% of the total population (WFP, 2009) (United Nations, 2015).

Food security at the household level is achieved when the household's entitlements exceed or are equal to its food needs in terms of energy requirements. This definition is anchored upon two basic concepts. The first concept is that of entitlements, which Sen introduced to indicate “the set of

alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces" (Sen, A. K, 1981). Sen (1981) distinguishes between four categories of entitlements:

– Trade-based entitlements, which consist of what a person can buy with the commodities that he or she owns and with cash;

– Production-based entitlements, which are represented by the right to own what a person produces with his or her resources;

– Labor entitlements, which refer to the sale of a person's labor power;

– Inheritance and transfer entitlements, which relate to the right to own what is willingly given by others.

Table 2. 2. Level of food security.

Food and Agriculture Organization (FAO). (2008). An introduction to the basic concepts of food security. *http://www.fao.org/documents*

Level of food security	**Definition**
Global	Sufficient food produced at the global level
National/regional	A satisfactory balance between food demand and supply at reasonable prices
Household	Household entitlements greater than or equal to food needs in terms of energy requirements
Individual	Individual food consumption meets individual food needs in terms of energy requirements

The second constituent of the definition of household-level food security is the concept of energy requirements. This concept is basic in characterizing food security from a theoretical perspective and in measuring its state. The report of the FAO/WHO/UNU Expert Consultation on Energy and

Protein Requirements defines energy requirements at the level of the individual as “the level of energy intake from food that will balance energy expenditure when an individual has a body size and composition and level of physical activity, consistent with long-term good health; and that will allow for the maintenance of economically necessary and socially desirable physical activity. In children and pregnant or lactating women, the energy requirement includes the energy needs associated with the deposition of tissues or the secretion of milk at rates consistent with good health” (FAO, WHO, & UNU, 1995).

The last level, concerning food security analysis, is the individual. At this level, food security is defined as a situation where the consumption of food, at an individual level, meets the individual's requirements in terms of food needs, which also is in terms of energy needs (FAO, WHO, & UNU, 1995).

2.6 Global Food Security and Food Security in the Middle East and Iran

According to the latest Global Report on Food Crises (GRFC), nearly 282 million people in 59 countries and territories experienced high levels of acute hunger in 2023 - a worldwide increase of 24 million from the previous year. In May 2022, the World Bank Group and the G7 Presidency co-convened the Global Alliance for Food Security, which aims to catalyze an immediate and concerted response to the unfolding global hunger crisis. The Alliance has developed the publicly accessible Global Food and Nutrition Security Dashboard, which provides timely information for global and local decision-makers to help improve coordination of the policy and financial response to the food crisis (The World Bank, 2024).

The heads of the FAO, IMF, World Bank Group, WFP, and WTO released a Third Joint Statement on February 8, 2023. The statement calls to prevent a worsening of the food and nutrition security crisis, further urgent actions are required to (i) rescue hunger hotspots, (ii) facilitate trade, improve the functioning of markets, and enhance the role of the private sector, and (iii) reform and repurpose harmful subsidies with careful targeting and efficiency. Countries should balance short-term urgent interventions with longer-term resilience efforts as they respond to the crisis (The World Bank, 2024).

In 2012, The Economist launched the Global Food Security Index, a resource that evaluates food security in 113 nations. Yearly scores show large disparities in food security across the globe (The Economist, 2012).

According to the results of the 2022 Index, Finland, Ireland, and Norway shared the number one position, with each scoring between 80 and 84 points on the index. This would suggest that they have sufficient and available food, as well as natural resources to carry their populations, in addition to strong food safety net programs. In contrast, the seven worst performers in 2012 were all African countries, with Syria and Haiti also listed among the worst countries. These nations scored between 34 and 37 points, indicating that they face food supply problems regarding supply and price, along with particularly low quality and safety scores (The Economist, 2022).

The Global Food Security Index (GFSI) is a dynamic quantitative and qualitative benchmarking model that measures the drivers of food security across both developing and developed countries. It is constructed from 28 unique indicators that assess various aspects of food security. The GFSI

includes four main components: Affordability, Availability, Quality and Safety, Natural Resources, and Resilience (Sara D. Garduño-Diaz, Philippe Y. Garduño-Diaz, 2015).

The GFSI is updated annually and provides insights into the strengths and weaknesses of food security systems globally, offering a comprehensive view that helps policymakers and researchers develop strategies to improve food security (The Economist, 2022).

The world population is growing at a rate of about 1% per year, down from 2.2% per year a half-century ago. The growth trend, however, indicates that the world population will increase by another two billion people in 2050 and almost touch 10 billion. This rapid growth in population will be devastating to the planet, and its food resources would be strained (United Nations, 2019).

Population growth and food security are very complicated, quite multifaceted relationships. Food production and how human beings consume food have changed. People in the more prosperous countries have gained more prosperity and increased consumption. Food consumption has shifted to resource-intensive and environmentally destructive food commodities. However, as demand increases, resources become scarce. To meet the increasing demand, food production has been increased, and it has brought humanity virtually to a point where it is crossing its ecological limits. The existing food production system is challenged to meet the soaring demand for food (United Nations, 2019).

Urbanization rates differ between countries and are often correlated with the stage of structural transformation in each country. On a global scale, urbanization is accelerating; as a result, by 2050, it is estimated that nearly 70 percent of the world population will be urban, compared to 56 percent currently. (UN DESA, 2018).

In low- and middle-income countries, the urban population is growing over three times faster than the rural population. By 2030, the urban populations in these countries are expected to exceed 4 billion, more than twice that of 2000, while the rural population will increase to around 3 billion by 2050. (UN DESA, 2022).

The challenges related to poverty, food insecurity, and access to healthy diets are particularly significant in rapidly urbanizing regions like sub-Saharan Africa and Southern Asia. In sub-Saharan Africa, the urban population will almost quadruple in 2050 to reach 1.3 billion (UN DESA, 2022).

Urbanization is the result of the push from rural areas by the forces of poverty and environmental degradation, combined with the pull of urban areas by job opportunities and better services. Even though there is an improvement in the general standards of living in urban areas, the problems of poverty persist, limiting access to affordable healthy diets and increasing food insecurity. Rural and urban households buy most of their food from markets. Thus, cost and affordability are decisive factors in the choice of household diets (Tefft, J. F., Jonasova, M., Adjao, R. T. O. A., & Morgan, A. M, 2018).

Therefore, effective policies and investments are needed to achieve access to affordable healthy diets for rural, peri-urban, and urban populations. This must take an integrated approach that

transcends sectoral boundaries and administrative borders (Tefft, J. F., Jonasova, M., Adjao, R. T. O. A., & Morgan, A. M, 2018).

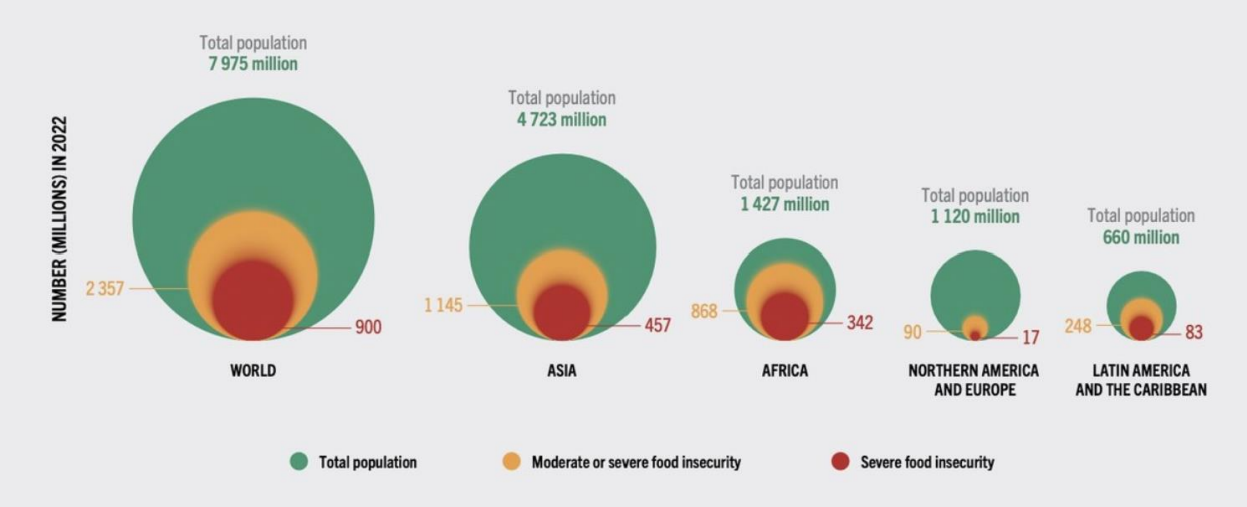

Figure 2. 5. Global Food Insecurity in 2022.

Source: FAO. 2023. FAOSTAT: suite of Food Security Indicators. In FAO. [Cited 12 July 2023]. www.fao.org/faostat/en/#data/FS

Figure 2.5 provides a visual representation of food insecurity across different regions in 2022, illustrating the total population of each region and the numbers experiencing moderate to severe food insecurity, as well as severe food insecurity. In 2022, the world population was approximately 7.975 billion, with 2.357 billion people experiencing moderate or severe food insecurity, and 900 million facing severe food insecurity. Asia and Africa together accounted for the majority of the global population suffering from food insecurity; nearly one-fourth of Asia's population faces moderate or severe food insecurity, with about 10% severely affected, while Africa shows an even higher proportion, with approximately 61% experiencing moderate or severe food insecurity and around 24% facing severe food insecurity. In contrast, Northern America and Europe have the lowest proportion of food insecurity, with only about 8% of the population experiencing moderate or severe food insecurity and less than 2% facing severe food insecurity. Latin America and the

Caribbean also show significant levels of food insecurity, with about 38% of the population experiencing moderate or severe food insecurity and roughly 13% facing severe food insecurity. The data highlights significant regional disparities in food security, particularly in Asia and Africa, where policy efforts should focus on increasing food accessibility and affordability, addressing both immediate needs and long-term agricultural productivity. Enhanced international cooperation and investment in sustainable agriculture, infrastructure, and social safety nets are crucial to mitigating the high levels of food insecurity in these regions (FAO, 2023).

Food Security in the Middle East and Iran

Asian civilizations represent very long histories and traditions of society. Major civilizations include China, India, Japan, Vietnam, Thailand, Burma, Java, and Angkor (Hall, KR, 1994).

Most countries in this region have a very long history of centralized government, political regulation, and social arrangement. Institutional arrangements differ across countries; however, they all influence how societies handle problems of poverty and famine. Considering the currently rapid pace of change in economic structures, the more enduring political, social, and cultural elements of the institutional framework have much longer histories. For example, as recently as 1880, Indonesia, Thailand, and Japan were relatively poor countries (Maddison, A, 1995). The transition to highly productive economies and affluent consumers is a recent development in historical terms.

The prevalence of food and nutrition insecurity has been reflected in several studies in Iran. (Abolhassani et al., 2015) (Gholami, A. and Foroozanfar, Z., 2015) (Rezazadeh, A et al., 2015) (Yaghoobi et al, 2015) (Alipour et al., 2016) (Behzadifar et al., 2016). Hence, our research is going

to quantify and evaluate food security and the influence of financial crises on that, which may help policymakers in the land to implement policies to reduce food insecurity and malnutrition.

According to the 2023 Global Hunger Index, Iran holds the 41st position out of 125 countries with sufficient data to calculate 2023 GHI scores. With a score of 7.7 in the 2023 Global Hunger Index, Iran experiences a relatively low level of hunger (GHI, 2023).

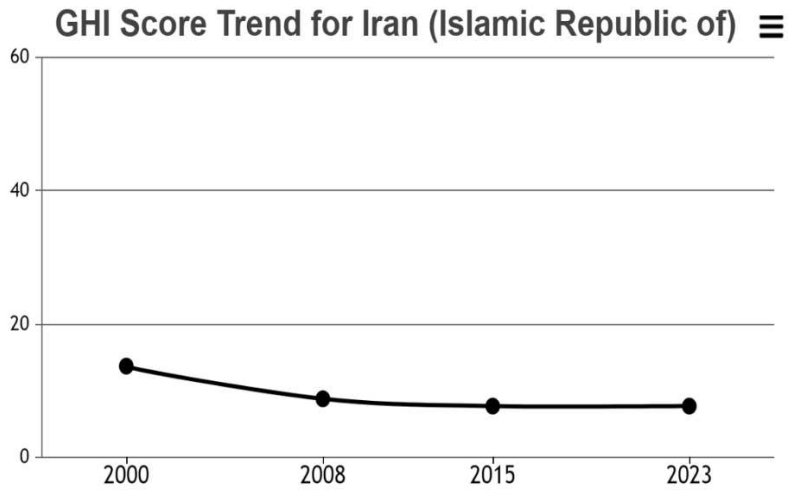

Figure 2. 6. Data for GHI scores are from 1998–2002 (2000), 2006–2010 (2008), 2013–2017 (2015), and 2018–2022 (GHI, 2023).

Source: the 2023 Global Hunger Index. https://www.globalhungerindex.org/pdf/en/2023/Iran.pdf

Iran is ranked as a middle-income country by the World Bank, after Saudi Arabia in terms of population size as well as being the second largest state in the Middle East with a current population of about 87 million people; estimated to reach 88 and 100 million people by 2025 and 2050 respectively (Heslot, S, 2014) (Emami et al., 2015).

Food security and nutrition can only be achieved through investment in agriculture by developing countries both publicly and privately (Branca et al., 2015). Despite being the main supplier of food,

Iran's agriculture sector has inefficiencies (Heslot, S, 2014) that hinder it from performing optimally within the production and marketing processes (Ardakani et al., 2009).

Moreover, Iran's situation seems to be similar to that of other developing nations since approximately one-third of food produced is lost along different stages of the supply chain (HLPE, 2014). This shows an ineffective system for marketing foods in the country. On average, some percentage like 35% of agricultural products get lost or wasted every year in Iran which could help to feed around fifteen or twenty million people out there based on estimates made according to this data (Pirmoradi et al., 2013).

2.7 Food Security at the National Level (Iran)

In September 2011, the Committee on World Food Security organized a roundtable on how to measure hunger. Following the recommendations emerging from the roundtable, the FAO adopted a suite of indicators to measure the following components of food security:

– Determinants related to food availability, physical and economic access, and utilization;

– Outcomes resulting from insufficient access to food and inadequate food utilization;

– Stability and vulnerability in terms of exposure to risk and shocks (Table 2.3).

The descriptions of the indicators of food security at the national level are based on the information from the Statistics Division of the FAO.

Table 2. 3. Food security index by component and dimension.

Source: Food and Agriculture Organization of the United Nations. (n.d.). Statistics Division. https://www.fao.org/about/who-we-are/departments/statistics-division

Component	Dimension	Index
Determinants	Availability	- Average dietary energy supply adequacy - Average value of food production - Share of dietary energy supply derived from cereals, roots, and tubers - Average protein supply - Average supply of proteins of animal origin
	Physical access	- Percentage of paved roads in total road network - Road density - Rail line density
	Economic access	- GDP per capita, PPP - Domestic Food Price Level Index
	Utilization	- Percentage of population with access to improved drinking water sources - Percentage of population with access to sanitation facilities
Outcome	Access	- Prevalence of undernourishment - Share of food expenditure of the poor - Depth of the food deficit
	Utilization	- Percentage of children under 5 years of age affected by wasting - Percentage of children under 5 years of age who are stunted - Percentage of children under 5 years of age who are underweight - Percentage of adults who are underweight - Prevalence of anemia among pregnant women - Prevalence of anemia among children under 5 years of age - Prevalence of vitamin A deficiency - Prevalence of iodine deficiency
Stability	Exposure to risk	- Cereal import dependency ratio - Percentage of arable land equipped for irrigation - Value of food (excluding fish) imports in total merchandise exports
	Shock	- Political stability and absence of violence - Domestic food price volatility - Per capita food production variability - Per capita food supply variability

The Food Security Index is an aggregate framework used to continuously monitor and assess food security at the national level, structured around three main components: Determinants, Outcomes, and Stability, each further divided into dimensions and specific indices for a detailed analysis (FAO, 2013). Determinants affect the overall food security situation and include availability, physical access, economic access, and utilization. Availability measures such as average dietary

energy supply adequacy, value of food production, reliance on staple foods, and protein supply provide insight into the adequacy and diversity of the food supply. Physical access indicators, such as the percentage of paved roads, road density, and rail line density, highlight the infrastructure's role in food distribution. Economic access is assessed through GDP per capita (PPP) and the Domestic Food Price Level Index, reflecting the affordability of food. Utilization measures focus on access to improved drinking water sources and sanitation facilities, which are essential for safe food preparation and nutrient absorption. The Outcome component evaluates the actual status of food security, emphasizing access (such as prevalence of undernourishment, share of food expenditure of the poor, and depth of the food deficit) and utilization (including various measures of malnutrition and deficiencies among children and adults). Stability addresses factors affecting the reliability and predictability of food access over time, covering exposure to risk (like cereal import dependency, percentage of arable land equipped for irrigation, and value of food imports) and shocks (such as political stability, domestic food price volatility, and variability in food production and supply) (FAO, 2013).

2.8 Food Security in Times of Crisis

The financial crisis, which originated in industrialized nations, has had significant ramifications on developing countries. This impact has been attributed to several factors, including escalated interest rates, substantial fluctuations in commodity prices, and downturns in investment, trade, migration, and remittances. It is like a ghost over the country, the one that was invented in the most advanced financial places on Earth. Propagated by intricate financial instruments, this crisis has permeated globally, driven by mechanisms such as the escalation of interest rates, disruptions in trade, dwindling remittance flows, and declining investment levels. The repercussions of this crisis

on individuals have been profound, with the anticipation of further adverse consequences (Lin, J & Martin, W, 2009).

Is particularly important for policymakers in both industrialized and developing countries to cleverly face the challenges posed by the crisis. Drawing attention to an understanding of and solution to the root causes of the problem, and not just the symptoms of the problem, becomes increasingly important, as poorly designed responses may be ineffective or even backfire. The effects on developing countries are diverse and widespread and include capital flow, commodity prices, interest rates, remittances, risk premiums, and trade prospects. (Blanchard, O, 2009) (Caballero, R et al., 2008) (Lin, J, 2008) (McKibbin, W. and Stoeckel, A, 2009).

2.9 Factors Contributing to Food Insecurity During Financial Crisis

Several interrelated factors contribute to food insecurity in the wake of financial crises, amplifying the challenges facing vulnerable populations (Loopstra, R et al., 2019). Economic downturns, manifesting in job losses, reduced income, and increased poverty levels, reduce people's purchasing power for food and therefore contribute to food insecurity (Loopstra, R et al., 2019). Such economic instability has affected the urban and rural populace, especially vulnerable groups like low-income families, informal workers, and small-scale farmers (Loopstra, R et al., 2019) (Sulaiman et al., 2021).

Another major force of food insecurity during financial crises is the rise in food prices (Sulaiman et al., 2021). Many factors, which include inflation, make it hard for households to afford a healthy diet, more so if the income level is reduced or kept constant. Low-income households, who spend a larger portion of their income on food, are disproportionately affected by this phenomenon

(Penne, T., & Goedemé, T, 2021). Families may resort to purchasing cheaper, less nutritious food or reducing the quantity and quality of their meals, contributing to malnutrition and food insecurity (Penne, T., & Goedemé, T, 2021).

Disruptions in food supply chains significantly worsen food insecurity during financial crises. Issues such as trade restrictions, reduced agricultural production, transportation bottlenecks, and hoarding behavior can create shortages and distribution problems (Zaçe, D et al., 2020). These disruptions particularly affect populations reliant on imported goods or those living in remote areas with limited market access (Zaçe, D et al., 2020).

Rising indebtedness is another major factor that exacerbates food insecurity during financial crises. Households often borrow money to cover basic needs, including food, but high levels of debt can lead to greater financial instability. This borrowing becomes unsustainable, especially if interest rates increase or if households struggle to repay their debts, resulting in a cycle of poverty and food insecurity (Mortazavi et al., 2017).

Government austerity measures taken during financial crises often aggravate food insecurity. When cuts are made to social welfare programs and subsidies, it disproportionately impacts vulnerable populations who depend on government assistance for food. Reducing food subsidies or social safety nets can leave low-income families without essential support, worsening their food insecurity (Amiresmaeili et al., 2021).

For policymakers and humanitarian organizations, understanding these dynamics is crucial for developing effective strategies to combat food insecurity during financial crises (Hejazi, J., and Emamgholipour, S, 2022). Potential interventions could include targeted food assistance programs, social protection measures, support for agricultural production, and policies aimed at

stabilizing food prices and ensuring market access for vulnerable groups (Smith, L. C., & Wesselbaum, D, 2020).

2.10 Impact of the Financial Crisis on Food Security

The financial crisis impacts food security immensely in regard to the world by disturbing economic stability, rising unemployment, and reducing household incomes. This has implications for the level of food accessibility and affordability among the vulnerable population (FAO, 2009). Financial crises also cause economic downturns, reducing incomes and increasing unemployment, hence severely affecting the state of household food security. It diminishes the power of households to buy food, mostly thrusting a number of them into food insecurity (World Bank, 2010). Economic crises, according to studies, result in a significant decrease in the consumption of food and dietary diversity, especially among households that have low incomes (Headey, D, 2011). Financial crises usually coincide with food price volatility periods, further aggravating food insecurity. During the 2008 financial crisis, food prices soared around the world, putting staple foods out of reach for many (Von Braun, J, 2008). This price volatility can cause millions to fall into hunger, as has been witnessed in many developing nations during the crisis (Ivanic, M., & Martin, W, 2008). The financial crisis has equally reduced agricultural production through its effects on credit accessibility and investment opportunities. Farmers have problems getting loans to support their production with inputs such as seeds and fertilizers, reducing agricultural productivity (FAO, 2009). This decline in production further aggravates food availability and accessibility, contributing to food insecurity (Torero, M, 2014). These social protection programs help in preventing the deleterious impacts of financial crises on food security. Countries with

strong safety nets can adequately protect their populations from the negative shocks of economic crises (Alderman, H., & Yemtsov, R, 2012). In most cases, however, these programs are not effective, and often the capacity is not enough to meet the heightened state of demand for assistance that occurs during crises (Hoddinott, J, 2013).

Several case studies demonstrate the impact of financial crises on food security. For instance, the 1997 Asian financial crisis saw a highly increased level of food insecurity in countries like Indonesia and Thailand as a result of increased food prices and falling incomes (Smith, L. C., & Haddad, L. J, 2000). Similarly, the 2008 global financial crisis aggravated food insecurity in Sub-Saharan Africa and South Asia, where economic shocks, coupled with high food prices, exacerbated the impacts of the crisis (FAO, 2010).

The Impact of Financial Crisis on Food Security in Iran

Food security has been badly affected by the financial crisis in Iran, especially among the more vulnerable households. The crisis witnessed a sharp rise in food prices, which further augmented food insecurity among the population. The impacts of the financial crisis on food security in Iran were also felt more in poorer households that are already vulnerable to food insecurity. The crisis led to a significant decrease in the purchasing power of these households, making it difficult for them to afford basic necessities like food. The monetary and fiscal policies of the Iranian government have also had devastating effects on food insecurity. The policies increased food prices, which further increased food insecurity among the people (Mohtashami, T., & Tavakoli, M, 2024).

The global and regional responses to the food price crisis have been effective, including pledges to provide support to food aid, nutrition programs, social protection initiatives, and agricultural production enhancement efforts in the affected countries. However, the promised funds must be given as soon as possible and be provided for the proper targets. Oxfam reports that of the US$12.3 billion pledged during the FAO-organized food security summit last June 2008, only a little more than US$ 1 billion has been disbursed (Oxfam International, 2008). Resource commitments must be pursued with the fulfillment of the commitment when necessary.

Increased food prices have negative effects on the food security of the vulnerable population (Hejazi, J., and Emamgholipour, S, 2022). Humanitarian aid in the time of crisis can help, but it may not be effective in reducing vulnerability to future emergencies (Safarpour, H, 2018) (Hejazi, J., and Emamgholipour, S, 2022). Various factors such as physical ability and living conditions, age, and ethnicity influence vulnerability to food insecurity in the time of crisis (Clay, L. A et al., 2018).

Economic factors appear to affect the food system in Iran to be vulnerable to achieving food and nutrition security. The high unemployment rate, high inflation rate, and high exchange rate have reduced the purchasing power of Iranians to buy enough and safe food (Heslot, S, 2014) (Mohammadi-Nasrabadi et al., 2014) (Emami et al., 2015). In recent years, several studies have reported that food and nutrition insecurity has occurred in Iran (Behzadifar et al., 2016) (Hamedi Shahraki, S et al., 2016). The prevalence of food and nutrition insecurity has been calculated to be high (Behzadifar et al., 2016) among diverse groups of people. Behzadifar et al. 2016 have calculated the prevalence of food and nutrition insecurity as follows: 49 percent among households, 67 percent in children, 61 percent in mothers, 49 percent in adolescents, and 65 percent

in the elderly. In addition, nutrition is changing in Iran. Intake of the traditional diet based on wheat, fruits, and vegetables has decreased and is changing to have more sugar, oil, and fat. These dietary changes have resulted in a widespread micronutrient deficiency, particularly iodine and iron (Heslot, S, 2014).

Rapid urbanization, changes in lifestyles, and nutrition transitions are the characteristics of many countries in the region (Alwan A, Elmi M, 2015), including the Islamic Republic of Iran (Ghassemi et al., 2002). Changes in nutritional patterns of Iranian people in recent decades have changed from healthy traditional diets to Western diets and bad eating behaviors and habits accompanied by reduction of physical activities and moves. As such, diets in Iran are characterized by high consumption of red and processed meat, refined cereals, and fried foods (Rezazadeh et al., 2010) (Asghari et al., 2012) (Esmaillzadeh A & Azadbakht L, 2008).

2.11 Economics and Financial Crisis in Iran

The Iranian economy has been in dire straits for the past few years due to severe economic sanctions by the United States and other international bodies. These sanctions have restrained access to oil revenues and hence caused budget deficits, high inflation, unemployment, and a deepening recession. The devaluation of Iran's national currency and the lack of effective policies to protect the assets of citizens have motivated unproductive activities, such as trade in currency, gold, and land. To counteract this, the Iranian government motivated investment in the stock exchange. The key financial markets of Iran, such as the stock exchange, foreign exchange, oil, and gold markets, have witnessed sharp fluctuations, especially in the recent past since the sanctions reimposed in May 2018 and the onset of the COVID-19 Pandemic. The government

response to the crisis has been quite volatile with simplistic policies, which worsened the situation in those financial markets. However, the Iranian financial crisis started much before Russia invaded Ukraine; thus, it is not only caused by these sanctions. The Iranian economy is suffering from the deeper structural problems of the rent-seeking economic structure, which also contributes to the current crisis (Samadi et al., 2020).

The economy in Iran is diversified, with a lot of involvement by the state in manufacturing and financial services, heavily reliant on hydrocarbon, agricultural, and service sectors. However, due to its dependence on oil revenues, Iran's economy remains susceptible to fluctuation. A period of stagnation, from 2019/20, followed external pressures such as sanctions and commodity price shocks. Recent growth has been driven by post-pandemic growth in service sectors, higher activity in the oil sector, and supportive policies. However, Iran faces intensified climate change challenges, including droughts, rising food prices, and insecurity. If economic sanctions persist, GDP growth is expected to be modest, with high inflation dampening domestic demand (World Bank, 2022).

2.12 The Right to Food and Food Sovereignty

The right to food is a human right first established in the Universal Declaration of Human Rights and subsequently included in many binding and non-binding instruments (Mechlem, K, 2004). In 1996, the International Covenant on Economic, Social, and Cultural Rights (ICESCR) defined the right to adequate food as “the availability of food in a quantity and quality sufficient to satisfy the dietary needs of individuals, free from adverse substances, and acceptable within a given culture; the accessibility of such food in ways that are sustainable and that do not interfere with the

enjoyment of other human rights" (Committee on Economic, Social and Cultural Rights, 1999). This definition was ratified by 156 states. The right to food is based on the food security pillars of food availability, access, utilization, and stability, but it complements the technical concept with legal aspects of human rights and its principles of human dignity, accountability, empowerment, non-discrimination, and participation. In addition, while the concept of food security is based on the government's acknowledgment of the population's needs, the right to food refers to the acknowledgment of human rights (Figure 2. 7), which has important implications. Whereas policy goals change according to the political environment, human rights are not negotiable.

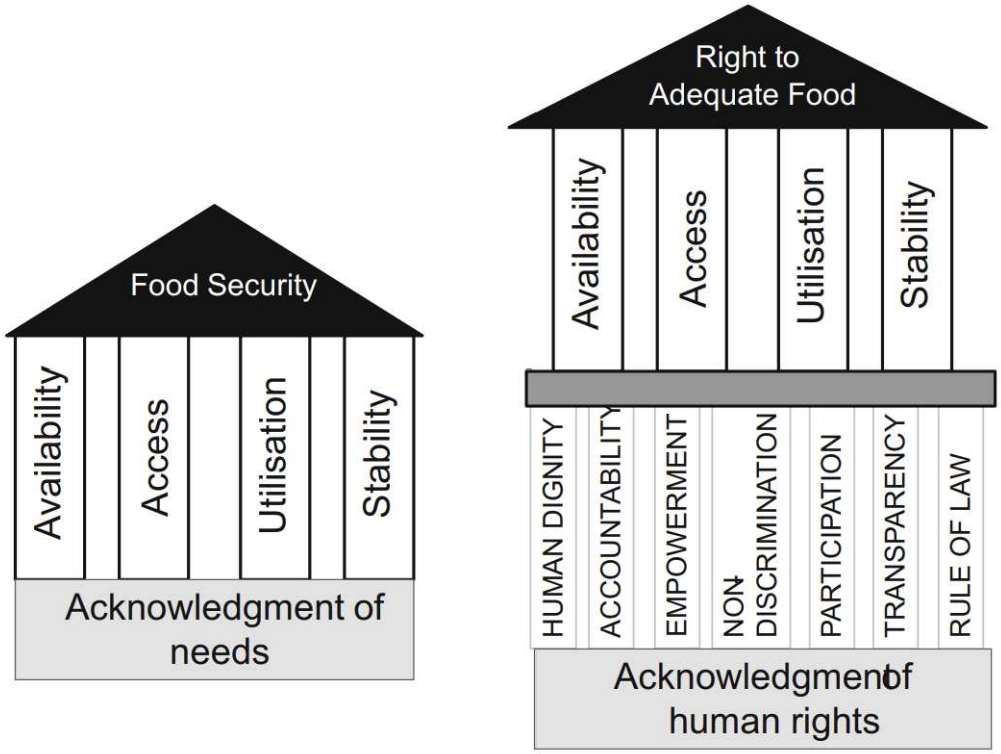

Figure 2. 7. Comparison between food security and the right to food. Adapted from FAO (2008).

Source: Food security concepts and frameworks. Lesson 2. Concepts Related to Food Security. Learner's Notes, FAO, Rome. From http://www.fao.org/elearning/Course/FC/en/pdf/ trainerresources/learnernotes0412.pdf.

Food sovereignty is a concept that goes beyond food security by emphasizing the rights of people to define their own food systems. It is closely associated with social movements like La Via Campesina, which advocate for the rights of small-scale farmers and local food production (Dunford, R, 2014).

Table 2. 4. The six pillars of food sovereignty.

Source: Food Secure Canada. (2012). The six pillars of food sovereignty, Developed at Nyéléni 2007. From http://usc-canada.org/UserFiles/File/SixPillars_Nyeleni.pdf

1. Focuses on food for the people by (a) putting people's need for food at the center of policies; (b) insisting that food is more than just a commodity	4. Establishes control at the local level by (a) putting control in the hands of local food suppliers; (b) recognizing the need to inhabit and share territories; (c) rejecting the privatization of natural resources
2. Values food providers by (a) supporting sustainable livelihoods; (b) respecting the work of all food providers	5. Promotes knowledge and skills by (a) building on traditional knowledge; (b) using research to support and disseminate this knowledge to future generations; (c) rejecting technologies that undermine local food systems
3. Supports localized food systems by (a) reducing the distance between suppliers and consumers; (b) rejecting dumping and inappropriate food aid; (c) resisting dependence on remote and unaccountable corporations	6. Works with nature by (a) maximizing the contributions of ecosystems; (b) improving resilience; (c) rejecting energy-intensive, monocultural, industrialized, and destructive production methods

In 2002, during the NGO/CSO Forum for Food Sovereignty held in parallel with the FAO World Food Summit: Five Years Later, this concept was defined as "a right of countries and peoples to define their own agricultural, pastoral, fishery and food policies which are ecologically, socially, economically and culturally appropriate. Food sovereignty promotes the right to food for the entire

population, through small and medium-sized production, respecting: the cultures, diversity of peasants, pastoralists, fisherfolk, Indigenous Peoples and their innovation systems, their ways and means of production, distribution and marketing, and their management of rural areas and landscapes. Women play a fundamental role in ensuring food sovereignty" (FAO, 2006).

In 2007, at the Nyéléni Forum for Food Sovereignty, the so-called six pillars of food sovereignty were defined (Food Secure Canada, 2012). They are described in Table 2.1.

The distinctive feature of food sovereignty is the right of people and states to determine their own food and agricultural policy that prioritizes small farming. Therefore, food sovereignty and food security are not antagonistic concepts, but the right to define one's food policy goes beyond the concept of food security. It is one of the pillars of a modern state. On the other side, the emphasis on small farmers or, more generally, on how to produce is a matter to be addressed through specific government policies (Gordillo, G., & Jeronimo, O. M., 2013).

2.13 Synthesis and Gap in Literature

Available evidence indicates that Iran encounters many challenges that jeopardize its food and nutrition security. However, scholarly studies addressing the situation in Iran have been very few in the context of the academic literature on food and nutrition security worldwide. The EIU Global Food Security Index presents the overall situation about countries' susceptibility to food and nutrition insecurity worldwide, assessing countries' food and nutrition insecurity based on parameters such as food and nutrition affordability, availability, and quality for 109 countries. Iran is one of the countries not considered in this index (Economist Intelligence Unit, 2021).

The 2010 WHO report on nutritional policies in the Islamic Republic of Iran shows that, like a quarter of other countries, Iran has no significant policies or programs that will address nutritional problems such as imbalances, under and over-nutrition, obesity, and chronic diseases, and micronutrient deficiencies among children and adolescents (WHO, 2010).

In 2012, after the first round of nuclear sanctions was imposed on Iran, the United Nations Children's Fund (UNICEF) identified Iran as a country experiencing severe unilateral economic sanctions. These sanctions were reported to have adverse effects on the environment, public health, and the socio-economic determinants of health, disproportionately impacting the well-being of ordinary citizens, with children being particularly vulnerable (UNICEF, Annual Report 2012 for Iran (MENA), 2012).

There is limited research on the impact of United Nations (UN) or U.S. sanctions on the food security of citizens in sanctioned countries. However, studies conducted in Iraq (Field, JO, 1993) (Koc, M et al., 2007) and Cuba (Ross, JE, 2004) confirm the adverse effects of sanctions on food security within these populations. Additionally, numerous studies have documented the detrimental impact of sanctions on human rights and various health aspects, including access to medications and medical devices for the general population. (Kokabisaghi, 2018) (Kheirandish, M et al., 2018) (Mirzaei, S et al., 2019)

The body of research on food security in Iran, especially in times of economic crisis, covers a wide range of topics, such as the effects on the economy, agricultural policies, and social ramifications. Financial crises can worsen food poverty by raising food costs, lowering household purchasing power, and upsetting supply systems, according to research. Studies show that since they depend on local markets and agriculture, disadvantaged populations—especially those living in rural

areas—are more likely to experience food insecurity during economic downturns. (Mohammadi, F et al., 2013) (Sadr, S. M. H, 2016) (Entezari, M. H., & Alipour, B, 2020) (Hejazi J, Emamgholipour S, 2022).

Even with the insightful knowledge that previous research has offered, there are still several gaps:

With little attention to Iran's distinct socioeconomic environment, the majority of research on food security during financial crises has been done in a global setting. Particularly because of the most recent sanctions and economic volatility, studies that place food security concerns within Iran's political and economic frameworks are necessary.

It's possible that the long-term impacts of financial crises on food security have not been sufficiently covered in the literature. It is rare to find research that looks at trends across time, especially with Iran's economy being so unstable.

Chapter 3: Materials and Methods

3.1 Study Design

The third chapter elaborates on the details of the research design, procedures for data collection, and analytical techniques in the impact study of financial crises on food security in Iran. This methodology involves analysis of the changes in food prices and household food security before and after the occurrence of a financial crisis and inflation in 2018.

The study evaluates how financial crises affect food security using an Interrupted Time Series (ITS) approach. This approach was selected because it makes it possible to compare trends before and after a particular action, in this case, the Iranian financial crisis.

Interrupted Time Series (ITS) analysis is a powerful statistical method used to evaluate the impact of an intervention or event on a time series of data. By analyzing data points before and after the intervention, ITS allows researchers to assess both immediate and long-term effects. The method involves fitting a regression model that includes terms for the time trend before the intervention, the level change immediately following the intervention and the change in trend after the intervention. ITS is particularly useful for assessing policy changes, public health interventions, and other events where randomized controlled trials are impractical. This method helps to isolate the effect of the intervention from underlying trends, providing robust evidence of causality. In the context of food security in Iran, ITS analysis can be used to evaluate the impact of the financial crisis on food prices and household food security, offering insights into economic vulnerability and resilience (Wagner, AK et al., 2002) (Linden A, 2015).

The impact of the financial crisis on the prices of the major food groups was assessed. The average costs of six different food groups were evaluated for this purpose throughout a 60-month period, starting in January 2017 and ending in December 2021. The effects, both immediate and gradual, were analyzed using interrupted time series (ITS) regression. Subsequently, the number of Iranian households who are facing low, modest, and severe food insecurity during the period from 2017 to 2021 was obtained, and eventually, the number of Iranians who can follow a healthy diet was estimated.

The Consumer Price Index (CPI) serves as a critical data source for this analysis. The CPI measures the average change in prices paid by consumers for a basket of goods and services over time, reflecting inflationary trends in the Iranian economy. In this study, the CPI data specifically for food products—including cereals, vegetables, fruits, dairy, meats, and oils—will be used to assess price changes across different food groups before and after the financial crisis of 2018.

By integrating CPI data into the ITS analysis, this study identifies the financial crisis's impact on the overall cost of living and its implications for food security. The ITS model will use monthly CPI data from January 2017 to December 2021 to evaluate the immediate and long-term effects of the financial crisis and sanctions on food prices. The CPI data will be analyzed to determine:

- Pre-intervention Trends: The baseline trend in food prices before the 2018 financial crisis.
- Immediate Impact: The change in food prices immediately following the crisis.
- Post-intervention Trends: The long-term trend in food prices after the crisis.

Understanding these patterns will help to determine how inflation influenced food security levels in Iranian households, particularly those most vulnerable to economic shocks. The CPI, as an

indicator of inflation, provides a quantifiable measure of the cost of maintaining a healthy diet, which is crucial for analyzing food security dynamics in Iran.

By employing this approach, the study aims to provide robust evidence of the financial crisis's impact on food security, thereby informing policy responses to mitigate future risks.

3.2 Data sources and operationalization

In this research, the required average retail prices in urban areas during the period of January 2017 to December 2021 have been collected from the Statistical Center of Iran (SCI). The food prices in May 2021 were used to appraise the cost of following a healthy diet based on the food pyramid in Iranian households. For staple foods of Iranian cuisine, like bread or pasta, average prices that are reported by economic news agencies in those time frames were applied.

To estimate the number of Iranian households facing food insecurity, the average yearly household income and spending, both non-food and food items, were taken from the statistical data of the "Iranian Urban and Rural Household Income and Expenditure Survey from 2017 to 2021".

moreover, the consumer price Index in urban areas during the period of January 2017 to December 2021 has been collected from the Statistical Center of Iran (SCI).

In the present study, a healthy diet was defined according to guidelines specified in “Food-Based Dietary Guidelines for Iran” published by the Iranian Ministry of Health in 2015 (Omidvar, N et al., 2015).

Except for only a few Iranian foods included in some food groups, these guidelines are precisely in line with the United States Department of Agriculture's "Food Pyramid." The pyramid indicates

the optimal range of servings for each food group. The appropriate number of servings for any individual is based on one's energy requirement, which depends on factors such as age, sex, body size, activity levels, etc.11 But, going by the "Good Food Basket for the Iranian Community" posted by the Iranian Ministry of Health, the average energy requirement works out to 2381 kcal for Iranians (Salehi, F et al., 2013).

In keeping with this, the most favorable number of servings for each food group and the serving size of each are shown in Table 4.1. Since the total number of servings of fat is not mentioned in the pyramid and fat dietary reference intake for healthy adults is between 20%-35% of total energy expenditure (Barr, SI, 2006), we calculated 25% of calories as fat which equals 66 g.

3.3 Statistical model

This study employs an Interrupted Time Series (ITS) analysis to evaluate the impact of financial crises on food security in Iran. ITS is particularly suitable for assessing the effect of a specific intervention over time by comparing data points before and after the event. The statistical model used in this study is specified as follows:

$Y_t = \beta_0 + \beta_1 \cdot \text{time} + \beta_2 \cdot \text{intervention} + \beta_3 \cdot \text{time after intervention}$

Where:

- Y_t is the outcome variable at time t. In this study, Y_t represents the Consumer Price Index (CPI) for various food groups.
- β_0 is the intercept, representing the baseline level of the outcome variable before the intervention.

- B_1 · time represents the underlying time trend of the outcome variable before the intervention.
- B_2 · intervention represents the immediate change in the level of the outcome variable following the intervention (the re-imposition of US sanctions in May 2018).
- B_3 · time after intervention represents the change in the trend of the outcome variable following the intervention.

The model allows us to distinguish between the pre-intervention trend (β1), the immediate impact of the intervention (β2), and the change in the trend post-intervention (β3). This provides a comprehensive understanding of how the financial crisis affected food prices and, consequently, food security in Iran.

Estimation Procedure:

1. **Data Preparation**: Monthly CPI data for each food group (cereals, vegetables, fruits, dairy products, meats, and oils) were structured into a time series format covering the period from January 2017 to December 2021.
2. **Model Fitting**: Using statistical software such as STATA, the ITS regression model was estimated separately for each food group.
3. **Parameter Interpretation**: The coefficients β2 and β3 were interpreted to understand the immediate and long-term effects of the intervention on food prices.
4. **Diagnostic Checking**: Residual diagnostics were performed to assess the adequacy of the model and to ensure that the assumptions of the regression analysis were met.

By employing ITS analysis, this study aims to provide robust evidence on the impact of financial crises on food security in Iran, thereby contributing to the formulation of effective policy responses.

Chapter 4: Data Analysis and Results

This chapter presents the findings from an analysis conducted on the impact of the financial crisis on food security in Iran. To be specific, it is structured around examining changes in food prices and household food security before and after the financial crisis in May 2018. Elsewhere, details of the ITS model are presented, but briefly, equation 1 was used to probe the immediate and gradual effects of these financial crises.

These results give insight into how these economic shocks have affected the food security status of Iranian households.

$Y_t=\beta_0+\beta_1 \cdot \text{time}+\beta_2 \cdot \text{intervention}+\beta_3 \cdot \text{time after intervention}$

In this equation, Y_t is the Consumer Price Index of each food group in a month, time is a continuous variable indicating the number of months that have elapsed since the start of the observation (2017), and intervention is an indicator variable for time t occurring before (0) or after (1) the financial crisis.

B_0 represents the intercept or starting level of the outcome variable, and β_1 is the slope or trajectory of the outcome variable until the introduction of the intervention.

B_2 represents the change in the level of the outcome that occurs in the period immediately following the introduction of the intervention (compared to the counterfactual), and β_3 represents the difference between pre-and post-intervention slopes of the outcome. The sum of β_1 and β_3 is the postintervention slope.

Table 4. 1. Good Food Basket for the Iranian community.

Source: Salehi F, Abdollahi Z, Abdollahi M. Good Food Basket for the Iranian Community. Ministry of Health and Medical Education; 2013:6-10.

Food Groups	Number of Servings	Serving Size (g)
Cereals	10	Bread, rice (raw), pasta (raw): 40
Vegetables	4	Cucumber, tomato, potato, onion: 75
Fruits	4	Banana, apple, orange: 150
Dairy products	3	Milk: 250, yogurt: 200, cheese: 40
Meat group	3	Lamb, beef, chicken (raw): 100, egg: 120, pinto beans, lentils (raw): 40

The total price of one serving of each foodstuff was calculated (based on the data presented in Table 4.1 and the average retail prices of 1 kg of some foodstuffs during May 2021 published by the SCI). Afterward, the average prices of one serving of each of the 5 food groups (cereals, vegetables, fruits, dairy products, and meats) were computed. For instance, the total average prices of one serving of beef, lamb, poultry, egg, pinto beans, and lentils were calculated. Next, these values were multiplied by the corresponding number of servings for each food group (Table 4.1) and were summed to achieve the average cost of a healthy diet for one person.

A report by the World Food Program indicates that the food market of Iran is highly dependent on imports, as it is counter-stricken with severe challenges in agricultural productivity, economic policies, and geopolitics.

Table 4.2 presents data on the average retail prices of 1 kg of various foodstuffs in Iran from May 2017 to May 2021. The table provides a snapshot of food price inflation over these years, coinciding with the period surrounding the financial crisis. Each food item's price is listed in

Iranian Rials (IRR), alongside its approximate value in U.S. Dollars (USD) at the given exchange rate for that year.

Steep Price Increases Post-2018: The average prices of food items such as rice, lamb, beef, chicken, milk, yogurt, cheese, and oil show a steep increase, particularly after 2018. For instance, the price of lamb increased from 366,477 IRR in May 2017 to 1,379,005 IRR in May 2021. Similarly, milk's price rose from 26,735 IRR to 112,078 IRR in the same period.

The fluctuating exchange rates significantly affect the USD-equivalent prices of these items. The exchange rate changes reflect the devaluation of the Iranian Rial, which compounded the effects of price inflation caused by the economic crisis.

The rates of inflation varied significantly across different food items. Staples like rice and bread had comparatively lower inflation rates than proteins like lamb, beef, and chicken.

Table 4. 2. Average Retail Prices of 1 kg of Some Foodstuffs.

Source: Statistical Centre of Iran. (n.d.). Average price of selected food items in urban areas of the country (Rials). https://amar.org.ir/statistical-information

Food Item	Price of 1 kg [IRI Rials (USD)a] (May 2017)	Price of 1 kg [IRI Rials (USD)b] (May 2018)	Price of 1 kg [IRI Rials (USD)c] (May 2019)	Price of 1 kg [IRI Rials (USD)d] (May 2020)	Price of 1 kg [IRI Rials (USD)e] (May 2021)
Rice (Iranian)	126440 (3.38)	136657 (2.24)	206097 (1.57)	(1.45) 250225	361415 (1.53)
Lamb	366477 (9.64)	447167 (7.33)	992218 (7.57)	(5.72) 984327	(5.84) 1379005
Beef	349531 (9.20)	405413 (6.64)	931732 (7.11)	(4.85) 834967	(5.33) 1257166
Chicken	67796 (1.78)	78856 (1.29)	118899 (0.91)	(0.64) 110570	258819 (1.10)
Milk	26735 (0.70)	28522 (0.47)	47853 (0.36)	61668 (0.35)	112078 (0.47)
Yogurt (pasteurized)	36580 (0.96)	39594 (0.65)	60625 (0.46)	80151 (0.47)	133189 (0.56)
Cheese (Iranian)	57856 (1.52)	59669 (0.98)	89904 (0.69)	112915 (0.66)	198396 (0.84)
Egg	53483 (1.41)	83195 (1.36)	89255 (0.68)	111263 (0.65)	185283 (0.78)
Butter	28489 (0.75)	34044 (0.56)	45596 (0.35)	46968 (0.27)	103958 (0.44)
Liquid vegetable oil	53698 (1.41)	54457 (0.89)	80185 (0.61)	87833 (0.51)	163527 (0.69)
Banana	51977 (1.37)	71120 (1.16)	141352 (1.08)	189500 (1.10)	295995 (1.25)
Apple	54558 (1.44)	43301 (0.71)	105072 (0.80)	113700 (0.66)	147139 (0.62)
Orange	51389 (1.35)	45353 (0.74)	84346 (0.64)	107596 (0.63)	138451 (0.59)
Cucumber	23337 (0.61)	25673 (0.42)	55681 (0.42)	45942 (0.27)	87204 (0.37)
Tomato	37937 (1.00)	19455 (0.32)	55797 (0.42)	52290 (0.30)	65806 (0.28)
Potato	21355 (0.56)	17160 (0.28)	58569 (0.45)	52516 (0.30)	54174 (0.23)
Onion	18950 (0.50)	18176 (0.30)	73802 (0.56)	44937 (0.26)	47602 (0.20)
Pinto beans	114247 (3.01)	119443 (1.96)	155334 (1.18)	248821 (1.44)	387123 (1.64)
Lentils	85308 (2.24)	79789 (1.31)	94825 (0.72)	200337 (1.16)	328934 (1.39)
Sugar	33082 (0.87)	33372 (0.55)	77489 (0.59)	76144 (0.44)	135601 (0.57)
pasta	53000 (1.39)	58400 (0.95)	72000 (0.55)	81008 (0.47)	126856(0.54)
Bread (500 g)	6500 (0.17)	7500 (0.12)	12000 (0.09)	18000 (0.10)	20000 (0.08)

[a]The exchange rate in May 2017 was 1 USD ≈ 38 000 IRR in Iranian exchange.
[b]The exchange rate in May 2018 was 1 USD ≈ 61 000 IRR in Iranian exchanges.
[c]The exchange rate in May 2019 was 1 USD ≈ 131 000 IRR in Iranian exchanges.
[d]The exchange rate in May 2020 was 1 USD ≈ 172,000 IRR in Iranian exchanges.
[e]The exchange rate in May 2021 was 1 USD ≈ 236,000 IRR in Iranian exchanges.

Source: https://www.investing.com/currencies/usd-irr-historical-data

Table 4.3 illustrates the yearly percentage changes in the average retail prices of the same foodstuffs listed in Table 4.2. The table shows that inflation rates were not uniform across the years. For example, the price of lamb increased by 22.02% from 2017 to 2018 but then surged by 121.89% from 2018 to 2019. This dramatic increase highlights the direct impact of financial crisis and economic instability following the 2018 financial crisis.

Table 4. 3. Percentage of yearly Change between Average Retail Prices of 1 kg of Some Foodstuffs.

Food Item	Percentage of Change 2017-2018	Percentage of Change 2018-2019	Percentage of Change 2019-2020	Percentage of Change 2020-2021	Percentage of Change 2017 & 2021
Rice (Iranian)	8.08	50.81	21.41	44.44	**185.84**
Lamb	22.02	121.89	-0.80	40.1	**276.29**
Beef	15.99	129.82	-10.39	50.56	**259.67**
Chicken	16.31	50.78	-7.01	134.08	**281.76**
Milk	6.68	67.78	28.87	81.74	**319.22**
Yogurt (pasteurized)	8.24	53.12	32.21	66.17	**264.1**
Cheese (Iranian)	3.13	50.67	25.60	75.7	**242.91**
Egg	55.55	7.28	24.66	66.53	**246.43**
Butter	19.5	33.93	3.01	121.34	**264.91**
Liquid vegetable oil	1.41	47.25	9.54	86.18	**204.53**
Banana	36.83	98.75	34.06	56.2	**469.47**
Apple	-20.63	142.66	8.21	29.41	**169.69**
Orange	-11.74	85.98	27.57	28.68	**169.42**
Cucumber	10.01	116.88	-17.49	89.81	**273.67**
Tomato	-48.72	186.81	-6.29	25.85	**73.46**
Potato	-19.65	241.32	-10.33	3.16	**153.68**
Onion	-4.08	306.04	-39.11	5.93	**151.2**
Pinto beans	4.55	30.05	60.18	55.58	**238.85**
Lentils	-6.47	18.85	111.27	64.19	**285.58**
Sugar	0.88	132.2	-1.74	78.08	**309.89**
pasta	10.18	23.28	12.51	56.59	**139.35**
Bread	15.38	60	50.00	11.11	**207.69**

Significant Price Spikes in Certain Years: Items such as potatoes, onions, and sugar experienced exceptionally high inflation rates in specific years. For instance, the price of onions increased by 306.04% from 2018 to 2019, demonstrating the volatility in food prices and the susceptibility of different food groups to economic shocks.

The table shows a significant overall increase in prices for all food items from 2017 to 2021, reflecting cumulative inflation.

As reported by SCI, the average family size in urban areas of Iran is 3.3 (SCI, 2016). Therefore, to find the daily cost of food for a family of 3.3, it was first calculated; then, it was multiplied by 365 to derive the average cost of a healthy diet for one year for a sample Iranian family. After that, the resultant value was compared with the budget that Iranians can spend on food.

The results on the average price of a healthy diet based on the food pyramid for one person and a sample family, the annual cost of each food group, and the average cost of a healthy diet for an Iranian family are given in Table 4.4. As shown in this table, the average annual cost of a healthy diet for a sample Iranian family is 941,994,884 rials (US$3991.503744).

Table 4. 4. The Average Price of a Healthy Diet for 1 Person and a Sample Family (2021).

Food Groups	The Daily Cost for 1 Person		The Daily Cost for a Family of 3.3		The Annual Cost for a Family of 3.3	
	Rials	USD	Rials	USD	Rials	USD
Cereals	62,995	0.27	207,884	0.88	75,877,478	321.5147352
Vegetables	19,109	0.08	63,060	0.27	23,016,791	97.52877331
Fruits	116,317	0.49	383,846	1.63	140,103,827	593.6602818
Dairy products	72,465	0.31	239,135	1.01	87,284,093	369.8478496
Meat group	493,523	2.09	1,628,626	6.90	594,448,454	2518.849379
Fats	17,654	0.07	58,258	0.25	21,264,243	90.10272458
Total	782,063	3.31	2,580,808	10.94	941,994,884	3991.503744

Assuming that every Iranian household eats homemade food, the average cost of a nutritious diet for them was calculated. the results of the previous studies demonstrate that this amount can rise for the families that eat most of their meals out.

Based on the data presented in Tables 4.5 and 4.6 regarding the annual income and food and non-food expenses of urban and rural households, it is observed that nearly 85% of household income is allocated to these expenses.

Table 4. 5. Average Income and Cost of an Urban Household (2017 - 2021) (thousand riyals).

Source: Statistics Center of Iran, the results of household income and expenditure statistics.

year	**2017**	**2018**	**2019**	**2020**	**2021**
Average annual income	366848	434905	541007	746764	1124217
Average annual cost (food+ non-food)	329525	393227	474379	621392	925017
Percentage of Cost to Income	89%	90%	87%	83%	82%

Table 4. 6. Average Income and Cost of a Rural Household (2017 - 2021) (thousand riyals).

Source: Statistics Center of Iran, the results of household income and expenditure statistics.

year	**2017**	**2018**	**2019**	**2020**	**2021**
Average annual income	201842	233114	297022	420470	637132
Average annual cost (food+ non-food)	178670	214472	261006	340679	519119
Percentage of Cost to Income	88%	92%	87%	81%	81%

We computed the economic vulnerability for this population according to the International Food Policy Research Institute's instructions to estimate the population proportion with food insecurity.

Economic vulnerability is defined based on the share of food expenditure.

Share of food expenditure (%) = household food expenditure/household income (Smith, LC, 2007).

Classification of economic vulnerability to food security based on Smith and Subandoro's manual is presented in Table 4.7.

Table 4.7 provides a framework for classifying economic vulnerability to food security based on the share of food expenditure as outlined by Smith and Subandoro's manual. This classification helps in understanding how much of a household's income is being spent on food, which is a crucial indicator of economic vulnerability and food insecurity.

The table categorizes households into four levels of economic vulnerability based on the percentage of household expenditures that go toward food:

Households that spend 75% or more of their total expenditure on food fall into the "very high" economic vulnerability category. This indicates extreme food insecurity where a significant portion of household income is directed towards food. These households have little to no financial flexibility to accommodate other basic needs or to cope with economic shocks such as price increases or loss of income.

Households spending between 65% and 75% of their income on food are classified under "high" economic vulnerability. Although slightly better off than those in the "very high" category, these households are still significantly burdened by food costs. They may be on the verge of falling into deeper food insecurity, especially in times of economic downturns or price volatility.

Households that allocate 50% to 65% of their total spending to food are considered to have "medium" economic vulnerability. These households have some capacity to manage their expenses and might be able to maintain their food security with careful budgeting and resource management. However, they remain at risk if exposed to prolonged economic challenges or rising food prices.

Households spending less than 50% of their income on food are categorized as having "low" economic vulnerability. These households typically have a stable economic condition, allowing them to afford a variety of foods without significantly compromising other needs. They have better resilience against economic changes and are less likely to fall into food insecurity compared to the other categories.

Table 4. 7. Guideline for Classification of Economic Vulnerability to Food Insecurity

Source: Smith LC, Subandoro A. Measuring Food Security Using Household Expenditure Surveys. Vol 3. International Food Policy Research Institute (IFPRI); 2007.

Economic Vulnerability	Percentage of Expenditures on Food
Very high	75%
High	65%-75%
Medium	50%-65%
Low	<50%

Figure 4.1 shows the price trend of different food groups from 2017 to 2019.The Consumer Price Index (CPI) data for Iran reveals significant changes in food prices over time, especially following economic shocks like the re-imposition of US sanctions in 2018. The data from 2017 to 2021 shows a steady increase in the prices of essential food items such as meat, milk, oil, vegetables, fruit, and bread.

For instance, the price of meat per kilogram increased dramatically from 105,000 IRR in May 2017 to 394,000 IRR in May 2021, showing a staggering cumulative increase. Similarly, milk prices went from 102,000 IRR to 364,000 IRR over the same period.

These trends indicate that inflation has severely affected the affordability of nutritious food items, pushing many households towards cheaper, less nutritious alternatives.

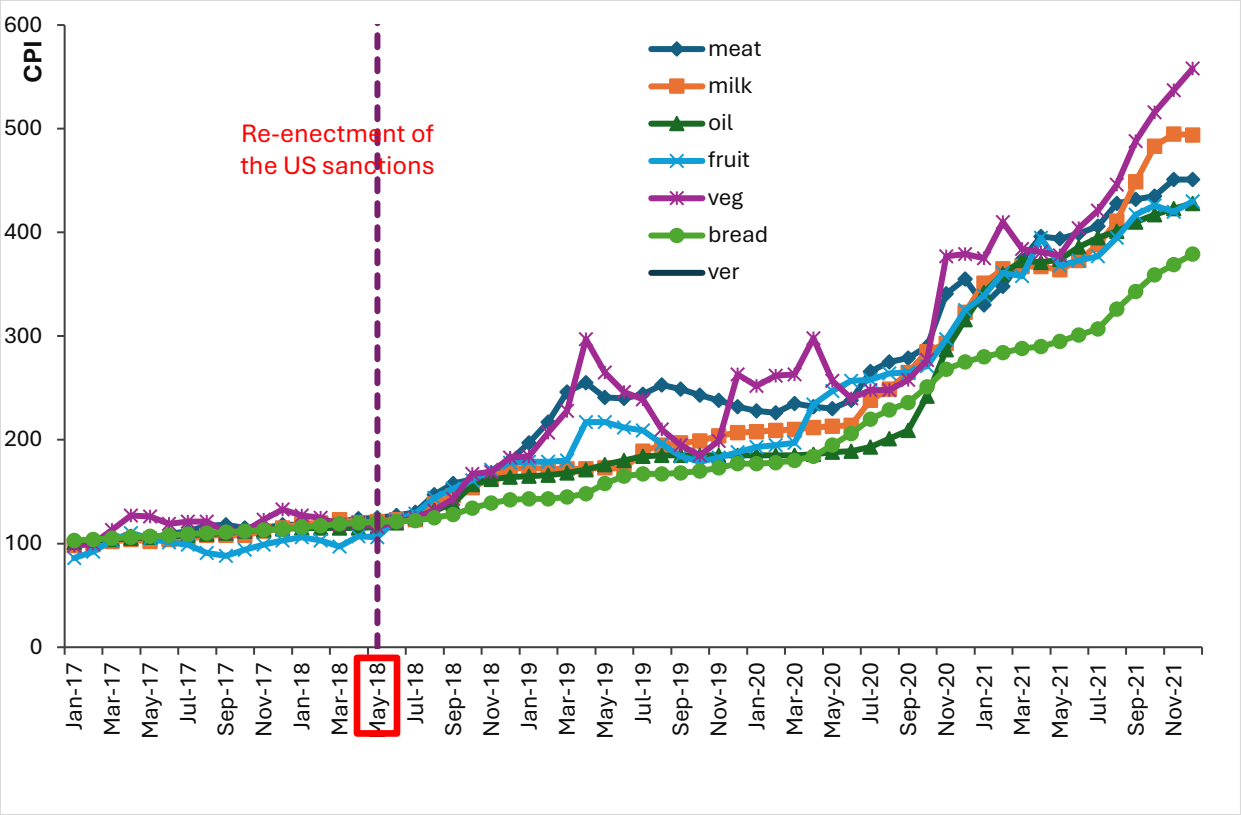

Figure 4. 1. Consumer Price Index Trend of Different Food Groups between January 2017 to December 2021. Abbreviation: CPI, Consumer Price Index.

Source: Consumer price index of the country's households: Iran Statistics Center. www.amar.org.ir

Tables 4.8 labeled (4.8.1 to 4.8.5) represent the Consumer Price Index of different food items in Iran from 2017 to 2021. They provide details on the price statistics for each year, including the average price, standard deviation, minimum price, and maximum price for each food item.

Across the period from 2017 to 2021, the CPI for all food categories in Iran shows a consistent upward trend. This reflects a significant increase in the cost of living, especially concerning basic food items.

The increase in standard deviation values over the years indicates growing variability in food prices, which suggests economic instability and potential regional disparities.

Table 4. 8. Consumer Price Index

Analysis of price statistics for each year: Average price, standard deviation, minimum price, and maximum price for each food item. Conducted using STATA.

Table 4.8. 1. Consumer Price Index -2017

Food Item	Average Price [IRR]	Standard Deviation	Minimum Price [IRR]	Maximum Price [IRR]
Meat	110.33	6.36	100.00	118.00
Milk	105.33	5.05	98.00	115.00
Oil	107.67	4.10	101.00	114.00
Vegetables	117.00	10.60	98.00	133.00
Fruit	97.58	7.37	86.00	110.00
Bread	108.50	3.61	103.00	114.00

Table 4.8. 2. Consumer Price Index -2018

Food Item	Average Price [IRR]	Standard Deviation	Minimum Price [IRR]	Maximum Price [IRR]
Meat	139.92	21.90	118.00	180.00
Milk	135.17	19.02	119.00	172.00
Oil	131.17	19.50	115.00	164.00
Vegetables	137.17	23.03	116.00	183.00
Fruit	131.50	28.91	97.00	178.00
Bread	125.33	8.64	116.00	142.00

Table 4.8. 3. Consumer Price Index -2019

Food Item	Average Price [IRR]	Standard Deviation	Minimum Price [IRR]	Maximum Price [IRR]
Meat	237.92	16.32	197.00	255.00
Milk	185.42	14.34	172.00	207.00
Oil	177.92	8.26	165.00	185.00
Vegetables	226.50	36.00	184.00	297.00
Fruit	193.58	15.77	179.00	217.00
Bread	160.33	12.41	143.00	177.00

Table 4.8. 4. Consumer Price Index -2020

Food Item	Average Price [IRR]	Standard Deviation	Minimum Price [IRR]	Maximum Price [IRR]
Meat	266.25	44.33	226.00	355.00
Milk	243.25	39.45	208.00	323.00
Oil	213.83	44.48	185.00	316.00
Vegetables	279.92	48.24	240.00	379.00
Fruit	250.25	40.63	193.00	325.00
Bread	216.58	35.44	177.00	275.00

Table 4.8. 5. Consumer Price Index -2021

Food Item	Average Price [IRR]	Standard Deviation	Minimum Price [IRR]	Maximum Price [IRR]
Meat	403.67	38.66	330.00	451.00
Milk	408.92	55.83	351.00	495.00
Oil	390.00	26.86	342.00	428.00
Vegetables	441.50	66.51	375.00	558.00
Fruit	388.25	30.07	339.00	430.00
Bread	348.42	35.56	280.00	379.00

This data provides clear evidence of the escalating costs of a basic diet in Iran during this period.

Table 4.9 uses Interrupted Time Series (ITS) analysis to quantify the immediate and ongoing effects of financial crisis (Sanctions) on different food categories.

Table 4 Columns:

- Intercept (β_0): The baseline log-transformed prices of each food group before the intervention.

- Time Effect (β_1): The slope showing the pre-intervention trend in prices (e.g., whether prices were rising or falling over time). A positive value indicates an increasing trend, while a negative value indicates a decreasing trend.

- Intervention Effect (β_2): The immediate effect of the intervention (the re-enactment of sanctions). If β_2 is negative, the intervention leads to a sudden decrease in prices; if positive, it leads to an increase.

- Time Intervention (β_3): The change in trend following the intervention. It shows whether the slope of the price trend became steeper or flatter after the intervention.

- The Trend of CPI After Sanction (β_1+β_3): The combined post-intervention trend. This value represents the ongoing change in prices after the intervention considering both pre-intervention and post-intervention effects.

Table 4. 9. Immediate and Gradual Effects of the financial crisis, affecting the Prices of Different Food Groups: The Results of ITS Analysis.

	Intercept β_0	*P*	Time Effect β_1 (SE)	*P*	Intervention Effect β_2 Immediate Effect (SE)	*P*	Time Intervention β_3 Gradual Effect (SE)	*P*	The Trend of CPI After Sanction $\beta_1 + \beta_3$
LOG*(MEAT)	4.63	.00	0.018(0.004)	.00	-0.003(0.015)	.82	0.011(0.005)	.04	.029
LOG*(MILK)	4.58	.00	0.013(0.003)	.00	-0.006(0.008)	.45	0.019(0.005)	.00	.032
LOG*(OIL)	4.62	.00	0.009(0.001)	.00	-0.0003(0.002)	.90	0.022(0.004)	.00	.031
LOG*(VEGETABLES)	4.65	.00	0.017(0.007)	.02	-0.036(0.050)	.48	0.015(0.008)	.07	.032
LOG*(FRUIT)	4.49	.00	0.019(0.007)	.01	-0.010(0.042)	.81	0.012(0.009)	.22	.031
LOG*(BREAD)	4.62	.00	0.009(0.001)	.00	-0.003(0.005)	.59	0.018(0.002)	.00	.027

In Table 4.9, we present a summary of The Results of ITS Analysis. For a comprehensive breakdown of the data, including additional statistical analyses and extended results, please see Appendix.

Key insights from Table 4.9:

Meat: Before the financial crisis intervention, meat prices were on a significant upward trend ($\beta_1 = 0.018$, P = .00), indicating consistent price increases over time. The immediate effect of the crisis intervention was a slight, non-significant decrease in meat prices ($\beta_2 = -0.003$, P = .82), suggesting no immediate substantial impact. However, post-intervention, there was a statistically significant gradual increase in prices ($\beta_3 = 0.011$, P = .04), indicating that prices started to rise again over time. The overall trend after the intervention ($\beta_1 + \beta_3 = 0.029$) shows a continued and significant increase in meat prices following the financial crisis.

Milk: Before the intervention, milk prices were on a statistically significant upward trend ($\beta_1 = 0.013$, P = .00). The immediate effect of the financial crisis intervention was a slight, non-

significant decrease in prices (β_2 = -0.006, P = .45). However, there was a statistically significant gradual increase in prices post-intervention (β_3 = 0.019, P = .00), indicating that milk prices resumed their upward trend after the initial shock. The overall trend post-intervention ($\beta_1 + \beta_3$ = 0.032) confirms a continued rise in milk prices over time, reflecting resilience in the market despite the financial crisis.

Oil: Prior to the intervention, oil prices exhibited a statistically significant positive trend (β_1 = 0.009, P = .00). The immediate impact of the intervention was a negligible and non-significant change in prices (β_2 = -0.0003, P = .90). However, a statistically significant gradual increase in oil prices was observed post-intervention (β_3 = 0.022, P = .00). The overall trend after the intervention ($\beta_1 + \beta_3$ = 0.031) indicates a continued rise in oil prices, showing a sustained upward trajectory despite the intervention.

Vegetables: Prior to the intervention, vegetable prices showed a statistically significant positive trend (β_1 = 0.017, P = .02). The immediate impact of the intervention was a non-significant decrease in prices (β_2 = -0.036, P = .48). Post-intervention, there was a marginally significant gradual increase in prices (β_3 = 0.015, P = .07). The overall trend after the intervention ($\beta_1 + \beta_3$ = 0.032) indicates a modest rise in vegetable prices, reflecting a slight recovery and continued increase after the initial drop.

Fruit: Before the intervention, fruit prices exhibited a statistically significant positive trend (β_1 = 0.019, P = .01). The immediate impact of the intervention was a slight, non-significant decrease in prices (β_2 = -0.010, P = .81). Following the intervention, there was a marginally positive but

statistically insignificant gradual increase (β_3 = 0.012, P = .22). The overall trend after the intervention ($\beta_1 + \beta_3$ = 0.031) indicates that fruit prices continued to rise, reflecting a sustained upward trajectory despite the initial decrease.

Bread: Prior to the intervention, bread prices had a statistically significant positive trend (β_1 = 0.009, P = .00). The intervention caused a slight, non-significant immediate drop in prices (β_2 = -0.003, P = .59). Post-intervention, there was a significant gradual increase in prices (β_3 = 0.018, P = .00). The overall trend after the intervention ($\beta_1 + \beta_3$ = 0.027) indicates that bread prices continued to rise, reflecting a sustained upward trajectory despite the initial minor decrease.

Interpretation of Positive and Negative Values:

- Positive Values: For the Time Effect (β_1) and Time Intervention Effect (β_3), positive values indicate that prices were generally on an upward trend, either before the intervention (β_1) or after the intervention (β_3). When these values are statistically significant (p-value < 0.05), it suggests strong evidence that these trends are not due to random chance.
- Negative Values: For the Intervention Effect (β_2), the negative values suggest a potential immediate reduction in prices following the financial crisis intervention. However, since none of the negative β_2 values have a p-value below 0.05, we cannot conclude that these reductions are statistically significant or that they represent a genuine immediate impact of the intervention. These negative values might be due to random fluctuations or short-term market reactions that were not strong or consistent enough to be significant.

Across various food groups, the impact of the financial crisis intervention showed some common patterns. For meat, milk, oil, and bread, prices exhibited significant upward trends both before and after the intervention. Despite minor immediate decreases in some cases, such as for meat, milk, and bread, the overall post-intervention trends indicated continued price increases, reflecting market resilience. Vegetables and fruit also demonstrated upward trends, though the increase was more modest and less consistent compared to the other groups. Overall, the financial crisis intervention had minimal immediate effects on prices, but most food groups resumed their upward trajectory over time, showing persistent inflationary pressures in the market.

Table 4.10 expresses the percentage share of urban and rural households prone to food insecurity in Iran based on the share of food expenditure. As indicated, this was 8.84% for urban families and 25.17% for rural in the year 2017, while in 2021 it increased to 13.64% and 33.23% for urban and rural respectively, thus showing the increasing trend of food insecurity in urban and rural families.

Table 4. 10. Percentage of Urban and Rural Households in Iran Prone to Food Insecurity From 2017 to 2021.

year	Urban Households				Rural Households			
	Very High	High	Medium	Low	Very High	High	Medium	Low
2017	1.91	1.54	5.39	91.16	8.37	4.4	12.4	74.83
2018	2.83	1.76	6	89.41	10.09	4.46	13.25	72.2
2019	3.4	1.84	6	88.76	10.68	5.21	13.31	70.8
2020	4.145	1.99	6.305	87.56	11.835	5.615	13.765	68.79
2021	4.89	2.14	6.61	86.36	12.99	6.02	14.22	66.77

In the current study, conducted over the period from 2017 to 2021, the percentage of severe (very high and high) food insecurity escalated by over 100% in urban areas and by 49% in rural areas. This significant increase reflects the impact of sanctions and the financial crisis on food security among the Iranian population.

Chapter 5: Conclusion and Recommendations

The food market in Iran, like many other sectors, has been significantly affected by inflation. According to the Statistical Center of Iran (SCI), the point-to-point inflation rate rose to 52.1% in May 2019 compared to May 2018. The rate was higher for some goods and services like housing. This steep jump of inflation is an absolute signal of a huge decline in the Iranians' purchasing power, meaning that they will have less ability to buy food.

Our study calculated the average cost of a healthy diet in Iran and explored strategies to reduce this cost. However, given the current precarious food purchasing power of Iranians, even halving the cost of a healthy diet would still make it unaffordable for most households. This points to a critical issue: the affordability of nutritious food is declining sharply, pushing many families toward less nutritious options.

A systematic review by Kokabisaghi (2018) highlighted that sanctions and financial restrictions have made it extremely difficult and costly to import food and medicinal goods into Iran. Following the first round of nuclear sanctions in 2012, UNICEF characterized Iran as a country under severe unilateral economic sanctions, with significant adverse effects on public health, the environment, and the socio-economic conditions of its citizens, especially children (UNICEF, 2012).

It is well-established that a healthy diet is typically more expensive than an unhealthy one, as nutrient-rich foods generally cost more than foods with empty calories. The results of the current study confirm that among all the healthy diet foods, meats and fruits are the most expensive, while fats are cheaper. As a result of this economic factor, therefore, most Iranians are likely to shift to more affordable energy-dense food items like fats, sugars, and refined carbohydrates, especially

those subsidized by the government, including white bread. This trend is likely to create a lot of obesity cases, accompanied by cardiovascular conditions, diabetes, and even various types of cancer in the near future. In addition, if food market inflation continues on the same path, it could turn the already existing "hidden hunger" into a more open and explicit food crisis.

Several studies have documented the deleterious effects of the financial crisis on human rights and multiple dimensions of health, including the availability of basic medications and medical devices. Due to the re-imposition of U.S. nuclear-related sanctions, the Iranian government implemented numerous measures to alleviate negative impacts on its general population. In April 2018, the Central Bank of Iran provided a subsidized exchange rate for importing "essential goods," including foodstuffs. However, an examination of the prices of food through the next year demonstrates that little improvement in curbing the costs was found as a result of this policy. For example, meat almost tripled in price, underscoring the limited effectiveness of this initiative.

To address the worsening food insecurity in Iran, the government should consider a range of strategies. These could include establishing effective food assistance programs, creating food banks in partnership with charities and NGOs, and launching nutrition education initiatives to help people make better food choices within their budget constraints.

Even before the U.S. sanctions and the financial crisis, Iran was already considered a high-risk country for food security. Since then, the situation has deteriorated further, and if current conditions persist, Iran may face a severe food crisis. This is occurring while the UN is advocating for the Zero Hunger Challenge to eradicate hunger worldwide by 2030 (Waminathan, MS, 2014; Hejazi J, Emamgholipour S, 2022). Therefore, immediate action from international bodies like the United Nations is essential to address this pressing issue.

Limitations of the Study

The findings of this study are subject to certain limitations. The study's design did not allow for the inclusion of a control group, making it challenging to isolate the specific effects of the financial crisis from other factors like weather conditions and agricultural productivity, which could also influence food security in Iran.

Policy Implications and Recommendations

The findings highlight the impact of the financial crisis, further exacerbated by sanctions, has gravely heightened vulnerability to food insecurity across all demographic groups, albeit to differing degrees. Food security in Iran is still intertwined with several other basic critical economic issues such as unemployment, low pay, and lack of availability and access to affordable and healthy food. Higher costs of a healthy diet compared to household incomes indicate an increase in the likelihood of deterioration of food insecurity if these economic situations persist.

It is, therefore, likely that the current trend could lead to the worst food crisis in the absence of effective interventions. Addressing this challenge requires both immediate relief measures and longer-term structural reforms:

Short-Term Policy Interventions:

1. **Food Subsidies and Price Controls**: Implement targeted subsidies for essential food items like bread, milk, and vegetables to cushion low-income households from rising prices. However, price controls must be managed carefully to prevent market distortions and shortages.

2. **Direct Cash Transfers and Food Vouchers**: Expand cash transfer programs and food vouchers for the most vulnerable households to provide immediate relief. These programs should be tailored to cover the nutritional needs of different household sizes and demographics.

3. **Emergency Food Assistance Programs**: Establish food banks and community kitchens, supported by government and non-governmental organizations, to offer temporary relief to those severely affected by food insecurity.

Long-Term Policy Interventions:

1. **Support for Domestic Agriculture**: Encourage local food production through subsidies for farmers, investment in agricultural infrastructure, and research into drought-resistant crops to reduce dependency on imports and stabilize prices in the long term.

2. **Diversification of the Economy**: Reduce Iran's heavy reliance on oil exports by diversifying its economy to buffer against sanctions and global market volatility. This would create more stable income opportunities, reducing economic vulnerability.

3. **Nutrition Education Programs**: Implement public health campaigns to educate people on affordable and healthy eating habits, helping households make better food choices even in times of financial stress.

4. **Strengthening Social Safety Nets**: Expand social safety nets like unemployment benefits and healthcare services to protect households from economic shocks and prevent them from falling deeper into poverty and food insecurity.

These multi-faceted strategies are essential for addressing food insecurity in Iran, providing both immediate relief and fostering resilience against future economic shocks.

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Appendix

In this section, we provide an extensive compilation of the statistical analyses and results derived from STATA, as presented in Chapter 4. The findings in these tables represent a crucial component of the study, which investigates the impacts of financial crises on food security in Iran. These results are organized to offer clarity on the methodology, data interpretations, and the statistical significance of the observed trends.

The output from an Interrupted Time Series (ITS) analysis was performed in Stata using the Prais-Winsten AR (1) regression method. This method is particularly useful for handling autocorrelation in time series data.

The dependent variable is the logarithm of the Consumer Price Index (Log_CPI).

The analysis is a single-group interrupted time series with an intervention (treatment) occurring at time period 17.

the Prais-Winsten AR (1) regression method was used to correct for autocorrelation.

The rhotype(tscorr) option specifies the type of autocorrelation correction, in this case, time-series autocorrelation.

The vce(robust) option indicates that robust standard errors were used.

The iteration process shows how the autocorrelation coefficient (rho) was estimated over several iterations.

Regression Output:

Dependent Variable: Log_CPI

Independent Variables:

_t: This represents the time trend before the intervention.

x17: This represents the intervention effect, capturing the immediate change after the intervention.

_xt17: This represents the change in the time trend after the intervention.

Meat:

```
.
. itsa Log_CPI, single treat(3) trperiod(17) replace prais rhotype(tscorr) vce(robust)


       panel variable:  Food_GroupX (strongly balanced)
        time variable:  time, 1 to 60
                delta:  1 unit

Iteration 0:  rho = 0.0000
Iteration 1:  rho = 0.8806
Iteration 2:  rho = 0.9165
Iteration 3:  rho = 0.9190
Iteration 4:  rho = 0.9192
Iteration 5:  rho = 0.9192
Iteration 6:  rho = 0.9192
Iteration 7:  rho = 0.9192

Prais-Winsten AR(1) regression -- iterated estimates

Linear regression                               Number of obs     =         60
                                                F(3, 56)          =      78.16
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9499
                                                Root MSE          =     .04232

------------------------------------------------------------------------------
             |             Semirobust
    _Log_CPI |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          _t |   .0176727   .0036671     4.82   0.000     .0103266    .0250188
        _x17 |  -.0034019   .0146691    -0.23   0.817    -.0327875    .0259838
      _x_t17 |   .0110867   .0052596     2.11   0.040     .0005505    .0216229
       _cons |   4.629445   .0273709   169.14   0.000     4.574614    4.684275
-------------+----------------------------------------------------------------
         rho |   .9192069
------------------------------------------------------------------------------
Durbin-Watson statistic (original)    0.237672
Durbin-Watson statistic (transformed) 1.285264
```

The Prais-Winsten method converged after 7 iterations, with the autocorrelation coefficient rho stabilizing at 0.9192, indicating high autocorrelation in the data.

Summary of Results (**Meat**):

- Pre-Intervention Trend: A significant upward trend in the CPI was observed before the intervention.

- Immediate Effect of Intervention: The intervention did not result in a statistically significant immediate change in the CPI.

- Post-Intervention Trend: There was a significant increase in the trend of CPI after the intervention, suggesting that the intervention might have had an impact in increasing the inflationary trend over time.

The results suggest that there was no immediate impact of the intervention on the CPI, but there is evidence of a significant increase in the rate of inflation following the intervention. This implies that the intervention might have led to a rise in inflationary pressures.

Milk:

```
.
. itsa Log_CPI, single treat(4) trperiod(17) replace prais rhotype(tscorr) vce(robust)

       panel variable:  Food_GroupX (strongly balanced)
        time variable:  time, 1 to 60
                delta:  1 unit

Iteration 0:  rho = 0.0000
Iteration 1:  rho = 0.8925
Iteration 2:  rho = 0.9073
Iteration 3:  rho = 0.9089
Iteration 4:  rho = 0.9091
Iteration 5:  rho = 0.9091
Iteration 6:  rho = 0.9091
Iteration 7:  rho = 0.9091

Prais-Winsten AR(1) regression -- iterated estimates

Linear regression                               Number of obs     =         60
                                                F(3, 56)          =     170.36
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9747
                                                Root MSE          =     .03117

------------------------------------------------------------------------------
             |               Semirobust
    _Log_CPI |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          _t |   .0129575   .0032758     3.96   0.000     .0063952    .0195197
        _x17 |  -.0063603   .0083906    -0.76   0.452    -.0231686     .010448
      _x_t17 |   .0190226    .004806     3.96   0.000     .0093949    .0286502
       _cons |    4.58257   .0114872   398.93   0.000     4.559559    4.605582
-------------+----------------------------------------------------------------
         rho |   .9091133
------------------------------------------------------------------------------
Durbin-Watson statistic (original)    0.190600
Durbin-Watson statistic (transformed) 1.323420
```

The final value of rho converged at 0.9091, indicating a strong autocorrelation in the data.

Summary of Results (**Milk**):

Pre-Intervention Trend: There was a significant upward trend in the CPI before the intervention (sanctions).

Immediate Effect of Intervention: The sanctions did not result in a statistically significant immediate change in the CPI.

Post-Intervention Trend: The trend in CPI increased significantly after the intervention, suggesting that the financial crisis had a gradual and significant impact on inflation, leading to a higher rate of increase in CPI.

These results support the hypothesis that while the financial crisis did not cause an immediate shock to food prices, it significantly increased the inflationary trend over time, contributing to rising food insecurity.

Oil:

```
.
. itsa Log_CPI, single treat(5) trperiod(17) replace prais rhotype(tscorr) vce(robust)


       panel variable:  Food_GroupX (strongly balanced)
        time variable:  time, 1 to 60
                delta:  1 unit

Iteration 0:  rho = 0.0000
Iteration 1:  rho = 0.9528
Iteration 2:  rho = 0.9544
Iteration 3:  rho = 0.9545
Iteration 4:  rho = 0.9545

Prais-Winsten AR(1) regression -- iterated estimates

Linear regression                               Number of obs     =         60
                                                F(3, 56)          =      65.96
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9521
                                                Root MSE          =      .0338

------------------------------------------------------------------------------
             |               Semirobust
    _Log_CPI |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          _t |    .008569   .0013965     6.14   0.000     .0057715    .0113665
        _x17 |  -.0002513   .0019388    -0.13   0.897    -.0041351    .0036325
      _x_t17 |   .0215482   .0036846     5.85   0.000      .014167    .0289294
       _cons |    4.61765   .0131993   349.84   0.000     4.591209    4.644092
-------------+----------------------------------------------------------------
         rho |   .9544544
------------------------------------------------------------------------------
Durbin-Watson statistic (original)    0.092460
Durbin-Watson statistic (transformed) 0.611897
```

The final value of rho converged at 0.9545, indicating a high degree of autocorrelation in the data.

Summary of Results (**Oil**):

Pre-Intervention Trend: A significant downward trend in the CPI was observed before the intervention.

Immediate Effect of Intervention: The intervention did not result in a statistically significant immediate change in the CPI.

Post-Intervention Trend: There was a significant upward trend in CPI after the intervention, suggesting that while the intervention did not have an immediate impact, it significantly increased the inflationary trend over time.

The results support the hypothesis that the intervention did not cause an immediate shock to the CPI but did lead to a significant increase in the inflationary trend over time. This could imply that while there was no abrupt change, the intervention gradually influenced the rate of inflation, potentially exacerbating inflationary pressures over time.

Vegetables:

```
. itsa Log_CPI, single treat(6) trperiod(17) replace prais rhotype(tscorr) vce(robust)

       panel variable:  Food_GroupX (strongly balanced)
        time variable:  time, 1 to 60
                delta:  1 unit

Iteration 0:  rho = 0.0000
Iteration 1:  rho = 0.7490
Iteration 2:  rho = 0.7716
Iteration 3:  rho = 0.7729
Iteration 4:  rho = 0.7730
Iteration 5:  rho = 0.7730
Iteration 6:  rho = 0.7730

Prais-Winsten AR(1) regression -- iterated estimates

Linear regression                               Number of obs     =         60
                                                F(3, 56)          =      98.31
                                                Prob > F          =     0.0000
                                                R-squared         =     0.8969
                                                Root MSE          =     .08464

------------------------------------------------------------------------------
             |               Semirobust
    _Log_CPI |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          _t |   .0168785   .0068265     2.47   0.016     .0032034    .0305536
        _x17 |  -.0357153   .0504757    -0.71   0.482    -.1368303    .0653997
      _x_t17 |   .0151975   .0081574     1.86   0.068    -.0011437    .0315386
       _cons |   4.645313   .0653149    71.12   0.000     4.514471    4.776154
-------------+----------------------------------------------------------------
         rho |   .7729862
------------------------------------------------------------------------------
Durbin-Watson statistic (original)    0.477598
Durbin-Watson statistic (transformed) 1.591542
```

Iteration Process The Prais-Winsten method converged after 6 iterations, with the autocorrelation coefficient rho reaching 0.7730, indicating moderate autocorrelation in the data.

Summary of Results (**Vegetables)**:

Pre-Intervention Trend: A significant downward trend in the CPI was observed before the intervention. Immediate Effect of Intervention: The intervention did not result in a statistically significant immediate change in the CPI. Post-Intervention Trend: There was a marginally significant decrease in the trend of CPI after the intervention, suggesting that the intervention might have had a gradual impact in reducing the inflationary trend over time.

The results suggest that while there was no immediate impact of the intervention on the CPI, there is evidence of a potential slowing in the rate of inflation following the intervention. This could imply that the intervention gradually curbed inflationary pressures, although the results are only marginally significant for the post-intervention trend. Further analysis or data may be needed to confirm this finding.

Fruits:

```
. itsa Log_CPI, single treat(2) trperiod(17) replace prais rhotype(tscorr) vce(robust)

       panel variable:  Food_GroupX (strongly balanced)
        time variable:  time, 1 to 60
                delta:  1 unit

Iteration 0:  rho = 0.0000
Iteration 1:  rho = 0.7556
Iteration 2:  rho = 0.8530
Iteration 3:  rho = 0.8630
Iteration 4:  rho = 0.8639
Iteration 5:  rho = 0.8640
Iteration 6:  rho = 0.8640
Iteration 7:  rho = 0.8640

Prais-Winsten AR(1) regression -- iterated estimates

Linear regression                               Number of obs     =         60
                                                F(3, 56)          =     115.36
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9359
                                                Root MSE          =     .05526

------------------------------------------------------------------------------
             |               Semirobust
    _Log_CPI |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          _t |    .019058   .0071712     2.66   0.010     .0046925    .0334236
        _x17 |  -.0102598    .041646    -0.25   0.806    -.0936867    .0731671
      _x_t17 |    .0115535  .0093456     1.24   0.222    -.0071681    .0302751
       _cons |    4.489038  .0492724    91.11   0.000     4.390333    4.587742
-------------+----------------------------------------------------------------
         rho |    .8639797
------------------------------------------------------------------------------
Durbin-Watson statistic (original)    0.468236
Durbin-Watson statistic (transformed) 1.518346
```

The Prais-Winsten method converged after 7 iterations, with the autocorrelation coefficient (rho) stabilizing at 0.8640 in the final iterations, indicating a relatively high level of autocorrelation in the data.

Summary of Results (**Fruits):**

- Pre-Intervention Trend: A significant upward trend in the CPI was observed before the intervention.

- Immediate Effect of Intervention: The intervention did not result in a statistically significant immediate change in the CPI.

- Post-Intervention Trend: The trend in CPI after the intervention did not change significantly, suggesting that the intervention did not have a significant impact on the inflationary trend.

The results indicate that there was a significant upward trend in the CPI before the intervention. However, the intervention itself did not produce a statistically significant immediate or long-term effect on the CPI trend. The model fit is strong, explaining most of the variance in the data, but further investigation might be needed to explore other factors influencing the CPI or to evaluate the intervention's effectiveness more conclusively.

Bread:

```
       panel variable:  Food_GroupX (strongly balanced)
        time variable:  time, 1 to 60
                delta:  1 unit

Iteration 0:  rho = 0.0000
Iteration 1:  rho = 0.8924
Iteration 2:  rho = 0.9319
Iteration 3:  rho = 0.9389
Iteration 4:  rho = 0.9407
Iteration 5:  rho = 0.9412
Iteration 6:  rho = 0.9413
Iteration 7:  rho = 0.9413
Iteration 8:  rho = 0.9413
Iteration 9:  rho = 0.9413
Iteration 10:  rho = 0.9413

Prais-Winsten AR(1) regression -- iterated estimates

Linear regression                               Number of obs     =         60
                                                F(3, 56)          =     168.21
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9894
                                                Root MSE          =      .0173

------------------------------------------------------------------------------
             |               Semirobust
    _Log_CPI |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          _t |   .0086965   .0012551     6.93   0.000     .0061822    .0112107
        _x17 |   -.002669   .0049558    -0.54   0.592    -.0125967    .0072587
      _x_t17 |   .0179475   .0020037     8.96   0.000     .0139335    .0219614
       _cons |   4.619024   .0170469   270.96   0.000     4.584874    4.653173
-------------+----------------------------------------------------------------
         rho |   .9413396
------------------------------------------------------------------------------
Durbin-Watson statistic (original)    0.186378
Durbin-Watson statistic (transformed) 0.807390
```

The Prais-Winsten method required 10 iterations to converge, with the autocorrelation coefficient (rho) stabilizing at 0.9413 in the final iterations, indicating a strong level of autocorrelation in the data.

Summary of Results (**Bread):**

- Pre-Intervention Trend: There was a highly significant upward trend in the CPI before the intervention.

- Immediate Effect of Intervention: The intervention did not result in a statistically significant immediate change in the CPI.

- Post-Intervention Trend: The trend in CPI increased significantly after the intervention, indicating that the intervention was associated with an accelerated rate of inflation, contrary to what might have been expected.

The analysis indicates that there was a significant upward trend in CPI before the intervention, and this trend accelerated significantly after the intervention. The intervention itself did not have a significant immediate impact on CPI, but it was followed by a notable increase in the CPI growth rate. The model fits the data extremely well, explaining nearly all the variance in CPI, but the post-intervention trend suggests that the intervention may have inadvertently cont