An economic analysis of agri-food firms' resiliency: a case study of six companies

by

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ABSTRACT

The thesis examines resilience of a select group of companies in the agri-food sector and outside the sector. The agri-food firms selected are ADM, Coca-Cola, PepsiCo, Conagra, AGCO, and Tyson. The non-agri-food firms are DISH, Walmart, Ford, ExxonMobil. ADM and AGCO are upstream in the agri-food chain while the others are processors. Similarly, Ford and ExxonMobil are manufacturers, DISH is a service provider, and Walmart is a comprehensive retailer. With monthly gross profit margin from the Wharton Research Data Service and macroeconomic shocks from the Federal Research of St. Louis, National Bureau of Economic Research, Bureau of Labor Statistics, and other public agencies, the research explored the relationship between gross profit margins of selected firms and the interaction between whether there was an adverse macroeconomic event the traditional indicators of such events – unemployment rate, interest rate, inflation rate, and labor participation rate. The results showed that while the majority of the firms experienced the expected negative sign on their coefficients for adverse macroeconomic shocks, the coefficients were not statistically significant. However, Coca-Cola and ExxonMobil had statistically significant negative coefficients, indicating that the gross profit margins of these two companies were adversely affected by the adverse macroeconomic events. We do not draw any inferential conclusions from this study because the companies were purposively selected, and they were all large publicly traded companies. It is suggested that future work use a more formalized sampling approach for firms, such as random sampling and consider multiple performance indicators.

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CHAPTER I: INTRODUCTION

The agri-food sector is a core foundation of the global economy because it provides food, fiber, and fuel to the world. As humans evolved from hunter-gatherers and living a nomadic lifestyle to developing and living in cities, the agri-food sector evolved to become an increasingly important supplier of the energy required to fuel human and industrial activities. Food has been described as the most essential consumer good, and the agri-food sector affects the economic development of many communities around the world (Barrett, Reardon, Swinnen, & Zilberman, 2019). Understanding the performance of the companies in the sector and their resilience to macroeconomic crises is key in helping to assess the practices that need to be in place to minimize disruptions to the economy.

Economic disruptions or crises are uncommon in the U.S. but can often produce significant impact on companies and communities. The National Bureau of Economic Research (NBER) has identified a dozen recessions since the Second World War, three of these occurring between 2000 and 2023. Recessions are considered disruptions to, or crises, in the macroeconomy because they halt and/or reverse prevailing economic growth as measured by the common indicators – Gross Domestic Product (GDP) and unemployment rate. However, in the last 102 years, there have been two global pandemics and the last one, the COVID-19 pandemic, which occurred officially between March 2020 and May 2023, did not only cause significant economic disruption, but seems to have altered the nature of the economy, if only briefly (Amanor-Boadu, 2022). For example, it made people aware, in a radical way, of the essentiality of the agri-food sector when grocery stores ran out of consumer-packaged goods and produce they have come to take for granted in this country.

The financial crisis or Great Recession, which started in late 2007 and stayed around through June 2009, was a *traditional* macroeconomic disruption because it was driven by economic decisions and choices made in the financial and housing markets. Thus, unlike the COVID-19 disruption, the Great Recession was triggered by a housing bubble that turned into a financial sector nightmare through risky financial instruments that emanated from creative criminality (Amanor-Boadu, 2008). Likewise, the Dotcom Recession, which occurred between March and October 2001, was a result of accelerated investments in emerging technologies leveraging the internet. The rapidity and seeming lack of rationality of these investments caused the then Chair of the Federal Reserve, Alan Greenspan, to refer to them as being driven by "irrational exuberance" in a speech given at the American Enterprise Institute on December 5, 1996 (Greenspan, 1996). While both the Dotcom and Great Recessions were foreseen and predicted by many years ahead of them happening, the COVID-19 pandemic was a true surprise for virtually all governments around the world, including the U.S. Government.

According to the USDA (2021), agriculture, food, and related industries accounted for approximately $1.3 trillion, putting the sector about 5.4% of the U.S. gross domestic product (GDP) in 2021. As a sector touching virtually all other segments of the economy, understanding the effect of these macroeconomic disruptions on the agri-food sector is important. Because everyone eats, it may be assumed that the agri-food sector would be immune to macroeconomic disruptions. The ability of firms in the agri-food sector to sustain their performance when the performance of firms in other sectors is under stress reveals the resilience of agri-food firms to macroeconomic shocks. Resilience is derived from the Latin word *resilire*, meaning to "recoil or leap back." It is, therefore, "the ability to recover quickly from or to deal with sudden, unexpected difficulties or hardships" (Hodder and Stoughton, 2024). The concept of economic resilience involves examining how quickly an economic entity can bounce back from a shock. There have been a few studies exploring resilience of agri-food industries, including Lindbloom (2018), Merritt (2020), and Lanza (2018). Indeed, Lindbloom developed methods for measuring the resilience of farms while Lanza and Merritt both explored the impact of weather shocks on fisheries in Peru and cotton production in Georgia and Texas. The effect of external macroeconomic shocks or disruptions on agri-food performance has not been studied extensively. Yet, it has been assumed that the sector is resilient to these disruptions because of the inelastic demand for food. Understanding the extent to which external shocks affect agri-food firm performance could provide insights on how to improve the resilience of the sector's firms to these disruptions.

1.1 Research Question and Thesis Objectives

This research was motivated by the need to understand the potential impact of macroeconomic shocks on agri-food firm performance. This motivation, therefore, frames the research question underscoring this research. Which indicators of macroeconomic crises have a significant impact on agri-food firms' performance? The nature of the question demands a definition of macroeconomic crises. The thesis identifies two broad types of shocks: (1) Recessions are said to occur when there are two or more successive negative growth in the GDP; and (2) Non-economic shocks, which encompass all shocks to the macroeconomy that originate outside economic factors. One such non-economic shock is the recent global public health challenge presented by the COVID-19 pandemic. The U.S. economy has experienced three recessions in the past two decades: The Dotcom Recession, The Financial Crisis, and the COVID-19 pandemic. Regardless of the shock, their macroeconomic indicators are assumed to be the following: Unemployment rate, Federal Funds rate, Inflation, and Labor force participation rate. For the thesis, agri-food firm performance was defined as the gross profit margin. This performance indicator was selected from among alternative measures for its reflection of revenues and costs associated with operations, positioning it to be a rapid test for any potential impact changes in the economy on firms.

Given the question, the overall research objective was to evaluate the impacts of macroeconomic crises and their primary indicators on the performance of agri-food firms. These crises, as described above, are the Dotcom bubble of 2000/2001, the financial crisis of 2007/2008, and the COVID pandemic of 2020/2023. The specific objectives were as follows:

1. Describe the nature of macroeconomic shocks the U.S. economy has experienced over the past two decades and their impact on the critical indicators of the economic performance; and
2. Explore the impacts of the macroeconomic crises on the performance of a case agri-food firms with the view to assessing their resilience to these crises and compare them to case companies outside the agri-food sector.

1.2 Thesis Organization

The thesis is organized into five sections or chapters. The first, this chapter, has provided a background and motivation for the study. It also defined the research question and the objectives. The next chapter presents a review of the literature on firm performance, macroeconomic shocks and disruptions, their expected and experienced impacts, and how they manifest. We show in Chapter 2 that firms respond to the different types of shocks differently because of the information associated with the shocks before and during their unfolding. Chapter 3 describes the conceptual framework employed to address the objectives of this research. It also presents sources of data and analytical methods employed to achieve the research's objectives. The results of the research are presented and discussed in Chapter 4. The final chapter presents the summary and conclusions from the study, any management practice implications emanating from the study, and finally suggestions for future research.

CHAPTER II: LITERATURE REVIEW

The literature review chapter is divided into three main sections. The first covers the extant literature on macroeconomic shocks over the past two decades and their antecedents and their impacts on the general economy as well as specific economic sectors. The second section reviews the literature on resilience from a broad perspective and narrows it down to explore resilience as an economic concept. The literature will cover how different disciplines see resilience in comparison to economics and business and explore how it has been measured. The literature review will explore the strengths and weaknesses of the different definitions and construct a definition from the alternatives encountered in the literature that provides a more robust definition. The final section focuses on the principal gaps in the literature with respect to how an organization's management capacity positions it to be more resilient. Any gaps in the literature are also presented and discussed.

2.1 Rethinking Macroeconomic Shocks and the Economy

Sinai (2010) argues for a need to challenge the status-quo on the data used in measuring recessions in the United States. He notes that the original formula, developed in the 1940s, is outdated as the economy and employment sectors have shifted. Manufacturing is down by over 20% and healthcare is up nearly triple in that same period, as a percentage of the workforce. Over the same period, Sinai notes, the service industry is approaching 50% of the workforce. Sinai continues that due to the globalization of the economy, shocks in certain parts of the world or certain sectors are not felt immediately and may have varying impacts across the world, and in so doing influence different sectors differently in different countries. The most important contribution of Sinai's work may be his call on the economics profession to revisit how we measure the impact of business cycles on the economy.

A new economy had been unveiled by a new technology towards the middle and latter half of the 1990s: The internet. There was significant excitement about what this could do for business and the economy (Loch, Carr, & Warkentin, 1992) as well as anxiety about its potential impact on privacy (Branscomb, 1992). The excitement exceeded the anxiety and innovations to business models led to significant flow of investments into the emerging technology sector. Companies, such as Amazon, Facebook, Priceline, and Google will emerge in this environment and a new description differentiated them from traditional businesses: dot com businesses. The traditional businesses became “Bricks and Mortar” businesses. The rapid flow of funds attracted people and accelerated investment which created what eventually became a bubble, the Internet bubble. The bubble built from about 1995 through 2000 when it bust. It was manifested by the emergence of a new stock index, the NASDAQ, which climbed rapidly from its inception to reach close to 5,000 in March 2000. Between 1995 and the peak of the NASDAQ, investments in NASDAQ composite stock market index rose by 800%. The NASDAQ dropped to less than 1,000 by October 2002, giving up all its gains during the bubble. It seemed “irrational exuberance” (Greenspan, 1996) had given way to rational expectations. In between the peak and the trough, most publicly traded dot com companies failed. Some of these were ably Pets.com and Webvan, as well as short-lived communication companies, including NorthPoint Communications, Worldcom, and Global Crossing. Others were acquired by “bricks and mortar” firms, and a few remained. Indeed, the dot com boom has been likened to the railroads in the 1840s, automobiles in the 1900s, and other technology inspired economic shifts.

The internet bubble did not only affect technology companies when it burst. It shook confidence in the general economy, creating a ripple effect on traditional companies. For example, Intel stock crashed from $73 to about $20 even though the company was not directly related to the dot com bubble (Pureza, n.d.). However, the economy experienced a relatively steady growth after the dot com bubble subsided. It experienced uninterrupted growth from the about 2003 through to 2008, when another bubble, the housing bubble, led to the most intensive financial crisis and far-reaching recession seen since the great depression was triggered by the 1929 stock market crash. Between 2008 and 2009, housing prices fell by nearly 32% and unemployment rose to above 9% and stay at that level well past the end of the recession. The Treasury spent close to $440 billion buying bank and automobile stocks in attempts to stem the problems. Interestingly, the U.S. Treasury bailed out AIG for $182 billion in exchange for stock. Upon selling its holdings the US Government made about $23 billion in profit.

Some have argued that the deregulation of the financial markets, which permitted banks to engage in hedge fund trading was the precursor to the financial crisis of 2007-2008 (Amanor-Boadu V. , 2008). The increased demand for mortgages led banks to create interest only subprime mortgages that created a bubble in the real estate market. Increasing share of what became known as toxic assets on banks' balance sheets led to a loss of investor confidence which tightened liquidity and threatened solvency of many financial institutions, including Bear Stearns, Lehman Brothers, Deutsch Bank, Fannie Mae, and Freddie Mac. This was a global challenge that brought countries like Greece to its knees, financially speaking. It seems the only part of the global economy that was not adversely affected extensively was Africa.

The U.S. and the world embarked on the longest economic growth after the Great Recession. March 2020 saw global economies coming to a halt with the World Health Organization's declaration of the COVID-19 pandemic (WHO, 2020). Due to the uncertainty of the pandemic's spread and absence of vaccines to deal with the virus, governments the world over took aggressive steps to control its spread and infection rates. The shutdown of global economies triggered a recession the rapidity of which had never been seen. However, maybe because the recession was triggered by policy actions that shut down the economy and not by any economic fundamentals, the recession was very short lived, indeed the shortest on record (Schneider, 2021). The U.S. recession barley lasted through the end of April 2020 but the loss of jobs and shifts in the employment dynamics have left a deep impression on the economy (Amanor-Boadu, 2022).

Each of these crises manifests in the economy through increasing unemployment (Passarides, 2013), decreasing labor force participation (Erceg & Levin, 2014), and the risk of inflation (Watson, 2014). These variables affect consumption and may, therefore, affect the performance of certain firms. For example, unemployment reduces disposable income and that may affect consumer expenditures on certain products. There is also a theoretical possibility that persistent unemployment could adversely affect people's willingness to participate in the labor force. The risk of inflation increases people's incentives to save or hoard, which can affect sales for certain companies. These potential consumption implications emanating from macroeconomic crises could have direct impacts on the profitability of firms. This research explores this potential impact and evaluates the extent to which agri-food firms may be affected.

2.2 Defining and Measuring Resilience

The expected impact of macroeconomic shocks on the economy is altering the economy's growth path. Thus, when a recession hits, the GDP falls, unemployment rate increases, and consumer expenditures fall. It is also possible that firm profitability decreases. As these happen, they reinforce each other and accelerate the falling GDP and the associated depth of the recession. However, there are always firms and sectors of the economy that are may be considered "recession proof," firms and sectors that do not experience the adverse impacts of macroeconomic shocks or who do not experience them to the same extent as the typical firm or sector. These firms and sectors are often described as resilient.

Coad et al. (2023) indicate that the COVID-19 shock, like all crisis, had a strong adverse impact on aggregate economic performance as well as the sales revenues of any firms. They reported observing a negative impact of the COVID-19 crisis on firm growth and hit firms that were already declining harder than growing firms. They also noted that while service sector firms were more affected by the pandemic, digitalized firms suffered less. They, however, did not look at the impact of the pandemic on agri-food firms. Therefore, there is some evidence of differential impact of crises on firms but not for agri-food companies.

Martin (2012) observes that there is no clear definition of resilience and a generally accepted approach to measure organizations' resilience. He discusses how regional recoveries vary due to the region's economic portfolio and the varying degree of shock. In discussions around resilience, assumptions that must be made about the state of economic agents and the overall economic conditions prior to a shock. A growing economy might experience a macroeconomic shock in a different way than a struggling economy. Martin argues that discussion about resilience must be conducted in tandem with economic hysteresis to help better understand the differences across regional recoveries from shocks. Martin (2012) evaluates three interpretations of resilience, engineering, ecological, and adaptive forms of resilience. A system's ability to resist external pressures and bounce back from external shocks may be enhanced through engineering resilience into the system. This perspective is supported by the argument Holling (1996) made, i.e., "resistance to disturbance and speed of return to the equilibrium are used to measure the property" of a system's capacity to of resilience. A more resilient system is less vulnerable to shocks.

Ecological resilience is the concept of a shock or disturbance that pushes a "system beyond its 'elastic threshold' to a new domain. In this case, resilience is measured by the magnitude of the disturbance or shock that can be absorbed before the system changes form, function, or position" (Martin, 2012). He continues by stating that the larger a shock a system can absorb, the more resilient it is.

The idea of bouncing back insinuates that an economy gets back to equilibrium. Here Martin (2012) further explores hysteresis in economics and describes the concept of multiple equilibrium and balance or stability points. This concept is further supported through Holling (1996) in ecosystems that there are multiple stable domains. Lindbloom (2018) sums ecological resilience by stating "the system does not necessarily return to a previous equilibrium steady state after a shock but can and will evolve over time into multiple equilibriums and steady states."

Adaptive resilience is discussed as systems that can reorganize and evolve in response to shocks. Martin (2012) continues to state that resilience is more of a process, not a property or descriptor. Through reorganizing and reprioritizing, firms and sectors can get creative in generating revenue and reprioritizing labor or investing in new technology. This adaptive resilience seems to be more aligned with ecological resilience when considering firms or sectors. With the thought of multiple equilibriums, firms must possess a form of adaptive resilience to be able to reorganize and evolve with shocks.

Hysteric outcomes from a recessionary shock are most notably labor and employment and output of the economy. Martin (2012) explains that there can be both good and bad hysterics from recessions. Firms closing and unemployment rising are the most obvious bad forms. Martin (2012) discusses the ideas from a region perspective, and that regions that can attract labor and capital from other regions can grow much faster and recover quicker. This idea can mirror to the economic sector of agri-food. Being a relatively recession resistant sector due to inelastic demand, talent and capital can flow into the safer sector. Lanza (2018) hypothesizes that well managed firms can capitalize on shocks by increasing market share.

Martin (2012) then describes four dimensions of resilience; resistance, recovery, re-orientation, and renewal. He describes resistance as being vulnerable or sensitive to shocks, and recovery as how quick can one get back to "normal." Re-orientation is mentioned as structural change and its impact on labor, output, and incomes, and renewal as resuming to a growth stage, comparatively to what it was prior to the shock.

Martin (2012) creates a 'sensitivity index' and if a sector has a lower ratio, it can be described as more resistant and less sensitive relative to the general economy. This concept is supported with a “Resilience Triangle” measured by Lanza (2018) and Lindbloom (2018). Lanza (2018) measures performance on the vertical y-axis and time on the horizontal x-axis. The triangle area points are measured at the point prior to the shock, the lowest performance, and the point of post-shock or recovery. The work completed by both Lindbloom (2018), and Lanza (2018) use the inverse of the area of the triangle to determine more or less resilience. The larger the triangle the less resilience either due to a long recovery or impact of the shock or both.

Martin (2012) also brings up a good point to discuss how there are varying types and degrees of recession. Some can be financially driven and have more of an impact on certain sectors. Recessions can also be caused by natural disasters in certain areas or driven by logistics log jams. Runde and Ramanujam (2020) discuss the impacts of COVID-19 on supply chains and logistics and the need for diversification to help become more resilient.

2.3 Becoming More Resilient

Briguglio, et al. (2005) discuss resilience from a nation’s point of view and provides insight into the idea of developing and measuring resilience. When comparing the ideas for a country, we can try to correlate that into a market sector or an individual firm. Briguglio, et al. (2015) state that small states or countries are considered economically vulnerable due to the major reliance on exports. One mention of becoming more resilient is having a skilled workforce that can shift around during times of shock. (Briguglio, Cordina, Farrugia, & Vella, 2005)

When looking at macroeconomic stability, they consider fiscal debt to GDP ratio, inflation and unemployment rates, and debt to GDP ratio. We can compare these to the agri-food sector to consider similar measures of resilience, by looking at performance indicators of firms. The study uses regression analysis to discover that GDP per capita is explained by vulnerability and resilience and that high GDP per capita leads to a high resilience score. Lindbloom (2018) uses net farm per acre income as his performance indicator. Arita, et al. (2021) present a compelling case in their research that indeed, the global agriculture trade is resilient. The group develops econometric analytics to compare change in agriculture and non-agricultural trade, and their findings support inelasticity of demand for food stuff. While certain commodities did not fare well, namely hides and skins and ethanol, down 15 and 10 percent respectively, the agriculture trade performed better than non-agriculture trade. Overall, agriculture trade was down, but was two to three times less impacted than non-agricultural trade. Higher value food items were down, which could be a result of lockdowns and closing of restaurants and food services. When comparing the agriculture trade to non, they determine that the agriculture sector is resilient.

2.4 Evidence of Macroeconomic Shocks

According to the Federal Reserve Bank of Philadelphia, the labor force participation rate has been declining for nearly 20 years (Dotsey, Fujita, & Rudanko, 2017). A lower participation rate slows GDP as fewer people are contributing to the output of the economy. According to the article, a low participation rate is a burden to the economy, resulting in "higher tax rates because the government has a narrower tax base from which to draw revenue." The authors pose the question, is a low participation rate the result of severe recessions or does it arise from other factors in the economy? They continue by stating that the labor force participation rate is "influenced by two types of forces: cyclical ups and downs associated with recessions and economic expansions, and secular forces such as long-term changes in demographics" (Dotsey, Fujita, & Rudanko, 2017). In crises or shocks, GDP falls and organizations reduce their workforce. The authors discuss this and unemployment in the statement:

> The average amount of time that a worker is unemployed also increases dramatically in a recession, leading some workers to abandon their job search and, by definition, drop out of the labor force. By not looking for work, they no longer participate. As the economy recovers, however, firms once again begin posting job openings and hiring, the unemployment rate falls, and people who had previously given up on the job market regain employment, thereby re-entering the labor force. The labor force participation rate thus begins its cyclical recovery (Dotsey, Fujita, & Rudanko, 2017).

Unemployment is often used as a key indicator of economic performance. As it rises, it typically means the economy is doing well and as it falls, it is an indicator of poor performance or a tough road ahead. Through Lunsford's (2021) work, he examines the relationships between unemployment and economic expansions and contractions. In summary, he states, "The unemployment rate in the United States falls slowly in expansions and it may not reach its previous low point before the next recession begins" (Lunsford, 2021).

Interest rates typically decline in recessionary times as demand slows down. The Federal Reserve can cut interest rates to spur burrowing and help to kickstart the economy. Inflation can be caused by consumers outpacing the production of the economy. As this scenario occurs, governments try to curb inflation, and "reduce economic activity until it meets the economy's productive capacity" (Reed, 2021). By raising interest rates, consumers are incentivized to save versus spend, although this slow down causes "businesses to start producing less and laying off workers" and thus the downturn in the economy can begin to produce a recession (Reed, 2021).

The labor force participation rate, inflation, and unemployment may be used as indicators or results of recessions. Agri-food firms should be resilient or resistant to these indicators. The gap in the literature that this work seeks to contribute to is the impact of macroeconomic crises on agri-food firm performance. It is envisaged that understanding how different firms in the sector respond to different economic crises could reveal some unique characteristics of the firms and the sector to help managers improve their response to future crises. This is the primary contribution this research makes to the literature on resilience.

CHAPTER III: DATA AND METHODS

The data and methods employed to achieve the objectives specified for this study in the introductory chapter are presented and discussed in this chapter. The chapter is organized into two broad segments: Sources and justification of data; and Analytical methods. Within each of these segments there are a number of sub-segments. Because the study seeks to assess whether performance is driven by the same exogenous variables, the sources of data must be defined in ways that ensure consistency across the different companies included in the study. To this end, Section 3.1 describes the primary sources of the endogenous variables used in the research and the exogenous variables. The section also describes the same variables to provide them with the context for their inclusion. Section 3.2 presents a description and discussion of the methods used to conduct the analyses supporting the achievement of the objectives.

3.1 Data Sources

3.1.1 Endogenous Variables

The study was designed to explore the effect of macroeconomic crisis on firm performance. Crisis was defined as any event that either tripped the macroeconomy into recession or had a significant adverse effect in the broad economy. In other words, crises are not limited to any single economic sector but to the whole economy, e.g., recessions. In the past two decades, there have been two recessions – Dotcom recession and the Financial-sector induced Great Recession – and one global pandemic, COVID-19, which we noted triggered a recession, albeit short-lived.

We use the gross profit margin (GM) as an indicator of firm performance. The components of the gross profit margin are income statement based and are, therefore, less subject to manipulation. GM is defined as the ratio of gross profit and revenue. That is:

$$GM = \left(\frac{R-C}{R}\right)*100\% = \left(1-\frac{C}{R}\right)*100\% \qquad (3.1)$$

where R and C are revenue and cost of goods. It is usually presented as a percentage by multiplying GM by 100%.

The gross profit margin data for each of the selected firms were pulled from the Wharton Research Data Services (WRDS). WRDS has been providing data for more than 25 years on global companies which are used by companies, researchers, and academics. Its service extends to 38 countries. The periodicity of the gross profit margin data used in this study was monthly and covered January 2000 to December 2022.

Firms were purposefully selected at several nodes in the supply chain based on them being publicly traded companies, and hence, their financial information being readily available. The selected firms were AGCO Corp (AGCO), Archer Daniels Midland (ADM), Conagra Brands Inc (CAG), Tyson Foods Inc (TSN), Coca-Cola (KO), and PepsiCo (PEP). The firms were also selected to present some diversity in both product and markets. For example, AGCO was selected as a capital asset supplier while Coca-Cola and PepsiCo were selected for their consumer-packaged goods status. The agri-food companies are contrasted with a select group of firms in the non-agri-food sector: ExxonMobil, Walmart, DISH, and Ford Motor Company. This allows us to explore the uniqueness of the results regarding the relationship between the agri-food companies and the crises. The foregoing notwithstanding, it must not come as a surprise if the selected firms behaved in the same way despite their assumed differences since they all experience some form of derived demand. A strong economy would enable consumers to purchase items such as cars or clothes, boosting performance at both Ford Motor Company and Walmart. Increasing crop prices could also lead to increased purchases of farm equipment and use more energy, thus affecting Exxon Mobile performance.

AGCO Corporation is an American agricultural machinery manufacturer headquartered in Duluth, Georgia, United States. AGCO is “a global leader in the design, manufacture and distribution of agriculture solutions” (AGCO, 2023). AGCO sells tractors, combine harvesters, hay, forage, seeding and tillage equipment, as well as grain storage and intelligent farming solutions. Founded in 1990 in Duluth, GA, their brands include Massey Fergusson, Fendt, Valtrex, Precision Planting, AGCO Power, and Gleaner, among others (AGCO , 2023). AGCO was chosen as they are at the beginning of the agri-food supply chain by providing producers equipment and solutions to get crops planted and harvested.

Archer Daniels Midland (ADM) is headquartered in Chicago, Illinois with assets touching six continents and in 2020, net sales were $64 billion (ADM, 2023). ADM is best described from their website’s sustainability report:

> Every day, our 42,000 employees work to transform agricultural commodities into ingredients and products for food, feed, fuel, and industrial and consumer products. We purchase millions of metric tons of agricultural commodities and transport them whole or processed to customers in more than 200 countries. We operate around 300 processing facilities, 440 procurement centers, and 64 innovation centers in 47 countries. Operating our own transportation fleet of 30,000 rail cars, 2,500 barges, 620 trucks, 1,700 trailers, 144 boats, and 27 oceangoing vessels allows us to move grain as needed in the event of weather or political disasters that may jeopardize food security. In 2022, we processed 18.6 million metric tons of corn and 33.0 million metric tons of oilseeds” (ADM, 2022).

ADM was included in the thesis as they serve agriculture producers and are vital to the commodity supply chain in transforming raw commodities into ingredients and energy.

Conagra Brands (Conagra) is headquartered in Chicago, Illinois and is a leading manufacturer of food with over 100 years in the food industry and approximately 18,000 employees (Conagra Brands, 2023). Conagra's vision is to be impactful and "challenge the marketplace/business conventions." They are "respected for [their] great brands, great food, and great margins and consistent results" (Conagra Brands, 2023). Their brands include Birds Eye®, Duncan Hines®, Healthy Choice®, Marie Callender's®, Reddi-wip®, and Slim Jim® among others. Conagra is a large buyer of carrots, peas, sweet corn, green beans, broccoli, cauliflower, popcorn, and tomatoes and supports farmers in the U.S. through regenerative agriculture and promoting a Good Agriculture Practices (GAP) program (Conagra Brands, 2022). Being a producer of a broad array of food items, Conagra was included in the thesis as they are buying both raw and processed commodities to create value-added food items for consumers.

Tyson Foods, Inc (Tyson) is a multinational food manufacturer based in Springdale, Arkansas and boasts that 1 in 5 pounds of chicken, beef, and pork in the United States is produced by them (Tyson Foods, 2023). With sales in the fiscal year 2022 reaching $53 billion, Tyson is a leader in protein processing with brands including Tyson, Jimmy Dean, Hillshire Farm, Ball Park, Wright Brand, and Sara Lee (Tyson Foods, Inc, 2023). Employing about 142,000 team members, Tyson buys raw and processed commodities for feed production and live animals for slaughter. Tyson is considered a vertically integrated poultry producer, owning assets from poultry genetics to hatcheries and feed mills, while claiming to work with "more than 11,000 independent livestock and poultry farmers" daily (Tyson Foods, Inc, 2023). Given Tyson Foods' presence in protein processing and its vast number of employees and staple brands, Tyson Foods was included in the study.

Founded in 1886, The Coca-Cola Company (Coca-Cola) is a leading producer of drinks across the globe, based in Atlanta, Georgia. The company states that "more than 2.2

billion servings of [their] drinks are enjoyed in more than 200 countries and territories each day" (The Coca-Cola Company, 2023). With drink selections from fizzy sodas to water, juices and dairy to alcohol and teas, Coca-Cola has brands including Coca-Cola, Sprite, BODYARMOR, Dasani, Gold Peak Tea, fairlife, and Topo Chico Hard Seltzer. Coca-Cola is a major buyer of "sugar, corn, fruit, coffee, tea, and soybeans" and claims that "Sustainably sourcing our ingredients increases the resilience of our supply chain, helps to conserve nature and empowers producers and farm workers" (The Coca-Cola Company, 2022). Being a staple for consumers across the globe, Coca-Cola was included in the study for their expansive consumer reach and end of the agri-food supply chain.

Headquartered in Purchase, New York, PepsiCo owns over 500 global food and drink brands. PepsiCo products can be found in over 200 countries and the company generated more than $86 billion in net revenue in 2022. They own a "beverage and convenient foods portfolio that includes Lay's, Doritos, Cheetos, Gatorade, Pepsi-Cola, Mountain Dew, Quaker and SodaStream" (PepsiCo, 2023). Employing 291,000 global employees, PepsiCo is both a large employer and supplier of everyday food and drink items to consumers. As described on their website, "At its core, PepsiCo is an agricultural company," relying "on a secure supply of more than 30 agricultural crops and ingredients – such as potatoes, corn and oats – from approximately 60 countries" (PepsiCo, 2023). Due to PepsiCo's global reach, vast food and drink offering, and buying the quantity of agriculture commodities, it was necessary to include PepsiCo in the study as well.

The thesis compares the performance of the above-mentioned firms that are a part of the agri-food supply chain to a group of firms that are not. The thesis compares this group to Walmart Inc (WMT), ExxonMobil Corporation (XOM), Ford Motor Company

(F), and DISH Network Corporation (DISH). We use these companies as a sample of the various sectors in the economy as a baseline.

Walmart is based in Rogers, Arkansas and owns and operates thousands of brick-and-mortar retail locations across the US and internationally, as well as a large online shopping presence. Walmart employs around 2.1 million employees at 10,500 locations in 19 countries (Walmart, 2024). Walmart is a leading retailer of consumer goods from groceries, household items, sporting goods, and crafts. The company also owns 210 distribution centers and a fleet of trucks and trailers, delivering their goods to retail locations. During the fiscal year 2023, Walmart generated $611.3 billion in revenue.

ExxonMobil Corporation (Exxon) operates in more than 60 countries and seeks "to provide the fuels and chemicals that make modern life possible and support human progress" (ExxonMobil, 2024). Located in Spring Texas, the company seeks to continue to discover, process and deliver energy around the world. With 140 years of experience as a descendant of John D. Rockefeller's Standard Oil, Exxon is a leader in the oil and gas industry. Exxon is committed to reinvesting in the discovery of new energy resources, and according to their website, continued to reinvest during the COVID pandemic, despite losing $22 billion (ExxonMobil, 2024).

The Ford Motor Company is headquartered out of Dearborn, Michigan and was founded by Henry Ford in 1903. Ford is a leader in consumer, industrial and fleet vehicles from cars, trucks and SUVs that use gas, diesel, electric, and hybrid engines. Known as "America's number 1 truck seller," Ford's US sales rose 7.1% in 2023, and they sold 72,608 electric vehicles in 2023, up 18% from the previous year (Ford Motor Company, 2024).

DISH Network Corporation is headquartered in Englewood, Colorado and provides 17 million customers with services including TV, mobile phone and internet. The company employs more than 14,000 employees in the US and has annual revenue of approximately $17 billion (Dish, 2024). DISH was created with the goal to bring rural America tv services and has continued to evolve and grow since. They now own the mobile phone brand, Boost Mobile, and have embraced the internet age and created SLING TV utilizing cloud services to further enhance their offerings.

3.1.2 Exogenous Variables

The exogenous variables were collected from various sources including the Federal Reserve, Bureau of Labor Statistics (BLS), the Centers for Disease Control and Prevention (CDC), and the NBER. From the Federal Reserve, data was gathered on the Labor Force Participation Rate, and Unemployment Rate. All data from the Federal Reserve were measured monthly and not seasonally adjusted to keep consistency. Monthly Consumer Price Index (CPI) data were extracted from the Bureau of Labor Statistics (BLS) for January 2000 through December 2022. The crisis months covered the “Dotcom bubble” (March 2001 - October 2001) and the “Financial Crisis” (December 2007 - May 2009) and were procured from NBER. The labor force participation rate (LFPR) is the ratio of the number of people aged 16 years and older who are employed or actively seeking employment to the total non-institutionalized, civilian working-age population (U.S. Bureau of Labor Statistics, 2023). It is determined by:

$$LFPR = \left(\frac{E + UE}{W}\right) * 100\% \tag{3.2}$$

where E and UE are employed and unemployed and W is the non-institutionalized civilian work age population 16 years and over. The LFPR is an important labor market measure because it indicates the relative amount of labor resources available for the production of goods and services. A higher LFPR means labor markets might be tight, i.e., increasing employment and decreasing unemployment, suggesting the wages may be increasing and putting pressure on variable cost of production while increasing consumption because of available income and more certainty about future income. If employment is decreasing or static and unemployment is increasing, the LFPR may remain unchanged but the impact on the economy will be the opposite since increasing unemployment not only reduces spending power in the economy but increases uncertainty about future incomes and accelerates reduction in spending.

Sometimes, but not always, these macroeconomic crises may be accompanied by inflation, defined as a rising CPI. It could imply heightened demand for goods and services, which could have a positive impact on firm performance. However, it could also have an adverse effect should the rate of growth cause consumers to control their spending because their incomes are not going as far as they expect due to rising prices. COVID-19 triggered supply chain problems that caused the CPI to rise because there just were not the goods that consumers wanted, and they were willing to bid up prices to get what was available.

3.2 Empirical Model

As indicated, company *i*'s performance in period *t* is defined by its gross profit margin, GM_i, and it is hypothesized to be influenced by the following:

$$GM_i = f(X_{jt} \mid c) \tag{3.3}$$

where X_{jt} is a vector of exogenous variables as defined above: CPI; unemployment rate; and labor force participation rate given whether a crisis, *c*, exists or not. All the covariates are lagged by one month for the regression. The structural equation is specified as:

$$GM_i = b_{i0} + c\left(b_1 x_{1t-k} + b_2 x_{2t-k} + b_3 x_{3t-k}\right) + b_5 c + e_i \quad (3.4)$$

where b_i are the estimated coefficients and the subscripts 1, 2, and 3 refer to the consumer price index, unemployment rate, and labor participation rate. The subscript k refers to the number of periods that the exogenous variables were lagged. The lagged independent variables were necessary because it was assumed that their impact on GPM could be captured in the month in which they occurred but at a later period. The value of *k* was determined using the Akaike Information Criterion (AIC).

Equation 3.4 shows that the independent variables were all interacted with the crisis variable, which is defined as a binary variable, where 0 is normal period and 1 is a crisis month. This allowed for the measuring of the impact of each of the independent variables on GM during normal economic periods and during macroeconomic crisis. Therefore, all eight months of the dot com recession carry c = 1 as do the months covering the Great financial recession and COVID-19 months. It is important to note that COVID months were defined from the official declaration of the pandemic to when the Centers for Diseases Control and Prevention, the official government agency responsible for declaring the end of the pandemic.

3.2.1 A Priori Expectations

The *a priori* expectations for the regression coefficients are presented in Table 3.1. It is hypothesized that the coefficient on LFPR would have a positive effect on agri-food and non-agri-food companies' gross profit margin in normal economic times. However, during crisis periods, the effect of the LFPR on firm GM is hypothesized to be ambiguous. The CPI is hypothesized to have a positive impact on agri-food firm performance during normal economic times and crisis times but a negative impact on firm performance during crisis times for non-agri-food firms. The coefficient on UER is hypothesized to be negative for both agri-food and non-agri-food firms under both normal and crisis economic times. The crisis itself is hypothesized to have a negative impact on the performance of non-agri-food firms and a zero impact on agri-food firms. The foregoing hypotheses are based principally on the difference between the effect of these factors on consumption and the differential price elasticity of demand. The coefficients for these variables for non-agri-food firms that have similar price elasticity of demand as those of agri-food firms will behave like agri-food firms.

Table 3.1: Exogenous Variables and A Priori Expectations for Coefficients

Variable	Description	A Priori Expectation	
		Agri-Food	**Not Agri-Food**
LFPR			
Normal	Labor Force Participation Rate	+	+
Crisis		?	?
CPI			
Normal	Consumer Price Index	+	+
Crisis		+	-
UER			
Normal	Unemployment Rate	-	-
Crisis		-	-
Crisis	Crisis Dummy	0	-

CHAPTER IV: RESULTS

This chapter discusses the results from the analyses, including the results of the regression model specified in Equation 3.2. The chapter is organized into three principal subsections. The first presents and discusses the summary statistics for all variables and the selected companies' performance. Section 4.2 presents the regression results by company. Due to the length of 4.2, we provide a summary of the results in Section 4.3.

4.1 Summary of Statistics and Variables by Status of the Economy

Table 4.1 shows the summary statistics for the monthly gross profit margin from January 2000 to December 2022 for the companies included in this study. Recall the companies are ADM, Coke, Pepsi, Conagra, AGCO, Tyson, DISH, Walmart, Ford, and ExxonMobil. The table includes the average, standard deviation, and the maximum and minimum gross margin as well as the number of monthly observations in the dataset. The summary statistics are presented by the state of the economy – Normal and Crisis, where the latter represents the three macroeconomic events that have affected the US within the study period, i.e., Dotcom bubble, Great Recession, and COVID-19. The table also shows the overall summary statistics over the duration of the analysis.

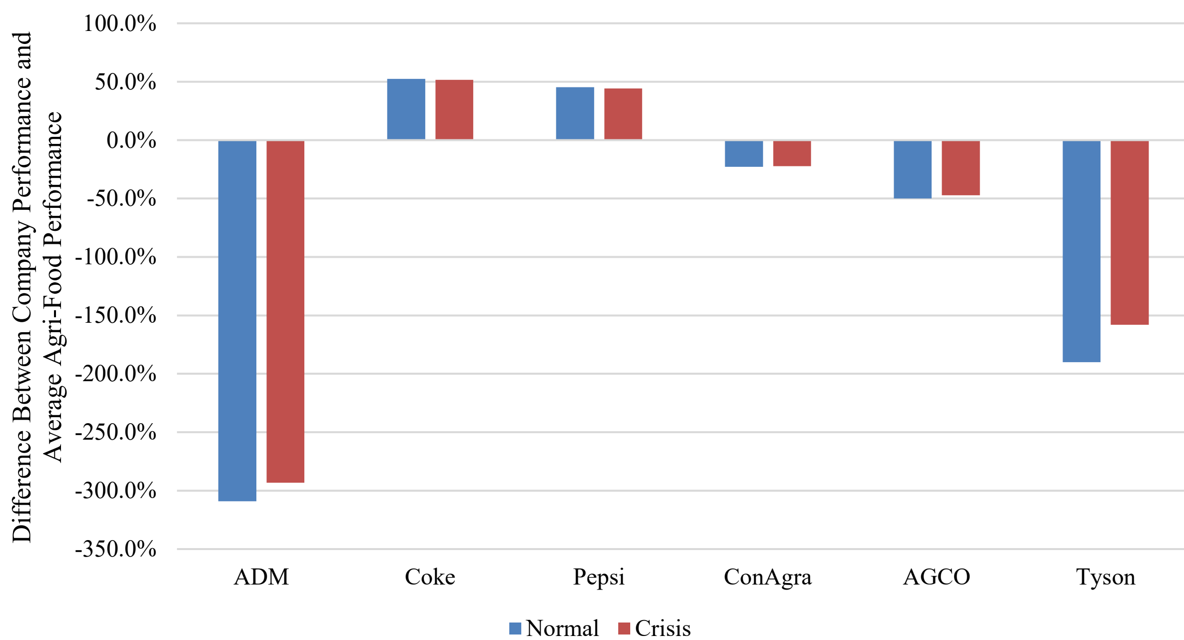
There were 276 observations, except for ADM with 258 which did not have 18 months of data between August 2013 and January 2015. In normal economic times, there were 226 observations, and the crisis periods represented 50 observations. ADM stood out with the lowest average gross profit margin of all companies represented in the study. At 7.9%, the company also has the most consistent performance compared to all the companies over the duration of the analysis. This consistency remains true for ADM during macroeconomic crises as they are during normal economic times. This may be due to the nature of ADM's commodity business.

Table 4.1: Summary Statistics for Gross Profit Margin for Firms Included in the Study by Macroeconomic Events

State of the Economy	Variable	N	Mean	SD	Min	Max
Normal	ADM	208	7.8%	1.8%	4.8%	15.0%
	Coke	226	67.1%	2.4%	63.9%	73.8%
	Pepsi	226	58.3%	2.1%	48.0%	65.2%
	ConAgra	226	26.0%	5.1%	15.5%	33.6%
	AGCO	226	21.3%	2.4%	17.4%	24.8%
	Tyson	226	11.0%	3.8%	5.2%	21.0%
	DISH	226	39.9%	5.1%	27.0%	49.0%
	Walmart	226	25.7%	2.4%	9.0%	28.0%
	Ford	226	19.2%	3.2%	6.0%	26.0%
	ExxonMobil	226	20.1%	3.3%	-13.0%	25.0%
Crisis	ADM	50	8.2%	1.0%	6.5%	10.3%
	Coke	50	66.6%	3.1%	61.5%	72.4%
	Pepsi	50	57.9%	1.7%	56.4%	65.2%
	ConAgra	50	26.4%	5.3%	16.1%	32.4%
	AGCO	50	21.9%	3.0%	18.3%	25.4%
	Tyson	50	12.5%	4.6%	5.2%	17.2%
	DISH	50	39.6%	5.3%	33.0%	47.0%
	Walmart	50	25.8%	1.2%	23.0%	27.0%
	Ford	50	18.8%	2.0%	14.0%	22.0%
	ExxonMobil	50	18.2%	7.7%	1.0%	25.0%
Total	ADM	258	7.9%	1.7%	4.8%	15.0%
	Coke	276	67.0%	2.6%	61.5%	73.8%
	Pepsi	276	58.2%	2.0%	48.0%	65.2%
	ConAgra	276	26.1%	5.1%	15.5%	33.6%
	AGCO	276	21.4%	2.5%	17.4%	25.4%
	Tyson	276	11.3%	4.0%	5.2%	21.0%
	DISH	276	39.9%	5.1%	27.0%	49.0%
	Walmart	276	25.7%	2.2%	9.0%	28.0%
	Ford	276	19.2%	3.0%	6.0%	26.0%
	ExxonMobil	276	19.8%	4.5%	-13.0%	25.0%

The beverage and snack companies – Coca-Cola and PepsiCo – have similar average gross profit margins. Their average gross profit margins were, respectively, between 52.4% and 45.3% higher than the average gross profit margin for all the agri-food companies during normal economic time in the study. During crises, their performance advantage decreases only slightly by about 1 percentage point to 51.6% and 44.3%, respectively. The results confirm that the average gross profit margins for Coca-Cola and PepsiCo are the only ones that are above the average for the six agri-food companies in the study. ADM's average gross profit margins under both economic conditions were almost 300% lower than the average gross profit margins for all agri-food companies included in the study. These results are summarized in Figure 4.1.

Figure 4.1: Percentage Difference Between the Gross Profit Margin for Each Company and All Agri-Food Companies in the Study Under Normal and Crisis Economic Conditions



The summary statistics for the exogenous variables by macroeconomic crisis is presented in Table 4.2. The table shows that the average LFPR during normal economic times was about 64.43% with a standard deviation of 1.7% and a range of about 7.7%. The CPI under normal economic times averaged about 1.9% and a maximum of about 2.9% and the average unemployment rate was 6.0% with a standard deviation of 2.0%. The average LFPR was lowest during the COVID-19 crisis and highest during the Dot com recession.

Table 4.2: Summary Statistics of the Exogenous Variables by Macroeconomic Crises

	N	Mean	SD	Min	Max
None					
LFPR	226.00	64.43	1.73	60.00	67.70
CPI	226.00	1.94	0.45	0.60	2.90
Unemployment Rate	226.00	6.01	2.03	3.30	14.40
Covid					
LFPR	24.00	62.10	0.43	61.40	63.30
CPI	24.00	4.94	1.50	1.60	6.60
Unemployment Rate	24.00	4.30	0.95	3.30	6.20
Financial					
LFPR	18.00	65.83	0.41	65.40	66.80
CPI	18.00	2.17	0.30	1.70	2.50
Unemployment Rate	18.00	6.57	1.55	4.80	9.10
Dotcom					
LFPR	8.00	66.87	0.30	66.60	67.40
CPI	8.00	2.64	0.07	2.50	2.70
Unemployment Rate	8.00	4.60	0.32	4.10	5.00

The pairwise differences between the mean LFPR and Unemployment rate under the alternative macroeconomic conditions were not statistically significant at the 5% level (Table 4.3). However, average CPI under COVID-19 was higher and different from those of the Financial and Dotcom crisis.

Table 4.3: Pairwise Comparison of Average Exogenous Variables by Macroeconomic State

Macroeconomic State	Margin	S.E.	Unadjusted Groups
	LFPR		
None	.	(not estimable)	
Covid	62.10	11.97	A
Financial	65.83	13.82	A
Dotcom	66.88	20.73	A
	CPI		
None	.	(not estimable)	
Covid	4.94	0.38	
Financial	2.17	0.44	A
Dotcom	2.64	0.66	A
	Unemployment Rate		
None	.	(not estimable)	
Covid	4.30	1.18	A
Financial	6.57	1.36	A
Dotcom	4.60	2.05	A

Margins sharing a letter in the group label are not significantly different at the 5% level.

4.2 Regression Results by Company

Recall the study's objective was to assess the resilience of selected agri-food companies to macroeconomic shocks. A firm is considered resilient to macroeconomic shocks when the coefficient of the independent variables with and without crisis are not statistically different from each other. Resilience is defined as the crisis events having no impact on firms' gross profit margin.

The Akaike Information Criterion (AIC) is an estimator of error prediction, and it tests the quality of the model used. A common misconception is that the objective is to minimize the AIC's absolute value. However, it is not the absolute size of the AIC value, but its relative values over the set of models considered that are important. That is, the differences between AIC values estimated for the different models considered is more important in considering relative quality of the models. While the AIC is usually positive, it can be negative. A negative AIC indicates less information loss than a positive AIC, and therefore a better model. For model comparison, the model with the lowest AIC score is preferred.

A major challenge of this research was to assess the duration of lags on the LFPR, CPI, and UER, which measures the number of months it took for these covariates to influence gross profit margin. We tested multiple lags (k) (one, two, four, six, and 12 months), and tested the lag effect on the quality of the model using the AIC statistic. The results showed that $k = 1$ provided the best model quality and was thus used in the regression analyses. The results from the regression are presented in the following sub-sections for each of the companies in the study.

4.2.1 ADM

ADM is a global leader in the procurement, processing, and distribution of commodities. The company sources raw commodities for the production of ingredients used in human, pet, and industrial products. As stated, the crisis variable would not negatively impact gross profit margin. Table 4.4 presents the results of the regression analysis for ADM. The regression for ADM, as for all other companies, was ran with the Crisis dummy interacting with a one-period lag of the four macroeconomic indicators. The F-value for the model was estimated at 37.95 ($p = 0.000$) and its R-square was estimated at about 51.6%.

The results show that ADM's gross profit margin increases by about 29.1% during crisis compared to normal time and it was statistically significant at the 1% level. This suggests that the hypothesis that ADM is resilient to macroeconomic crises cannot be rejected. Additionally, while the coefficient for LFPR under normal economic conditions was statistically significant, that under macroeconomic crisis was not, again leading to our inability to reject the hypothesis of ADM's resilience to increasing LFPR. Inflation had no effect on ADM but increasing UER affected ADM's gross profit margin regardless of crisis. However, the impact under macroeconomic crisis was about three times higher. That is, while a percentage increase in the UER decreased ADM's gross profit margin by 0.17% (t = 3.57; p = 0.000) when the economy was in a normal state and by 0.44% (t = 2.79; p = 0.000) when the economy was in a crisis, this is what is expected. This implies that the hypothesis that UER no effect on ADM's performance is rejected. Thus, ADM is not resilient to increasing unemployment rate under any conditions.

Table 4.4: Regression Results for ADM's Performance Response to Macroeconomic Crises

ADM	Coef.	S.E.	t-value	p-value	[95% Conf	Interval]	Sig
LFPR (Normal)	0.546	0.048	11.30	0.000	0.451	0.641	***
LFPR (Crisis)	0.146	0.106	1.38	0.168	-0.062	0.354	
CPI (Normal)	0.836	0.226	3.70	0.000	0.391	1.281	***
CPI (Crisis)	-0.001	0.170	-0.01	0.994	-0.337	0.334	
UER (Normal)	-0.172	0.048	-3.57	0.000	-0.266	-0.077	***
UER (Crisis)	-0.438	0.157	-2.79	0.006	-0.747	-0.129	***
Normal	0.000	.	.	.	.	.	
Crisis	29.113	8.043	3.62	0.000	13.273	44.953	***
Constant	-28.025	3.100	-9.04	0.000	-34.131	-21.920	***

Mean dependent var	7.894	SD dependent var	1.648
R-squared	0.516	Number of obs	257
F-test	37.946	Prob > F	0.000
Akaike crit. (AIC)	814.412	Bayesian crit. (BIC)	842.805

**** p<.01, ** p<.05, * p<.1*

4.2.2 Coca-Cola

Table 4.5 presents the regression results for Coca-Cola. The F-value for the model was estimated at 108.35 (p = 0.000) and its R-square was estimated at about 74.0%. The coefficient on the crisis dummy was not statistically significant, which leads us to conclude that we are unable to reject the hypothesis that Coca-Cola is resilient to macroeconomic crisis since the coefficient for the crisis dummy is positive but not statistically significant. This makes sense since the company's products are low-priced and consumed frequently. Regarding the consequences of macroeconomic crisis events, increasing LFPR increases

Coca-Cola's gross profit margin under both crisis and normal conditions but increasing CPI under crisis conditions has an adverse effect on performance. This suggests that we reject the hypothesis that Coca-Cola is resilient to inflation under crisis conditions. Its resilience to the unemployment rate cannot, however, be rejected.

Table 4.5: Regression Results for Coke's Performance Response to Macroeconomic Crises

COCACOLA	Coef.	S.E.	t-value	p-value	[95% Conf	Interval]	Sig
LFPR (Normal)	1.137	0.053	21.39	0.000	1.032	1.241	***
LFPR (Crisis)	1.174	0.119	9.83	0.000	0.939	1.409	***
CPI (Normal)	0.452	0.254	1.78	0.076	-0.048	0.951	*
CPI (Crisis)	-0.425	0.193	-2.21	0.028	-0.804	-0.046	**
UER (Normal)	0.048	0.054	0.90	0.370	-0.058	0.155	
UER (Crisis)	-0.269	0.178	-1.51	0.131	-0.618	0.081	
Normal	0.000	.	.	.	.	.	
Crisis	1.428	9.051	0.16	0.875	-16.393	19.248	
Constant	-7.376	3.388	-2.18	0.030	-14.047	-0.704	**

Mean dependent var	66.952	SD dependent var	2.542
R-squared	0.740	Number of obs	275
F-test	108.352	Prob > F	0.000
Akaike crit. (AIC)	938.578	Bayesian crit. (BIC)	967.512

**** p<.01, ** p<.05, * p<.1*

4.2.3 PepsiCo

Table 4.6 shows the results of the regression analysis completed. The F-value for the model was estimated at 11.18 (p = 0.000) and its R-square was estimated at about 22.7%. The coefficient on the crisis dummy was not statistically significant, which leads us to conclude that we are unable to reject the hypothesis that PepsiCo, as it was with Coca-Cola, is resilient to macroeconomic crisis. Regarding the consequences of macroeconomic crisis events, increasing LFPR increases PepsiCo's gross profit margin under both crisis and normal conditions but increasing CPI under crisis conditions has an adverse effect on performance. This suggests that we reject the hypothesis that PepsiCo is resilient to inflation under crisis conditions. Its resilience to the unemployment rate cannot, however, be rejected. The results show that PepsiCo and Coca-Cola respond to the consequences of these macroeconomic variables in the same way. This is not surprising since the two companies are at the same node in the agri-food industry.

Table 4.6: Regression Results for PepsiCo's Performance Response to Macroeconomic Crises

PEPSICO	Coef.	S.E.	t-value	p-value	[95% Conf	Interval]	Sig
LFPR (Normal)	0.220	0.072	3.04	0.003	0.078	0.362	***
LFPR (Crisis)	0.093	0.163	0.58	0.566	-0.226	0.413	
CPI (Normal)	1.415	0.345	4.10	0.000	0.735	2.095	***
CPI (Crisis)	-0.652	0.262	-2.49	0.013	-1.168	-0.136	**
UER (Normal)	-0.095	0.073	-1.30	0.196	-0.240	0.049	
UER (Crisis)	-0.725	0.242	-3.00	0.003	-1.201	-0.250	***
Normal	0.000	.	.	.	.	.	
Crisis	15.945	12.314	1.29	0.196	-8.300	40.190	
Constant	41.904	4.610	9.09	0.000	32.828	50.980	***

Mean dependent var	58.186	SD dependent var	2.007
R-squared	0.227	Number of obs	275
F-test	11.183	Prob > F	0.000
Akaike crit. (AIC)	1107.901	Bayesian crit. (BIC)	1136.835

**** p<.01, ** p<.05, * p<.1*

4.2.4 Conagra Brands

Table 4.7 below shows the regression results for ConAgra Brands. The F-value for the model was estimated at 48.18 (p = 0.000) and its R-square was estimated at about 55.8%. Like the preceding companies, ConAgra Brands is resilient to macroeconomic crisis given that the coefficient on the crisis variable was non-negative and not statistically significant. However, unlike the preceding companies, ConAgra was adversely affected by LFPR, CPI, and UER under both normal and crisis conditions. Yet, the coefficient for UER under crisis was not statistically significant, leading to our inability to reject the hypothesis that UER has no effect on the company's performance.

Table 4.7: Regression Results for Conagra's Performance Response to Macroeconomic Crises

CONAGRA	Coef.	S.E.	t-value	p-value	[95% Conf	Interval]	Sig
LFPR (Normal)	-2.061	0.138	-14.93	0.000	-2.332	-1.789	***
LFPR (Crisis)	-2.471	0.310	-7.97	0.000	-3.082	-1.861	***
CPI (Normal)	-1.465	0.659	-2.22	0.027	-2.763	-0.168	**
CPI (Crisis)	-1.122	0.500	-2.24	0.026	-2.107	-0.137	**
UER (Normal)	-0.605	0.140	-4.32	0.000	-0.881	-0.329	***
UER (Crisis)	-0.298	0.461	-0.65	0.519	-1.206	0.610	
Normal	0.000	.	.	.	.	.	
Crisis	25.183	23.511	1.07	0.285	-21.107	71.474	
Constant	165.345	8.802	18.79	0.000	148.015	182.674	***

Mean dependent var	26.120	SD dependent var	5.070
R-squared	0.558	Number of obs	275
F-test	48.182	Prob > F	0.000
Akaike crit. (AIC)	1463.605	Bayesian crit. (BIC)	1492.539

**** p<.01, ** p<.05, * p<.1*

4.2.5 AGCO

Table 4.8 shows the results of the regression analysis for AGCO. The F-value for the model was estimated at 348.17 (p = 0.000) and its R-square was estimated at about 90.1%. The coefficient for Crisis was -3.33 but it was not statistically significant. Therefore, the firm's gross profit margin was deemed to be resilient to adverse macroeconomic crises. However, its response to LFPR was negative with and without crisis and both were statistically significant while crisis-triggered inflation did not affect its performance. On the other hand, increasing unemployment rate adversely affects AGCO's performance. Given where the company is in the agri-food supply chain, i.e., equipment manufacturer, this response to the unemployment rate in and out of crisis conditions was difficult to explain. It is something that further research is needed to illuminate, and it is beyond the scope and resources of this research.

Table 4.8: Regression Results for AGCO Performance Response to Macroeconomic Crises

AGCO	Coef.	S.E.	t-value	p-value	[95% Conf	Interval]	Sig
LFPR (Normal)	-1.325	0.032	-41.12	0.000	-1.389	-1.262	***
LFPR (Crisis)	-1.265	0.072	-17.47	0.000	-1.408	-1.123	***
CPI (Normal)	0.462	0.154	3.01	0.003	0.160	0.765	***
CPI (Crisis)	0.135	0.117	1.15	0.250	-0.095	0.364	
UER (Normal)	-0.188	0.033	-5.76	0.000	-0.253	-0.124	***
UER (Crisis)	-0.190	0.108	-1.76	0.079	-0.402	0.022	*
Normal	0.000	.	.	.	.	.	
Crisis	-3.325	5.489	-0.61	0.545	-14.132	7.482	
Constant	106.968	2.055	52.06	0.000	102.923	111.014	***

Mean dependent var	21.441	SD dependent var	2.504
R-squared	0.901	Number of obs	275
F-test	348.169	Prob > F	0.000
Akaike crit. (AIC)	663.485	Bayesian crit. (BIC)	692.419

**** p<.01, ** p<.05, * p<.1*

4.2.6 Tyson Foods

Table 4.9 shows the regression results for Tyson Foods. The F-value for the model was estimated at 20.36 (p = 0.000) and R-square was estimated at about 34.8%. That less than 35% of the variability in Tyson's gross profit margin was explained by the variables in the model was indicative that there could be some important variable missing from the model. However, we maintained the uniformity of the framework defined for the research and left a further exploration of the factors influencing Tyson's gross profit margin for future research. The results show that the coefficient on Crisis was positive and statistically significant. Indeed, compared to non-crisis periods, Tyson's gross profit margin was up nearly 40%. Like ConAgra, which is at the same node in the supply chain as Tyson, UER and LFPR had negative effects with and without crisis. The CPI, as expected, was neutral under both crisis conditions.

Table 4.9: Regression Results for Tyson's Performance Response to Macroeconomic Crises

TYSON	Coef.	S.E.	t-value	p-value	[95% Conf	Interval]	Sig
LFPR (Normal)	-0.634	0.131	-4.84	0.000	-0.893	-0.376	***
LFPR (Crisis)	-1.169	0.295	-3.97	0.000	-1.749	-0.589	***
CPI (Normal)	-0.285	0.626	-0.46	0.649	-1.518	0.948	
CPI (Crisis)	-0.351	0.475	-0.74	0.461	-1.286	0.585	
UER (Normal)	-0.860	0.133	-6.46	0.000	-1.122	-0.598	***
UER (Crisis)	-1.696	0.438	-3.87	0.000	-2.559	-0.834	***
Normal	0.000	.	.	.	.	.	
Crisis	39.921	22.338	1.79	0.075	-4.061	83.902	*
Constant	57.586	8.363	6.89	0.000	41.121	74.051	***

Mean dependent var	11.243	SD dependent var	3.965
R-squared	0.348	Number of obs	275
F-test	20.356	Prob > F	0.000
Akaike crit. (AIC)	1435.458	Bayesian crit. (BIC)	1464.392

**** p<.01, ** p<.05, * p<.1*

4.2.7 DISH

Table 4.10 presents the regression results for DISH. The F-value for the model was estimated at 72.26 (p = 0.000) and the R-square was estimated at about 65.5%. The coefficient for Crisis was about 7.1, suggesting that the company's gross profit margin increases by about 7% in times of crisis compared to normal times. This coefficient was, however, not statistically significant. Therefore, it is concluded that macroeconomic crises have no effect on DISH, and we are unable to reject the hypothesis that the company is resilient to these events. Like the companies already discussed, DISH's gross profit margin increased with increasing LFPR under both normal and crisis conditions, and both were statistically significant. The same was true for CPI and UER under normal economic conditions but not crisis conditions.

Table 4.10: Regression Results for DISH's Performance Response to Macroeconomic Crises

DISH	Coef.	S.E.	t-value	p-value	[95% Conf	Interval]	Sig
LFPR (Normal)	1.991	0.123	16.15	0.000	1.748	2.234	***
LFPR (Crisis)	2.089	0.277	7.54	0.000	1.543	2.635	***
CPI (Normal)	2.677	0.589	4.55	0.000	1.518	3.836	***
CPI (Crisis)	-0.502	0.447	-1.12	0.262	-1.382	0.378	
UER (Normal)	1.193	0.125	9.53	0.000	0.947	1.440	***
UER (Crisis)	0.179	0.412	0.44	0.663	-0.632	0.990	
Normal	0.000	.	.	.	.	.	
Crisis	7.091	21.002	0.34	0.736	-34.260	48.442	
Constant	-100.776	7.862	-12.82	0.000	-116.256	-85.296	***

Mean dependent var	39.851	SD dependent var	5.121
R-squared	0.655	Number of obs	275
F-test	72.261	Prob > F	0.000
Akaike crit. (AIC)	1401.536	Bayesian crit. (BIC)	1430.470

**** p<.01, ** p<.05, * p<.1*

4.2.8 Walmart

Table 4.11 presents the regression results for Walmart. The F-value for the model was estimated at 21.459 (p = 0.000) and its R-square was estimated at about 36.0%. Surprisingly, the coefficient of Crisis for Walmart is negative, indicating that the company performs poorly under crisis than under normal economic conditions. However, this coefficient is not statistically significant. Therefore, the hypothesis that Walmart is resilient to macroeconomic crisis cannot be rejected. The effects of LFPR under both normal and crisis conditions and CPI under crisis conditions were negative and statistically significant at the 1% level. None of the other variables had any statistically significant effect on Walmart's gross profit margin.

Table 4.11: Regression Results for Walmart's Performance Response to Macroeconomic Crises

WALMART	Coef.	S.E.	t-value	p-value	[95% Conf	Interval]	Sig
LFPR (Normal)	-0.686	0.072	-9.51	0.000	-0.827	-0.544	***
LFPR (Crisis)	-0.533	0.162	-3.29	0.001	-0.852	-0.214	***
CPI (Normal)	-1.019	0.344	-2.96	0.003	-1.696	-0.341	***
CPI (Crisis)	0.086	0.261	0.33	0.741	-0.428	0.601	
UER (Normal)	-0.026	0.073	-0.36	0.719	-0.170	0.118	
UER (Crisis)	0.301	0.241	1.25	0.212	-0.173	0.775	
Normal	0.000	.	.	.	.	.	
Crisis	-13.899	12.274	-1.13	0.258	-38.065	10.267	
Constant	72.049	4.595	15.68	0.000	63.002	81.096	***

Mean dependent var	25.738	SD dependent var	2.199
R-squared	0.360	Number of obs	275
F-test	21.459	Prob > F	0.000
Akaike crit. (AIC)	1106.109	Bayesian crit. (BIC)	1135.043

**** p<.01, ** p<.05, * p<.1*

4.2.9 Ford

Table 4.12 presents the regression results for Ford Motor Company. The table shows that the F-value for the model was about 5.21 (p = 0.000) and its R-squared was estimated at about 12.0%, the lowest among the firms considered in this research. Like Walmart, the Crisis variable's coefficient was negative but not statistically significant. Therefore, we are unable to reject the hypothesis that Ford is resilient to macroeconomic crisis. Given that Ford was more prepared for the Financial Crisis (Great Recession) than the other two big automobile companies, since it was the only one that did not qualify for the Federal Government's bailout, this result is not surprising. However, the fact that the coefficient was negative is evidence that macroeconomic crises do have adverse effects on gross profit margins even if they are not statistically significant. LFPR has a positive impact on Ford's gross profit margin and the CPI and the UER both have a negative impact on the company's gross profit margin under normal economic conditions. They were all statistically significant. However, their effects on Ford's gross profit margin were not statistically significant, suggesting that they had no impact on Ford.'

Table 4.12: Regression Results for Ford's Performance Response to Macroeconomic Crises

FORD	Coef.	S.E.	t-value	p-value	[95% Conf	Interval]	Sig
LFPR (Normal)	0.192	0.115	1.67	0.096	-0.034	0.417	*
LFPR (Crisis)	0.139	0.257	0.54	0.589	-0.368	0.646	
CPI (Normal)	-3.089	0.547	-5.65	0.000	-4.166	-2.012	***
CPI (Crisis)	0.396	0.415	0.95	0.341	-0.421	1.213	
UER (Normal)	-0.231	0.116	-1.99	0.048	-0.460	-0.002	**
UER (Crisis)	0.258	0.383	0.67	0.501	-0.495	1.011	
Normal	0.000	.	.	.	.	.	
Crisis	-7.134	19.510	-0.37	0.715	-45.548	31.280	
Constant	14.280	7.304	1.96	0.052	-0.100	28.661	*

Mean dependent var	19.153	SD dependent var	2.981
R-squared	0.120	Number of obs	275
F-test	5.212	Prob > F	0.000
Akaike crit. (AIC)	1361.019	Bayesian crit. (BIC)	1389.954

*** *p*<.01, ** *p*<.05, * *p*<.1

4.2.10 ExxonMobil

Table 4.13 presents the regression results for ExxonMobil. The F-value for the model was estimated at 85.206 (p = 0.000) while its R-square was estimated at about 69.1%. Macroeconomic crises had the most dramatic impact on ExxonMobil compared to all other companies explored in this research. Compared to its performance under normal economic conditions, the gross profit margin for the company declined 205% under crisis conditions. This coefficient was statistically significant at the less than 1% level. UER has no effect on the company's gross profit margin but LFPR and the CPI both had positive and statistically significant effects.

Table 4.13: Regression Results for ExxonMobil's Performance Response to Macroeconomic Crises

EXXONMOBIL	Coef.	S.E.	t-value	p-value	[95% Conf	Interval]	Sig
LFPR (Normal)	1.059	0.092	11.50	0.000	0.878	1.241	***
LFPR (Crisis)	4.066	0.207	19.63	0.000	3.658	4.474	***
CPI (Normal)	0.917	0.440	2.08	0.038	0.051	1.783	**
CPI (Crisis)	3.103	0.334	9.29	0.000	2.445	3.760	***
UER (Normal)	0.109	0.094	1.16	0.247	-0.076	0.293	
UER (Crisis)	0.322	0.308	1.05	0.296	-0.284	0.928	
Normal	0.000	.	.	.	.	.	
Crisis	-205.030	15.692	-13.07	0.000	-235.925	-174.135	***
Constant	-50.409	5.874	-8.58	0.000	-61.975	-38.843	***

Mean dependent var	19.902	SD dependent var	4.045
R-squared	0.691	Number of obs	275
F-test	85.206	Prob > F	0.000
Akaike crit. (AIC)	1241.216	Bayesian crit. (BIC)	1270.151

**** p<.01, ** p<.05, * p<.1*

4.3 Composite Effect of Crisis on Selected Companies

In the foregoing presentation of results, the regression coefficients were used to evaluate the resilience of the selected companies to macroeconomic crisis. However, the covariates were interacted with the crisis variable and the results were presented as how crisis led each of them to affect the gross profit margin. However, when the effect of crisis was evaluated, it did not take into consideration the effect of those interactions. It just kept each of those variables constant.

In this section, the results of the composite effect of crisis on gross profit margin given the role of the interactions are presented. The composite marginal effect on gross profit margin under crisis (i.e., C = 1) for each company, *i*, is defined as:

$$\frac{d(GM_i)}{dC} = \left(b_1 LFPR + b_2 CPI + b_3 UER\right) \text{ for } C = 1 \tag{4.1}$$

Table 4.14 shows the composite marginal effects on gross profit margin under crisis for each of the companies. The results show that except for Tyson Foods and ConAgra Brands, which were not statistically significant and positive, all others were statistically significant. Thus, a percentage point increase in the composite of the covariates under crisis conditions reduced the gross profit margin for ADM by 0.86 percentage points, and this was statistically significant at the 5% level. The effect of a percentage point change in the composite on AGCO's gross profit margin was -0.65 percentage points. Coca-Cola, PepsiCo, DISH and ExxonMobil all experienced a negative impact as a result of the crisis. However, Walmart and Ford experienced positive and statistically significant impact from the crisis. Therefore, while Tyson, ConAgra, Walmart, and Ford were all resilient under the crisis, the hypothesis that the other firms were resilient was rejected when crisis was deemed to have occurred and the interaction effect of the crisis with the LFPR, CPU and UER were considered.

Table 4.14: Composite Effect of Crisis on the Gross Profit Margin of Selected Companies and Their Resilience

Companies	dy/dx	S.E.	t-value	p-value	Sig
ADM	-0.855	0.377	-2.270	0.024	**
AGCO	-0.647	0.258	-2.510	0.013	**
Coca-Cola	-0.844	0.425	-1.990	0.048	**
PepsiCo	-2.647	0.578	-4.580	0.000	***
Conagra	1.577	1.104	1.430	0.154	
Tyson	1.085	1.049	1.030	0.302	
Dish	-2.908	0.986	-2.950	0.003	***
Walmart	1.442	0.576	2.500	0.013	**
Ford	4.217	0.916	4.600	0.000	***
ExxonMobil	-3.204	0.737	-4.350	0.000	***

**** p<.01, ** p<.05, * p<.1*

CHAPTER V: SUMMARY AND CONCLUSIONS

This chapter presents the summary and conclusions emanating from the study. It is organized into three sections. The first presents the summary of the research purpose and the results. The second presents the conclusions emanating from the research. The final section presents some observations about the weaknesses of the study and opportunities for future research.

5.1 Summary

The motivation for the study was the need to understand the potential impact of macroeconomic shocks on agri-food firm performance. Given the reliance of the agri-food supply chain it is important to know how these firms act in the face of crises. The research problem was to identify which indicators of macroeconomic crises have a significant impact on agri-food firms' performance? The research question was to identify crisis indicators which affected agri-food firm's performance. The thesis identified two broad types of shocks: (1) Recessions are said to occur when there are two or more successive negative gross domestic product growth; and (2) Non-economic shocks, which encompass all shocks to the macroeconomy that originate outside economic factors.

The objectives of the thesis were to define macroeconomic shocks and their impact on gross profit margin because of the timeliness of impact of any external shocks affecting companies on this performance indicator. The analyses were conducted for a purposive sample of agri-food companies as well as companies that were selected from other sectors of the economy. The thesis evaluated the impact of the exogenous variables on gross profit margin of the selected firms and compared the results.

The study used econometric modeling to estimate the potential impact of macroeconomic shocks on firm performance and how resilient firms are to economic crisis.

The results indicate that using the coefficients in the regression equations alone to assess resilience was inaccurate. That is because it estimated the average impact of crisis and normal economic times. When gross profit margin was evaluated under only crisis conditions, the results were different. They showed that ConAgra, Tyson Foods, Walmart, and Ford were resilient to macroeconomic crisis in the presence of the labor force participation rate, the consumer price index, and unemployment rate. The others – ADM, AGCO, Coca-Cola, PepsiCo, and ExxonMobil were all not resilient under the macroeconomic crisis in the presence of the identified covariates.

Are agri-food firms resilient to macroeconomic crisis? The results indicate that firms with inelastic demand for their products, and these are firms supplying staples – meat and meat products, frozen and canned vegetables, and sauces. These companies include Tyson Foods and ConAgra Brands. Agri-food firms producing "discretionary" products, such as snacks, soda, and fun foods, including PepsiCo and Coca-Cola, suffered under macroeconomic crisis conditions. Firms further upstream in the agri-food chain, such as AGCO and ADM, also experience adverse impact of macroeconomic crisis probably because of the fact that they are dependent on derived demand. Therefore, if their customers are adversely affected, then they would too.

5.2 Suggestions for Future Research

This research is more explorative than conclusive. The research needed to test other quick-response indicators besides gross profit margin for resilience to macroeconomic conditions. The research had assumed internal conditions and their strategies as fixed and unchanging. This was done more for expediency than a belief that firms do not change their strategies in the face of macroeconomic crises. The expediency was driven by the challenge of getting time series data on corporate strategies and organizing them in ways that allowed inter-period comparison and consistency across firms.

The performance indicator was gross profit margin, an indicator that depended solely on revenues and variable costs. There might be value in testing if the reason for using gross profit margin was unique and different from other potential indicators, such as quick ratio and return on sales. The company might shed hourly workers to control variable cost even as it made investments in technology to enhance productivity. This replacement of variables costs with capital costs will not be captured by the gross profit margin and could camouflage performance.

The research did not differentiate among the three macroeconomic crises considered. However, the potential impact of the Dot com recession, short-lived as it were, could have been very different from the other two. More importantly, the COVID-19 crisis was a different beast altogether. It was not economic in origin and its direct effect on the economy was very short-lived. However, the lingering effects in the public health sector caused the government to not declare it over till its direct effects were probably dissipated. Future research may explore alternative ends for the COVID-19 pandemic and determine the “economic end” of the crisis and then explore its impact on companies’ performance to measure its independent effect on resilience.

Finally, we used a purposive approach to select companies included in the study. The availability of the required data was the principal the principal driver for this approach. The approach was also constrained by the time available to complete the research. It is suggested that future research should use a more systematic approach to select firms. This could be simple random sampling or some form of systematic sampling, stratified sampling, or clustered sampling. Such an approach will enable the development of inferences from the regression results and provide a higher level of confidence in extending the study's results to the general economy. In doing this, future study could include firms of different sizes instead of relatively large publicly traded companies, and multiple firms from multiple industries to determine the resilience outcomes based on industry type, industry structure, and even firm location.

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