Food Price Inflation in the United States: The Role of Transport Costs and Challenges

Michael K. Adjemian, University of Georgia

Delmy L. Salin, USDA, Agricultural Marketing Service

Jungkeon Jo, University of Georgia

Author contact: Michael.adjemian@uga.edu; 706-542-0756

USDA contact: Delmy.Salin@usda.gov

Recommended citation: Adjemian, M.K., D.L. Salin, and J. Jo. 2025. "Food Price Inflation in the United States: The Role of Transport Costs and Challenges." *USDA Agricultural Marketing Service*.

Acknowledgements: This research was partially supported by Cooperative Agreement Number 21-TMTSD-GA-0009 with the U.S. Department of Agriculture, Agricultural Marketing Service. The full paper is available at: https://agecon.uga.edu/people/faculty/michael-adjemian.html.

Michael K. Adjemian is a professor in the Department of Agricultural and Applied Economics at the University of Georgia and a consultant to the Commodity Futures Trading Commission. No Commission resources were used in this work and its findings do not necessarily represent its views. Jungkeon Jo is a Ph.D. candidate in the same academic department. Delmy L. Salin is a senior economist at the USDA's Agricultural Marketing Service. We thank seminar participants at the 2024 meeting of the Agricultural and Applied Economics Association meeting and the 2023 European Association of Agricultural Economists meeting for their helpful comments.

What Is the Issue?

Food price inflation spiked during the Covid-19 pandemic (2020-23) and notably outpaced general inflation. This issue remains one of significant concern to consumers, policy makers, and academics in the United States. Food price inflation particularly affects lower-income households, who must devote a large share of their budget to food—up to 32.6 percent of after-tax income for the lowest quintile of households.

This study investigated the extent to which rising transportation costs and supply chain issues contributed to food price inflation. The researchers explored how these factors raised food prices by increasing the cost of food provision ("supply-side pressure"). The analysis also examined whether transportation costs and supply chain issues correlated to consumers' higher willingness to pay for food ("demand-side pressure"). The report's findings are useful for understanding the dynamics behind food price inflation and guiding policy responses aimed at mitigating its impact on U.S. consumers.

How Was the Study Conducted?

This study employed two distinct analytical approaches to investigate the relationship between transport costs, supply chain issues, and food price inflation, for the period January 2004 - October 2023.[1] First, the researchers used conventional time series models to understand the direct relationship among various explanatory variables, such as fuel prices, labor costs, and

[1] Data availability narrows our focus to this period.

supply chain disruptions, on food prices. Second, they used a recently developed decomposition technique to isolate the portions of food price increases (for food consumed both at home and away from home) that can be explained by supply- or demand-driven pressure. The researchers then related explanatory factors to these components to understand how and why they affect food prices. Together, the analysis and discussion provide a comprehensive view of how transportation factors affect the prices that U.S. consumers pay for food consumed at home (FAH) and food consumed away from home (FAFH).

What Did the Study Find?

In the Fall of 2022, food price inflation spiked at the fastest pace observed in over four decades; it also ran far higher than inflation for other goods and services in the economy. Historically, supply-side pressures dominate increases in food prices. That is, food prices tend to rise when supplying food becomes more expensive. Certainly, during the COVID-19 pandemic, higher transport costs and supply chain issues played an important role in rising food prices. However, from 2020 to 2023, demand-side pressures raised food prices more than they had since at least since the early 1990s. Demand-side pressures rise when consumers demonstrate a higher willingness to pay for food.

Supply-Side Pressures

Over the 2004-23 study period, the researchers showed that transportation factors influenced food prices directly through the supply side of the market: food prices increased in direct response to rising fuel prices and higher shipping costs (for containers), as firms passed them on to consumers. However, the effects were stronger for FAH, for which transport costs made up a larger share of production costs than for FAFH. The researchers also showed that both anticipated food shortages and higher pressure on supply chains (because of various types of disruptions) can cause firms to raise prices through this supply-side channel.

Demand-Side Pressures

Besides supply-side pressures, demand-side inflationary pressures also impacted transportation costs and, in turn, food prices—especially for FAFH. For FAFH, higher energy, diesel, and refrigerated truck prices predict rising prices. For both FAFH and FAH, higher container rates predict rising prices. The authors argued that these findings stem from the correlative relationships between transport factors and overall demand in the economy at large.

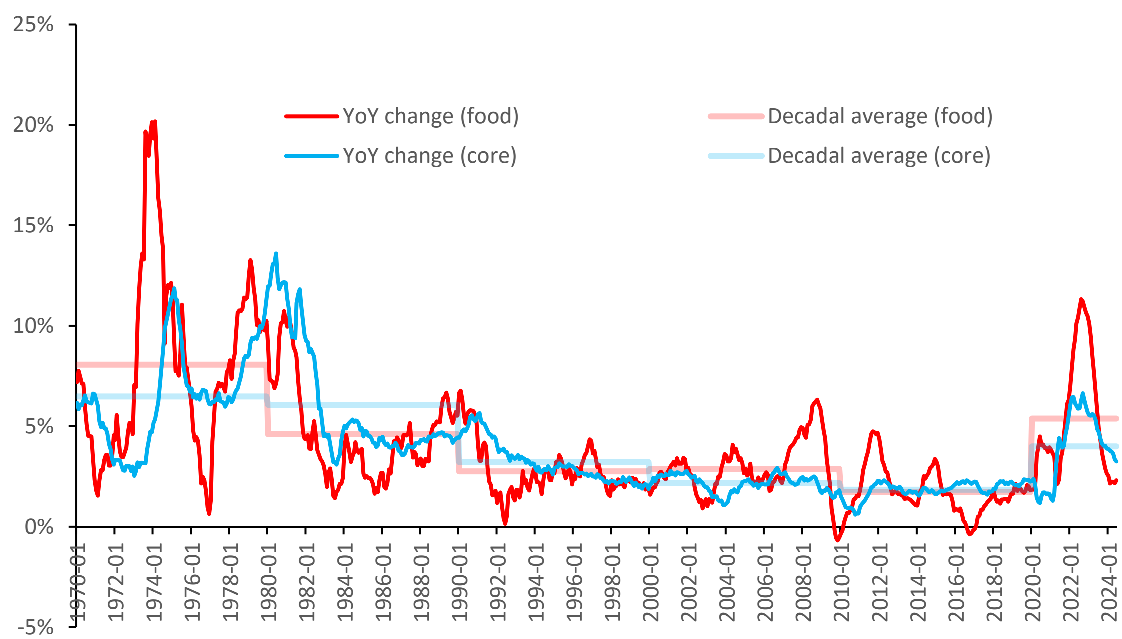
Yet, the researchers showed that the demand side of the market could also be impacted directly by anticipated food shortages and higher pressure on supply chains (because of various disruptions)—even though these are historically considered supply-side factors. These factors can impact the demand side of the market when consumers become willing to pay higher food prices in anticipation of scarcity in the supply chain. For example, the researchers showed that a higher Global Supply Chain Pressure Index and increased Google searches for the term "scarcity" both signaled rising prices for FAH and FAFH—likely by capturing an elevated marketwide willingness to pay.[2]

[2] Global Supply Chain Pressure Index (GSCPI) tracks changes in transportation costs and manufacturing delays globally, sourced from Benigno et al. (2022), See: https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr1017.pdf.

Introduction

Between January 2020 and June 2024, the price of food paid by urban U.S. consumers increased by over 26 percent. While the pace of inflation for other items likewise jumped—the price of "core" goods and services increased by about 19 percent over the same timeframe—food prices spiked at a significantly faster pace.[3] As shown in figure 1, recent food price inflation (FPI) is closer to the extraordinary levels observed in the 1970s and early-1980s than the last few decades.

Figure 1. Consumer price index inflation in the United States, year-over-year



Source: Bureau of Labor Statistics; author calculations.

Food price increases are particularly concerning for policy makers because food prices impact every consumer. As a necessary good, food must be purchased routinely regardless of changes in income levels or prices for other goods and services; it also represents a sizable portion

[3] "Core" goods and services exclude food and energy, since their prices tend to be more volatile.

of household budgets, especially for lower-income U.S. consumers. In 2021, food expenditures accounted for 12.4 percent of all domestic household expenditures, and lower-income households allocated fully 30.6 percent of their budgets to food (Sweitzer et al., 2023); by 2023 that figure increased to 32.6 percent (Sweitzer and Davidenko, 2024). As prices rise, these households may have to cut back on other expenses in order to buy enough food. According to the Economic Research Service (ERS), in 2021 more than 10 percent of U.S. households reported that their ability to acquire adequate food for their family members was limited due to insufficient budgets and other financial challenges (Coleman-Jensen et al., 2022). Nearly 4 percent reported that one or more household members experienced reduced food intake and disrupted eating patterns at times during the course of the year. Despite some deceleration in the pace of food price rises by 2024, the time of this writing, persistent elevated prices remain a pressing issue because of the cumulative effects of inflation. Grocery prices may not be rising at the same rate, but consumers are upset by the price they pay at the register. Naturally, food prices routinely make headlines (see, e.g., Yarrow, 2024). Consumers with limited budgets express that food prices are among their top concerns (Green, 2024).

According to basic economic theory, prices for a given product change due to shifts in either the demand curve, the supply curve, or both. The supply curve represents the cost of providing food; the demand curve represents consumer willingness to pay for that food. Furman (2022), for example, discusses the recent bout of domestic inflation in this framing, and offers reasons for why both sides of the market may have contributed to the bout of inflation in the economy after the pandemic onset. The pandemic period was characterized by significant supply-side shocks: bottlenecks and longer delay times at ports leading to higher transportation costs (Adjemian et al., 2023a; Carrière-Swallow et al., 2022), shortages for a wide variety of intermediate and final products, a tight labor market and rising wages, Russia's invasion of Ukraine and its effect on fuel prices as well as global cereal and fertilizer markets (Glauber et al., 2022), and even an outbreak of highly pathogenic avian influenza (Polansek and Hamaide, 2022). Each of these developments contributed to rising prices through a "supply-push" effect. On the demand side, government fiscal and monetary stimulus increased the funds available to consumers and firms at a time of pandemic lockdown. As lockdowns eased, U.S. consumers spent the excess savings they built up, pressuring prices higher through a "demand-pull" effect (see, e.g., Aladangady et al., 2022; de Soyres et al., 2023).

This report summarizes the findings of two streams of work exploring the causes of recent FPI, with a special focus on the role of transport costs. Each applies time series techniques to better understand the forces behind food price changes. The first uses conventional decomposition methods—which rely on relatively strong classification and econometric assumptions—to identify how a set of explanatory factors affects both the path of food prices and their variation;[4] it finds that rising transportation costs and supply chain stress both increase food prices. The second approach uses a new decomposition technique to first split food price inflation into (a) the portion explained by the demand side of the market, and (b) the portion explained by the supply side; then, it estimates the predictive power that transportation-related variables have for each measure of market pressure. Beyond relaxing the strong assumptions

[4] For example, the first approach classifies different variables as either representing the supply or demand side of the market; the second analysis shows that variables can affect both the supply and demand side at once.

required in the first approach, as we explain below another advantage of the second approach is that it quantifies the relationship transport variables have with supply and demand forces. In any case, both approaches agree that (1) while supply-side factors dominate historical food price changes, demand-side pressure grew in importance during the pandemic period, and that (2) transportation factors played an important role.

Conventional Methods

Adjemian et al. (2023b) use structural vector autoregressions (SVARs) to analyze how various factors influence food prices over time. SVARs allow the authors to analyze the interactions among different variables, showing how past values and unexpected changes—known as "shocks"—in one factor can affect others. These shocks are central to estimating causal impacts on food prices. To interpret the effects of these shocks, the authors employ three main forms of innovation accounting: impulse response functions (IRFs), forecast error variance decompositions (FEVDs), and historical decompositions (HDs). IRFs trace out the expected path of food prices over time following a one standard deviation shock to each modeled variable. This technique reveals the dynamic response of food prices to identified shocks. FEVDs measure the average proportion (over the timeframe of analysis) of the error in forecasting food prices that is attributable to shocks to the modeled variables; they indicate the relative importance of each factor in explaining the observed variations in food prices over different time horizons. Finally, HDs analyze how innovations to the variables in the model predict observed changes in food prices over the period of observation; they enumerate the contribution of different factors to the food price changes, highlighting the role of both supply-side and demand-side shocks over time.

To ensure robustness in their results, Adjemian et al. (2023b) apply four different identification techniques in the SVAR framework to identify shocks. The first technique, a classic Cholesky decomposition, orders the variables based on the primacy of their relationships in the short run. The other three techniques—non-Gaussian maximum likelihood, distance covariance, and Cramér-von Mises distance (CVM)—are data-driven techniques that identify shocks based on statistical dependencies rather than predefined ordering. Together, these methods offer a comprehensive approach that enhances the consistency of the findings, yielding reliable insights into the complex dynamics of food price inflation. Additional details on these conventional methods are provided in Appendix A.1.

Data and findings

Adjemian et al. (2023b) secure a set of variables to carry out the analysis and classify them as relating to one side of the market or the other. On the supply side, they include wages, energy prices, supply-chain pressure, transportation costs, and farm commodity prices. For wages, they use the average hourly earnings of employees working in production and non-management roles. Energy prices are represented by the Producer Price Index (PPI) for fuels and related products and power. Transportation costs are based on the PPI for truck shipping, and farm commodity prices are measured by the PPI for farm products. These data are sourced from the U.S. Bureau of Labor Statistics (BLS). In addition, supply chain pressure is captured by the Global Supply Chain

Pressure Index (GSCPI), which tracks changes in transportation costs and manufacturing delays globally, sourced from Benigno et al. (2022).

On the demand side, the study uses the money supply as indicated by the M2 monetary aggregate, which indicates the amount of money circulating in the economy. These data are sourced from the Federal Reserve.[5] They draw per-capita disposable income, which are sourced from the Bureau of Economic Analysis (BEA) and represents the income available to consumers after taxes. Finally, they use core prices as a control variable, represented by the Consumer Price Index for All Items Less Food and Energy (CPI-U), and sourced from BLS. The dataset spans from January 2004 through June 2022, with variables transformed in their natural logarithm (except for GSCPI, which is an index containing negative values), first-differencing, and de-seasoning. Each variable is standardized by subtracting its mean and dividing by its standard deviation.

The researchers show that, historically, food price inflation is driven primarily by supply-side shocks—factors that raise the cost of the production and distribution of food. However, the authors show that demand-side pressures became increasingly influential after the onset of the COVID-19 pandemic; while supply-side factors still play a major role, demand factors now contribute more substantially to food price inflation. Across specifications, Adjemian et al.'s (2023b) IRFs indicate that increases in the money supply, wage, energy, and supply chain pressures raise food prices in the short term. Core prices, transport prices, and farm prices also

[5] For more information about monetary aggregates and what they represent, see the Federal Reserve's publication Money Stock Measures, at https://www.federalreserve.gov/releases/h6/current/default.htm.

increase food prices, although core prices' impact varies depending on the time frame considered. They also find that energy prices do not significantly affect food prices.

Further analysis using FEVDs indicates that supply-side factors (wages, energy, transport, farm inputs, and supply chain disruptions) account for a significant portion of average food price error variance. Depending on the identification method, these factors' contributions vary, but they consistently emerge as key determinants. Demand-side factors, including the money supply and consumer income, also play a substantial role, particularly in the short term, suggesting that consumer spending power and liquidity in the market contribute to inflationary pressure on food. HDs in the paper show how changes in supply and demand factors have driven food prices over time; they report that supply-side factors, such as energy prices, farm products, labor costs, transport costs, and supply chain pressures are traditionally among the most important contributors to food price changes. However, demand-side factors—particularly the money supply and per-capita income—have become more influential since the pandemic, contributing to the increase in food prices since 2020. Overall, the published analysis shows that demand factors play a smaller role in food price changes before the pandemic (2015-19) compared to the more recent period (2021-22). Supply factors remain the primary drivers of food prices, but the importance of demand shocks has increased in recent years.

Novel methods

Adjemian, Li, and Jo (2025) use a new approach, grounded in basic economic theory, to separate food price increases into supply-side pressure that raises costs, like production or shipping delays, or demand-side pressure that leads to price increase, like shifting consumer preferences. The basic idea is that either side of the market can contribute to price changes; once the share of price changes caused by pressure to each side of the market is identified, then the authors estimate their relationship with different explanatory factors. As a result, this approach uses a more developed economic structure to study the question of food price determinants, and permits the relaxation of the identifying assumptions required under the conventional time series methods. For example, this approach permits the empirical study of whether fuel prices and other transport variables correlate to either or both supply- and demand-driven inflationary pressure on food products.

The approach in this section follows the Shapiro's (2024) model, and uses detailed data on U.S. consumers' spending as well as the prices and quantities of various food categories maintained by the Bureau of Economic Analysis (BEA).[6] By tracking unexpected monthly changes in price and quantity data, the model classifies these shocks as demand-driven if prices and quantities move in the same direction (when the demand curve shifts out, prices and quantities both rise; an inward demand shift reduces both price and quantity) and supply-driven if they move in opposite directions (when the demand curve shifts in, prices rise and quantities fall). Unexpected changes in price and quantity are identified by first modeling food-category-level VARs of log-transformed price and quantity indices, which control for trends, and isolating model residuals. Using cutoffs between the absolute value of each residual and zero defines ambiguity in whether a given shock is actually on the supply or demand side of the market. By weighting

[6] The BEA's Personal Consumption Expenditures (PCE) dataset provides detailed information on food consumption both at home and away from home, allowing for a comprehensive analysis of food price inflation. The BEA PCE data include indices as well as total expenditure levels at the annual, quarterly, and monthly frequencies. The authors conduct analyses at the monthly level, since it is the most frequent.

each category according to its share of total expenditures,[7] the contributions of supply and demand shocks to overall food price inflation can be estimated.

The novel approach produces data series that represent the food changes driven by supply shocks, and the price changes driven by demand, allowing researchers to study how other factors, like transportation costs or economic conditions, operate through each side of the market to raise (or lower) food prices. Adjemian, Li, and Jo (2025) perform a novel approach decomposition and estimate IRFs using local projection methods (Jordà, 2005), which measure the dynamic responses of supply- and demand-driven inflation to different factors (see Appendix A.2 for more details).[8]

In this report, we apply the same model those authors use, but focus exclusively on transportation-related explanatory factors, to estimate their relationship to FAH and FAFH price inflation that emerges from either side of the market. Although a handful of the factors we consider are externally-identified shocks (and so their results can be interpreted causally), most of the variables in the analysis are recovered from observational data so their impulse responses should be thought of as predictive or indicative relationships rather than strictly causal.

Data

We include externally-identified oil supply and demand shocks as estimated by Baumeister and Hamilton (2019), an index representing Google searches for the term "shortage", Benigno et al.'s

[7] These are also known as Laspeyres weights.
[8] IRFs estimated via local projections use ordinary squares (with HAC standard errors) at each forecast horizon; they are known to be equivalent to IFRs recovered from VARs under weak assumptions (Plagborg-Møller and Wolf, 2021).

(2022) supply chain pressure index, transportation and energy prices identified above, No.2 Diesel retail prices, the Shanghai Shipping Exchange's China Containerized Freight Index, the Baltic Exchange Dry Index, the USDA AMS-maintained national average for refrigerated truck rates—also from USDA AMS.

The oil supply and demand shocks capture significant changes in global oil production or consumption, where a negative supply shock represents disruptions in oil production, and a positive demand shock indicates a sudden increase in global oil consumption—with both shocks responsible for raising oil prices. These data are sourced from Christiane Baumeister's personal website.[9] The "shortage" index reflects the popularity of searches for the term "shortage" in the United States, sourced from Google Trends, and provides insight into consumer concerns about product availability. The supply chain pressure index helps to assess how global supply constraints may affect economic conditions (Benigno et al., 2022).[10] Additional data include U.S. diesel prices (sourced from the Energy Information Administration), the Shanghai Shipping Exchange's China Containerized Freight Index, which reflects Shanghai's export shipping rates for various global routes, and the Baltic Dry Index, a measure of shipping costs for bulk raw materials obtained from the Bloomberg terminal.[11] For purposes of data ability, the timeframe of analysis is set to January 2004 – October 2023.

[9] Structural oil supply and demand shock data can be obtained at: https://sites.google.com/site/cjsbaumeister/datasets.

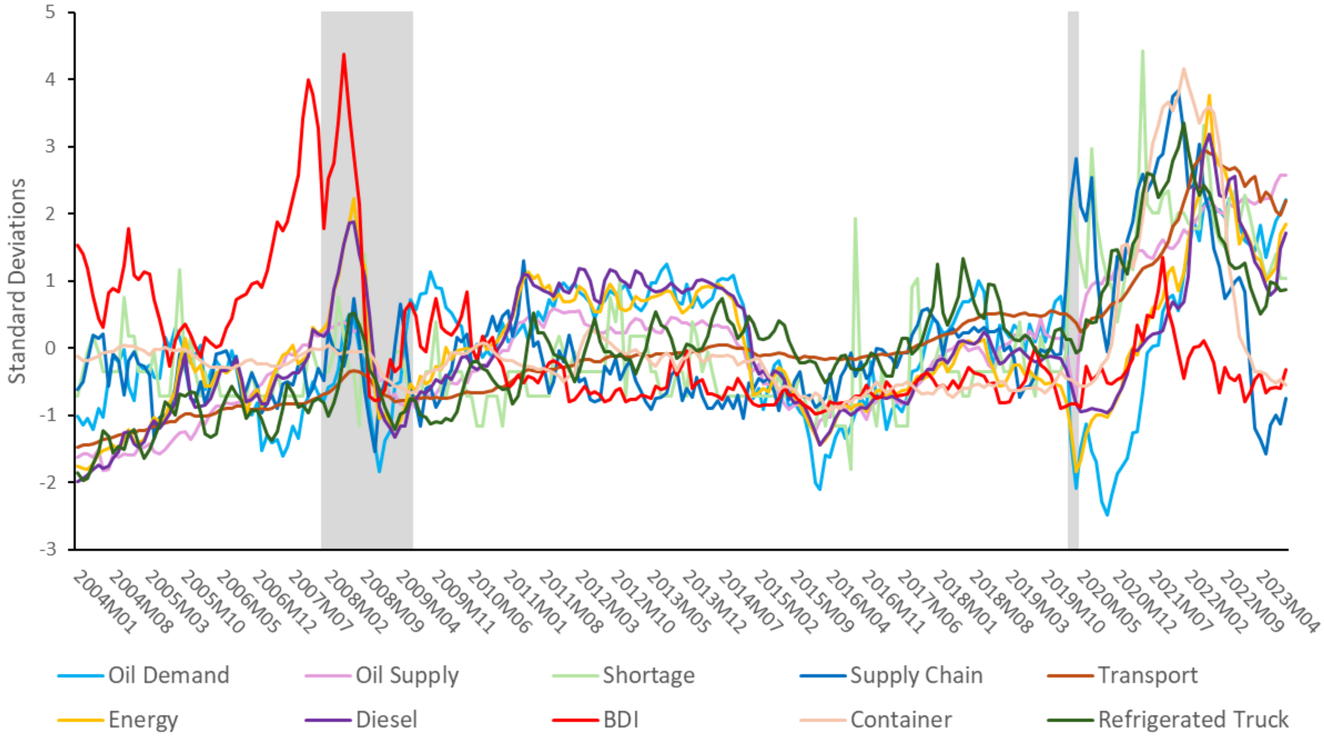
[10] The Global Supply Chain Pressure Index (GSCPI) can be obtained at: https://www.newyorkfed.org/research/policy/gscpi#/interactive.

[11] The Shanghai Containerized Freight Index (SCFI) can be obtained at: https://en.sse.net.cn/indices/scfinew.jsp.

Figure 2 illustrates historical trends for the explanatory variables in our analysis. Following the onset of the COVID-19 pandemic, supply chain pressure increased sharply, peaking at the end of 2021 before receding. The "shortage" index followed a similar trend, reaching its highest point around mid-2021. Pandemic-related disruptions, including supply constraints like container and labor shortages, combined with increased freight demand as the global economy recovered from pandemic shutdowns, as well as consumer-driven concerns about the availability of products and expression of precautionary demand, contributed to these trends.

Other variables, such as positive oil demand shocks, negative oil supply shocks, transport prices, energy prices, diesel prices, the Baltic Dry Index (BDI), and container rates, all fell in early 2020, as aggregate demand dropped in the United States and globally. However, beginning in late 2020, these variables began to rise as the global economy recovered, with steady increases continuing until mid-2022. As a reference point, during the 2008 Great Recession, these variables similarly declined as a global demand cooled.

Figure 2. Historical variations for explanatory variables, 2004-2023



Sources: Author calculations based on data from: oil demand and oil supply (Baumeister and Hamilton, 2019); Shortage (Google Trends); supply chain pressure index (Benigno et al., 2022); transport PPI and energy PPI (St. Louis Federal Reserve Board); Baltic dry index (Bloomberg), truck rates (USDA AMS), and container rates (Shanghai Shipping Exchange).

Notes: Each variable in the figure is standardized by subtracting the mean and dividing by its standard deviation over the period of observation. Gray shaded areas indicate periods of recession as defined by the NBER.

How do transportation factors affect food prices?

In theory, transportation costs affect the prices U.S. consumers pay for both food at home and food away from home directly, as nearly all food products are processed and transported from farms to grocery stores or restaurants. In 2022, transportation expenses made up about 5 percent of the cost of food at home (USDA, 2024a). According to the USDA Economic Service (USDA, 2024b), transportation costs increased by 27.1 percent from 2019 to 2023, outpacing rises in other major spending categories such as food (25 percent), housing (20 percent), recreation (13 percent), and medical care (10 percent). Increased fuel prices, such as energy prices, and no.2 diesel prices in our model, directly raise food prices as firms pass these higher transportation costs on to consumers. Consumer concerns over shortages and increased supply chain pressures can also drive inflationary effects; on the supply side, an increase in “shortage” searches may signal anticipated supply chain disruptions, which in turn can intensify supply chain pressures. Such disruptions can result in an inadequate supply of food to meet demand, pushing food prices higher. On the demand side, concerns about shortages may lead to precautionary or “panic” buying, as consumers purchase more in anticipation of future scarcity.

Negative oil supply shocks that raise oil prices might also contribute to higher food prices through supply-side channels: as oil prices climb, fuel and transportation costs increase, making it more expensive to move food products from farms to processing facilities or from factories to grocery stores and restaurants. Positive oil demand shocks, driven by increased global oil consumption, lead to higher energy prices, which in turn raise transportation costs and subsequently pressure food prices. Similarly, rising ocean freight rates for containerized goods increase the cost of imported food ingredients and products, adding supply-side pressure to domestic food prices.

To study the empirical role played by each of these factors we first isolate the non-ambiguous component of the identified supply- and demand-side pressure on food prices, and then use bivariate local projections to relate them to a set of transportation variables. Recall that local projections present the dynamic relationship between a shock to the factor of interest in time h=0, and then the inflation component of interest over an arbitrary horizon. Figures 3 and 4 present the results of our analysis, with figure 3 focusing on supply-side results and figure 4 focused on demand-side. Solid lines in each chart can be interpreted as the estimated percent change over the period of interest following a time zero 10% increase in the modeled variables (named in each figure pane) from their mean.[12] All effects are cumulative, meaning that the value at time *h* in the chart represents the expected change in food prices from that side of the market between time zero and time *h*. FAH effects are represented in green; FAFH effects are depicted in magenta. Shading in each pane represents the 95% confidence interval; all standard errors are heteroskedasticity and autocorrelation robust (Newey and West, 1987).

Broadly, according to the figures, transport variables tend to influence food consumed at home through the supply channel, while they predict demand channel effects for food consumed away from home. For example, we observe that negative oil supply shocks, which raise oil prices, increase food prices at the mean (although the effect on food service is not significant) through the supply channel: higher oil prices raise production costs across the food supply chain, ultimately leading firms to pass those on to consumers in the form of higher food prices. Since they predict negative macroeconomic conditions and wage effects (Baumeister, Peersman, and Van Robays, 2010), these unfavorable oil supply shocks may also reduce the demand pressure on FAH according to figure 4, though the impact is far more muted. Positive oil demand shocks do not appear to hold much explanatory power for FAH; on the other hand, they slightly reduce supply-side pressure on FAFH, but raise them through the demand channel. This effect likely stems from the broader economic growth associated with rising oil demand, as higher oil consumption usually coincides with periods of economic expansion. This suggests that consumer

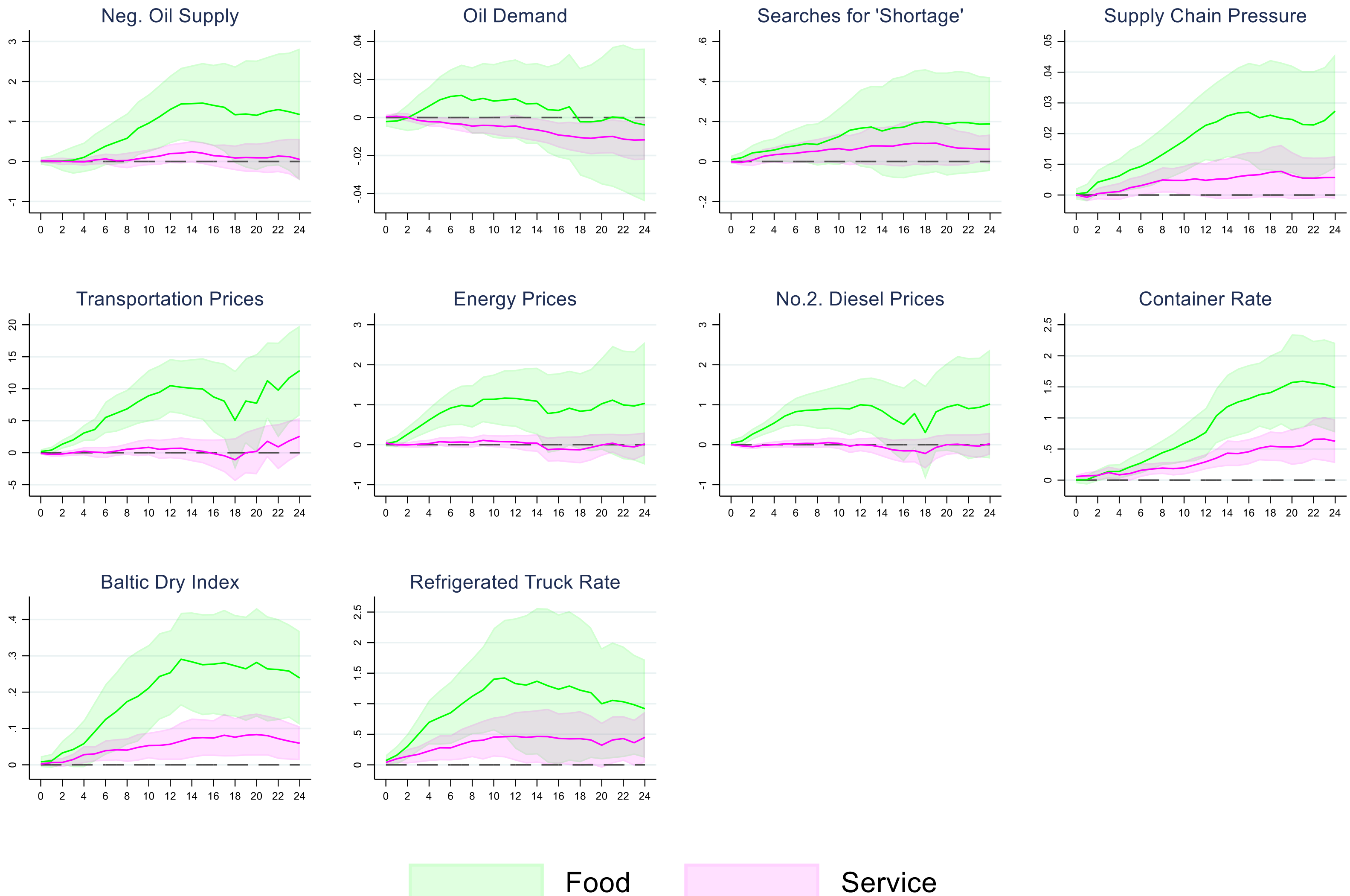
[12] All models include six lags of the dependent and independent variables, and the opposite market-side pressure as controls. Results are robust to estimating them in the differences, as well.

spending in food service may rise with economic growth, indirectly affecting FAFH—a pattern that likely applies to several other demand channel effects too, as we describe below.

We also find that Google searches for the term "shortage" are associated with rising food prices through both supply and demand-side effects. On the supply side, these Google searches could predict supply chain bottlenecks and actual shortages, suggesting consumers anticipate disruptions and possible stockouts that raise firm costs and eventually food prices. On the demand side, they may trigger precautionary (or panic) buying behavior, where consumers purchase more in anticipation of scarcity, raising prices as demand outstrips supply. In a similar way, rising supply chain pressure increases food prices through both sides of the market. Supply chain participants pass the costs on to consumers, who demonstrate more willingness to pay for them in an environment of stockouts and transportation delays. This indicates that supply chain bottlenecks not only affect the availability of goods but also raise food prices by straining the distribution system, particularly in times of high demand.

Fuel prices, on the other hand—as represented in the figures by transportation prices, energy prices, and no 2. diesel prices—tend to affect FAH through the supply channel, but FAFH through the demand side. This is intuitive: higher fuel costs cause input suppliers to raise FAH costs. For FAFH, however, food inputs make up a far smaller proportion of costs relative to labor (since FAFH is much more labor intensive), so the predictive effect is more muted. On the other hand, rising energy prices imply a growing economy, and richer consumers will pay more to visit eateries. The same sort of effect is implied by the container freight index in figure 4: rising ocean transport costs for containerized goods imply a growing economy and predict higher food prices through the demand channel. However, the Baltic Dry Index, representing the price to transport bulk commodities by sea, does not itself predict demand-induced food price rises. Instead, both container and bulk freight rates predict rising pressure on food prices through the supply side of the market as higher shipping costs directly affect the cost of importing and distributing food products domestically (Hossen et al., 2024). (Both sets of ocean shipping effects on food prices—through demand and supply pressure—are consistent with the findings and discussion in Adjemian et al. (2023a)). In a similar way, higher U.S. nationwide refrigerated truck rates also imply supply-side pressure on prices for FAH and FAFH, and also help predict more demand-channel effects on FAFH.

Figure 3. Responses of (non-ambiguous) supply-driven inflation to a 10% rise in a set of transportation factors



Source: Author calculations.

Figure 4. Responses of (non-ambiguous) demand-driven inflation to a 10% rise in a set of transportation factors

Source: Author calculations.

Conclusions

This report is focused on the contribution of transportation costs and supply chain problems to FPI in the United States. Since the COVID-19 pandemic onset, domestic prices for food (consumed at home or elsewhere) have surged at a pace significantly beyond that of general inflation, a situation that is especially challenging for lower-income households. Price increases occur due to pressure from either the supply or demand side of the market (or both). Using that framing, we consider them using two different approaches, and find that transport factors influence food prices through both sides of the market, although the demand-side effects tend to be correlative in nature. Conventional time series models and a more recent decomposition technique agree that while supply factors continue to play a dominant role in shaping American food prices, the demand side has grown in importance.

We show that rising transportation costs and supply chain disruptions increase the overall cost of food production and distribution; firms pass them along to consumers. These supply-side effects are most evident in prices for food consumed at home. We further show that transport factors predict demand-side pressures on food, in particular food consumed away from home; we conclude that much of this demand channel effect is likely indirect and due to the influence of aggregate demand, although it may also operate directly through precautionary/panic buying by consumers concerned about shortages.

Our results imply that investments that improve supply chain efficiency, reduce bottlenecks and their resulting shortages, and lower fuel prices would ease some of the supply-side pressures that drive up the cost of food. At the same time, understanding the impact of consumer demand on food prices, particularly in the food service sector, would be helpful for understanding and predicting future inflationary episodes.

References

Adjemian, M.K., D. Salin, and W. Wilson. 2023a. "Implications of Rising Ocean Freight Rates for Agri-food Product Markets." Report for the USDA *Agricultural Marketing Service*. February. Accessed at: https://agecon.uga.edu/content/dam/caes-subsite/ag-econ/documents/cvs/Ocean%20Transport%20Cost%20Shocks-Adjemian%20Salin%20and%20Wilson%202023.pdf

Adjemian, M.K., S. Arita, S. Meyer, and D. Salin. 2023b. "Factors Affecting Recent Food Price Inflation in the United States." *Applied Economic Perspectives and Policy*. https://onlinelibrary.wiley.com/doi/full/10.1002/aepp.13378

Adjemian, M.K., Q. Li, and J. Jo. 2025. "Supply and Demand Dynamics Behind Recent U.S. Food Price Inflation." *Working paper*. Accessed at: https://agecon.uga.edu/content/dam/caes-subsite/ag-econ/documents/cvs/Decomposing%20Food%20Price%20Inflation%20into%20Supply%20and%20Demand%20Shocks%20-%20july2023.pdf

Aladangady, A., D. Cho, L. Feiveson, and E. Pinto. 2022. "Excess Savings during the COVID-19 Pandemic." *FEDS Notes*. October 21st. Accessed at: https://www.federalreserve.gov/econres/notes/feds-notes/excess-savings-during-the-covid-19-pandemic-20221021.html

Baumeister, C., and J.D. Hamilton. 2019. "Structural Interpretation of Vector Autoregressions with Incomplete Identification: Revisiting the Role of Oil Supply and Demand Shocks." *American Economic Review*, 109(5), May 2019, 1873-1910.

Baumeister, C., Peersman, G., and Van Robays, I. 2010. "The economic consequences of oil shocks: differences across countries and time." *Inflation in an era of relative price shocks, Reserve Bank of Australia,* pp.91-128. Accessed at: https://wps-feb.ugent.be/Papers/wp_09_630.pdf

Benigno, G., J. di Giovanni, J.J. Groen, and A.I. Noble. 2022. "The GSCPI: A New Barometer of Global Supply Chain Pressures." *Federal Reserve Bank of New York Staff Reports*, no. 1017. Accessed at: https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr1017.pdf

Carrière-Swallow, Y., Pragyan Deb, Davide Furceri, Daniel Jiménez, Jonathan D. Ostry. 2022. "How Soaring Shipping Costs Raise Prices Around the World." *IMF Blog*. Chart of the Week. Accessed at: https://www.imf.org/en/Blogs/Articles/2022/03/28/how-soaring-shipping-costs-raise-prices-around-the-world

Coleman-Jensen, Alisha, Matthew P. Rabbitt, Christian A. Gregory, Anita Singh. September 2022. "Household Food Security in the United States in 2021." ERR-309, U.S. Department of Agriculture, Economic Research Service. Accessed at: https://www.ers.usda.gov/webdocs/publications/104656/err-309.pdf

de Soyres, F., D. Moore, and J. Ortiz. 2023. "Accumulated Savings During the Pandemic: An International Comparison with Historical Perspective." *FEDS Notes*. Accessed at: https://www.federalreserve.gov/econres/notes/feds-notes/accumulated-savings-during-the-pandemic-an-international-comparison-with-historical-perspective-20230623.html

Furman, J. 2022. "This Inflation is Demand-Driven and Persistent." Project Syndicate. April 20th. Accessed at: https://www.project-syndicate.org/commentary/inflation-demand-driven-persistent-by-jason-furman-2022-04

Glauber, J., Hernández, M., Laborde, D., Martin, W., Rice, B., Vos, R. 2022. "No end in sight yet for the global food price crisis." *IFPRI Blog: Issue Post*. Accessed at: https://www.ifpri.org/blog/no-end-sight-yet-global-food-price-crisis/

Green, J. 2024. "Young Voters' Top Concern Is Their Grocery Bills." Bloomberg. May 30th. Accessed at: https://www.bloomberg.com/news/newsletters/2024-05-30/high-prices-for-groceries-is-top-issue-for-young-swing-voters

Hossen, M.D., Muhammad, A., Kenner, B. and Kaufman, J.2024. "Unraveling the impacts of freight rates on US containerized agricultural trade." *Journal of the Agricultural and Applied Economics Association*, 3(1), pp.199-211. Accessed at: https://onlinelibrary.wiley.com/doi/full/10.1002/jaa2.105

Jordà, Ò. 2005. "Estimation and inference of impulse responses by local projections." *American Economic Review*, 95(1):161–182, 2005. Accessed at: https://doi.org/10.1257/0002828053828518

Newey, W.K., & D.K. West. 1987. "A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix." *Econometrica*, 55(3), 703-708.

Plagborg-Møller, M. & C.K. Wolf, 2021. "Local Projections and VARs Estimate the Same Impulse Responses," *Econometrica*, Econometric Society, vol. 89(2), pages 955-980, March.

Polansek, T. and Hamaide, S. 2022. "Focus: Bird flu, Ukraine war push egg prices higher worldwide." Reuters. April 14th. Accessed at: https://www.reuters.com/world/bird-flu-ukraine-war-push-egg-prices-higher-worldwide-2022-04-14/

Shapiro, A.H., 2024. "Decomposing Supply-and Demand-Driven Inflation." *Journal of Money, Credit and Banking*. Accessed at: https://onlinelibrary.wiley.com/doi/full/10.1111/jmcb.13209?casa_token=ZR1wd8DmusAAAAAA%3Am1ZzhG-Oni6hxJYqkrWbyaHCoICJBM90W7I8bwCZA_1_KdvVrzdpJ5Pf_SXOYDaL9wztze1XxLJ3-3U

Sweitzer, M., and V. Davidenko. 2024. "Feed spending as a share of income declines as income rises." USDA ERS Charting the Essentials: Food Prices and Spending. November 1st. Accessed at: https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/food-prices-and-spending?topicId=2b168260-a717-4708-a264-cb354e815c67

Sweitzer, M., MacLachlan, M., Sinclair, W., Stevens, A., Stewart, H., Zachary, J., and Zeballos, E. 2023. "ERS Data Products Show Food-At-Home Price Inflation from Producers to Consumers." Economic Research Service of the USDA (ERS). Accessed at: https://www.ers.usda.gov/amber-waves/2023/july/ers-data-products-show-food-at-home-price-inflation-from-producers-to-consumers/

U.S. Department of Agriculture. 2024a. Food Dollar Real Data, Economic Research Service. Accessed November 11, 2024, (November 15, 2023). Accessed at: https://www.ers.usda.gov/data-products/food-dollar-series/download-the-data/

U.S. Department of Agriculture. 2024b. "U.S. food prices rose by 25 percent from 2019 to 2023." Economic Research Service. Accessed November 11, 2024, (November 1, 2024). Accessed at: https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/food-prices-and-spending/

U.S. Bureau of Labor Statistics (BLS). 2022. *Economic News Release: Consumer Price Index Summary*. Dec. 16th. Accessed at: https://www.bls.gov/news.release/cpi.nr0.htm

Yarrow, G. 2024. "The (Election) food fight is on." *Politico*. August 19th. Accessed at: https://www.politico.com/newsletters/weekly-agriculture/2024/08/19/the-election-food-fight-is-on-00174531

Appendix

A. Methods

A.1 Conventional Time Series Models

Adjemian et al. (2023b) employ several related time series models—specifically, structural vector autoregressions (SVARs)—to analyze the way that food prices are affected by a range of potential explanatory variables. While an ordinary autoregression relates observations of a given variable to its own previous realizations, a vector autoregression permits each variable in a set to be affected by its own past values, as well as the contemporaneous and past values of the other variables in the vector. A structural autoregression is specified the same way, except that it uses some method selected by the econometrician—from economic theory to data-driven techniques—to identify economic "shocks" from the reduced form errors across the vector of modeled variables. Here, "shocks" refer to unexpected innovations of each variable; they are crucial to the estimation of causal impacts, also known as "innovation accounting".

Adjemian et al. (2023b) use four different identification techniques to estimate SVARs—recursive Cholesky decomposition, and three data-driven methods: non-Gaussian maximum likelihood (NGML), distance covariance (DC), and Cramér-von Mises distance (CVM). They show that these techniques yield similar results. Cholesky decomposition, a classic method, uses theory to order variables in terms of the primacy of their relationships in the short run; it is therefore also known as recursive identification. Certain shocks are permitted to have contemporaneous relationships with some or all of the modeled variables' residuals, while others are not. This technique is useful but may be too restrictive if the contemporaneous shocks do not follow a recursive pattern. Non-Gaussian Maximum Likelihood specifies a log-likelihood function assuming a standardized Student's t-distribution for each component factor. It exploits the non-Gaussianity of the variables to achieve identification. Distance Covariance (DC) minimizes a measure of dependence between random vectors, to identify structural shocks. It is robust to various distributions of structural shocks and does not rely on the assumption of normality. Finally, similar to DC, Cramér-von Mises distance (CVM) minimizes the Cramér-von Mises distance, another measure of statistical dependence, for identification. It ensures robustness in identifying structural shocks and provides a complementary perspective to other techniques.

A.2. Local Projections

When estimating impulse response functions (IRFs) with a Vector Autoregressions (VAR) model, certain restrictive properties can affect the impulse responses, such as symmetry, shape invariance, history independence, and multi-dimensionality (see Jordà, 2005). In contrast, the local projection method proposed by Jordà (2005) relaxes these restrictions and can be estimated using simple least squares, making it a more flexible alternative for estimating IRFs compared to the VAR model. In this study, we use local projections to analyze the impulse responses of supply- and demand-driven inflation to the identified transportation-related shocks. This involves estimating a series of regressions as follows:

$$y_{i,t+h} = \beta_0^i + \delta_h^i Shock_t + \beta_h^{i\prime} x_{t-1} + \varepsilon_{i,t,h},$$

where $y_{i,t+h}$ represents the outcome variable i (such as supply- or demand-induced inflation) at horizon h. $Shock_t$ represents the transport related shocks (i.e., the variables of interest) at time

t, x_{t-1} is a vector of control variables, and the error term, $\varepsilon_{i,t,h}$, is serially correlated—so robust methods are generally used to adjust the associated standard errors. The coefficient δ_h^i indicates the impulse responses of variable i to transportation-related shocks at horizon h.