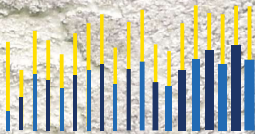




Capital  
Markets

# Digital Intelligence Strategy: Full Grocery Cart, Empty Wallet

Food Series Deep Dive, Part 2



**RBC Elements**<sup>TM</sup>

Driving insights through data

DIGITAL INTELLIGENCE STRATEGY RESEARCH | JUNE 1, 2022

For Required Digital Intelligence Strategy Research Conflicts Disclosures, see page 16.

For Required Equity Research Non-U.S. Analyst and Conflicts Disclosures, see page 18.





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### RBC Food Input Index (FIX)

In Part 1 of our food series deep dive, [Quantifying the Nature of Rising Food Prices](#), we introduced our Food Input Index (FIX). The FIX is a measure that incorporates weekly inputs with the aim of quantifying the evolution of key drivers of food prices. The index remains at 16 on a scale of 1 to 20, with a score of 20 representing perceived maximum upward pressure on inputs to the food supply chain. This index updates weekly. Please reach out to us for more details.

Figure 2 – FIX Price Pressures Meter

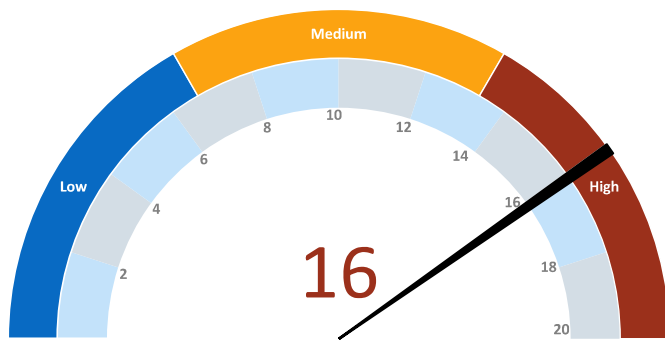
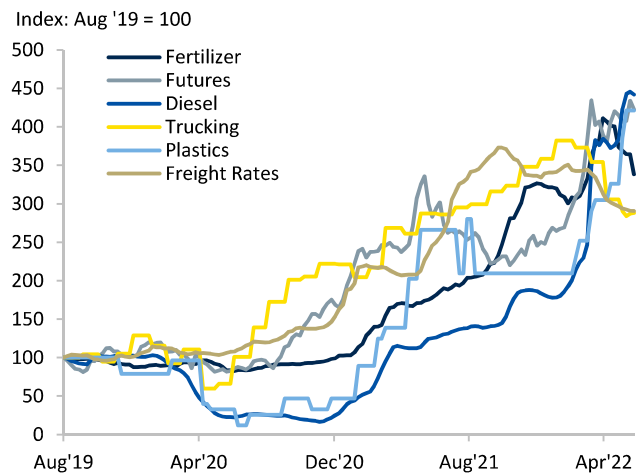


Figure 3 – FIX Components



Source: RBC Capital Markets, CRU, Bloomberg, AAA, DAT, Polymer Update, Drewry

### What’s in Your Basket?

To understand the impact of rising food prices on the American consumer, we first look to unpack the key ingredients that are staples in the average American diet. Rather than leaning on the USDA for dietary guidelines or the food pyramid, we collaborated with **RBC Elements**, our in-house data science team, to guide the contents of a key ingredients grocery cart.

**Using Natural Language Processing, we scrape 64k recipes to determine the key ingredients in American households.**

We used Natural Language Processing to scrape nearly 64,000 recipes from the Food Network website. Our algorithm kept a running count of the ingredients that showed up most frequently across the library of recipes. In short, we looked to solve for the groceries that are most important to the American diet.

To set boundaries around our exercise, we took the top 25 most often used ingredients in the 64,000 recipes. We then monitored how pricing has changed over time. See Figure 4 for our list of grocery items.

Figure 4 – Basket Components (In Order of Importance)

Ingredient	WoW	MoM	YoY	Current vs. 2019
Oil	1.2%	2.3%	33.4%	48.1%
Butter	2.8%	0.6%	18.1%	11.1%
Flour	0.9%	1.1%	15.1%	22.1%
Potatoes	-1.9%	-27.0%	7.9%	9.5%
Chicken	0.0%	2.3%	19.0%	22.7%
Sugar	0.4%	0.6%	8.3%	22.3%
Salt	0.2%	0.6%	7.9%	17.5%
Eggs	2.3%	8.9%	38.1%	58.8%
Cream	0.5%	-0.2%	9.7%	14.0%
Milk	1.9%	2.9%	16.9%	24.7%
Pork	-1.8%	-3.6%	15.7%	15.7%
Meat (not Pork or Chicken)	0.8%	3.2%	15.9%	26.0%
Chocolate	-0.7%	5.5%	10.5%	27.1%
Cheese	-0.2%	0.4%	9.0%	12.5%
Bacon	0.1%	-3.1%	18.4%	22.6%
Rice	-1.4%	0.0%	10.6%	21.9%
Beans	-0.5%	0.0%	6.8%	19.8%
Spices	-0.6%	-1.2%	8.4%	13.9%
Mayonnaise	3.3%	0.0%	23.4%	30.7%
Vinegar	0.0%	10.1%	9.0%	12.2%
Bread	0.0%	0.7%	11.3%	20.1%
Pepper	-0.1%	0.8%	10.8%	17.3%
Corn	1.9%	3.3%	13.2%	14.4%
Shrimp	2.1%	1.9%	1.0%	5.1%
Turkey	0.2%	0.4%	10.7%	15.6%
<b>Average</b>	<b>0.5%</b>	<b>0.4%</b>	<b>14.0%</b>	<b>21.0%</b>

Oil, butter, and flour are the top 3 ingredients used in American cooking.

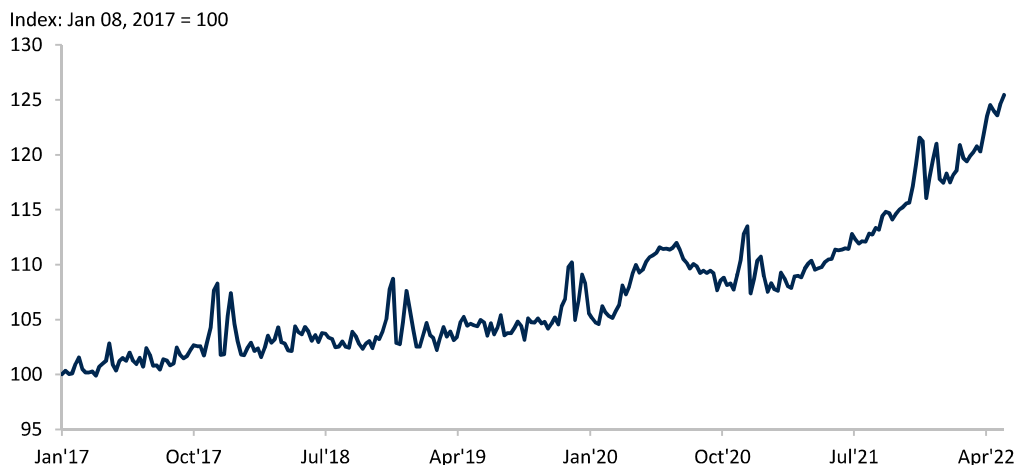
Source: RBC Capital Markets, Food Network, IRI

### Burning a Hole in Your Wallet

Year-over-year, the price of our basket has increased by 13.6%.

We compiled a basket that was inclusive of one unit of each of the 25 grocery items. To assess how food prices have changed over the last five years, the basket was indexed to 100 for the year 2017. By the end of Q1'22, the basket priced at 120, and it currently sits at 125.5. In other words, the cost of the typical grocery cart has increased by 25.5% over the last five years (Figure 5).

Figure 5 – Top 25 Items Grocery Basket Price Evolution



Price increases have accelerated quickly since the onset of the COVID-19 pandemic.

Source: RBC Capital Markets, IRI



**US households spend ~\$7,200 per year on food, approximately 12.7% of total expenditures.**

**Highest-income earners spend only 8% of after-tax income on food, compared with 34% for the lowest quintile.**

### The Historical Context: Food Expenditures by Income Bracket

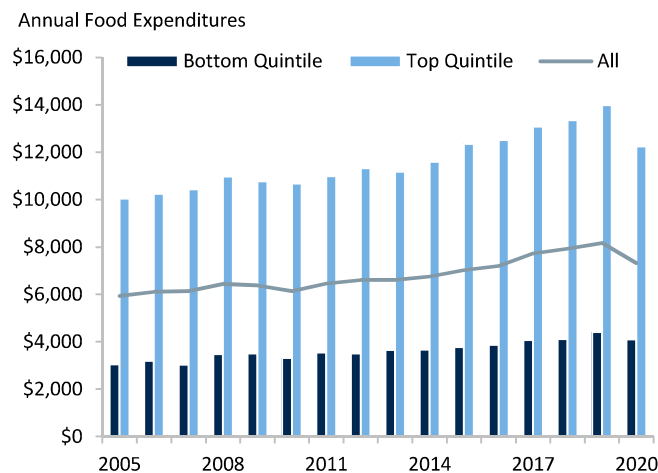
The average US household spends nearly \$7,200 per year on food, accounting for about 12.7% of total expenditures (Figure 6). Historically there has been little volatility around this figure. Over the last 15 years, spending on food as a percentage of total personal expenditures trended consistently within a tight range of 11.9% to 13% (Figure 7).

By comparison, food spend sees much less volatility than the annual expenditure on [gasoline](#). This suggests that while food prices have increased by about 2.5%, annually, for several years, the average annual after-tax income has increased at a similar rate. Given the surge in food pricing, we anticipate a larger percentage of spend allocated to food this year than has historically been the case. Here, we explore the impact of rising food prices on the wallet of the American consumer.

There is no way to sugar coat it. Food prices are high and rising. During the last decade, average household spend on food as a percentage of after-tax income was 11.2%. This was during a decade when take-home pay averaged a sliver over \$64k. The lowest-income quintile is typically the most financially vulnerable of the cohorts in an inflationary environment. This is particularly visible given that spend on food comprises nearly 34% of after-tax income for this cohort, compared to 8% for the top-income quintile.

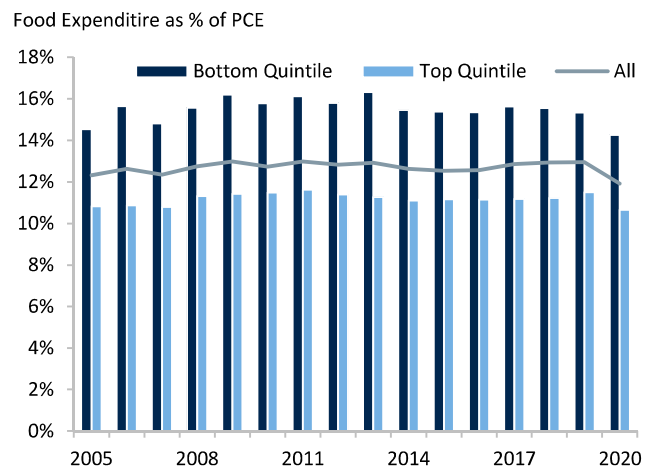
As we know, higher prices on other expenditures can potentially cannibalize food spend. So far, we find that real-time grocery basket data continues to show notional spend per trip to the grocery store relatively unchanged versus levels prior to the growing inflationary prints seen over the last 12 months.

Figure 6 – Annual Food Expenditures by Income



Source: RBC Capital Markets, BLS

Figure 7 – Food Expenditures as a Percentage of PCE





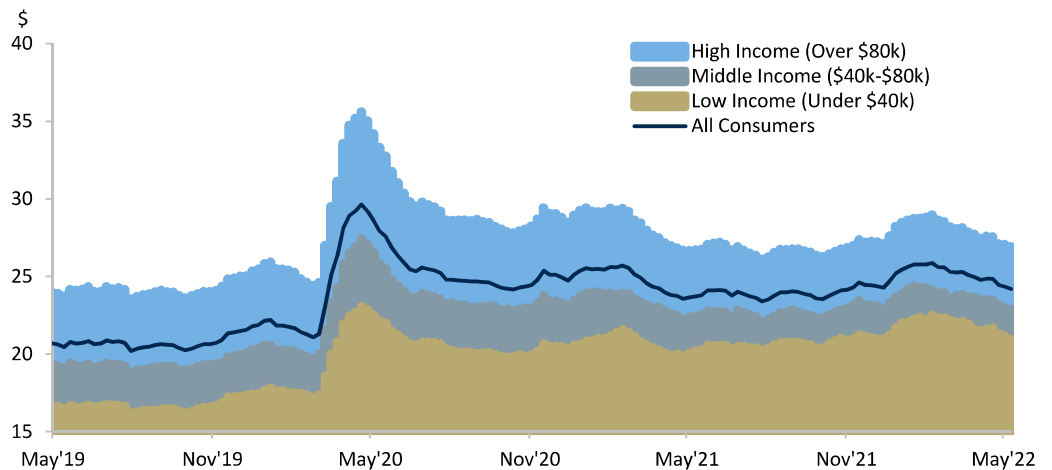
**High-income households are spending 0.6% less on food than they did last year. Low-income households are spending 6% more.**

### Quantifying Consumer Behavior

The market has focused on behavioral changes in the low-income cohort over recent months given rising inflationary pressures and the potential changes to societal behavior. Naturally, that would be the group to focus on within some discretionary consumer sectors, but could staples like food be different? Our analysis suggests this to be the case. Naturally, all income cohorts are spending more at the grocery store this year, but the most profound changes in spending, judging by metrics that we assessed, stem from the portion of the population earning more than \$40k/year. In fact, our alternative data approach indicates that the low-income consumer has yet to materially change their behavior at the grocery store.

For example, when considering spend per grocery store trip metrics on a year-to-date basis, we have found that those with annual incomes greater than \$80k are actually spending less per trip relative to the same period last year (Figure 8). On average, this cohort is spending 0.6% less per trip, which compares to a spend of +6% more for the low-income cohort with earnings below \$40k and increased expenditure of +1.9% for the middle cohort. Let's pause and consider this.

Figure 8 – Spend per Grocery Store Trip



Source: RBC Capital Markets, Numerator

**Average grocery trip transaction size has remained flat even as prices have risen by more than 13.6%.**

The notion that the delta in spend per trip is either moving lower or increasing at a rate lower than our food inflation basket suggests that either items are being dropped from the grocery basket or there exists a degree of product trade-down, i.e., reducing the number of units purchased or swapping for cheaper brands. In other words, our real-time gauge of food inflation is higher by 13.6%, YoY, but average spend is largely flat.

**As prices increase, spend per trip remains flat, units per trip fall, and trips to the store increase.**

Budgeting likely also plays a role. In the case of our recent exercise in which we used geolocation analysis to track consumer behavior at 135,000 unique US [retail gas stations](#), as pump prices rose, we found that regardless of price point, the US consumer maintained the same notional spend at each visit to the pump. Considering that the same spend does not go as far in an inflationary environment, the average person fills their car up 5.9 times per week rather than once every seven days. This phenomenon is similar to what we are seeing in real-time trips to the grocery store. Historically, if the average person made one trip per week to the grocery store, that number is now a trip every 6.2 days. We expect the current phenomenon of reasonably consistent spend per trip to persist, and the number of visits to the grocery store to increase in cadence.



Figure 9 – Units vs. Trips

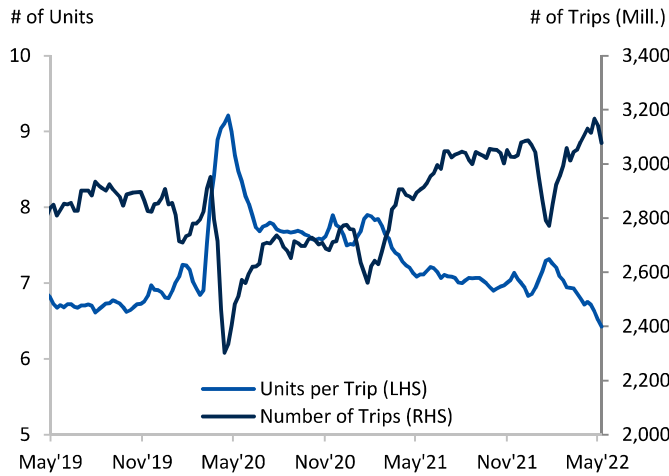
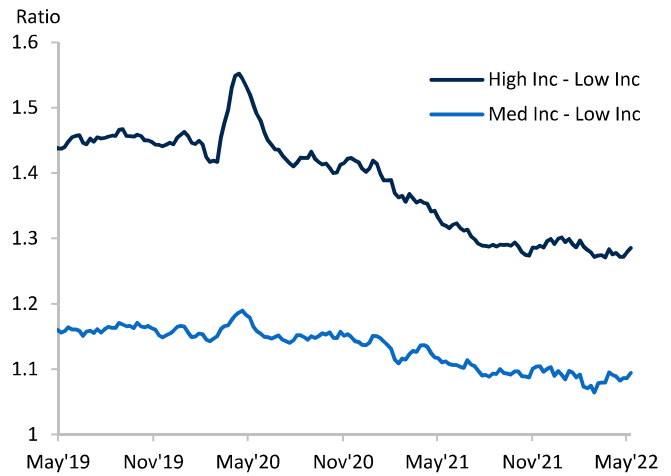


Figure 10 – Spend per Trip Ratio



Source: RBC Capital Markets, Numerator

**High-income consumers are reducing grocery spend, low-income consumers are not.**

**42% of food spend goes toward away-from-home purchases like restaurants.**

Trade-downs aside, we could make the argument that those earning more than \$80k are dropping the largest number of items from their baskets relative to the lower-income group given the decreasing spend per trip metric (Figure 10). The data platform that we collaborate with, Numerator, splits its real-time panel data into three defined groups: below \$40k is the low-income bracket, above \$80k is the high-income bucket, and everything in between these two is the medium bucket. As such, the highest-income group certainly includes individuals in the highest tax brackets, but it also comprises a wider group given the \$80k hurdle rate.

The highest-income cohort, naturally, spends more on grocery from a notional perspective, but the ratio of spend per trip between high-income and low-income has narrowed significantly (Figure 10). The weekly ratio of high-income to low-income spend on grocery has averaged 1.29 so far this year, which has compressed from an average of 1.45 over the same period in 2019 (this means that higher-income would historically spend 45% more on groceries than low-income). Given that the outright spend per trip has not deviated significantly, one would logically infer that the higher-income cohort is trading down or dropping goods from their baskets at a faster rate than the lowest-income cohort.

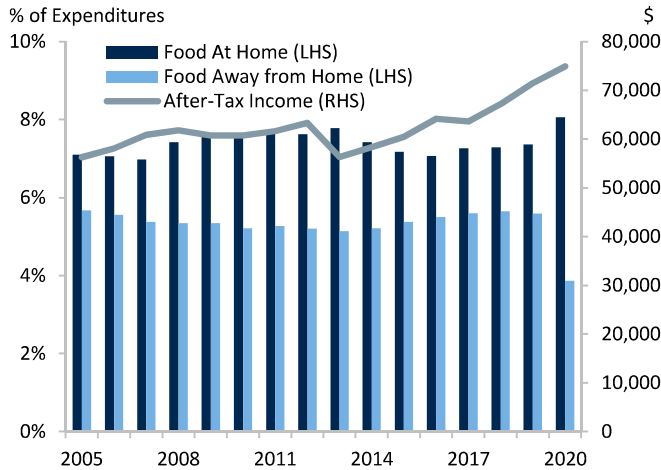
The units per grocery trip ratio between high-income and low-income has fallen from 1.22 in 2019 to 1.10 so far this year. In short, the high-income group is altering its notional spending habits and dropping goods from the basket at a faster rate than the low-income group. How do we explain this? Perhaps the low-income consumer has always been buying essentials and house-branded goods, meaning that there is little to drop and fewer cheaper options with which to substitute, regardless of pricing environment.

**Food Expenditure: Home and Away**

Historically, 58% of total US food expenditure is spent at home, leaving the remaining 42% spent away from home. The latter includes meals and snacks consumed outside the home, ranging from full-service restaurants to cafeterias to vending machines. Naturally, the splits tell more of the story, with the bottom quintile of income earners spending 67% of food expenditure in the home relative to 52% for the top quintile. The splits also suggest that the low-income cohort is more reliant on grocery than other income brackets.

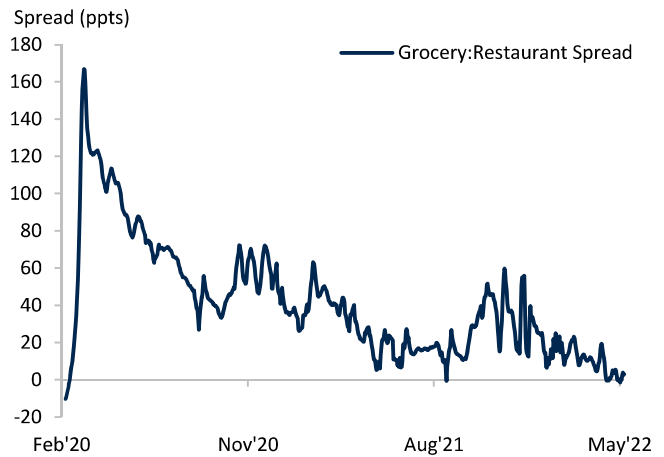


Figure 11 – At Home or Away? Percentage of Expenditures



Source: RBC Capital Markets, BLS, Orbital Insight, OpenTable

Figure 12 – Grocery Foot Traffic vs. Restaurant Reservations



**Increasing take-home pay has not resulted in a shift toward eating out.**

For this cohort, home dining accounted for 66.3% of food expenditure in 2015 and averaged 63.4% in 2019, meaning perhaps some incremental dining out, but the 2.9 percentage point change was the largest across all of the income brackets during the same period. The elasticity is less pronounced for the more affluent quintiles. The third quintile saw a 25% increase in after-tax income over the same period, but the shift in food expenditure from home to away was only 0.5%. This is also consistent across the higher-income brackets. An increase in take-home pay has not resulted in a shift toward dining out.

**We measure foot traffic through 170 grocery stores across the US to get a real-time read on demand.**

**Grocery Store vs. Restaurant Foot Traffic, a Real-Time Read**

Overlaying our geospatial intelligence tools that we designed to measure foot traffic across 170 conventional US grocery stores with US aggregate restaurant reservation data from OpenTable indicates that the ratio of grocery store visits to restaurant visits has reverted to flat (see Figure 13). To be fair, this ratio compares both the difference in grocery foot traffic relative to the difference in restaurant reservations, both as percent changes in relation to 2019 levels. Simply put, the COVID-era trend favoring cooking at home at the expense of dining at restaurants is over.

**Grocery store prices outpaced increases at restaurants by roughly 3 percentage points in April.**

For reference, the grocery to restaurant spread printed as wide as 166 during the peak of lockdowns during the early days of the COVID period and averaged 42 in the COVID era. Naturally, the directional arrows of progress suggest this is a function of easing restrictions and sentiment around COVID. This is likely true, and corroborated by our Get Out and Live Index ([GOAL](#)), which continues to suggest a strong propensity toward normalization (see Figure 13).

However, we offer an additional point to deliberate: the rate of change in prices for food at home is increasing at a faster pace than for food away from home. According to the latest monthly data from the Bureau of Labor Statistics, food at home is not only rising at a faster rate than the CPI measure of food away from home, but indexed to Apr'19, or 36 months ago, the price of grocery has become more expensive than the price of dining away from home (see Figure 14).

*Note: To conduct our geospatial analysis, we drew geo-fences around 170 conventional grocery stores across 39 US states and monitored daily percent changes to foot traffic relative to 2019 levels. This allows for relative value comparison against the congruent OpenTable data. Our sample of geo-fenced areas of interest is distributed evenly to loosely mirror the grocery landscape of the US. In store selection, we chose the most common grocery chain in each relevant US region.*

Figure 13 – US Get Out and Live Index

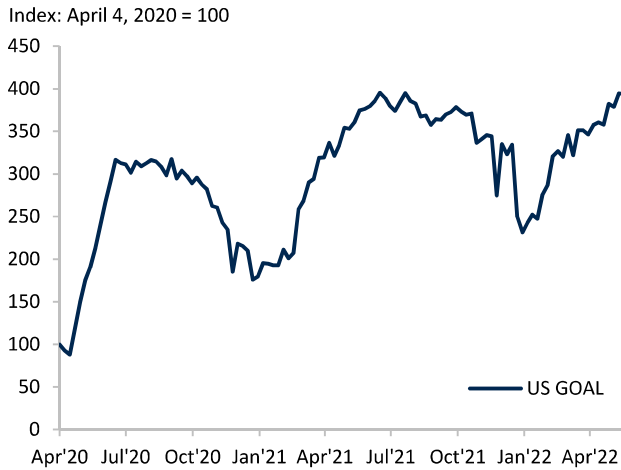
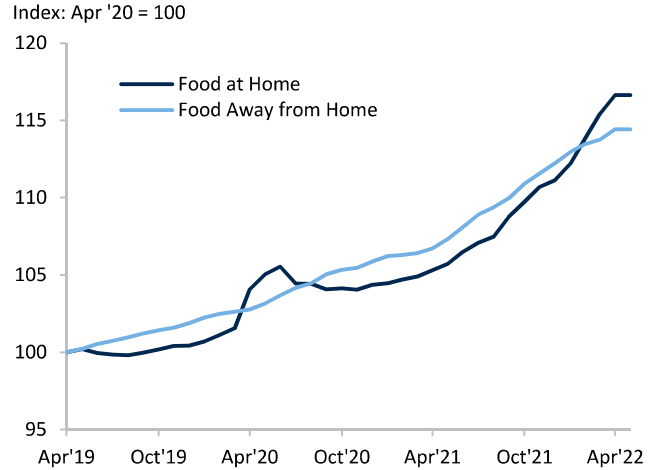


Figure 14 – Changes in Food at Home and Away Inflation



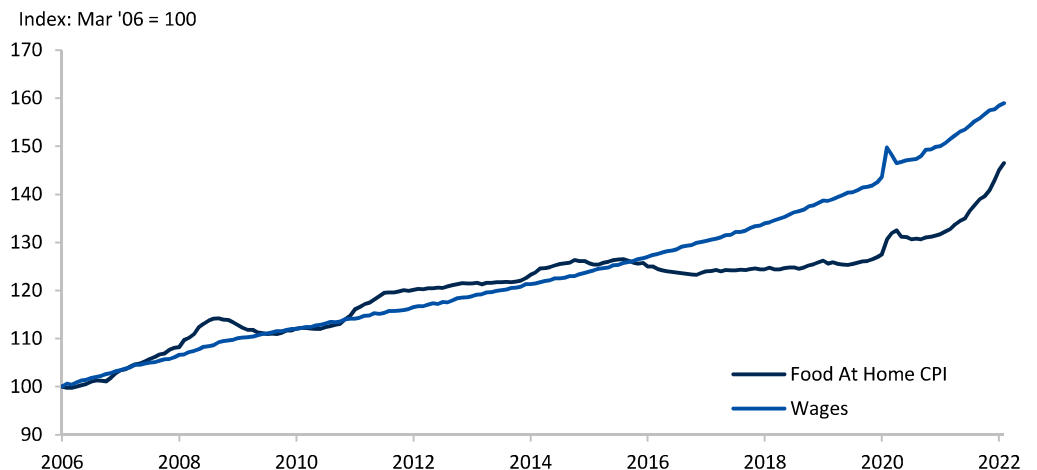
Source: RBC Capital Markets, RBC Elements, BLS, Google Mobility, TomTom, OpenTable

To be clear, this is not a relative value measure suggesting that it is cheaper to dine out than at home on a per-meal basis. Instead, this data suggests that preparing a meal at home today costs more than it did previously when compared to the rate of change in dining out and having the same entrée at a restaurant. This is indicative that dining out is more expensive than it used to be on a notional basis but cheaper than it used to be relative to dining in. In short, food away from home has not seen prices rise as fast as grocery. This raises questions on the margins for restaurants, which are facing not only higher food costs but also upward pressure on rent and wages. The bottom line is that inflation for food at home hit 10.8%, YoY in April, vs. 7.2% for food away from home.

**Further Upward Pressure on Food Prices to Be Expected?**

Historically, increases in wages have been matched by commensurate changes in food-at-home prices. However, the two series decoupled starting in May'15. As wages rose, grocery prices remained flat. The onset of the COVID-19 pandemic has accelerated food-at-home prices, which are now rising at twice the pace of wages. Food prices must rise by an additional 9% in order to recouple with wages.

Figure 15 – Food-at-Home CPI vs. Wages



Source: RBC Capital Markets, BLS



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## Equity Analyst's Perspective

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## Nik Modi, Packaged Food, Beverages, Household Products, and Tobacco

### What level of input cost inflation are companies experiencing?

CPG companies are experiencing cost inflation in the double-digit range on average. Importantly, many companies have hedges in place for 2022, resulting in lower realized cost pressure than what would have been implied by spot prices. This, however, will result in inflationary pressures lingering into 2023. In terms of individual input costs, companies are seeing large increases in the energy commodity complex (also affecting transportation costs), agricultural and ag-linked commodities (grains, coffee, proteins, edible oils), and several packaging materials (paper, corrugated cardboard, metals, resins). Labor has also been a pressure point, with companies struggling to fill manufacturing and distribution jobs and having to pay higher wages. Most companies have updated their commodity guidance with Q1 earnings to reflect the higher commodity prices, exacerbated by the Russia-Ukraine conflict, but we continue to see potential risk in the balance of the year given continued geopolitical uncertainty (Finland and Sweden asking to join NATO, Russia using its energy exports as a bargaining chip, China-Taiwan tensions).

### How is pricing realization evolving?

In order to offset cost inflation, most CPG companies have implemented multiple rounds of price increases (with some companies already in their third or fourth round of pricing). Price increases across CPG categories have been in the high-single- to low-double-digit range. So far, CPG price increases have been getting through without much pushback, expect for a handful of situations. However, our retail contacts have indicated that price increases from the consumer staples companies are seeing a lot more scrutiny. We expect that price increases will become much harder to realize in 2H'22, especially given the significant margin pressure felt by large retailers, such as Walmart and Target, which is likely to result in increased pushback on their suppliers (i.e., CPG companies). Additionally, while price elasticities remain below historical levels, we believe we may see a worsening after the summer, as consumers reassess their financial situation. We continue to worry that 2H guidance ranges for many companies rely on a level of pricing that we are skeptical will materialize as expected by management, as this could be partially promoted back due to a weakening consumer backdrop and retailers increasingly coming under margin pressure.

### What is the current demand environment?

The companies we cover are generally indicating that the demand environment in the US remains solid, with trends for at-home food and beverage categories still above pre-COVID levels and the on-premise channel recovering with increased mobility. We believe this is, in part, being driven by “revenge spending,” a term used to describe consumers’ impulse spending on experiences and goods after more than two years of living through COVID. We believe this phenomenon will continue throughout the summer, with pent-up demand for travel and experiences, but once we reach the fall, we expect that consumers will have to reassess their financial situation due to rising credit card balances as a result of inflationary pressures and their spending patterns. We are also starting to see volume declines in scanner data in the low- to mid-single-digit range for food, beverages, and HPC categories as incremental price increases are implemented. We expect further pressure on volume trends for CPG companies in the balance of the year as consumers feel more the pressure of general inflation, we cycle the benefit of stimulus, and private-label supply chain issues abate, potentially resulting in improved private-label market share performance.



## Irene Nattel, Consumer Staples and Discretionary

### What's driving food price inflation?

Average food purchased from stores CPI in Canada is up +8.1% YTD, including +9.7% in April, the highest on record going back to 1981 when it reached the mid-teens. Our research indicates that supply chain dislocation and wage pressure underpinned the initial run-up, with COVID-related absenteeism significantly exacerbating the impact of tight labour markets. While structural labour vacancies are planned events that can be managed with augmented wages and benefits, and adjustments to production schedules and plant output, health-related absenteeism by contrast is unplanned and unpredictable, further disrupting operations and raising production costs. This is particularly true of meat production facilities, where adequate staffing is critical to line operations and where confined spaces and labour intensity challenge physical distancing requirements. With the passing of the Omicron wave, anecdotal evidence suggests that pandemic-related absenteeism is normalizing as of Q2. Looking ahead, however, the outlook for key agricultural commodities and fuel is much less constructive.

### What are *consumers* saying about food price inflation and its impact on behaviour?

While grocer basket inflation typically runs lower than CPI due to real world substitutions vs. a theoretical CPI basket that is largely fixed, consumers are clearly feeling the pinch. More than half of respondents to the [grocery-focused consumer survey](#) we ran at the beginning of the year indicated that food prices are rising much more quickly than income. Against this backdrop, consumers indicated adopting a broad range of strategies to ease the burden and, in our view, the surge in fuel prices is likely reinforcing these behaviours. Most notable among these: shopping around for best deals (47% of respondents), paying closer attention to weekly flyers (42%), making better use of coupons (34%), substituting for lower-priced items (40%), and moderating restaurant spend including delivery to the home (38%).

### What are *grocers* saying about food price inflation and its impact on behaviour?

Predictably, survey results were consistent with the grocer narrative since H2/2021 and which intensified with CQ1 results, namely: i) channel shift in favour of discount banners; ii) mix shift in favour of private brands; iii) deeper penetration of sales on promotion; and iv) greater consumer engagement with loyalty programs to capitalize on incremental value opportunities. Against this backdrop, promotional penetration is back to pre-pandemic levels and rising, both in-store and online, and grocers are adopting more tactical merchandising and pricing strategies and leveraging consumer data to protect share and margins.

### What are *processors* saying about inflation and its impact on operations and consumer behaviour?

Nonetheless, shifting consumer behaviour appeared to be somewhat selective in Q1, with one notable animal protein processor indicating that demand had been inelastic to pricing initiatives implemented prior to Q1, reflecting brand strength and revenue management capability. In particular, the company reported evidence of sustained migration toward its high-margin portfolio of sustainable meats, an indication that, so far, consumers are unwilling to compromise in certain categories. However, with acute inflation in labour, input costs, packaging, ingredients, and freight, and another round of price increases implemented in early Q2, we could see a period of transient volume contraction as 2022 unfolds and consumers adjust to new pricing. According to this processor, the key caveat to further price action looking ahead is the war in Ukraine and its impact on commodity prices, notably animal feed and energy.

## Steve Shemesh, Consumer Discretionary

**How does inflation in food compare to other segments, and will consumers soon see even higher prices?**

Generally speaking, inflation in food has been higher than in other consumer categories and has ranged from MSD to LDD depending on the item/category. Given the inelastic demand for groceries and industry pricing dynamics, we think it is often easier for companies to pass through food inflation relative to general merchandise. We note that through the latest reading (April), core CPI lagged core PPI by ~270 bps as retailers ate some of the supplier price increases in order to keep prices low for consumers.

Now that retailer margins have come under pressure; we suspect that dynamic may soon change. We anticipate that retailers will begin to push back more on supplier price increases and will end up raising list prices in-store to curb the slew of margin headwinds currently being felt. This may end up somewhat accelerating consumer softness, especially in more discretionary categories.

Over the past few weeks, it's become crystal clear that inflation is beginning to have an impact on consumer purchasing behavior. Numerator Insights data suggests that food inflation has driven consumers to buy fewer units per trip (or perhaps smaller pack sizes), seemingly in an effort to keep the overall ticket unchanged.

**How has food inflation impacted general consumption trends?**

This has resulted in consumers on average returning to the grocery store more frequently. Importantly, we believe grocery/gas inflation has resulted in less spend in more discretionary categories. Several companies in our coverage universe recently called out a mix shift away from general merchandise and toward food/consumables. They also called out a somewhat sudden drop-off in categories such as kitchen appliances, electronics, furniture, and apparel. With persistent inflation, it's hard to imagine that these trends won't continue.



## Christopher Carril, Restaurants

### What is the current demand environment like in restaurants?

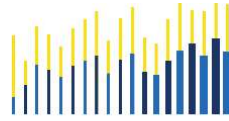
Aside from Omicron's impact to begin the year and the lapping of last year's stimulus tailwind, domestic restaurant demand has generally remained steady, with little indication thus far that trends have materially decelerated. For instance, weekly trends for casual dining—a segment of the more "discretionary" full-service restaurant industry—have remained in the +MSD to +HSD % range from late March through the end of April, despite growing inflationary pressures on the consumer. We continue to believe that in the very near term, pricing actions, improving mobility, and pent-up demand should continue to support restaurants' top lines. However, we expect this will likely increase focus on 2H22 trends as these tailwinds normalize. In the meantime, we will be watching for leading indicators of changes in restaurant demand or consumer behavior at restaurants, including pricing flow-through, average check size, and trade-up/down between value and premium menu items. International trends, meanwhile, will likely remain mixed, with improving mobility in certain regions helping to offset headwinds elsewhere (e.g., Russia, Ukraine, China).

### How has cost inflation impacted restaurant margins?

More worrisome for restaurant operators, however, are growing inflationary pressures on profitability and margins. Thus far, it appears that labor pressures have largely stabilized, though costs have remained elevated year-to-date. However, commodity and food prices remain volatile and remain a challenge even to restaurant brands with significant scale. Across our coverage, as of 1Q earnings reports, commodity basket/food cost inflation is expected to be in the +low-double-digit to mid-teens % range in 2022, with these estimates up materially from only a quarter ago. Note that restaurant companies' inflation estimates are also impacted by how much and when companies choose to contract out specific items, with some companies choosing to float costs of certain items. In addition to food costs, restaurant companies have also called out higher freight costs as weighing on margins.

### How are restaurants responding to margin pressures?

Given the elevated cost inflation levels described above—on both the labor and food cost sides—aggregate pricing actions at restaurant brands over the last year will continue to keep pricing well above historical levels, with some large chains running in the +HSD % range. While pricing is in line with or lower than that of food-at-home pricing, the risk for restaurants is negative traffic impact as a result of these actions. Thus far, many restaurant companies have noted that they have seen little resistance to pricing, though some large fast food brands—including McDonald's and Wendy's—have quantified flow-through from pricing in the 70–85% range. And while some restaurant companies have indicated that they believe they have further pricing power should the cost environment worsen, we will be watching to see whether they pull this lever again amid current pressures on the consumer.



## RBC Elements™

Driving insights through data

### Description

RBC Elements™ is a primary research and data science team embedded within RBC's Global Research division. The main focus of RBC Elements™ is to use scientific methods, algorithms and systems to analyze vast amounts of structured and unstructured data, to obtain insights that are inputs into RBC's Fundamental Global Research teams.

### Objective

The team is involved in creating various machine learning and predictive modeling tools and processes, helping RBC Research discover the information hidden in big data, and allowing the Research division to make smarter decisions and deliver differentiated products to our clients. RBC Elements™ strives to augment the already available industry data with different alternative data sources, and enhance data collection procedures to include information that is relevant.

### Methods

The team is implementing different machine learning and data mining algorithms using state-of-the-art methods. Examples include:

- Machine learning techniques and algorithms, such as k-NN, Naive Bayes, SVM, Decision Forests, Clustering, Artificial Neural Networks, and Natural Language Processing to find patterns in the past, and to predict the future.
- Feature selection techniques to find what matters most in the data.
- Statistical modeling and analysis, and statistical tests such as distributions, and regression/GLM.
- Developing hypotheses and making inferences using large amounts of data.



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