# A New Model for Core Inflation

Tristan Gacon for PragmaOne.com, August 2022.

The US central bank uses core inflation as the primary indicator for measuring inflation in the United States. Indeed, core inflation excludes two volatile elements: energy subject to geopolitical hazards and food inflation subject to weather hazards. Through its monetary policy decisions, the Fed has the means to influence consumption and, therefore, core inflation. In March 2022, core inflation was measured at 6.5%, a 40-year high.

In this working paper, we propose a new model of core inflation, considering the supply shock recorded during Covid. In the first part of this paper, we model core inflation by looking for the most relevant economic indicators for the 15 years before Covid. In the second part, we model the impact of supply shortages and identify variables capable of measuring this impact. Finally, we propose a forecast for future core inflation for the next 12 months, considering both traditional and supply variables.

## Pre-Covid Models

We study the pre-Covid period until the end of 2019 and calibrate our core inflation models over the last 15 years, using quarterly data.

Starting from the study conducted by Banerjee and Marcellino (2002), we consider a wide range of explanatory variables, including economic activity variables, consumption variables, monetary expansion, sentiment... We begin by selecting the best unit variables explaining core inflation over the pre-covid period. We have chosen **four variables: GDP, industrial production, retail sales, and shelter inflation** (see our other paper “forecasting shelter inflation”).

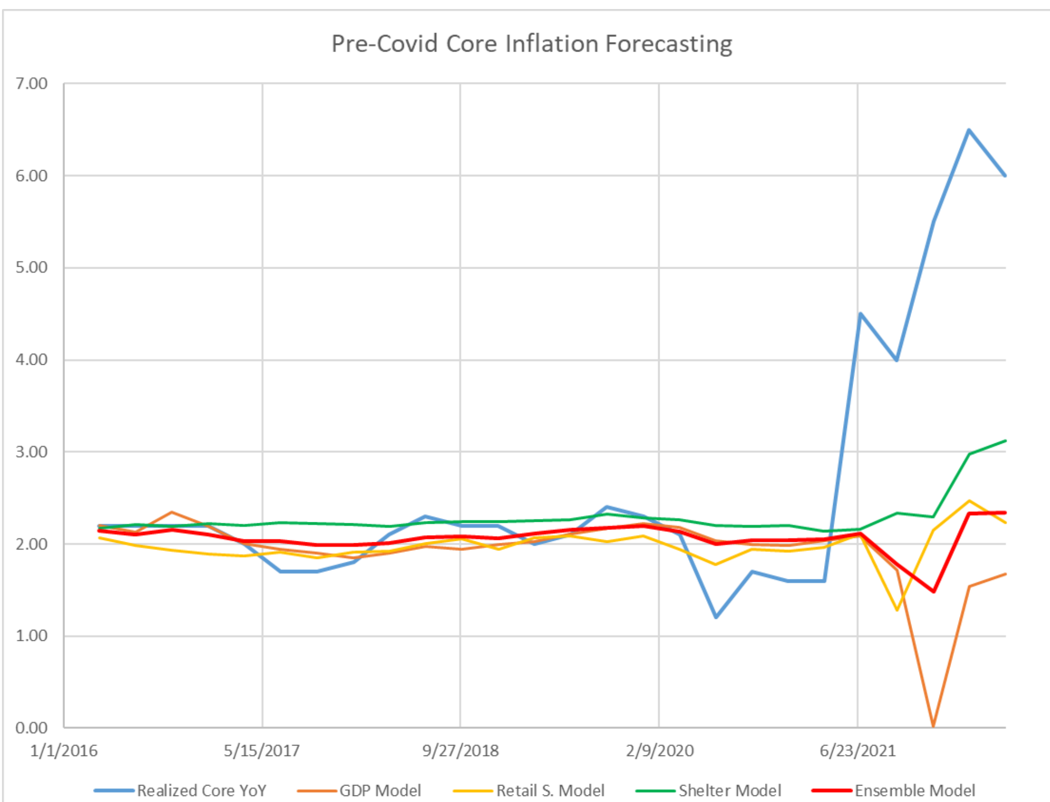
We explain the year-on-year core inflation realized between t and t+4 quarters, with explanatory variables measured at dates in the past (t-2 for example being the observation 2 quarters before the estimation date). **Each model is univariate**. The main statistics of these models are summarized in Table 1 provided opposite. **The ‘ensemble model’ represented by the red line, averages out the predictions from GDP, retail sales and shelter.**

We can see from graph 1, that the estimators provided by those models do not cope well with the Covid situation, from 2021, when inflation exhibits a fast surge induced by supply shortages together with strong demand: the **forecast error reaches 4.2% in Q1 2022.**

TABLE 1 – MODELS CALIBRATED PRE-COVID

| | Model1 | Model2 | Model3 | Model4 |
|---|---|---|---|---|
| **Intercept** | 1.57 | 1.90 | 1.70 | 0.96 |
| **Real GDP YoY t-2** | 0.1974 | - | - | - |
| **Industrial Production YoY t-2** | - | 0.0707 | - | - |
| **Retail Sales YoY t-2** | - | - | 0.0764 | - |
| **Shelter inflation t** | | | | 0.395 |
| **Adjusted R^2** | 0.64 | 0.55 | 0.55 | - |
| **RMSE** | 0.25 | 0.28 | 0.28 | 0.34 |
| **F-score** | 106.70 | 72.3 | 74.10 | - |
| **Out-Of-Sample RMSE** | 1.39 | 1.34 | 1.14 | 1.09 |

GRAPH 1



## Modeling the Supply Shock

Covid has had a significant impact on the economy: on the one hand, production chains have been stopped totally or partially to preserve the health of workers, which has led to **supply problems** in other industries, such as electronics or automotive; on the other hand, **the government's policy of supporting consumption by distributing cheques also contributed to an increased consumption of durable goods. The coincidence of these two effects has led to extra inflation associated with the saturation of the production chain.**

In this section, we try to model this phenomenon, that is, to adjust the predictions provided by pre-covid caliber models, by identifying **relevant variables:**

- The **cost of shipping**, **measured by the Drewry shipping index**. The Drewry index measures the average cost of shipping containers across the main routes. The cost of shipping containers represents well the effect of excessive demand and the shortage of logistic workers. Since the cost of shipping also depends on the price of oil, we must adjust it to be neutral to oil prices (1),
- The **manufacturing delivery times** recorded by the New York and Dallas Federal banks illustrate the shortages experienced by real businesses. Using delivery time and backlog statistics is suggested by Santacreu and Labelle (2022). We consider the average of both data as our variable.
- The **Global Supply Chain Pressure Index,** calculated by the NY FED, combines shipping and airfreight costs, delivery times, manufacturing backlogs, and inventory. More details about the index can be found in Benigno and al (2022). We will take the 12 months rolling average of the GSCPI as a variable.

The graphic illustrations (Graph 2) exhibit a significant change in those variables during Covid: shipping costs were multiplied by six, and delivery times reached all-time highs. We can see, however, that all variables are now pointing to normalization.

Our task is difficult, considering the limited amount of data to model a one-time event. Thus we will not seek to calibrate regression statistics but to **estimate a coefficient to match the peak of the estimation error from our pre-covid models with the peak of the 'shortage variables'**. And then, select the best variable or average out the extra inflation contribution across the variables.

Practically, we are going to look only at abnormal values of those variables beyond a level considered statistically improbable in normal time. We will **trim the variable to neglect its value when it is within 2.5 standard deviations from its mean** (corresponding to a 99.5% quantile). **The value above this threshold represents the supply glut experienced**. Both mean and standard deviations are measured from 2004 to 2019.

**Trimmed variable = Max(variable - K, 0),**

**with K = mean(variable) + 2.5 * std(variable)**

Table 2 displays the statistics for the three selected variables of shortage, including the thresholds and the coefficients to match the forecasting error at its peak. We used 1 and 2 quarters lags to adjust for the best fit. We can observe the results in Graph 3, with shipping in red as the best variable and the average of the three effects in blue.

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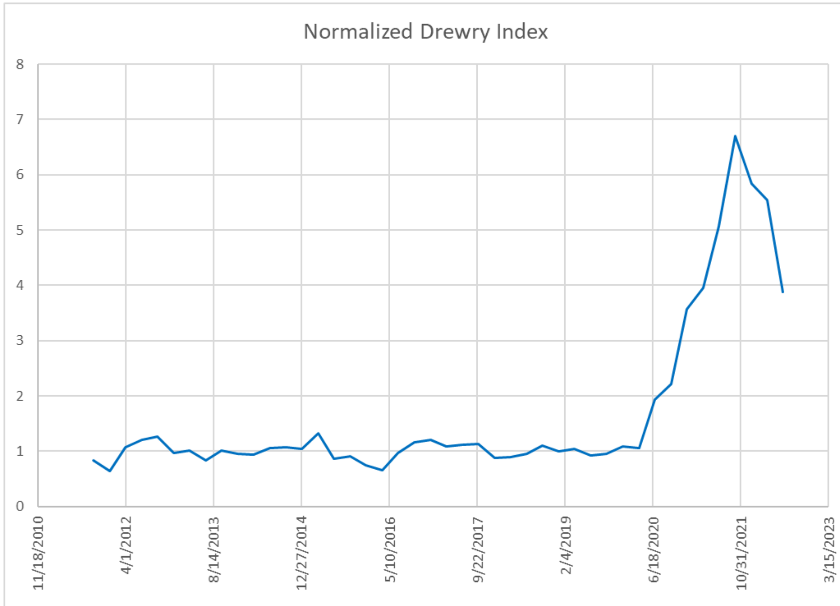
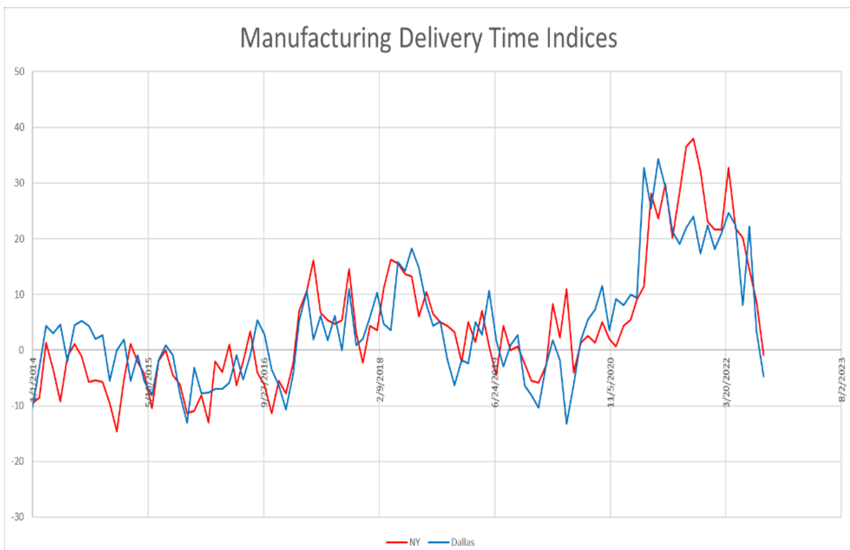
1. We estimated a regression from 2011 to 2019 to assess the dependency of the Drewry shipping index to oil prices, measured by the Brent prices with 2 quarters lag. We obtain a theoretical Drewry index = 11.42 x Brent(t-2) + 678. The normalized shipping index is obtained by dividing the observed Drewry index by its theoretical value: Drewry / (11.42 x Brent(t-2) + 678).

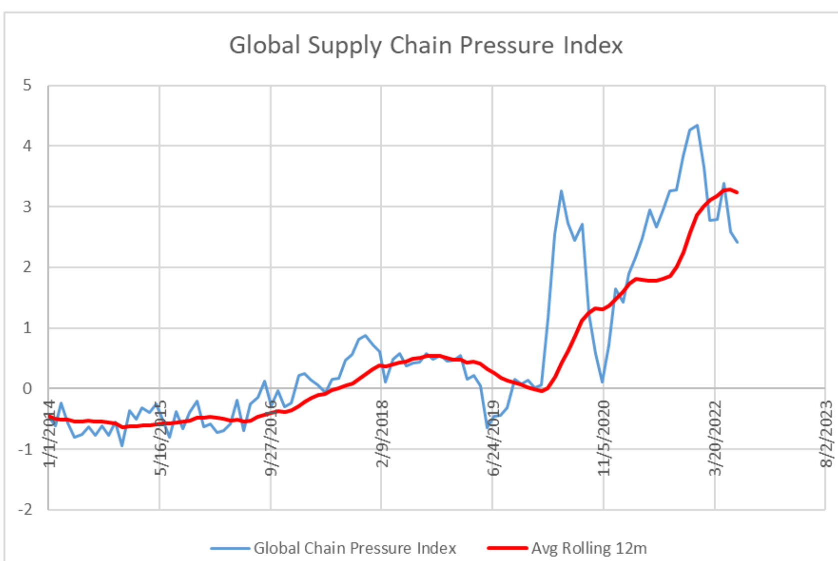
GRAPH 2



Normalized Drewry Index
8
7
6
5
4
3
2
1
0
11/18/2010
4/1/2012
8/14/2013
12/27/2014
5/10/2016
9/22/2017
2/4/2019
6/18/2020
10/31/2021
3/15/2023

Manufacturing Delivery Time Indices
50
40
30
20
10
0
-10
-20
-30
2/9/2018
11/5/2020
3/20/2022
8/2/2023
NY
Dallas

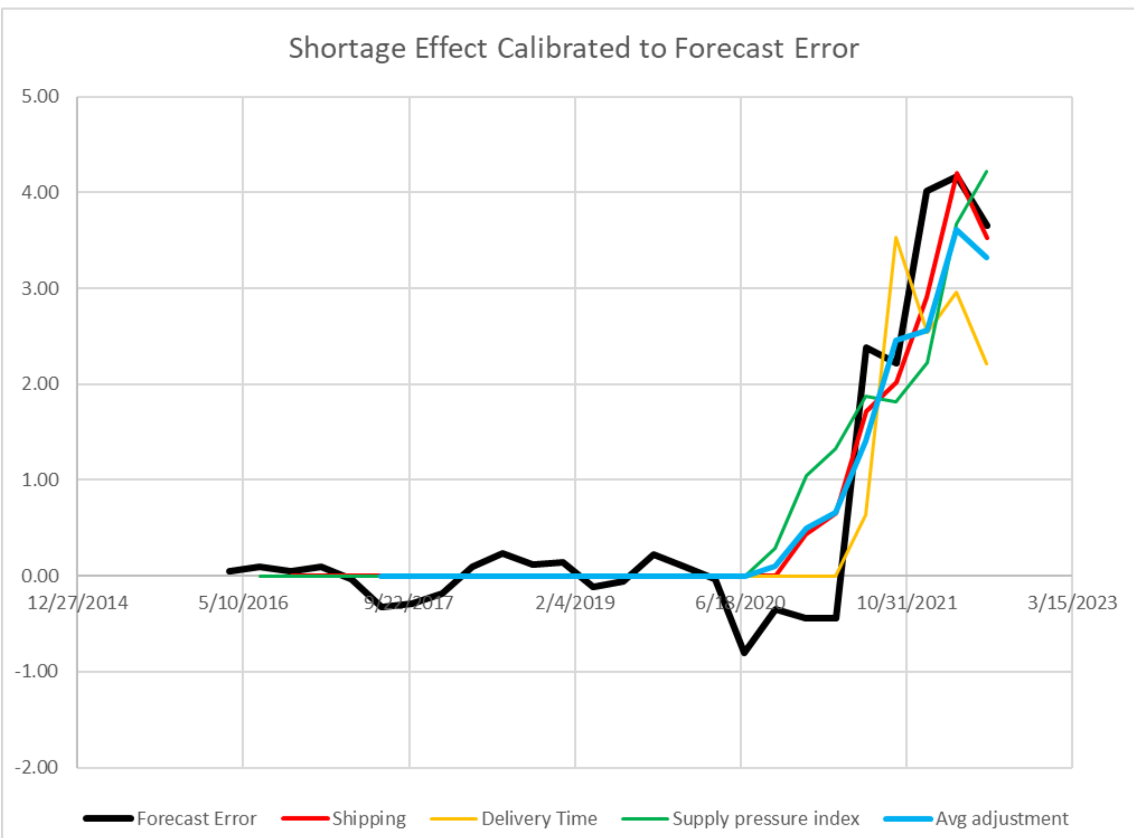



Global Supply Chain Pressure Index
5
4
3
2
1
0
-1
-2
2/9/2018
11/5/2020
3/20/2022
8/2/2023
Global Chain Pressure Index
Avg Rolling 12m

TABLE 2 – STATISTICS FOR 'SHORTAGE VARIABLES'

| | Normalized shipping | Delivery Time | Supply Pressure Index |
|---|---|---|---|
| Mean | 1.00 | -0.80 | -0.17 |
| Max | 1.33 | 15.75 | 0.61 |
| Min | 0.65 | -17.20 | -0.66 |
| StD | 0.15 | 6.17 | 0.35 |
| K | 1.39 | 14.64 | 0.70 |
| **Coef** | **0.79** | **0.26** | **1.29** |
| Lag | -2 | -1 | -1 |

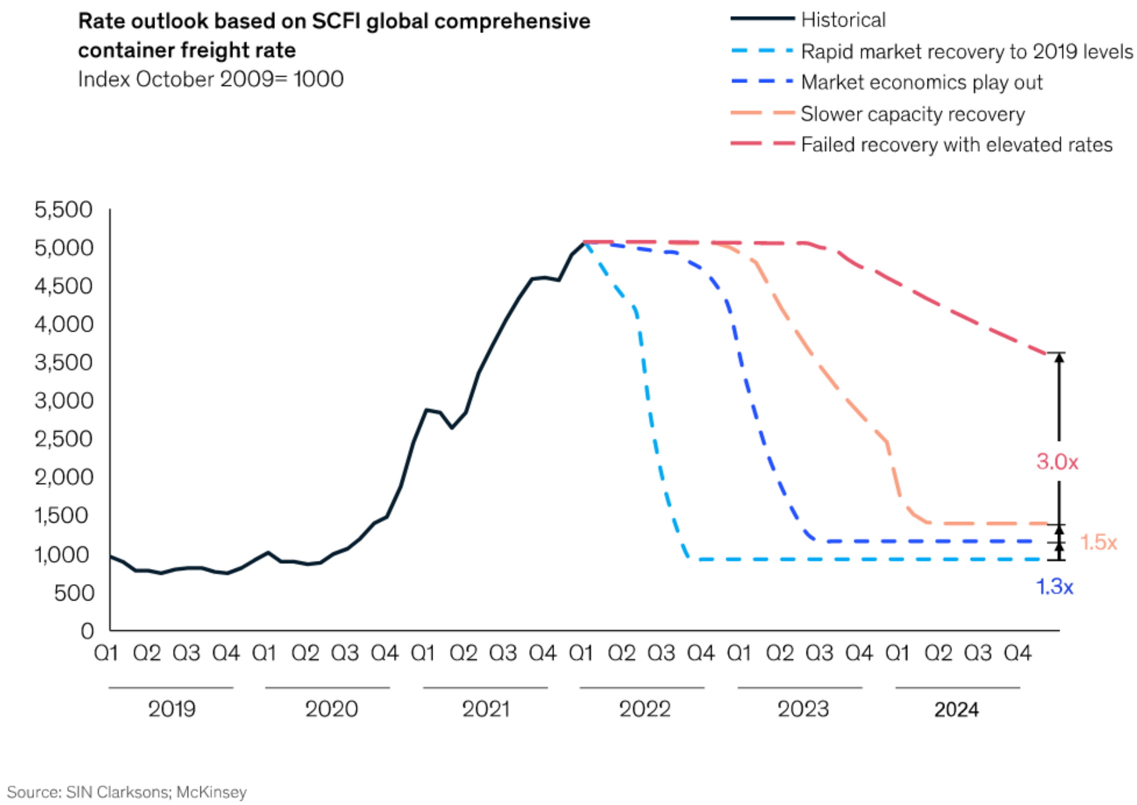
GRAPH 3



**Scenarios for the Shipping Costs**

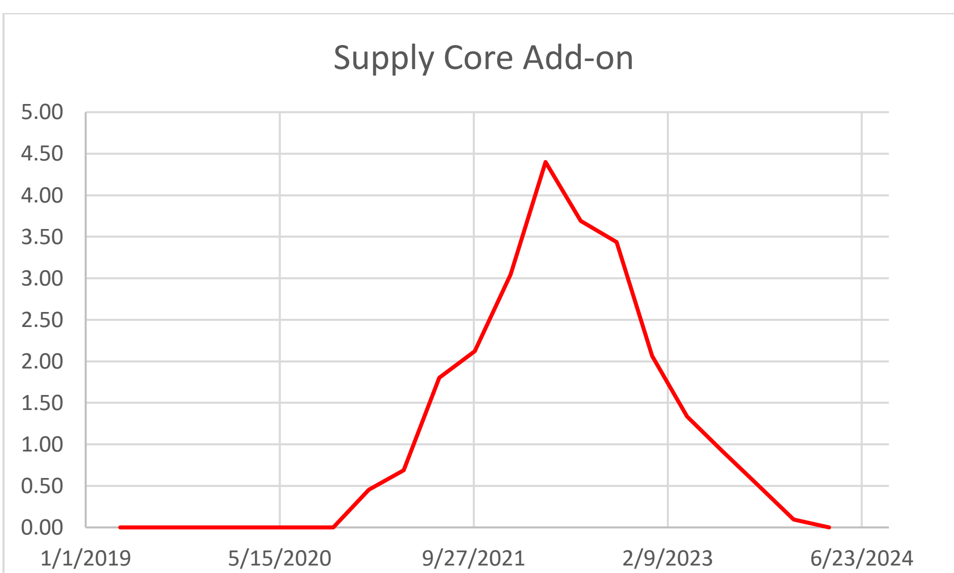
Practically, we will use the shipping cost as our main indicator, as it both has the best fit, and we can find scenarios for its evolution as published by McKinsey's experts (2022). Compared to the scenarios released in March 2022, the current situation is between both blue curves.

GRAPH 4




We obtain the following **'inflation add-ons'** associated with supply and bottlenecks: we can notice that those **phase out until the end of 2023.**

GRAPH 5



**Putting Things Together**

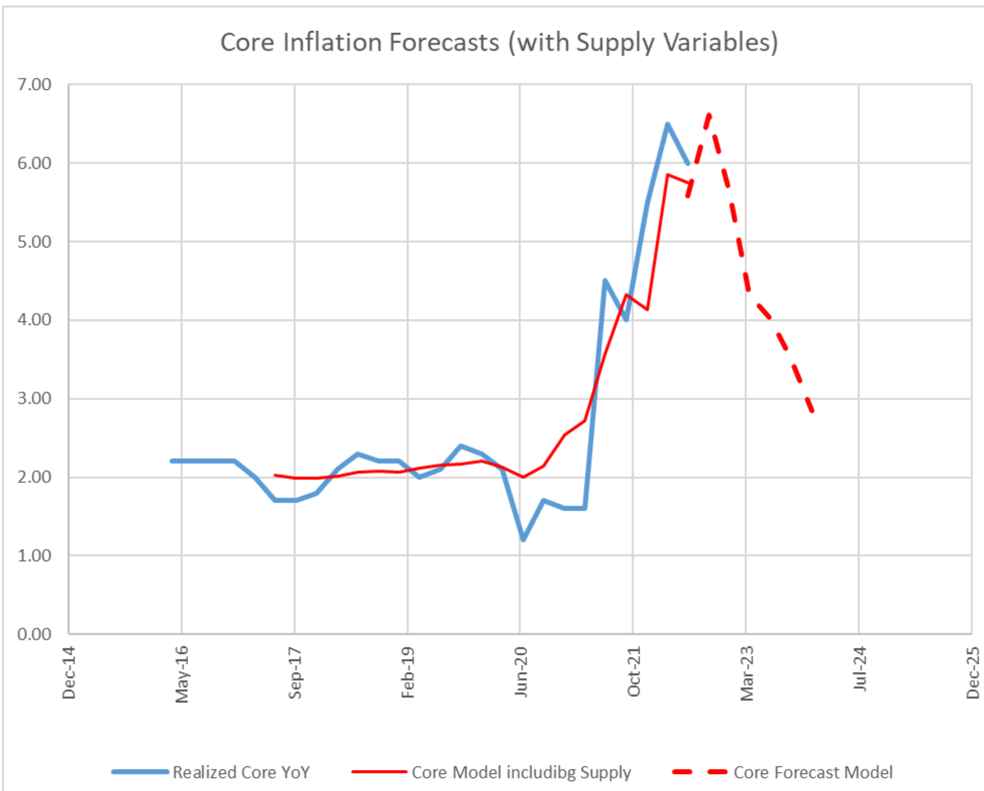
We build our final forecast for US core inflation using Housing and GDP projections published by Fannie Mae in their August reports to feed our shelter and GDP inflation models. Table 3 presents those hypotheses. Then we derive our Core CPI forecasts, using the supply add-on described above.

TABLE 3

| | 2022 | | 2023 | | | |
|---|---|---|---|---|---|---|
| | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| **GDP (Q SAAR)** | 1.40 | 1.10 | -0.60 | -1.60 | -0.50 | 1.00 |
| **Housing HPI (YoY)** | 17.40 | 16.00 | 11.30 | 7.80 | 6.30 | 4.40 |

SourceL Fannie Mae research

GRAPH 6




We observe that **we expect core inflation to peak in September 2022, reaching 6.5% year-on-year, then declining to reach 4% by June 2023, and finally slightly below 3% at the end of 2023.**

Obviously, those predictions rely on scenarios that might materialize differently.

## References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