FINAL REPORT

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WYOMING DEPARTMENT OF TRANSPORTATION

STATE OF WYOMING

Construction Cost Inflation Model

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16. Abstract:

Federal legislation requires state departments of transportation to consider and apply inflation to the costs of transportation projects. However, there is no guidance on how inflation should be calculated. Previous research on this topic primarily focused on developing construction cost indexes. Previous methods of prediction included neural networks and statistical modeling. We used producer price indexes from the Federal Reserve Economic Data to calculate inflation rates and built auto-regressive models to predict inflation for nine cost categories: Asphalt, Bridge Metal, Concrete, Excavation, Gravel, Liquid Asphalt, Reinforcing Steel, Structural Steel, and Non-Supervisor Construction Wages. The models were not very good predictors of 2024 inflation by category. However, when the inflation rates were averaged, the predicted inflation rate for materials outperformed 2024 estimations for the previous methods used by the Wyoming Department of Transportation.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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Problem Statement
The Wyoming Department of Transportation (WYDOT) utilizes a continuous and comprehensive planning process to determine transportation system project selections. Engineering studies, performance management analysis, asset management systems, and professional judgment of engineers are used to select the transportation system projects that are incorporated into the Statewide Transportation Improvement Program(STIP).

Federal legislation requires state departments of transportation to consider and apply inflation, but do not tell them how to do so. In 2007, WYDOT developed a framework to address inflation. The key issue was, as inflation changed over time, it was not being consistently applied to the life of STIP projects, which was causing projects to move in the STIP due to lack of budget. An inflation committee was established within WYDOT, composed of the State Construction Engineer, State Programming Engineer, Budget Program Analyst, a District Engineer (on a rotating basis), and led by the Contracts and Estimates Office program manager.

Last year, WYDOT's current Contracts and Estimates Engineer presented three construction cost index (CCI) calculation methods his office has historically used, along with the corresponding results when including 2021 data. First was the Spear method. This method was developed by the previous Contracts and Estimates Engineer. It compares the current year's data to a 10-year data set average, starting in 1997. Second was the Rolling 10 method. This method uses a "rolling" 10-year data set that considers the last 10 years, including the present year, to calculate averages for comparison. Third was the Fisher method. This method compares the current year to the previous year.

There are a few flaws with the CCI methods used. The Spear and Rolling 10 methods struggle with years where the product bundle purchased deviates away from the average. The Fisher method focuses exclusively on recency, which may overemphasize years, like 2022, where we have irregularities with inflation.

Committee members discovered there are many different calculation methods and indexes out there with wide ranges of results. The committee concluded that they do not have the expertise or background to determine which calculation methods and indexes are the most appropriate for WYDOT's business needs. The committee based their inflation recommendations on the Contracts and Estimates Engineer's recent contracts and estimates observations, the Rolling 10 method, and Fisher method for construction cost calculations. Committee members recommended using an inflation rate of 4.5 percent for projects within STIP and 4 percent inflation for long term asset management purposes. These projected rates fell well short of actual inflation in 2022, which, using the methods mentioned above, was over 50 percent in 2022. The committee recommended that WYDOT look into a research study to help determine how, and by whom, inflation rates should be calculated.

Background Statement
The STIP is a continually updated snapshot of planned construction, construction engineering, and preliminary engineering costs of the projects and the splits in funding sources (federal, state,

local, and other) for each project. It is a six-year, fiscally constrained program that is approved annually by the Transportation Commission. The current STIP program is fiscally constrained for the years 2023-2028. Changes in state and federal funding, construction costs, re-evaluation of priorities, economic conditions, and conditions of roadway assets can and do occur during the year, making the scheduling of projects a complex undertaking and requiring the STIP to be fluid. Changes to the STIP are approved by the Transportation Commission.

The Federal Highway Administration(FHWA) developed the concept of a highway construction cost index(HCCI) in 2003 to replace the Bid-Price Index (GAO, 2022). A HCCI uses data from construction bids to determine which factors, ranging from asphalt to traffic control, are moving the most and driving the market bids on construction. The most common categories in HCCIs are as follows: Asphalt, Base Stone, Bridge, Concrete, Drainage, Electrical, Grading/Excavation, Traffic Control, and Utilities.

WYDOT has tracked a CCI that includes Excavation, Crushed Rock, Mainline Asphalt, Performance Grade Binder, Non-Performance Grade Binder, Tack, Concrete Pavement, Structural Steel, Class Concrete, and Reinforcing Steel. This data has aggregated information on the amount used and unit prices. This data is useful, but it is only updated annually.

The current method for determining inflation is left to the inflation committee, which has no economists on it. The methods used, such as averages and rolling averages, are rather simple and do not adapt quickly when inflation changes. Using an HCCI that is updated on a regular basis would provide both an objective estimation of inflation and incorporate economic data in their inflation calculations.

Literature Review

The literature shows that highway construction cost underestimation is not unique to Wyoming and WYDOT. Wilmot and Cheng developed highway construction index estimations in Louisiana and improved on those estimations after Hurricane Katrina (Wilmot, 2003; Wilmot and Cheng, 2009). Kyte developed a highway construction project cost estimation tool for the Virginia Department of Transportation (2004).

The methods used to estimate costs can vary substantially. Adeli and Wu used neural networks to estimate highway construction costs in Ohio (1998). Chou used generalized linear modeling to improve cost estimates for the Texas Department of Transportation (2009). Karaca, Gransberg, and Jeong ran through both neural networks and machine learning techniques on Montana Department of Transportation early estimates (2020).

However, this project focuses more on highway construction cost inflation, which is more specific and less researched. Gransberg and Diekmann studied California and South Dakota highway construction cost inflation to see if there is a difference between urban and rural inflation (2004). They found that inflation in urban California was less volatile than rural South Dakota's inflation. We should expect Wyoming's inflation to be volatile as it is the least populous state and second to last in population density. This reaffirms the need for better inflation estimation techniques.

O'Brien, Rubin, and Brown used a survey of contractors to determine the drivers of highway construction bid inflation (2022). Their research found that labor costs account for nearly 40 percent of project costs. They also found that lack of competition, elevated input costs, and project type and size are the most important factors driving bid inflation.

The closest study to what this project is proposing is Qin, Wang, and Wang (2014). They were modeling the best interest rates, inflation rates, and discount rates to use for infrastructure investments in South Dakota. They used BID TABS software to extract information on eight inputs in construction: Unclassified Excavation, Liquid Asphalt, Asphalt Concrete, Gravel Cushion, PCC Pavement, Class A Concrete, Reinforcing Steel, and Structural Steel.

Methodology and Data

The data used was Producer Price Index(PPI) data on eight construction material cost areas – asphalt, bridge metal, concrete, excavation, gravel, liquid asphalt, reinforcing steel, and structural steel – and PPI data for non-supervisor construction wages. Inflation rates were calculated using the percentage change in PPI for each material and wages. Inflation rate lags were also calculated going up to 10 years forward and 10 years back.

All PPI data was gathered from the Federal Reserve Economic Data (FRED) website through December 2024. The databases vary in size based on when they started gathering data. Asphalt data was collected starting in December 2004. Bridge metal data was collected starting in July 2011. Concrete data was collected starting in December 2003. Excavation data was collected starting in December 1999. Gravel data was collected starting in January 1973. Liquid Asphalt data was collected starting in December 2004. Reinforcing steel data was collected starting in January 1965. Structural steel data was collected starting in June 1982. Non-supervisor construction wage data was collected starting in January 1947.

The Center for Business and Economic Analysis(CBEA) used auto-regressive models, with annual lags going back up to 10 years, to estimate inflation rates for the upcoming year. Inflation for a material y years into the future is a function of inflation for that material in the current and previous years.

$$\text{Inflation}_{xt+y} = \sum_{0}^{N} \beta_{xn} \text{Inflation}_{xt-n} + \varepsilon$$

For one-year estimations, most models used all 10 lags. That is, most models used inflation information from up to 10 years ago to help estimate future inflation. Gravel (4), reinforcing steel (3), bridge metal (8), and construction wages (4) all yielded better adjusted r-squares with fewer lags. In total, there were 99 models developed, 11 for each material and wages, and nine models were chosen based on their adjusted r-squared values. The chosen models and their coefficients can be found in tables 3 through 11.

One-Year Model Results

The need for modeling became apparent when running overall inflation rates against the three prediction methods previously used. Using the Spear method, the inflation rate was over or underestimated by more than 10 percentage points in seven of the last ten years. Using the Fisher method, the inflation rate was over or underestimated by more than 10 percentage points in six of the last ten years. Using a Rolling 10 method, the inflation rate was over or underestimated by more than 10 percentage points in three of the last ten years. These results can be seen in Figure 1.

Using auto-regressive models, the models with lags up to 10 years take 10 years to start fitting the data well. This result makes sense since missing values will not contribute to the model throwing the estimations off. However, once the models have values to match all coefficients, they often fit very well. For seven of the nine models, the adjusted r-squared values were larger than 0.60, meaning 60 percent or more of the variation in the data can be explained by the model. In two models, reinforcing steel and structural steel, the adjusted r-squared values were significantly lower due to volatility in steel prices.

The asphalt model had an adjusted r-squared of 0.6441 and used all 10 lags. The model has a full set of observations starting in 2015. From December 2015 through December 2022, the estimation was off by more than 10 percentage points in just 2 of the 85 months.

The bridge metal model had an adjusted r-squared of 0.8019 and used 8 lags. The model has a full set of observations starting in 2019. From July 2019 through December 2022, the estimation was off by more than 10 percentage points in 11 months out of the 42 months.

The concrete model had an adjusted r-squared of 0.9572 and used all 10 lags. The model has a full set of observations starting in 2015. From December 2015 through December 2022, the estimation was not off by more than 10 percentage points in any of the 85 months.

The excavation model had an adjusted r-squared of 0.6532 and used all 10 lags. The model has a full set of observations starting in 2010. From December 2010 through December 2022, the estimation was off by more than 10 percentage points in just 2 of the 145 months.

The gravel model had an adjusted r-squared of 0.8538 and used 4 lags. The model has a full set of observations starting in 1978. From January 1978 through December 2022, the estimation was never off by more than 10 percentage points in any of the 540 months.

The liquid asphalt model had an adjusted r-squared of 0.8747 and used all 10 lags. The model has a full set of observations starting in 2015. From December 2015 through December 2022, the estimation was off by more than 10 percentage points in 6 of the 85 months.

The reinforcing steel model had an adjusted r-squared of 0.2075 and used 3 lags. The model has a full set of observations starting in 1969. From January 1969 through December 2022, the estimation was off by more than 10 percentage points in 71 of the 648 months.

The structural steel model had an adjusted r-squared of 0.2542 and used all 10 lags. The model has a full set of observations starting in 1993. From June 1993 through December 2022, the estimation was off by more than 10 percentage points in 113 of the 355 months.

The construction wages model had an adjusted r-squared of 0.8726 and used 4 lags. The model has a full set of observations starting in 1952. From January 1952 through December 2022, the estimation was never off by more than 10 percentage points in any of the 852 months.

Average predicted inflation for all materials and wages was weighted 60 percent for materials and 40 percent for wages and determined to be 5.1 percent for 2024.

Two-year to Five-year Model Results

All nine inputs were also modeled to estimate inflation rates two, three, four, and five years into the future. Most of these models implemented 10 lags. Seven of the nine input categories had adjusted r-squares over 0.60 for all five models. Reinforcing steel and structural steel still had low adjusted r-squares due to price volatility.

I would caution users to rely heavily on these predictions. These models implement the 2021 and 2022 PPIs which were incredibly volatile due to supply chain issues caused by COVID-19. As a result, some of the predicted inflation rates are incredibly large in terms of magnitude. For example, it is unrealistic to expect bridge metal prices to fall 168 percent 4 years from now. However, when the rates are averaged, it is much more reasonable to expect all prices to fall 11 percent 4 years from now.

The two-year models determined 10.6 percent inflation for 2025. The three-year models determined inflation to be 9.8 percent for 2026. The four-year models determined inflation to be negative 11.4 percent for 2027. The five-year models determined inflation to be 1.0 percent for 2028. The estimated inflation rates for all inputs for the next five years are found in Table 1.

One-year Model Predicted Inflation against One-year Actual Inflation

The one-year model predictions on inflation were inaccurate for individual categories, but not terribly far off for overall inflation. Of the nine cost areas of study, the model was within three percentage points of accuracy in just two PPI areas: Gravel and Wages. However, when averaging the cost categories and weighting materials costs against wages, national inflation was 1.8 percent. The models predicted an average inflation of 5.1 percent, which is just 3.3 percentage points away.

When compared to WYDOT's actual price changes from year to year, the number of categories where inflation rates were within three percentage points falls to zero. WYDOT's average materials prices fell 2.5 percent. However, five categories saw prices fall more than 10 percent. These predictions and results can be seen in Table 2.

The overall estimation for total inflation through 2024 by the models was 5.10 percent. WYDOT's material prices fell 2.46 percent and WYDOT's purchases, overall, fell 35.93 percent. In 2023, the Spear model predicted inflation of 14.07 percent, Rolling 10 predicted inflation of 10.21 percent, and the Fisher model predicted inflation of 12.30 percent. Even though the auto-regressive models performed poorly, they performed better than the previous models used.

There are several reasons why the auto-regressive models failed. The first reason the model failed is the model did not include external variables that could affect inflation, like changes in public policy and strikes in the transportation industry. The second reason it failed is that the model may have over-corrected. In certain variables, the models used 10 lags, which may look too far back in the past to predict future prices. The third reason the models failed is because 2022's figures were included. 2022 had multiple categories where prices more than doubled from 2021. The fourth reason the models failed is because the data nationally and the data in Wyoming are vastly different. For example, the price of concrete, nationally, rose 5.25 percent. In Wyoming, the price of concrete, averaged between pavement and class, rose 20.73 percent. Nationally, gravel prices rose 7.58 percent. In Wyoming, gravel prices fell 14.14 percent. The fifth reason for the models' failure is that WYDOT's production mix choices vary wildly year-to-year. For example, in 2023, WYDOT purchased 7.9 million pounds of structural steel. In 2024, WYDOT purchased 85,000 pounds of structural steel, a 99 percent drop from the year prior.

Reflection and Future Work

Given the poor performance of the auto-regressive models, the CBEA recommends giving WYDOT the option to not renew the project. Even though the prediction was closer to reality, it was still off by nearly 7.5 percentage points. That said, there were still some useful revelations in this work.

The first revelation is that WYDOT's cost drivers have changed and the drivers fluctuate. In 1997, when WYDOT first started tracking data, the largest cost categories were hot plant mix, unclassified excavation, and crushed base. In 2024, the primary cost drivers of materials for WYDOT were hot plant mix and performance-grade(modified) asphalt. In 2024, those two categories made up over 70 percent of all materials purchased. If WYDOT can get a useful prediction on those two category price changes, they will have a much easier time predicting materials costs in the future.

The second revelation was making predictions for wages. The auto-regressive models were off by less than one percentage point in the one-year predictions. WYDOT may be well served by including wage predictions and weighting them at 40 percent of total costs for projects.

The third revelation was that WYDOT's payments for materials are materially different from the US. There are several reasons why WYDOT may differ. First, Wyoming is a rather remote state, so shipping materials to the state may prove costly. Second, certain materials may be produced in-state, like gravel, so shipping may be far less expensive.

In the future, as the COVID-era price shocks are worked out of the models, the auto-regressive models may do a better job of predicting inflation. It would also be useful to include external data, like oil prices and tariff information, to provide better predictions.

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Appendix

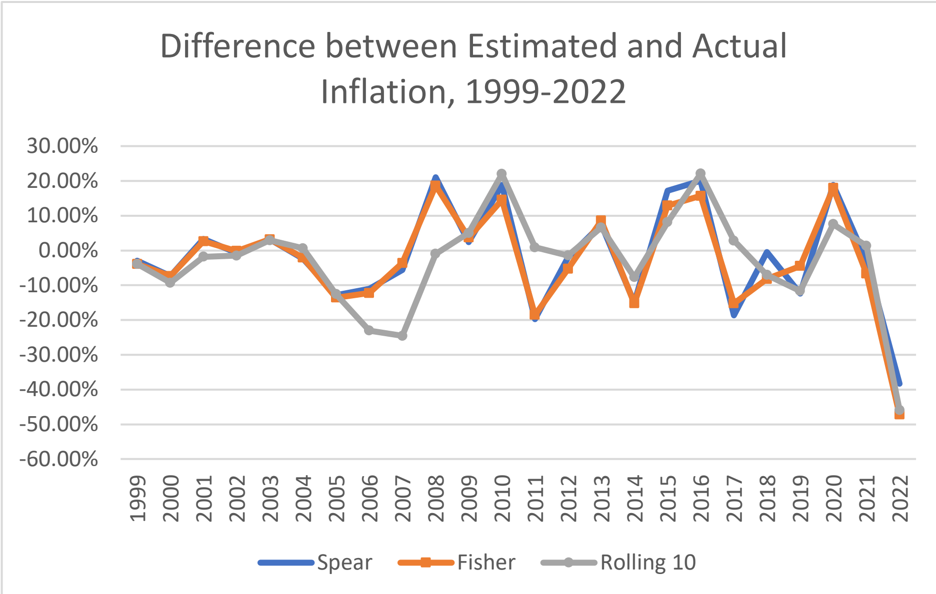

Figure 1. Difference Between Estimated and Actual Inflation Using Previous Estimation Methods

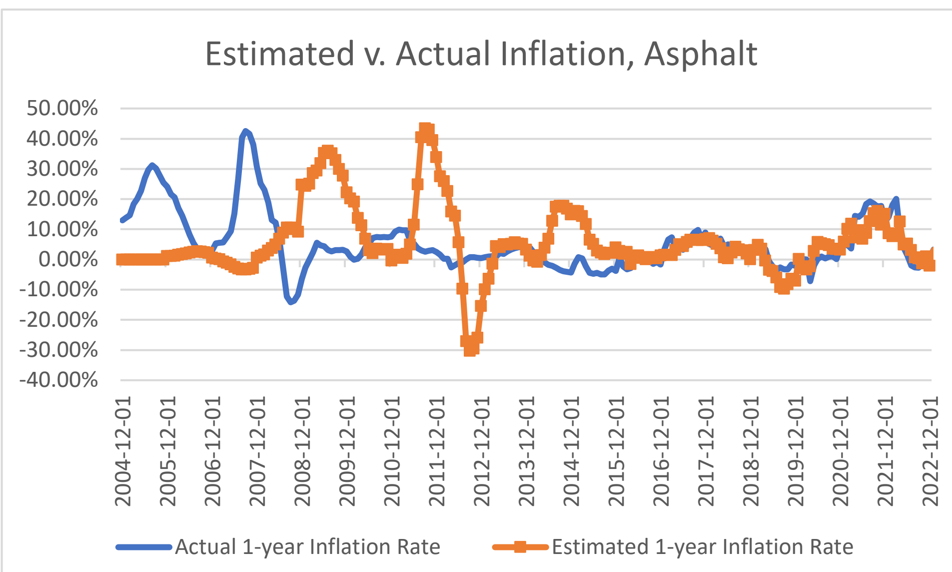

Figure 2. Estimated versus Actual Inflation for Asphalt, 1-year Model

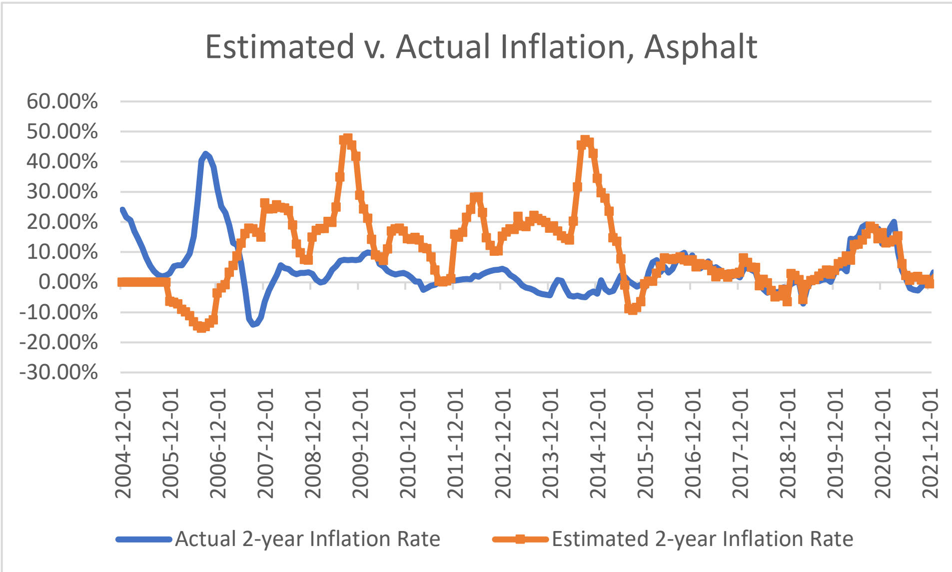

Figure 3. Estimated versus Actual Inflation for Asphalt, 2-year Model

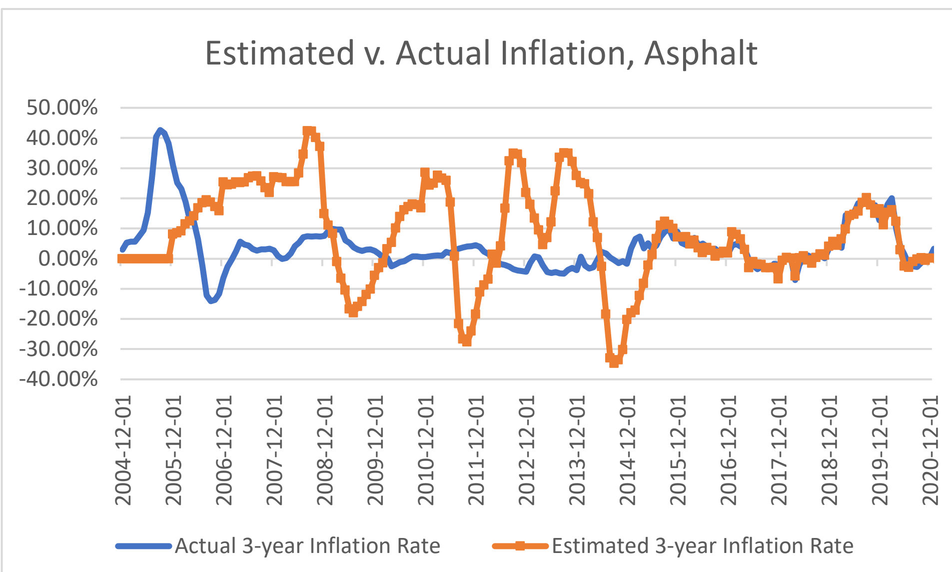

Figure 4. Estimated versus Actual Inflation for Asphalt, 3-year Model

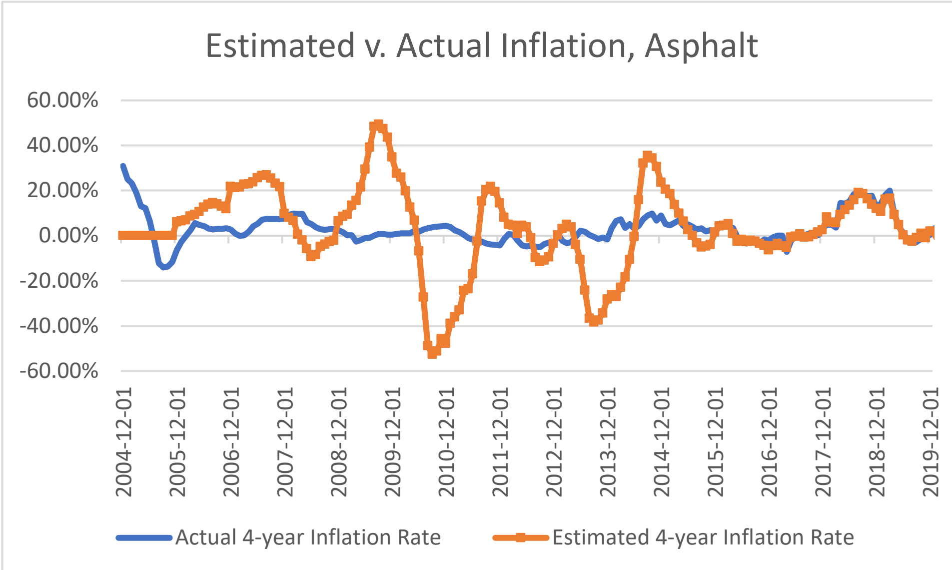

Figure 5. Estimated versus Actual Inflation for Asphalt, 4-year Model

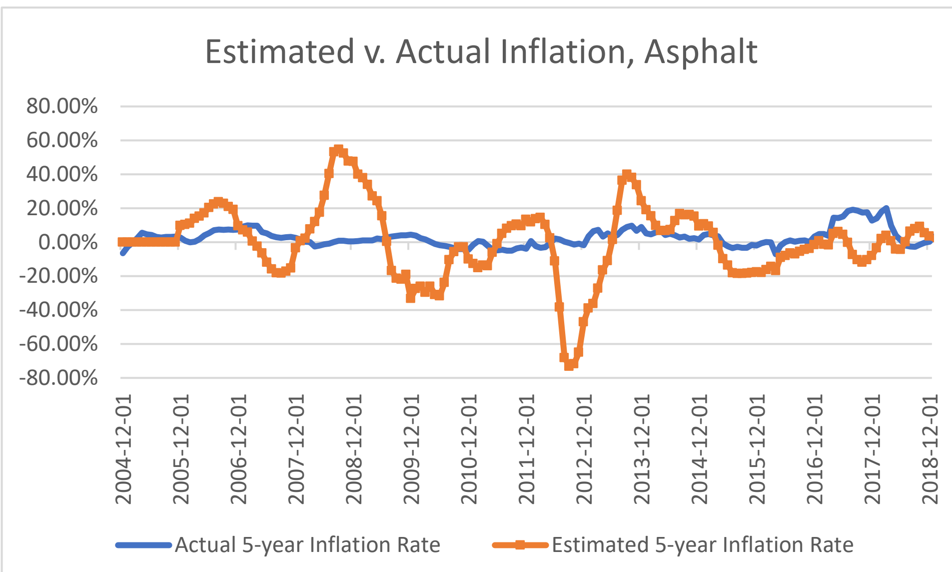

Figure 6. Estimated versus Actual Inflation for Asphalt, 5-year Model

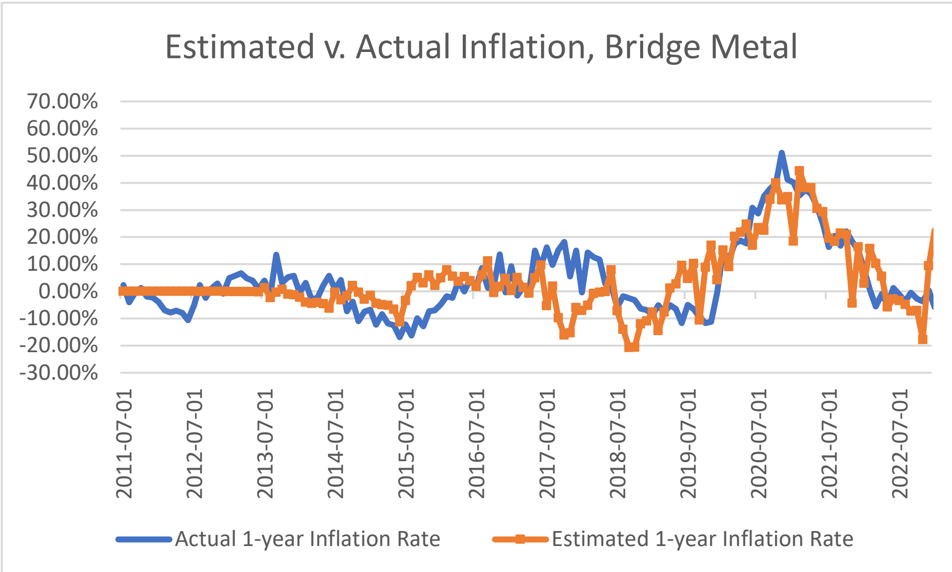

Figure 7. Estimated versus Actual Inflation for Bridge Metal, 1-year Model

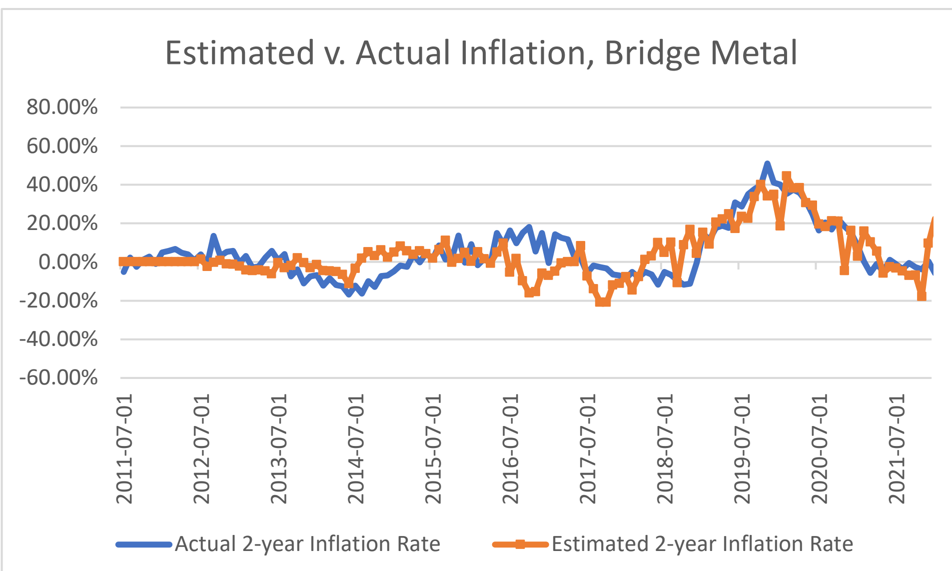

Figure 8. Estimated versus Actual Inflation for Bridge Metal, 2-year Model

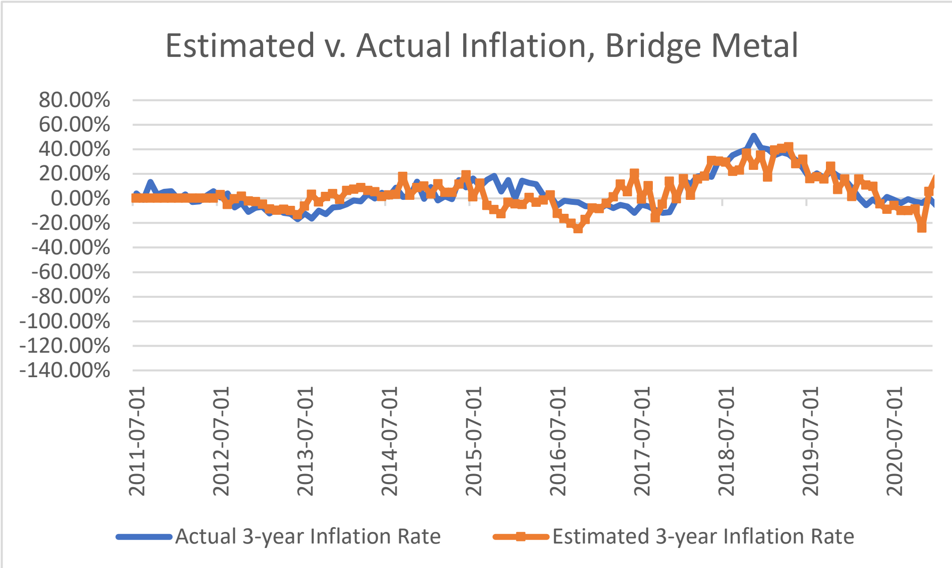

Figure 9. Estimated versus Actual Inflation for Bridge Metal, 3-year Model

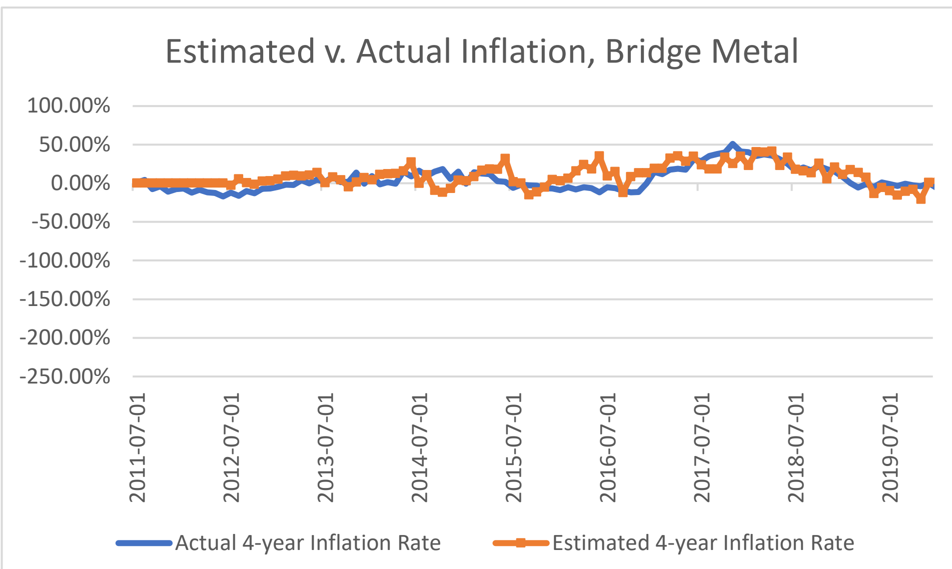

Figure 10. Estimated versus Actual Inflation for Bridge Metal, 4-year Model

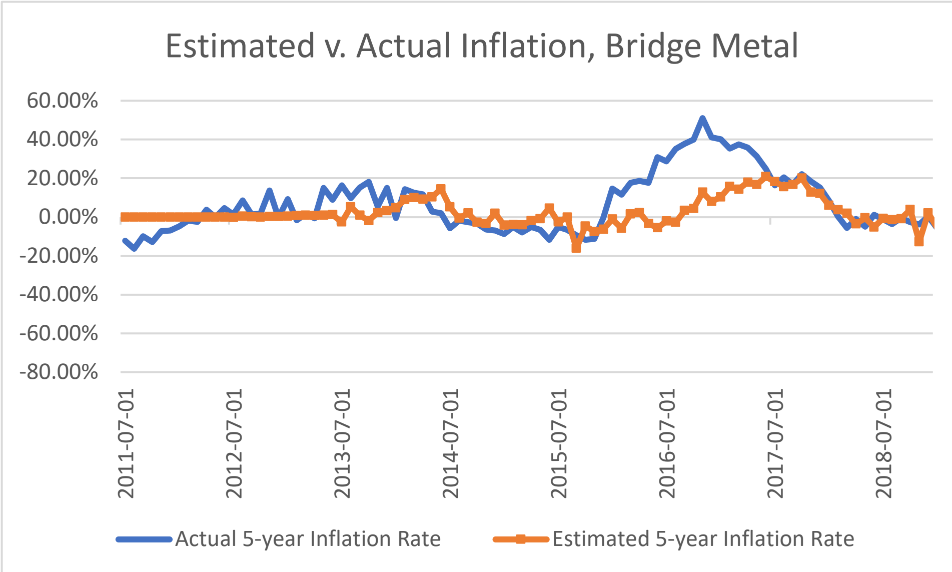

Figure 11. Estimated versus Actual Inflation for Bridge Metal, 5-year Model

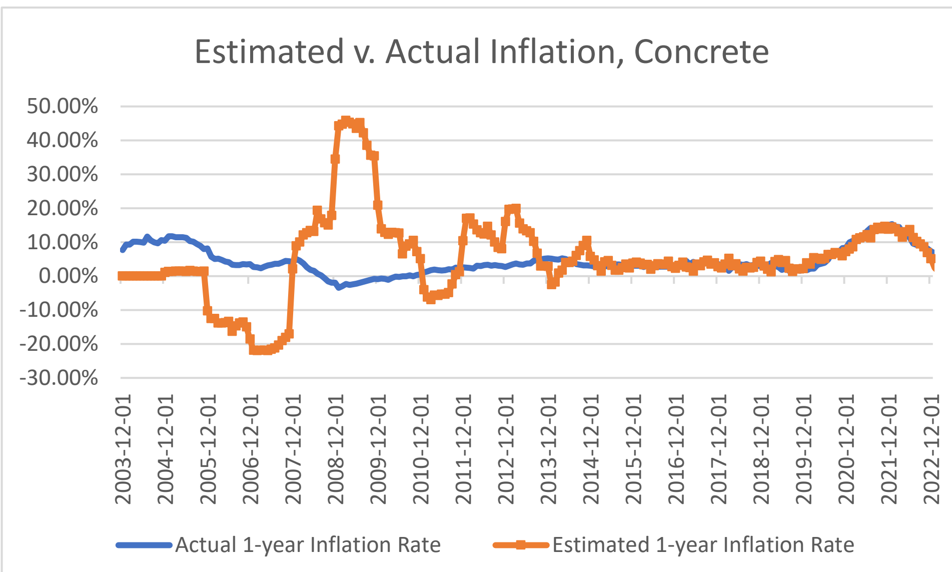

Figure 12. Estimated versus Actual Inflation for Concrete, 1-year Model

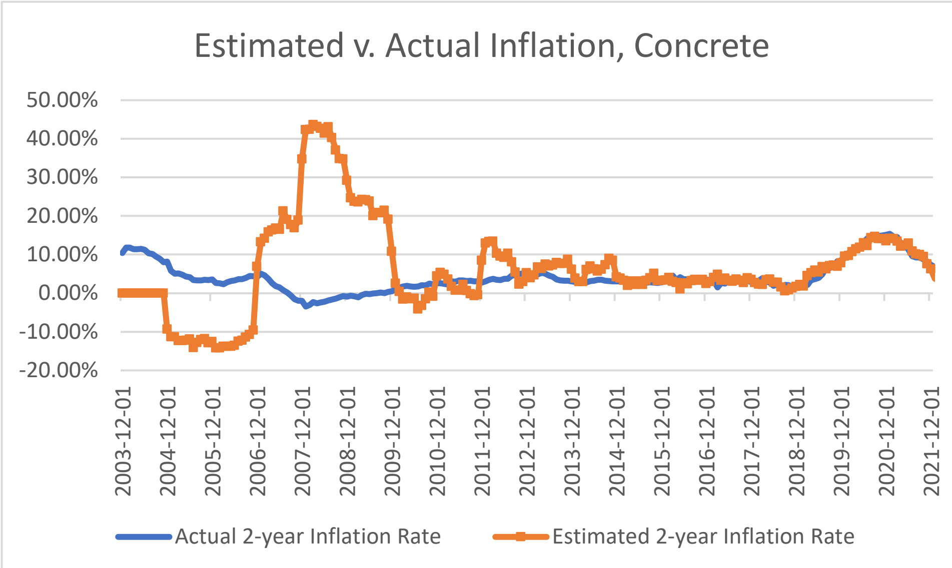

Figure 13. Estimated versus Actual Inflation for Concrete, 2-year Model

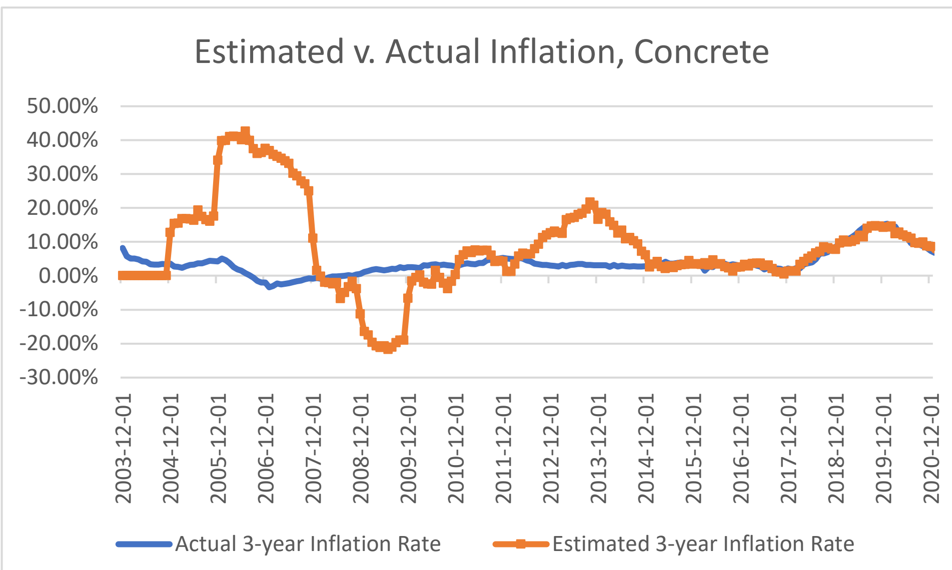

Figure 14. Estimated versus Actual Inflation for Concrete, 3-year Model

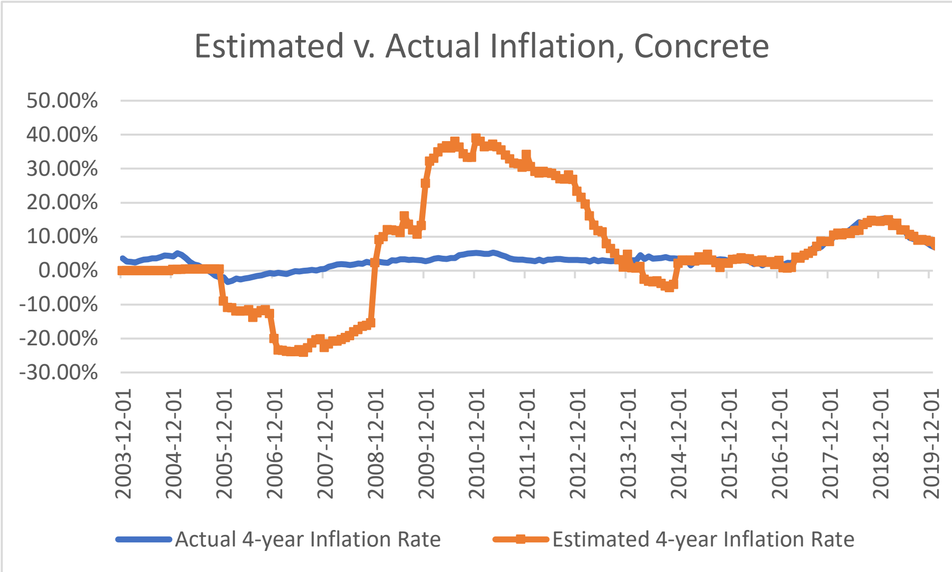

Figure 15. Estimated versus Actual Inflation for Concrete, 4-year Model

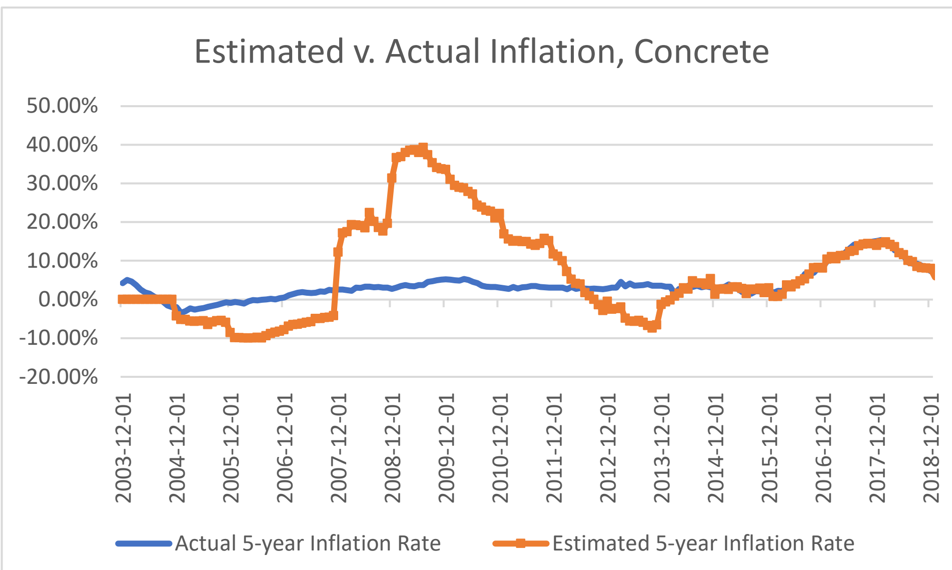

Figure 16. Estimated versus Actual Inflation for Concrete, 5-year Model

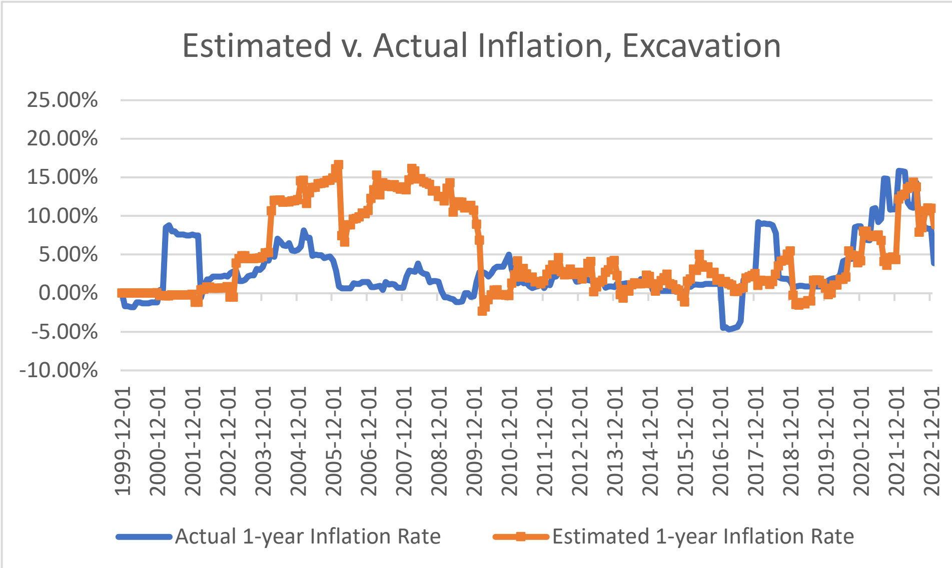

Figure 17. Estimated versus Actual Inflation for Excavation, 1-year Model

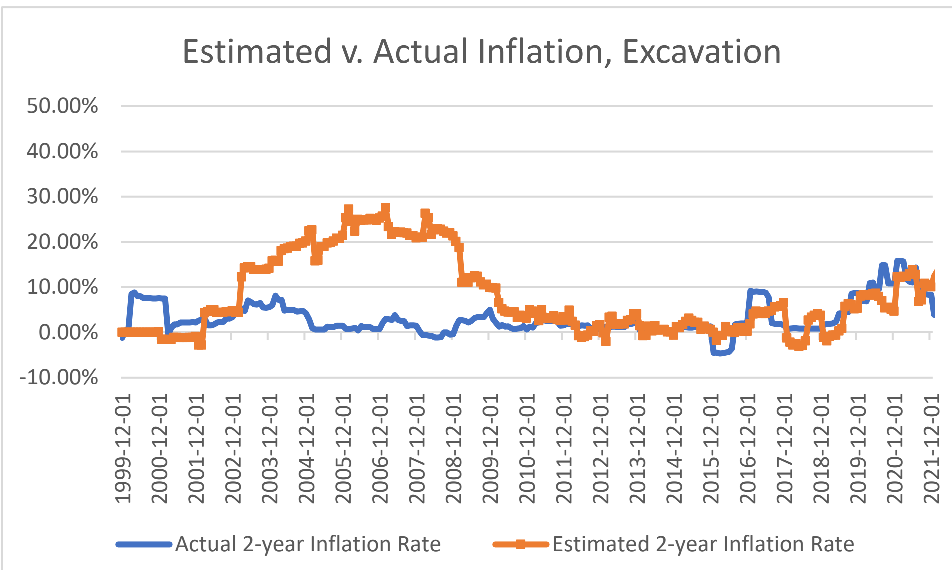

Figure 18. Estimated versus Actual Inflation for Excavation, 2-year Model

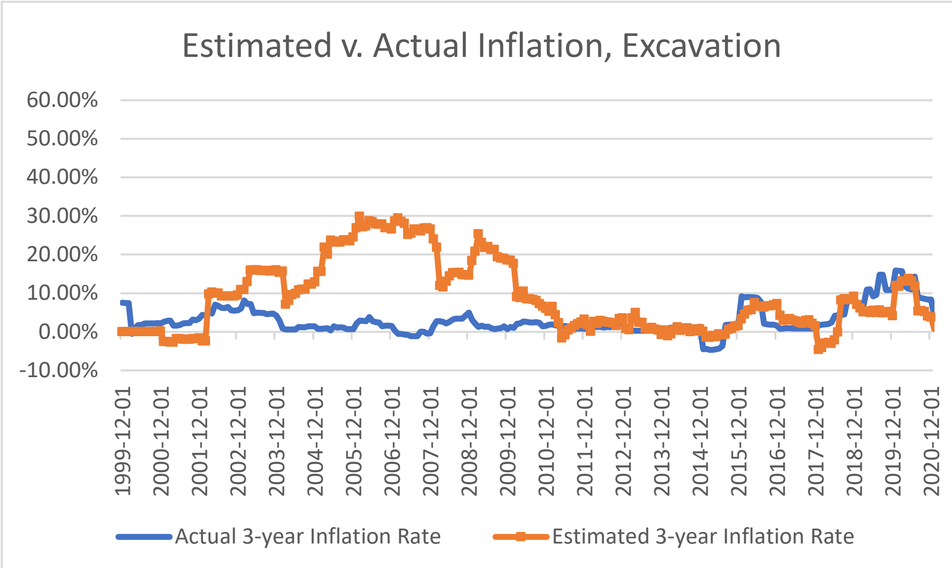

Figure 19. Estimated versus Actual Inflation for Excavation, 3-year Model

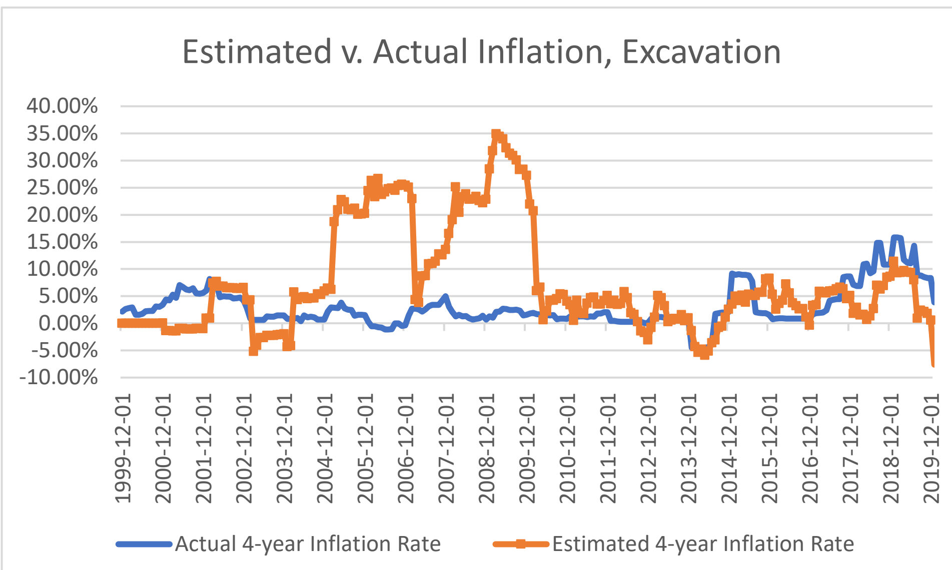

Figure 20. Estimated versus Actual Inflation for Excavation, 4-year Model

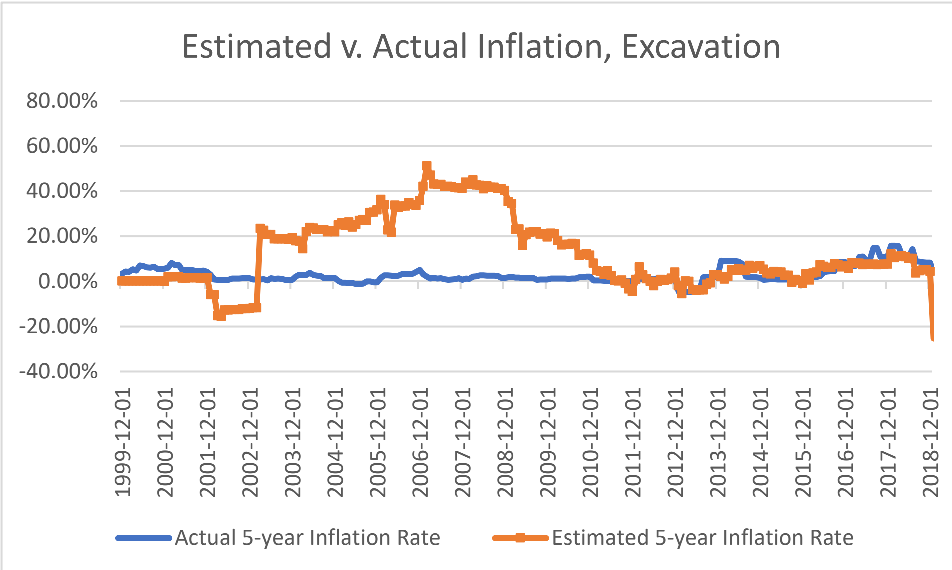

Figure 21. Estimated versus Actual Inflation for Excavation, 5-year Model

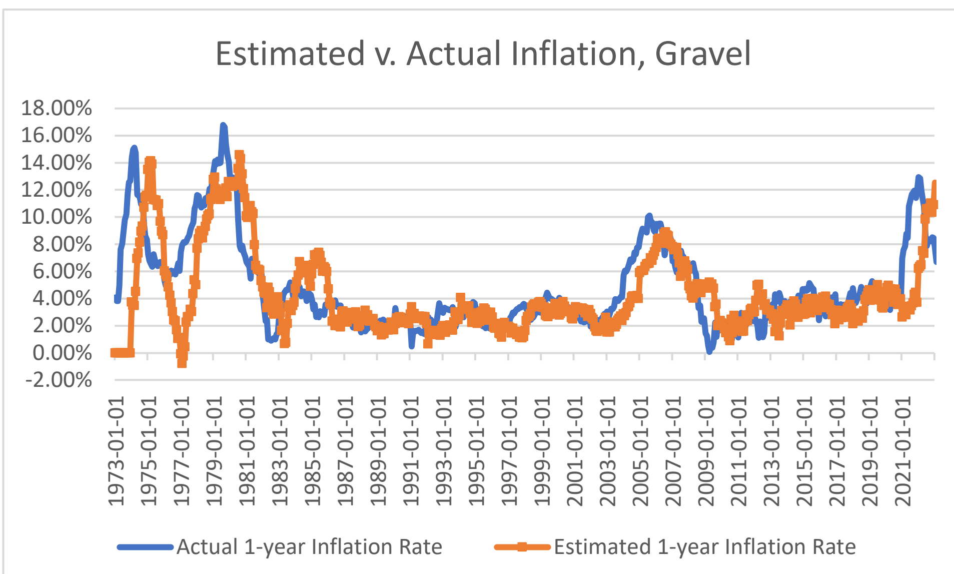

Figure 22. Estimated versus Actual Inflation for Gravel, 1-year Model

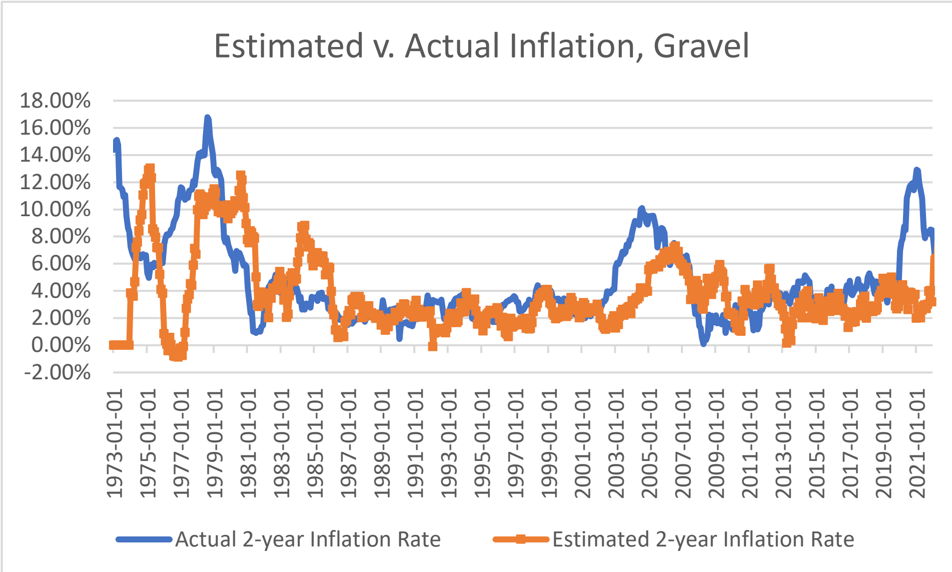

Figure 23. Estimated versus Actual Inflation for Gravel, 2-year Model

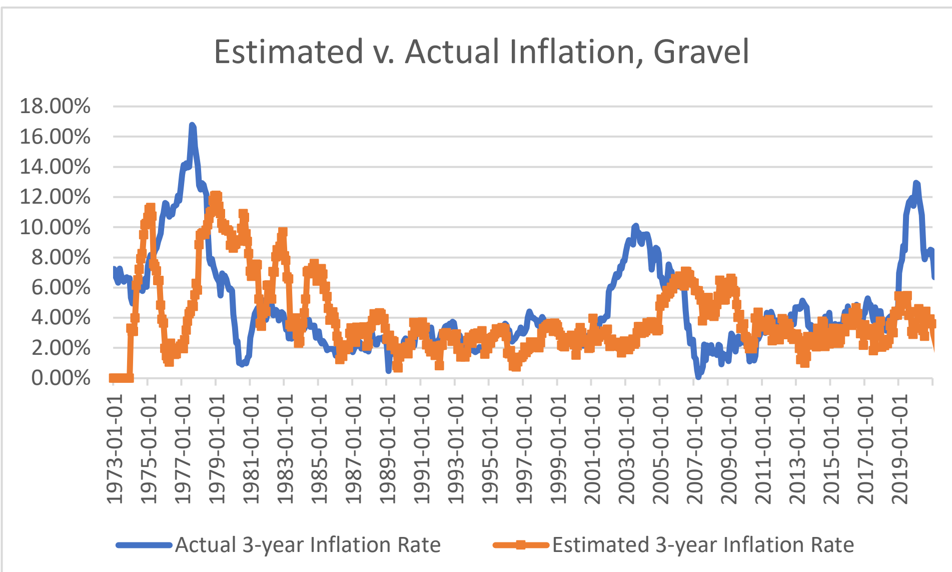

Figure 24. Estimated versus Actual Inflation for Gravel, 3-year Model

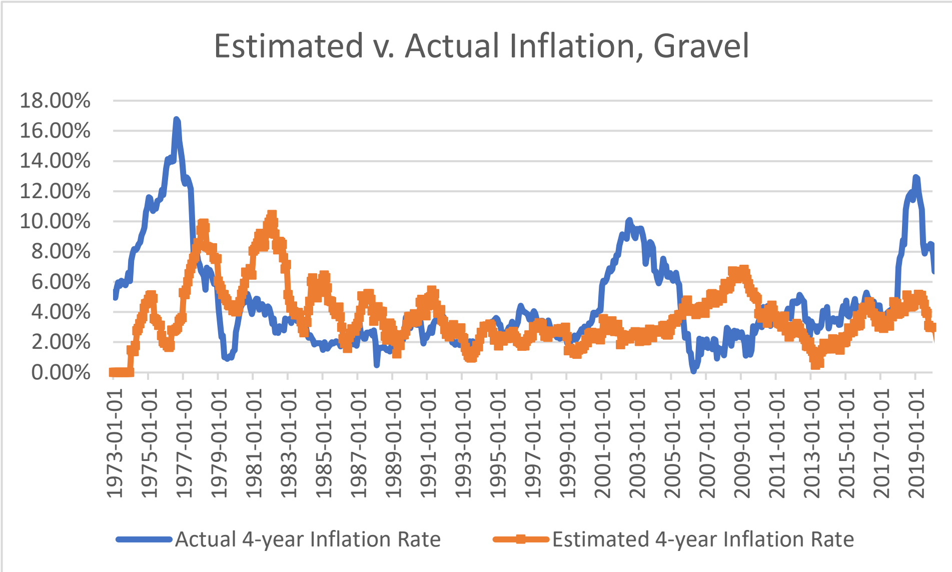

Figure 25. Estimated versus Actual Inflation for Gravel, 4-year Model

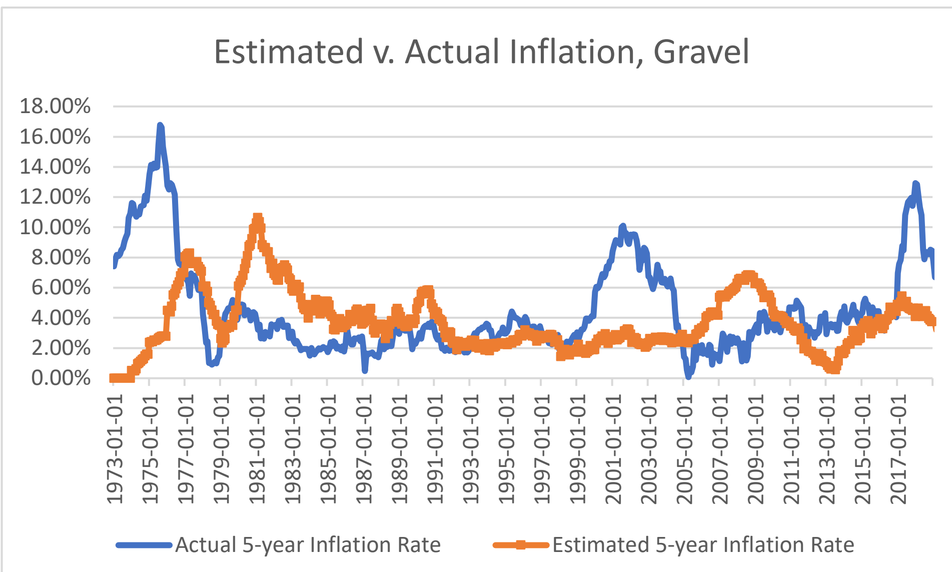

Figure 26. Estimated versus Actual Inflation for Gravel, 5-year Model

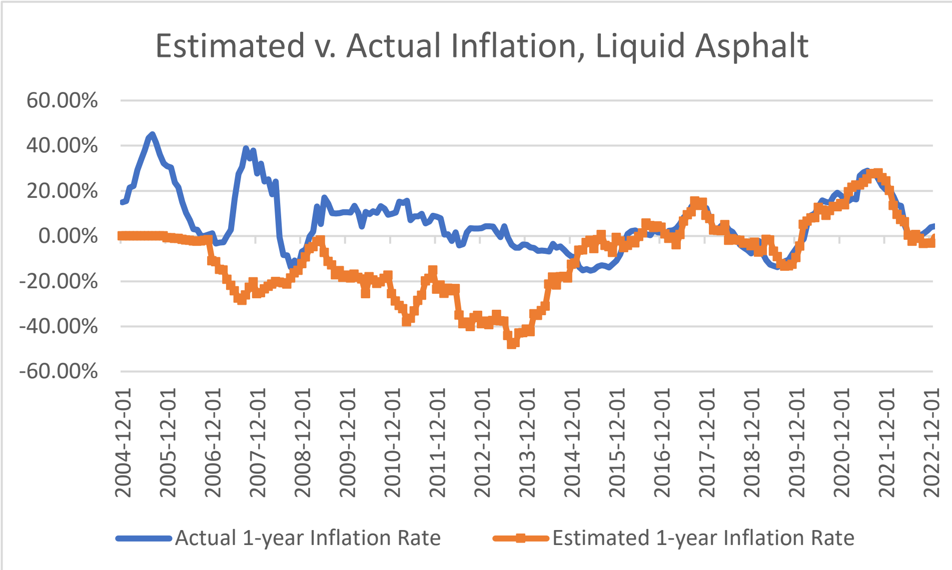

Figure 27. Estimated versus Actual Inflation for Liquid Asphalt, 1-year Model

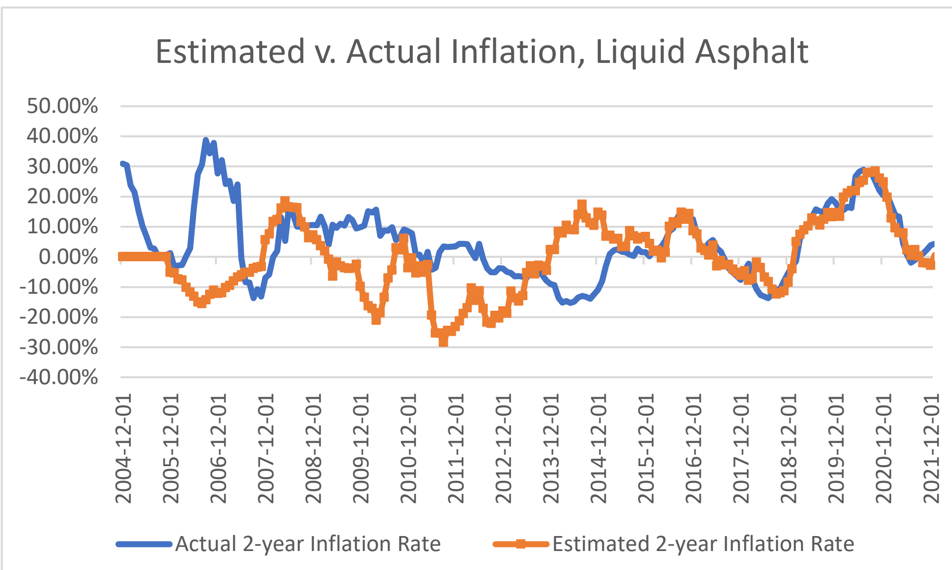

Figure 28. Estimated versus Actual Inflation for Liquid Asphalt, 2-year Model

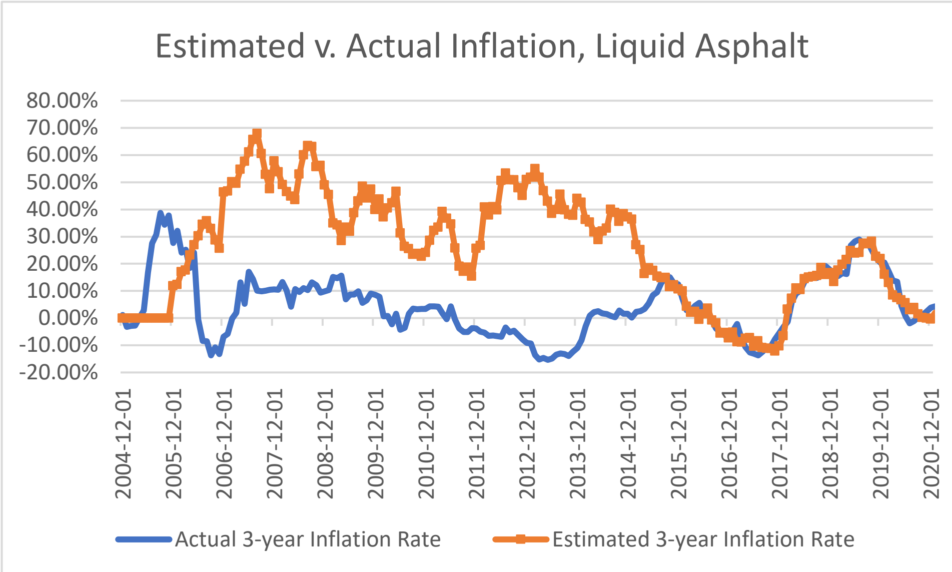

Figure 29. Estimated versus Actual Inflation for Liquid Asphalt, 3-year Model

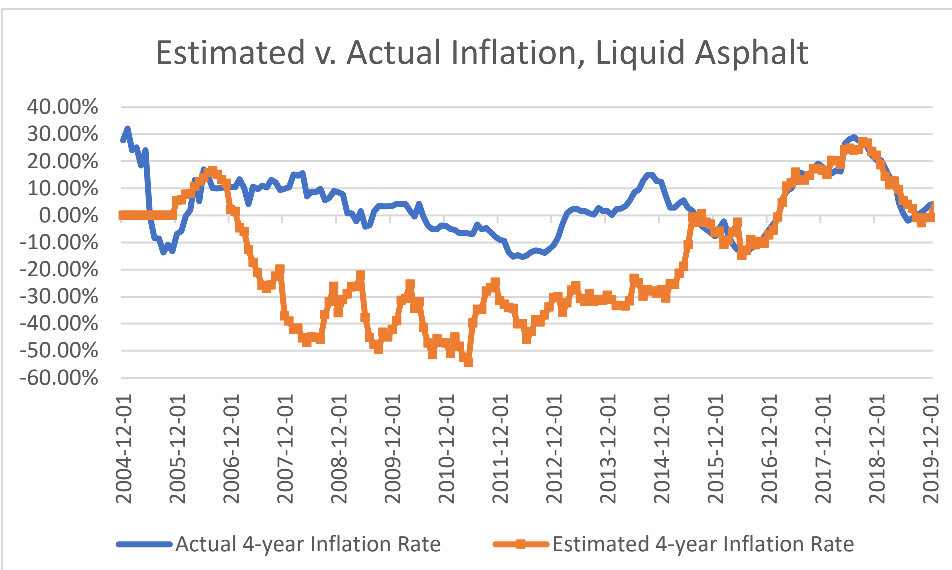

Figure 30. Estimated versus Actual Inflation for Liquid Asphalt, 4-year Model

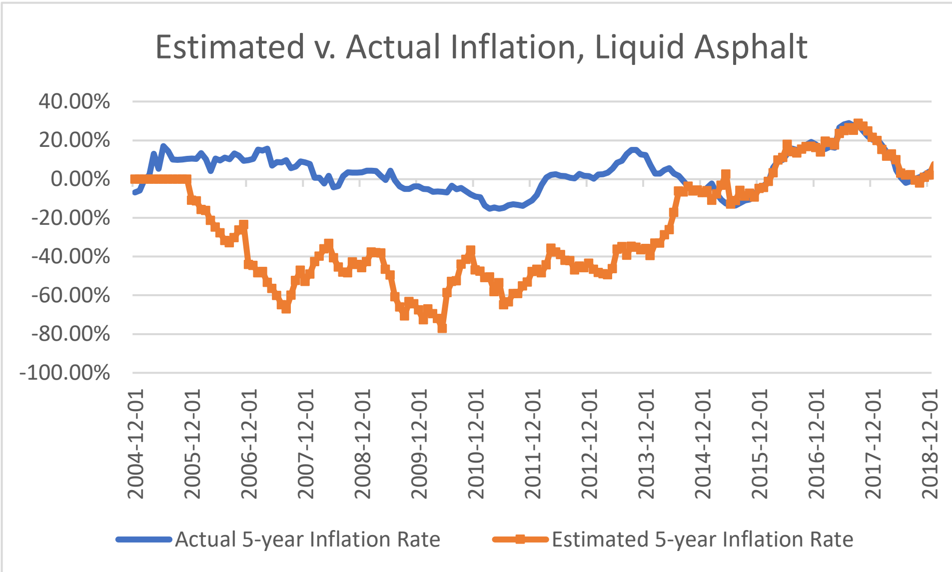

Figure 31. Estimated versus Actual Inflation for Liquid Asphalt, 5-year Model

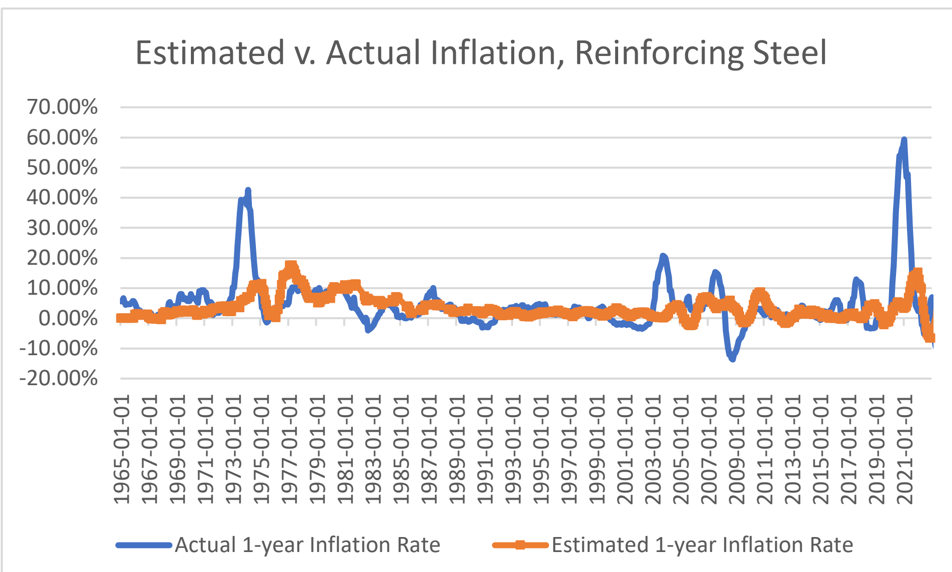

Figure 32. Estimated versus Actual Inflation for Reinforcing Steel, 1-year Model

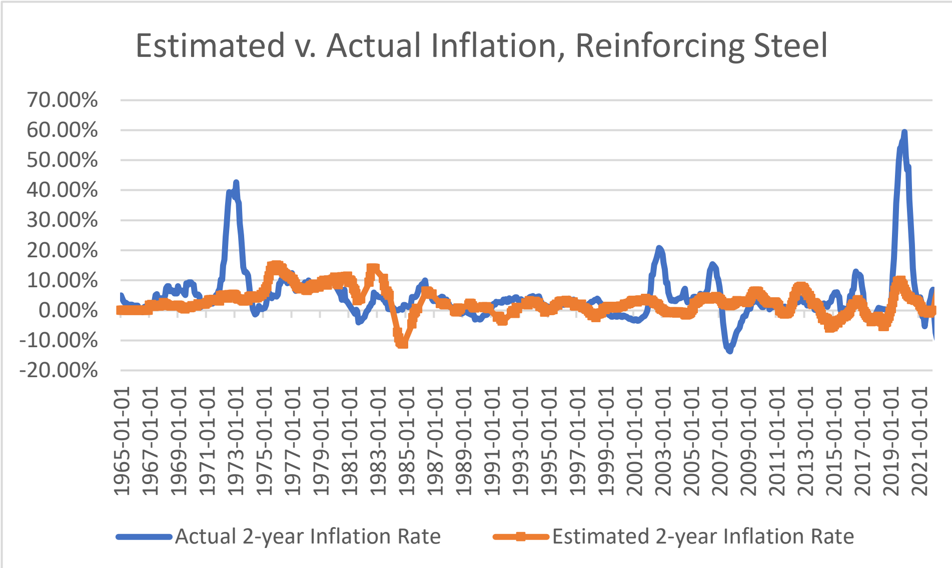

Figure 33. Estimated versus Actual Inflation for Reinforcing Steel, 2-year Model

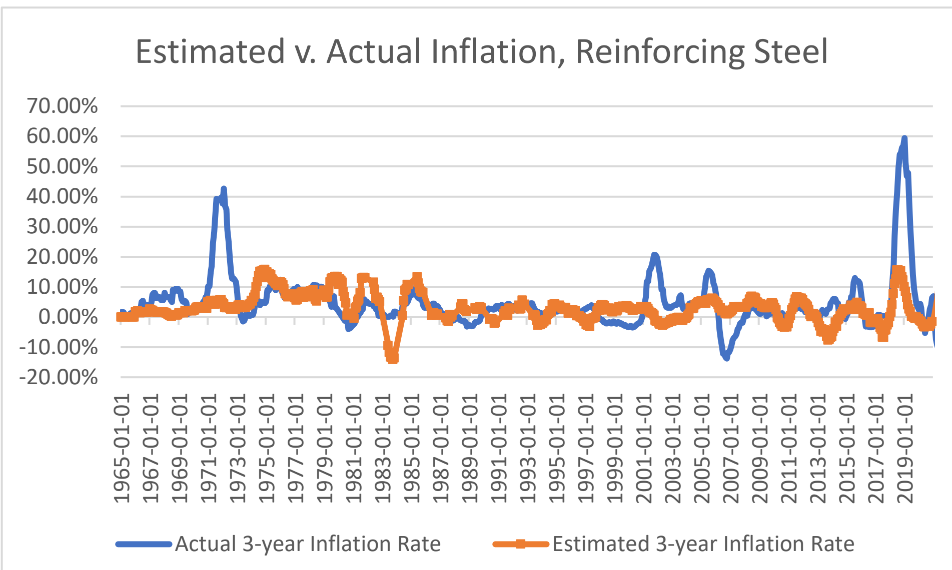

Figure 34. Estimated versus Actual Inflation for Reinforcing Steel, 3-year Model

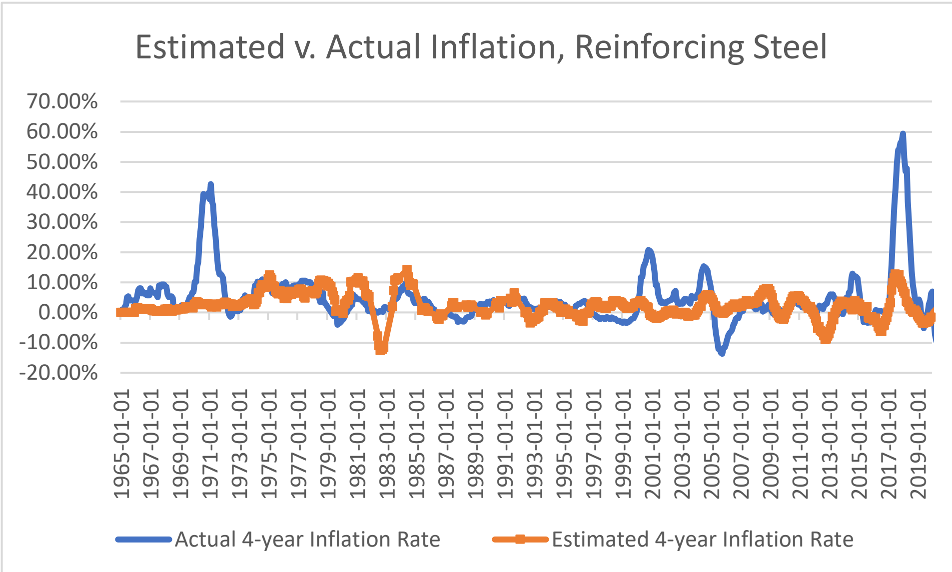

Figure 35. Estimated versus Actual Inflation for Reinforcing Steel, 4-year Model

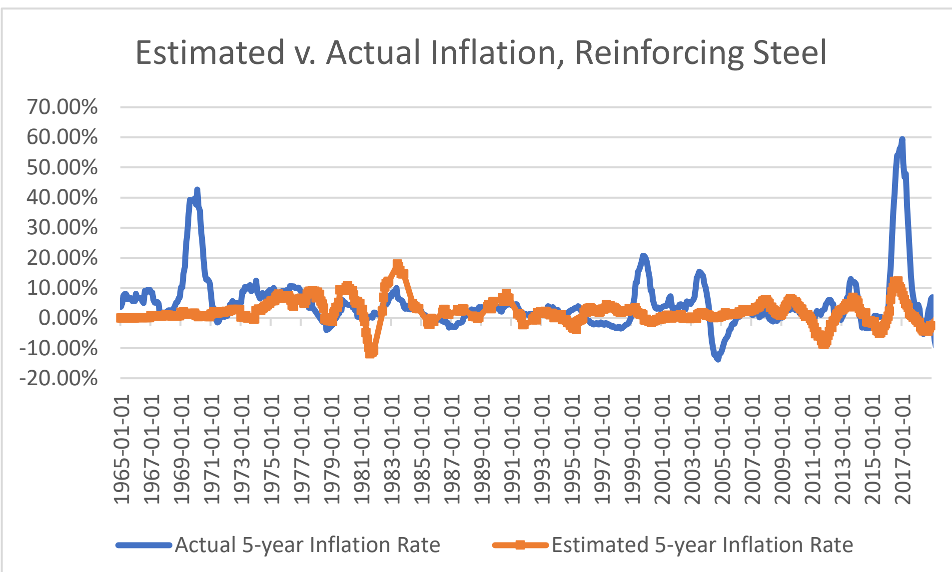

Figure 36. Estimated versus Actual Inflation for Reinforcing Steel, 5-year Model

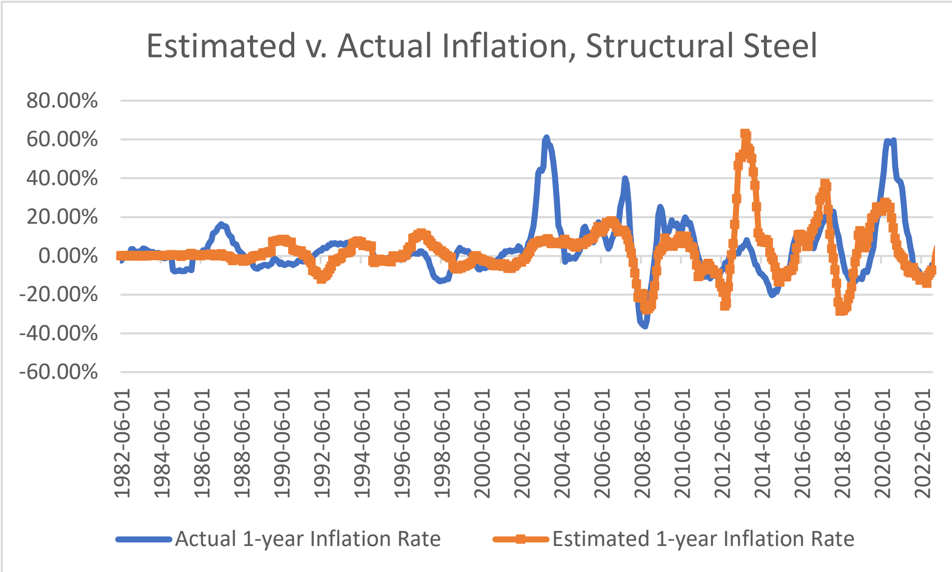

Figure 37. Estimated versus Actual Inflation for Structural Steel, 1-year Model

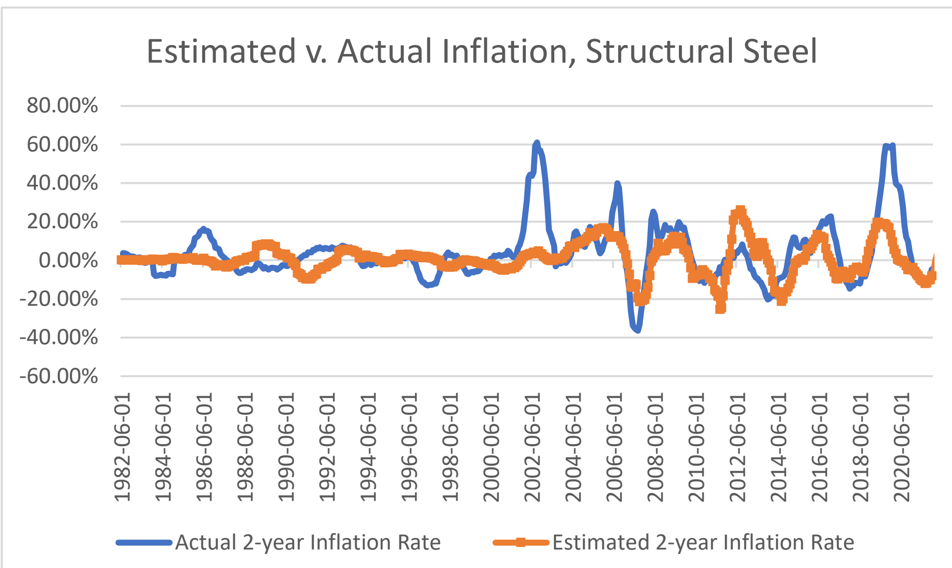

Figure 38. Estimated versus Actual Inflation for Structural Steel, 2-year Model

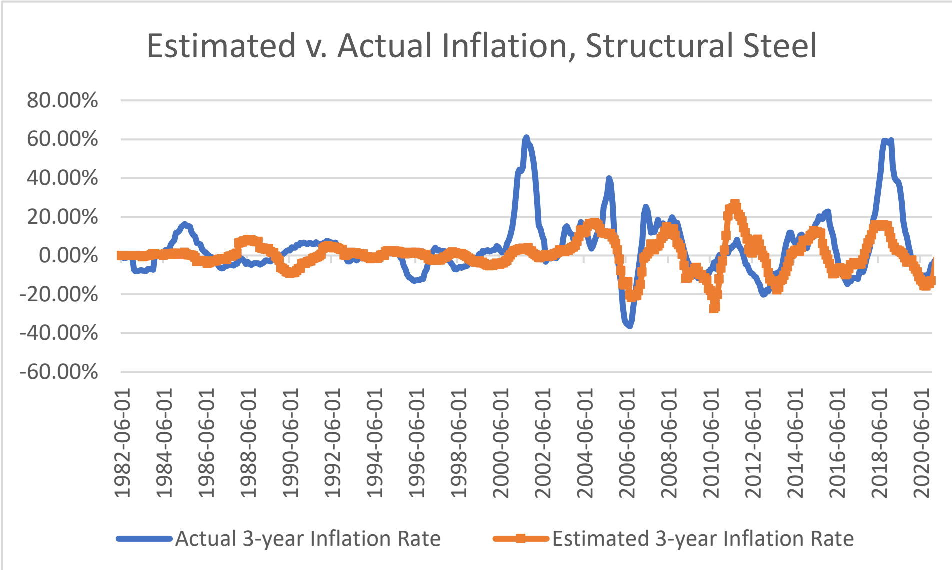

Figure 39. Estimated versus Actual Inflation for Structural Steel, 3-year Model

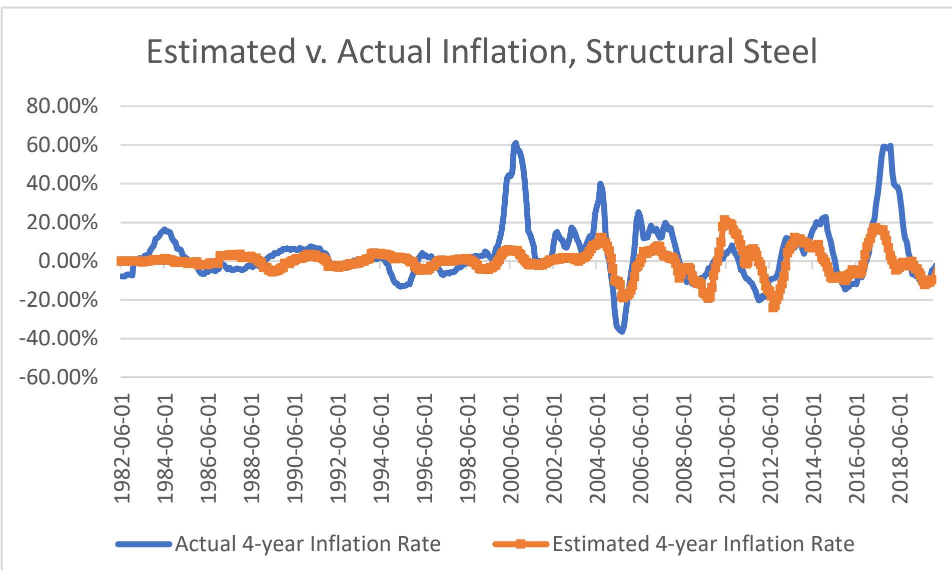

Figure 40. Estimated versus Actual Inflation for Structural Steel, 4-year Model

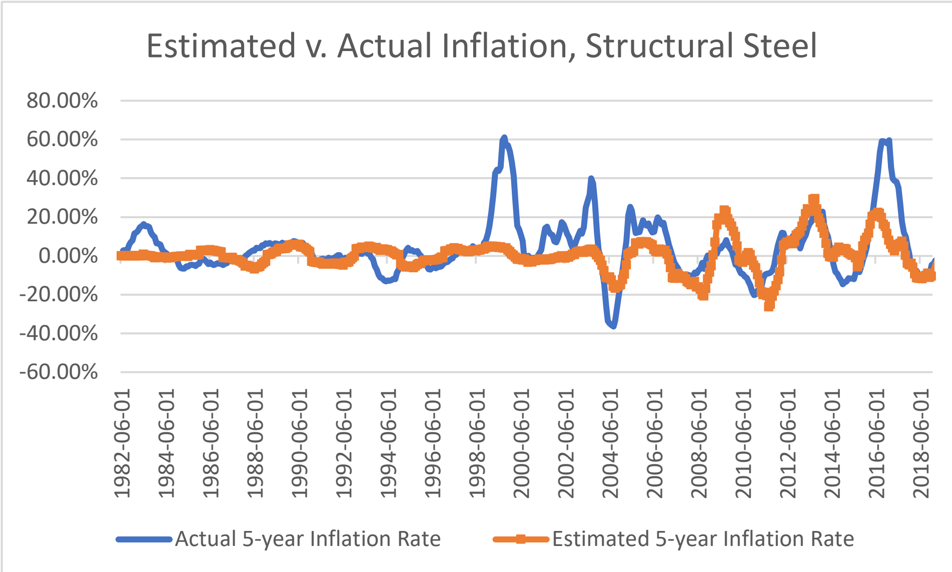

Figure 41. Estimated versus Actual Inflation for Structural Steel, 5-year Model

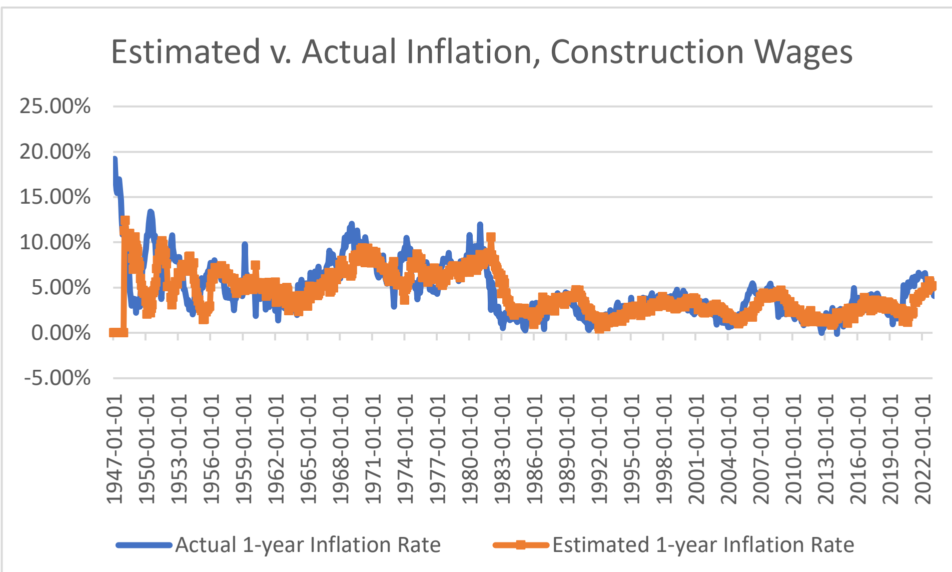

Figure 42. Estimated versus Actual Inflation for Non-supervisor Construction Wages, 1-year Model

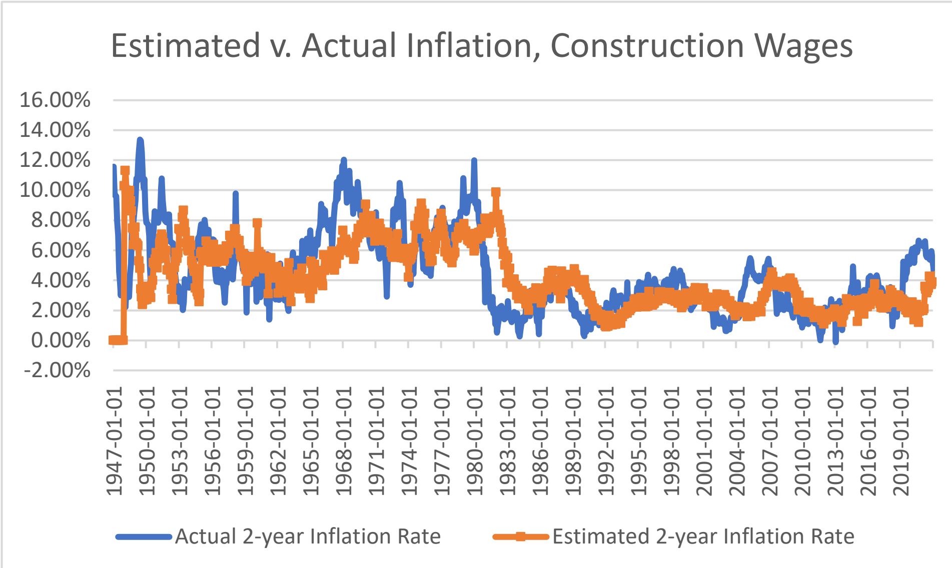

Figure 43. Estimated versus Actual Inflation for Non-supervisor Construction Wages, 2-year Model

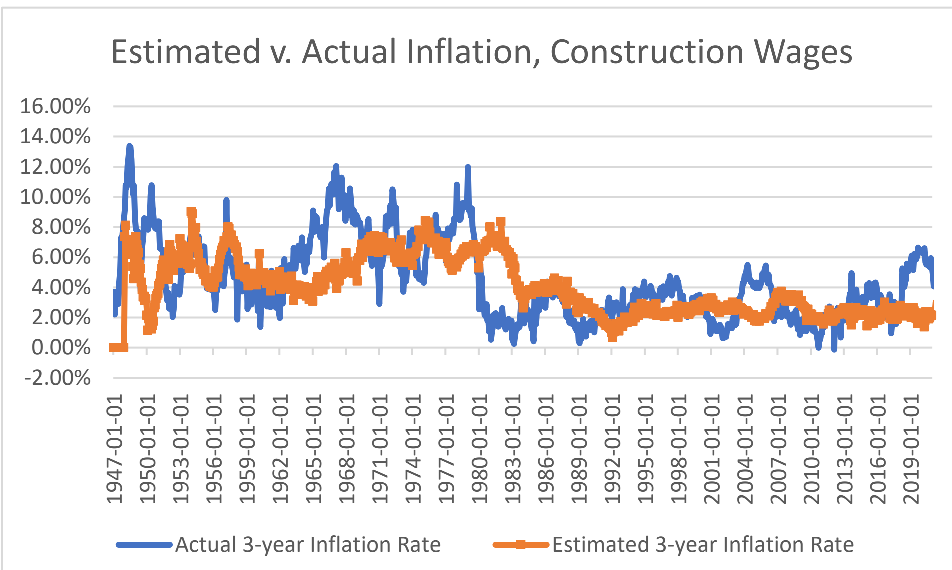

Figure 44. Estimated versus Actual Inflation for Non-supervisor Construction Wages, 3-year Model

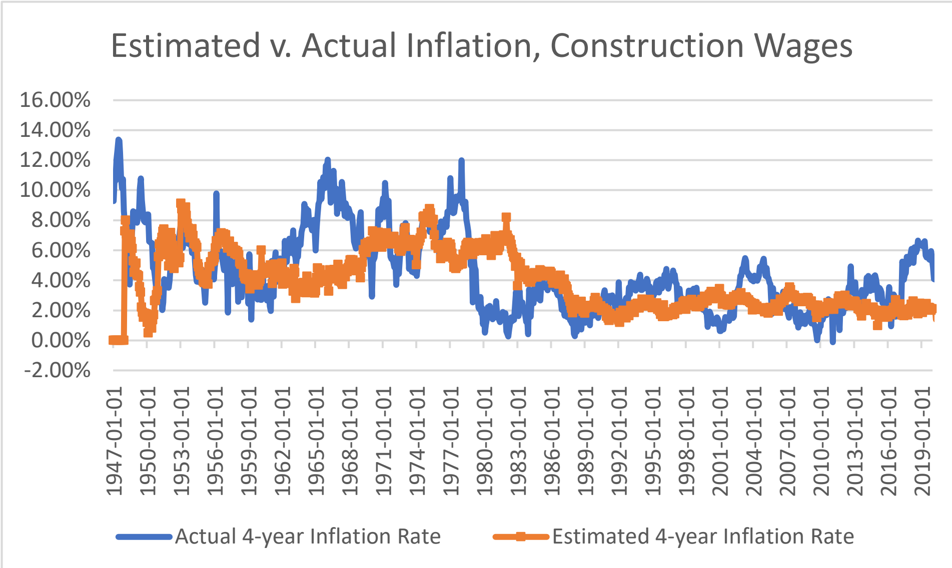

Figure 45. Estimated versus Actual Inflation for Non-supervisor Construction Wages, 4-year Model

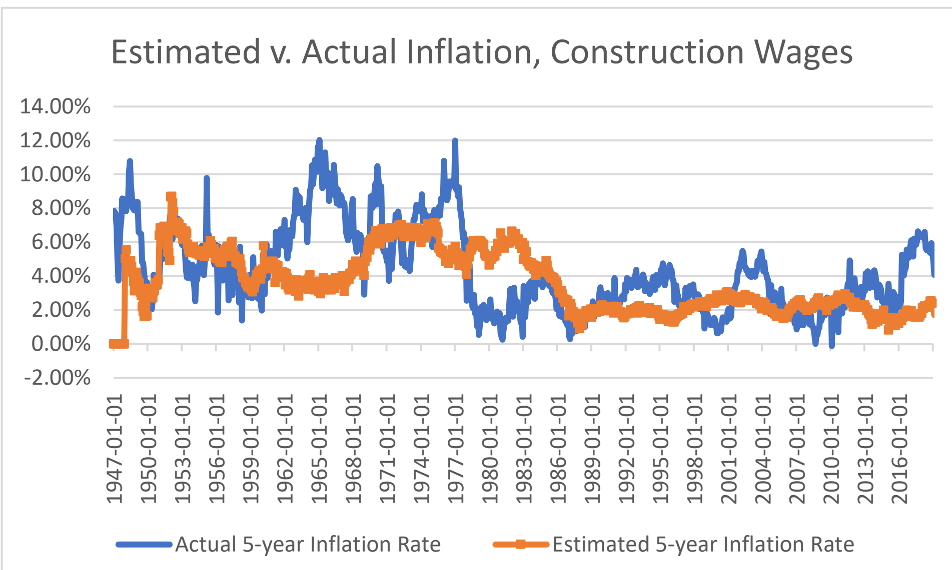

Figure 46. Estimated versus Actual Inflation for Non-supervisor Construction Wages, 5-year Model

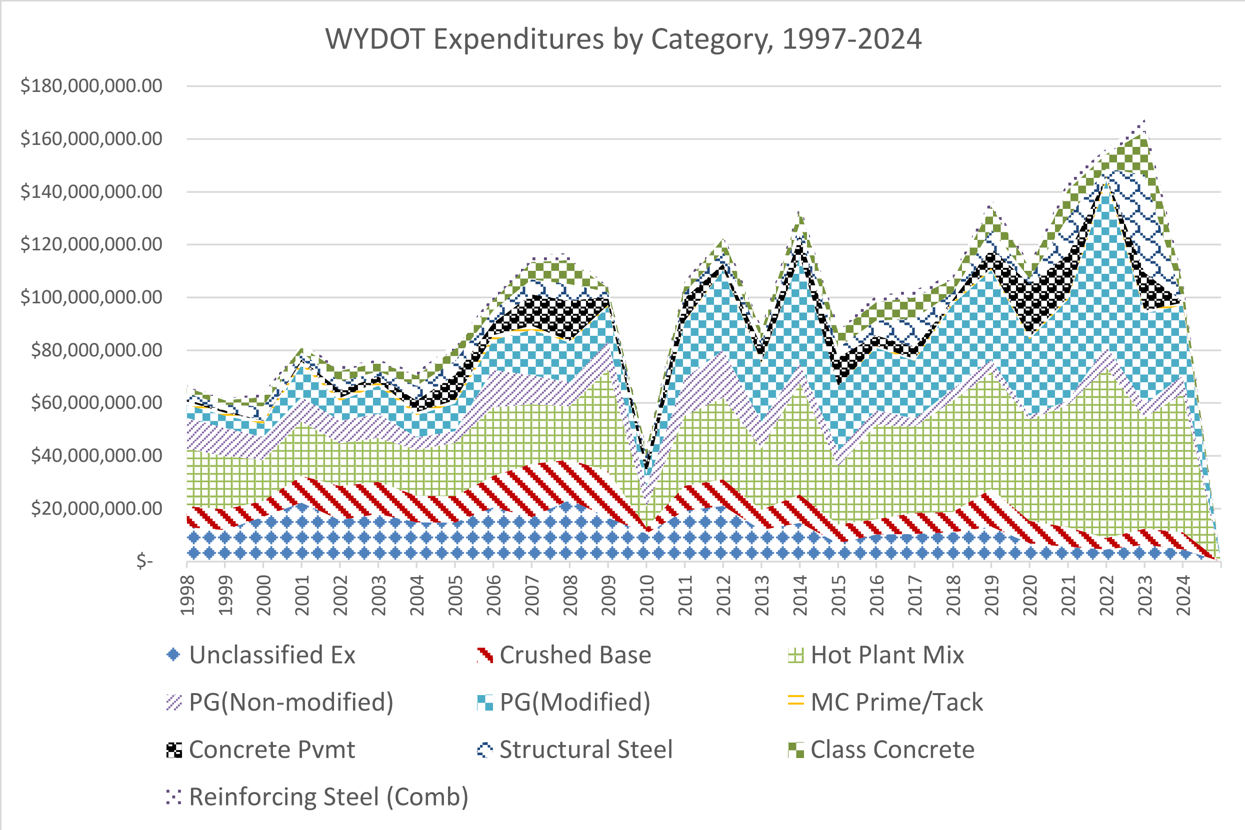

Figure 47. WYDOT Expenditures by Category, 1997-2024

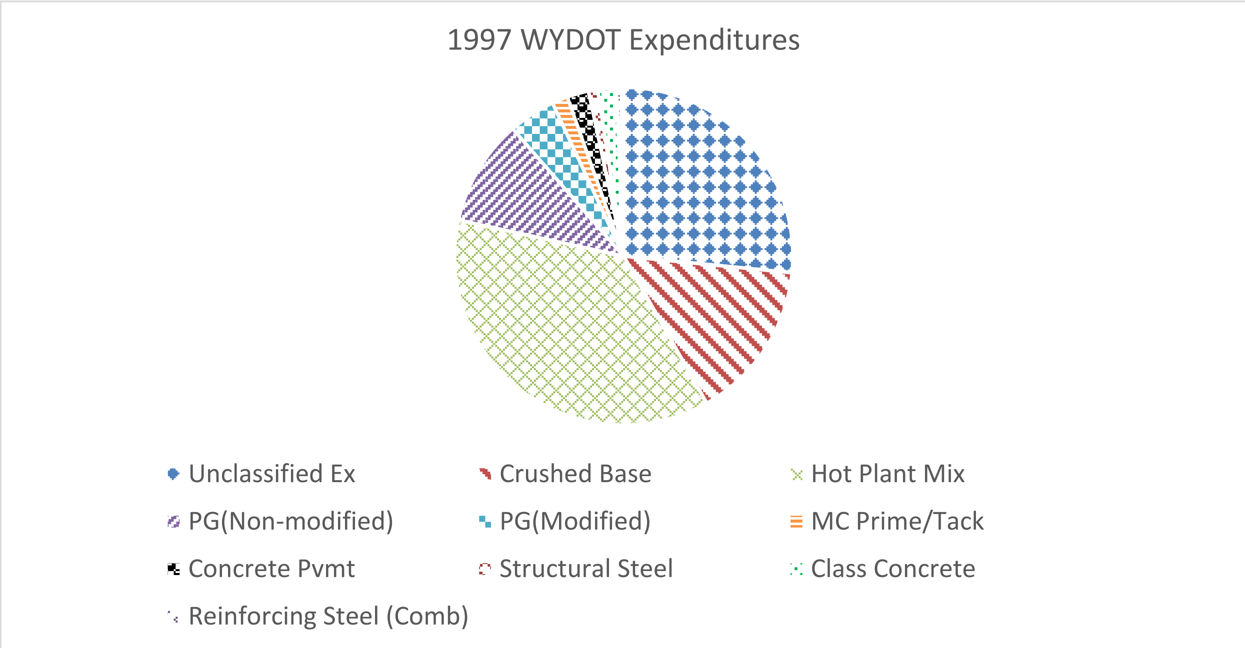

Figure 48. 1997 WYDOT Expenditures by Category

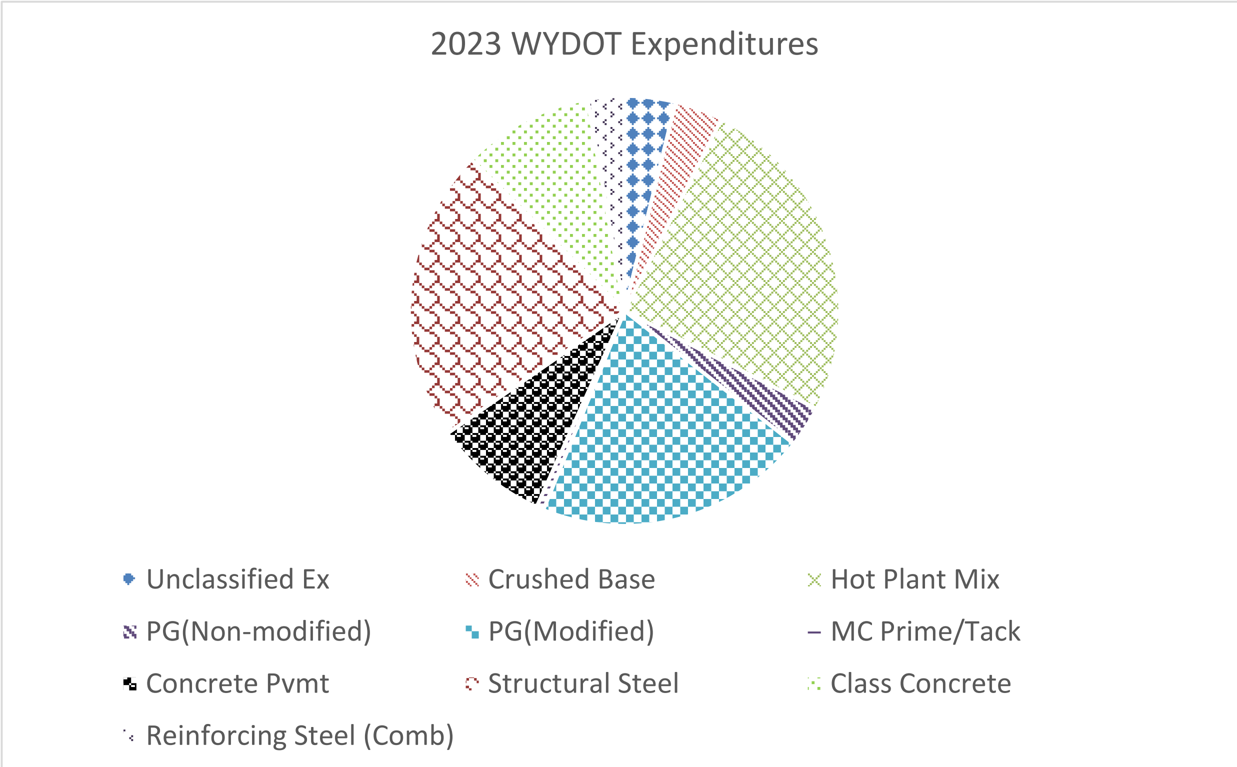

Figure 49. 2023 WYDOT Expenditures by Category

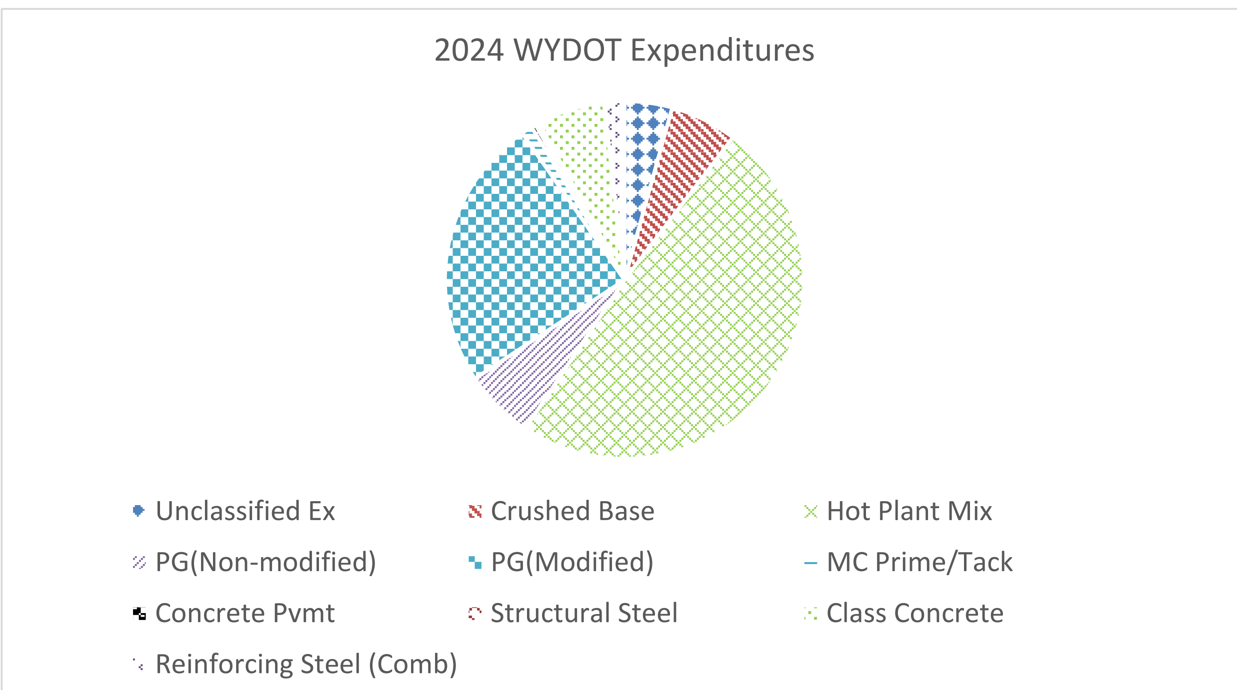

Figure 50. 2024 WYDOT Expenditures by Category

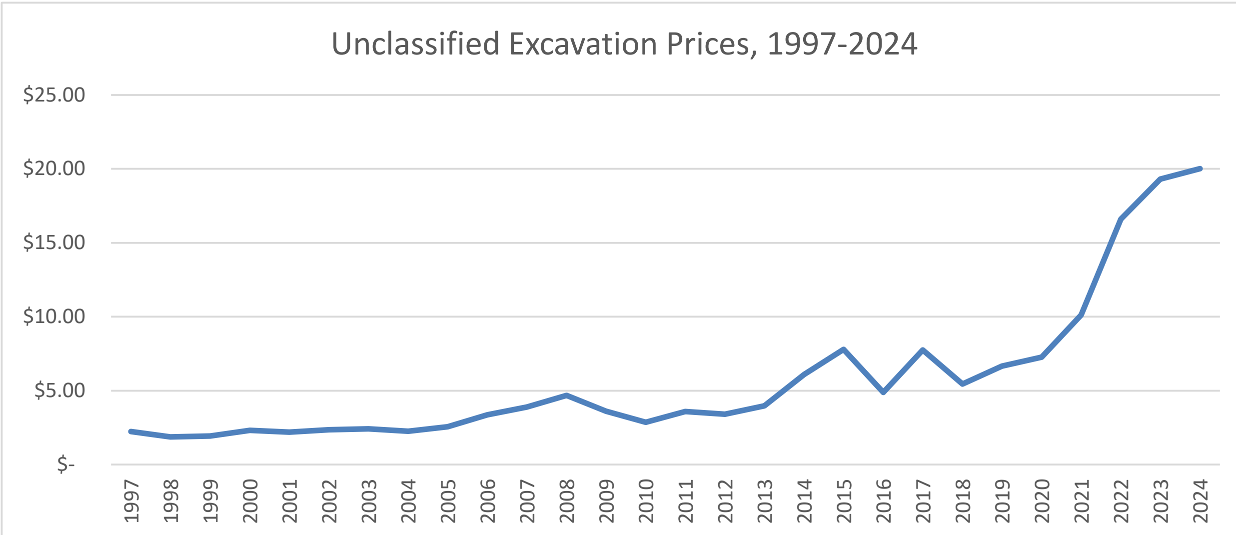

Figure 51. Excavation Price Per Cubic Yard, 1997-2024

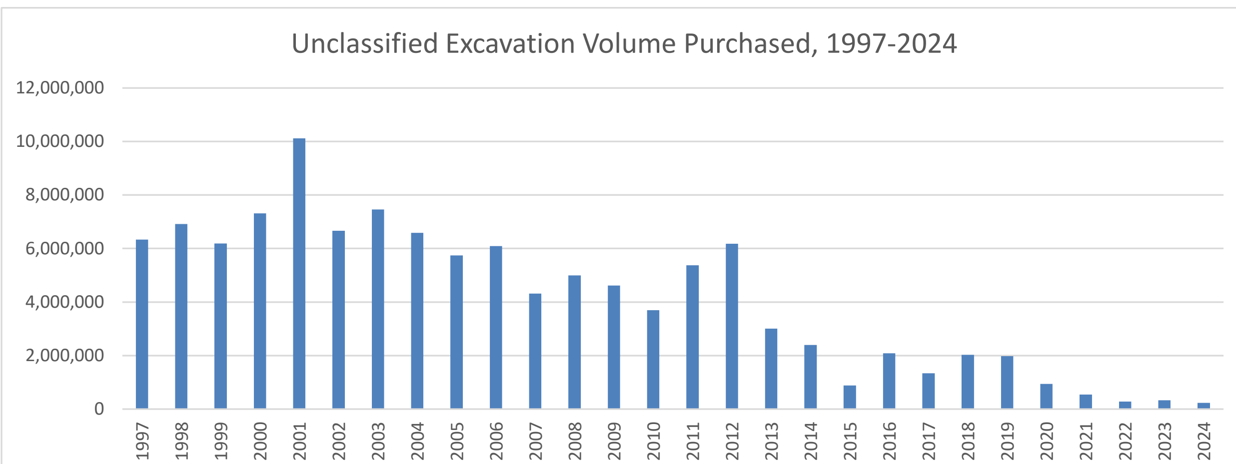

Figure 52. Cubic Yards of Excavation Purchased, 1997-2024

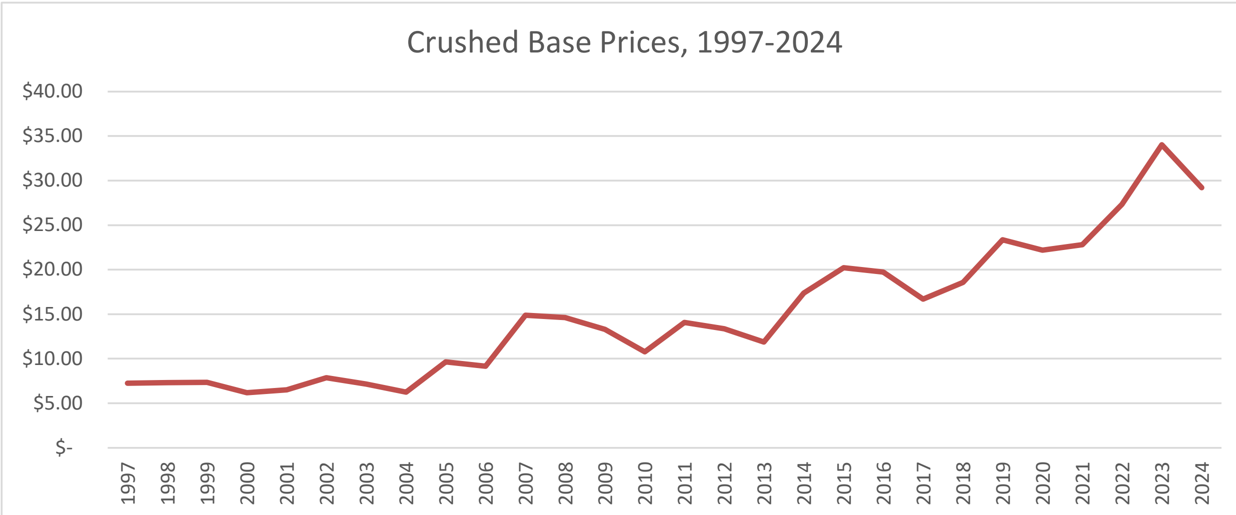

Figure 53. Gravel Price Per Ton, 1997-2024

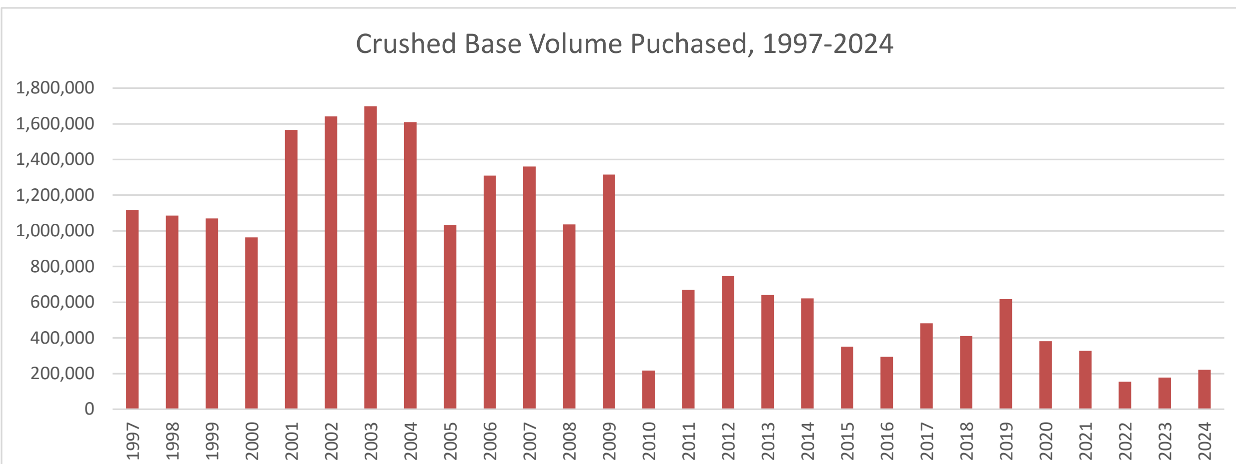

Figure 54. Tons of Gravel Purchased, 1997-2024

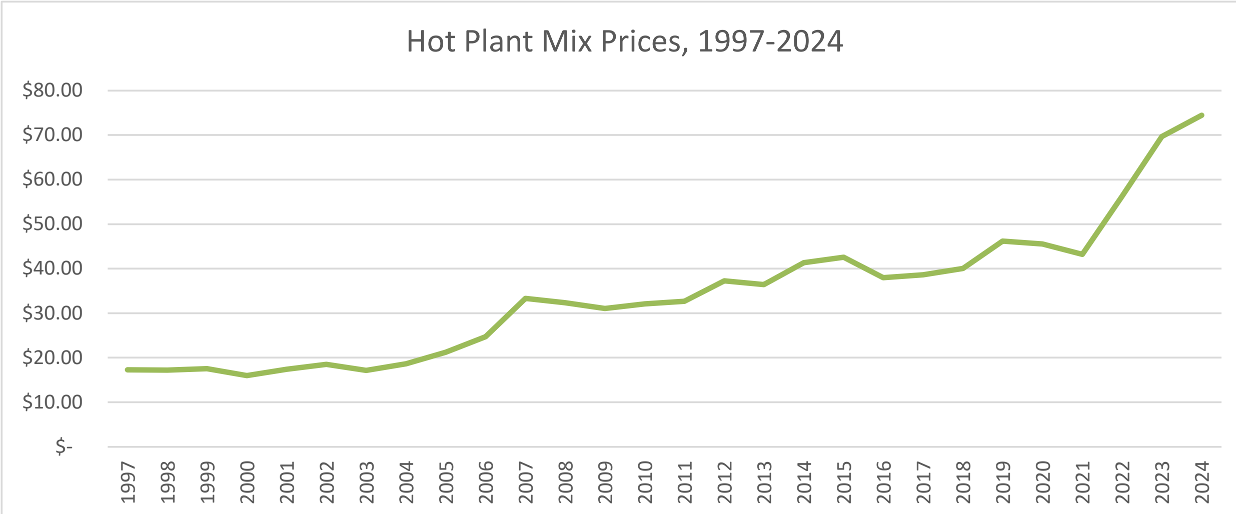

Figure 55. Hot Plant Mix Price Per Ton, 1997-2024

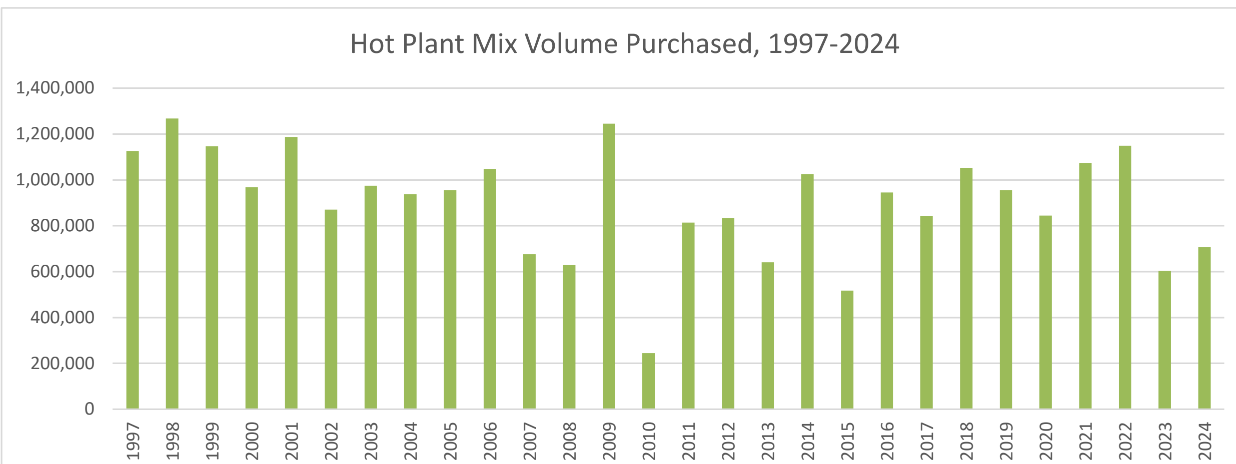

Figure 56. Tons of Hot Plant Mix Purchased, 1997-2024

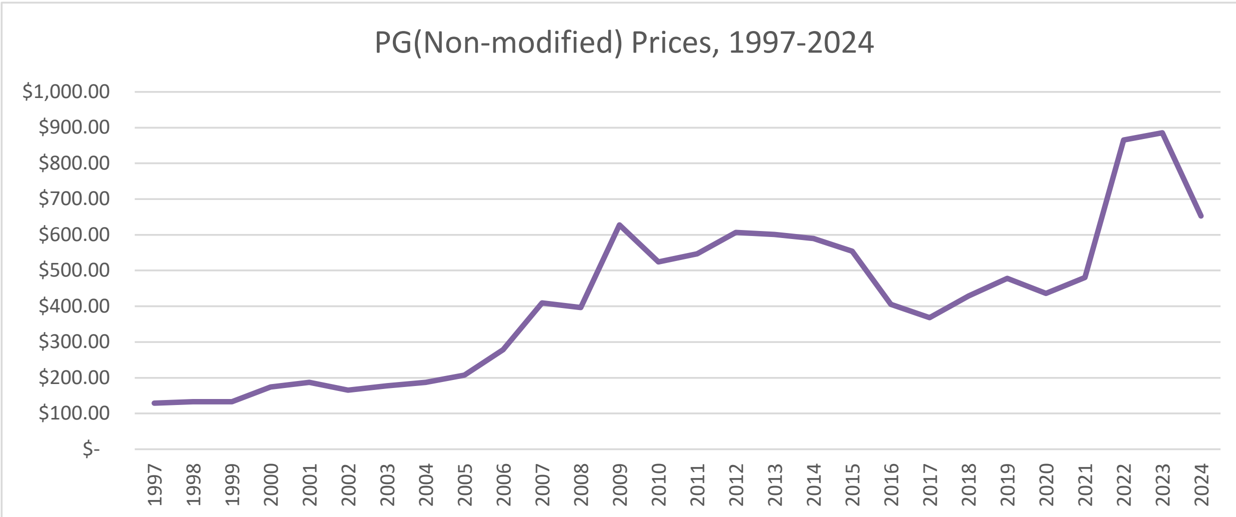

Figure 57. Non-modified Performance Grade Asphalt Price Per Ton, 1997-2024

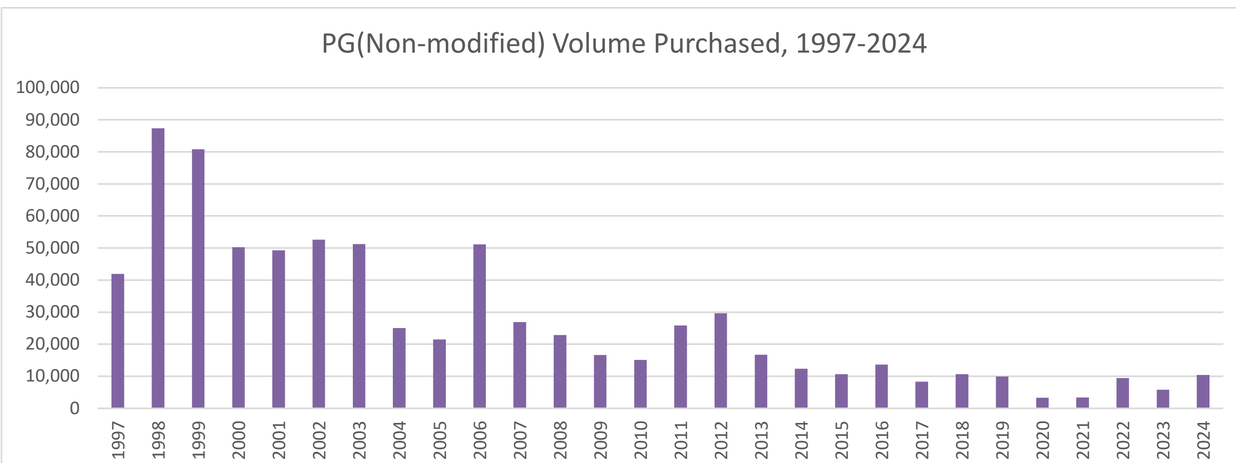

Figure 58. Tons of Non-modified Performance Grade Asphalt Purchased, 1997-2024

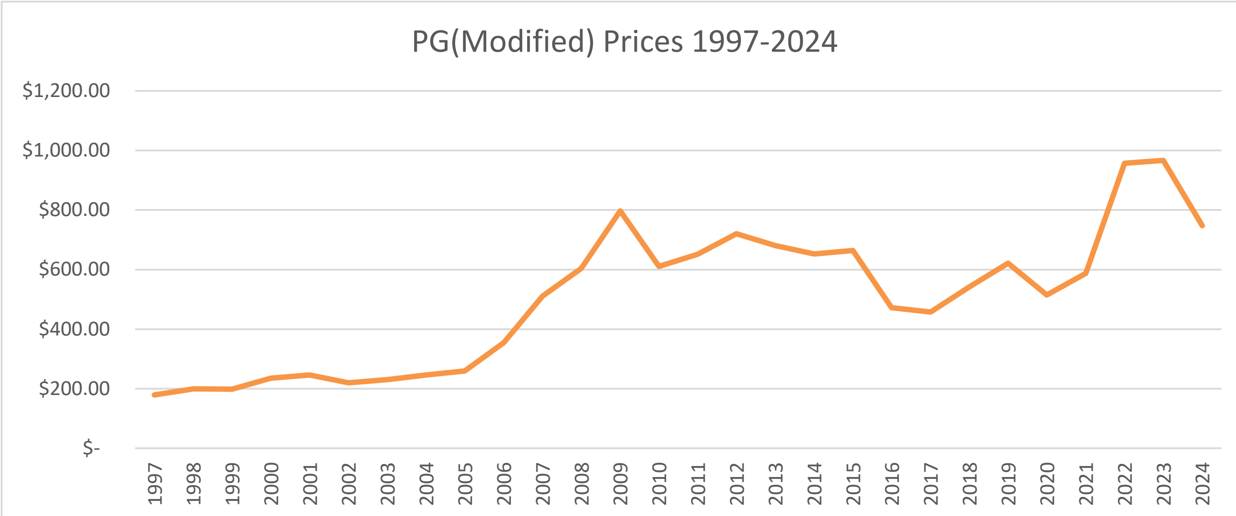

Figure 59. Modified Performance Grade Asphalt Price Per Ton, 1997-2024

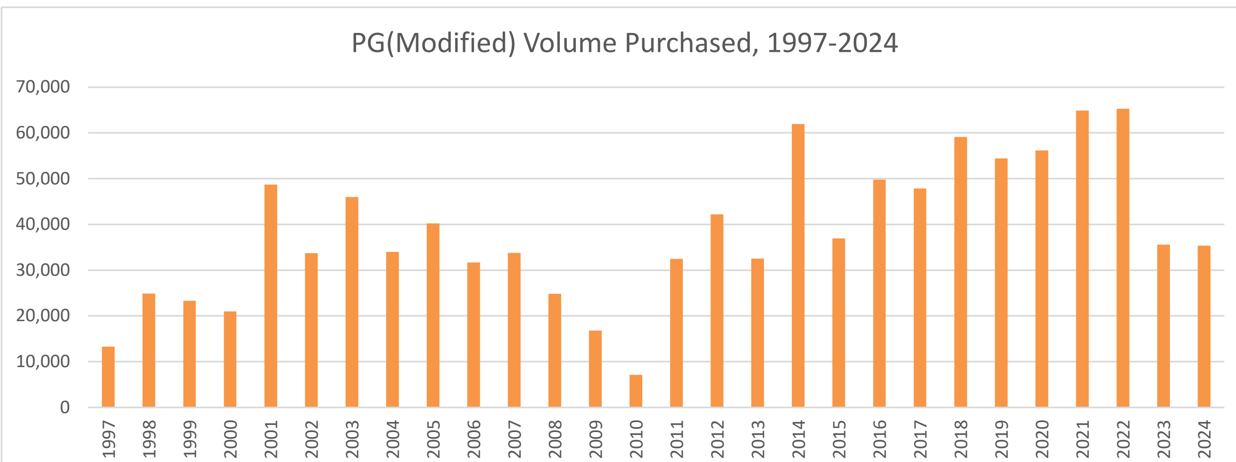

Figure 60. Tons of Modified Performance Grade Asphalt Purchased, 1997-2024

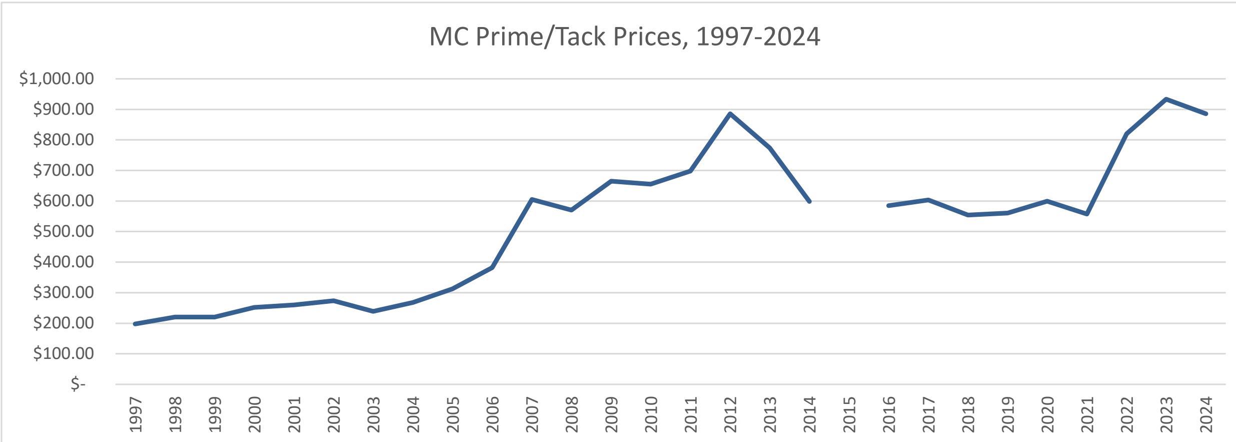

Figure 61. Medium Cure Prime/Tack Price Per Ton, 1997-2024

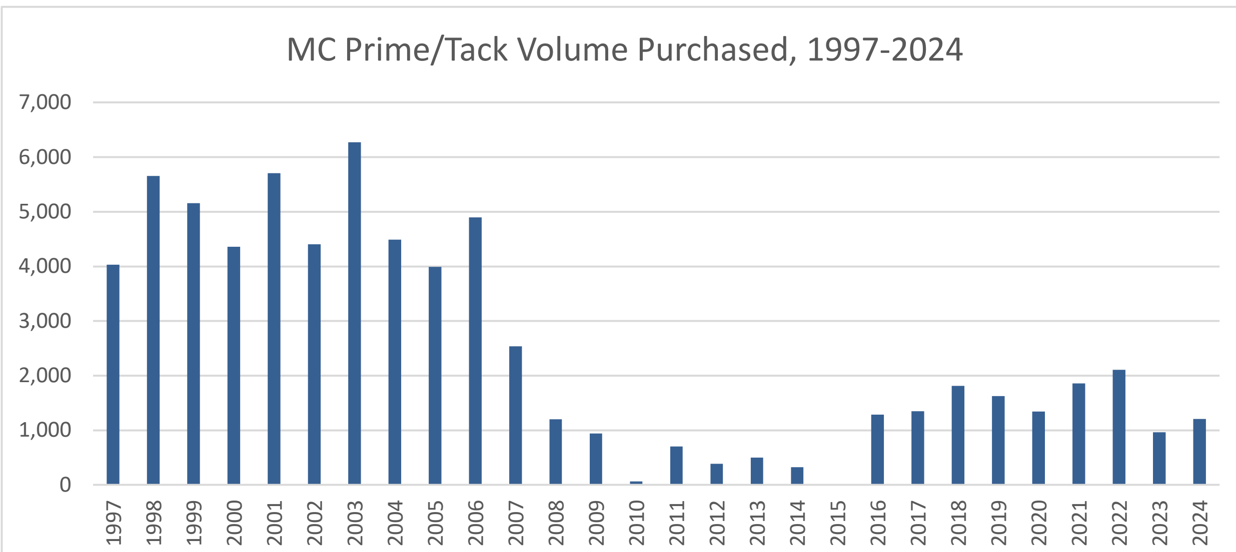

Figure 62. Tons of Medium Cure Prime/Tack Purchased, 1997-2024

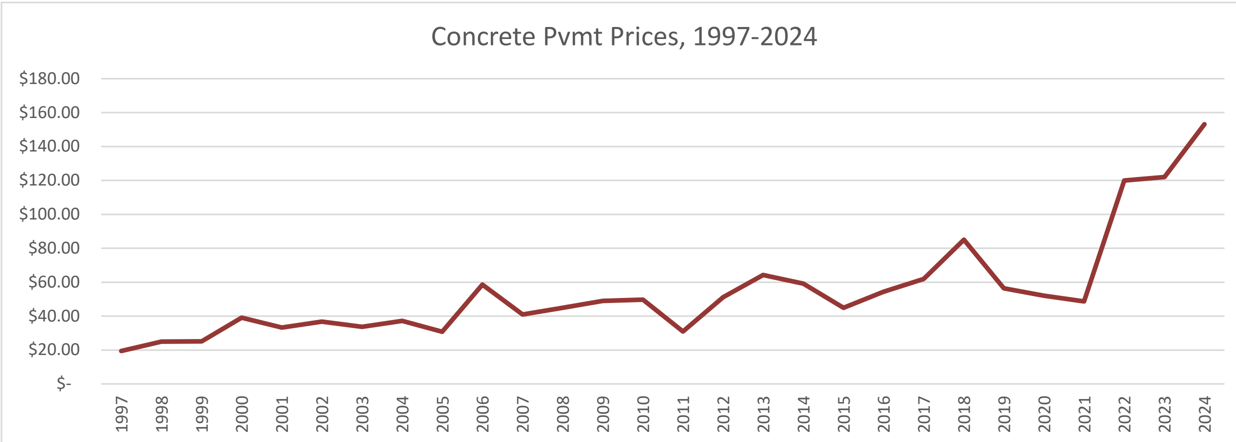

Figure 63. Concrete Pavement Price Per Square Yard, 1997-2024

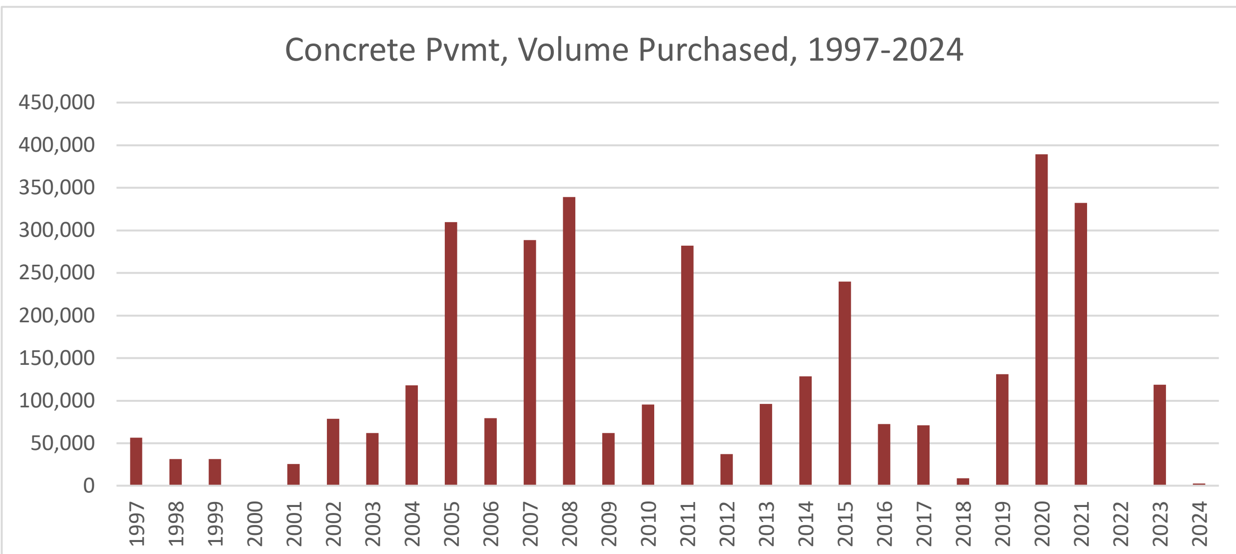

Figure 64. Square Yards of Concrete Pavement Purchased, 1997-2024

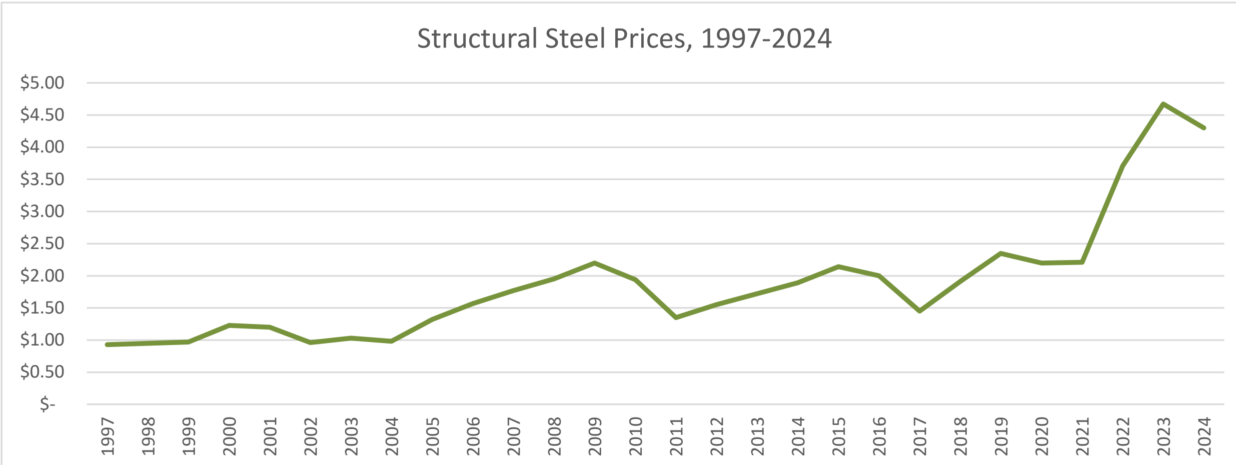

Figure 65. Structural Steel Price Per Pound, 1997-2024

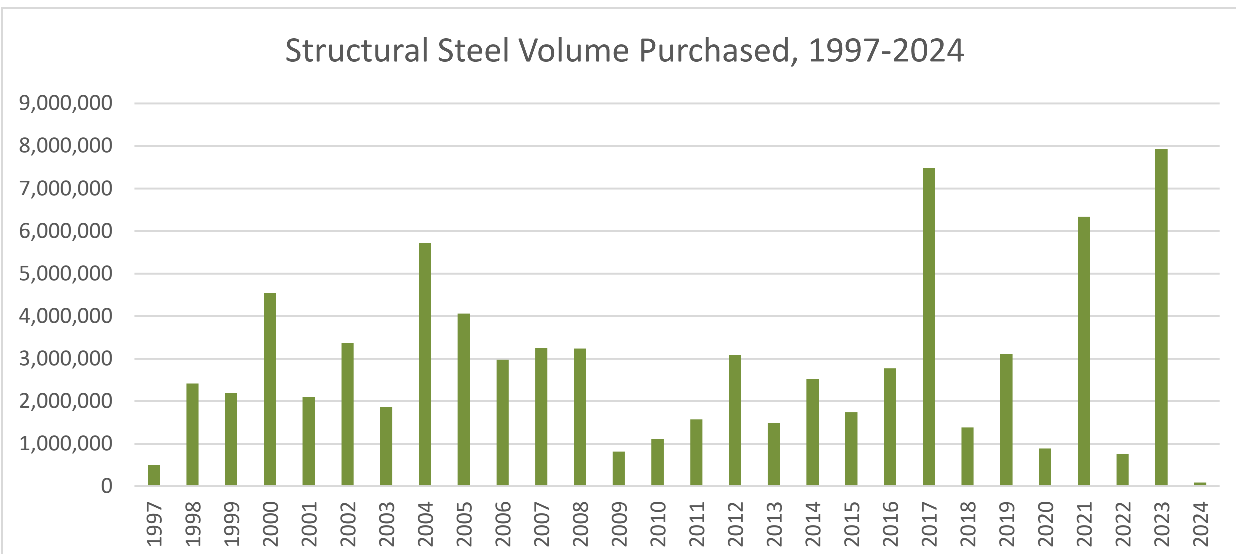

Figure 66. Pounds of Structural Steel Purchased, 1997-2024

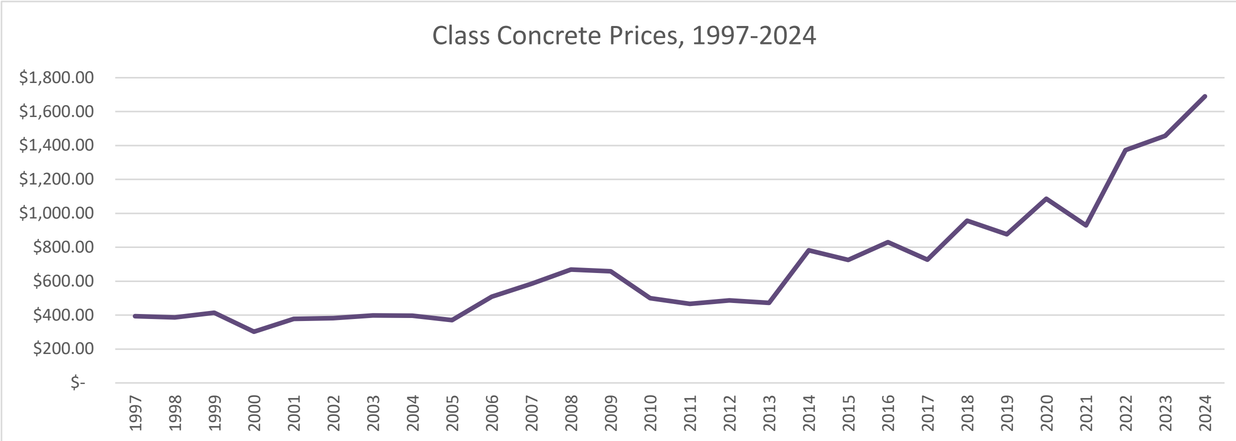

Figure 67. Class Concrete Price Per Cubic Yard, 1997-2024

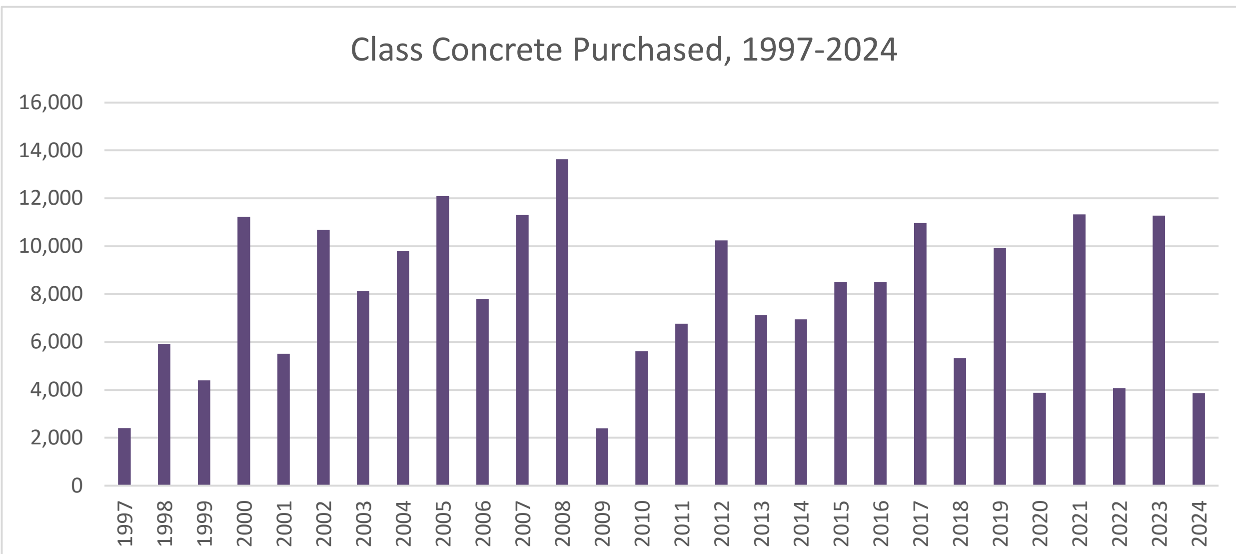

Figure 68. Cubic Yards of Class Concrete Purchased, 1997-2024

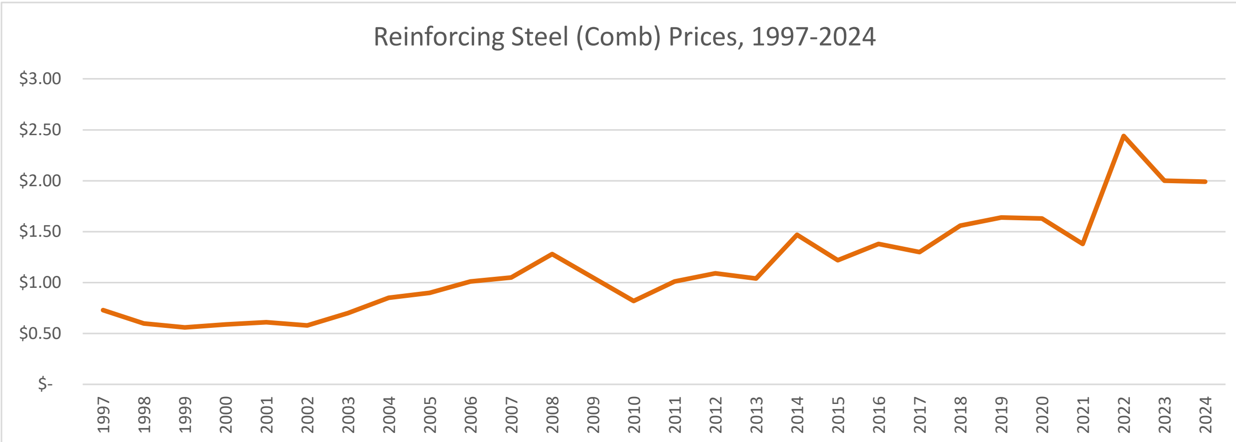

Figure 69. Reinforcing Steel Price Per Pound, 1997-2024

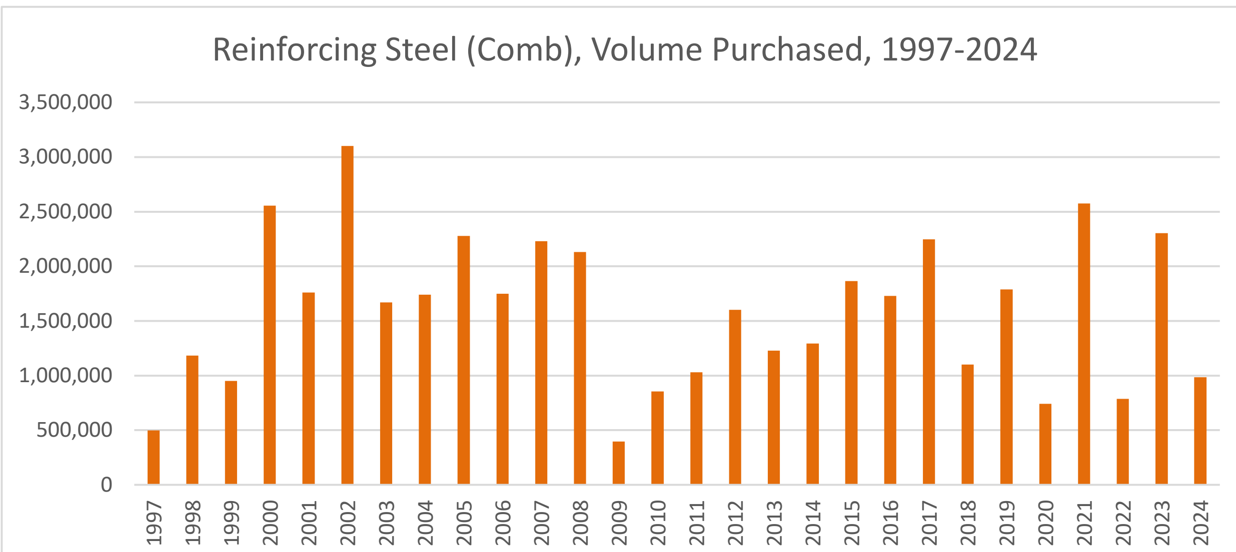

Figure 70. Pounds of Reinforcing Steel Purchased, 1997-2024

Table 1. Estimated Inflation Rates for Materials and Wages, 2024 - 2028

	2024	2025	2026	2027	2028
Asphalt	-4.94%	2.81%	22.69%	5.10%	14.68%
Bridge Metal	22.15%	31.13%	-34.53%	-168.98%	-45.94%
Concrete	-8.71%	-0.15%	43.90%	-1.58%	1.27%
Excavation	14.59%	38.18%	39.26%	21.14%	35.95%
Gravel	9.71%	7.22%	6.88%	4.94%	4.54%
Liquid Asphalt	-17.45%	-0.08%	37.73%	-28.62%	39.40%
Reinforcing Steel	9.24%	15.38%	7.36%	4.48%	7.61%
Structural Steel	15.96%	21.33%	-15.87%	-8.74%	16.78%
Wages	5.07%	4.81%	4.33%	3.90%	3.39%
Weighted Average Inflation	5.10%	10.61%	9.79%	-11.36%	1.02%

Table 2. Estimated Inflation versus Actual Inflation Rates for Materials and Wages, 2024

	Estimated Rate	Actual Rate (PPI)	Actual Rate (WYDOT)
Asphalt	-4.94%	1.94%	-14.02%
Bridge Metal	22.15%	-3.89%	N/A
Concrete	-8.71%	5.25%	20.73%
Excavation	14.59%	2.06%	3.68%
Gravel	9.71%	7.58%	-14.14%
Liquid Asphalt	-17.45%	3.61%	-5.12%
Reinforcing Steel	9.24%	-9.08%	-0.50%
Structural Steel	15.96%	-6.26%	-7.92%
Wages	5.07%	4.30%	N/A

Table 3. One-year Model for Asphalt Inflation

Adjusted R-squared = 0.6441

Coefficient	Coefficient Value
Current Inflation	0.0865813
One-year Lag	-0.1169748
Two-year Lag	0.2413764
Three-year Lag	1.28053***
Four-year Lag	-0.3980527**
Five-year Lag	-0.2293758
Six-year Lag	0.1748494
Seven-year Lag	0.13014
Eight-year Lag	-0.0757889
Nine-year Lag	-0.0062496
Ten-year Lag	0.2020424***

Table 4. One-year Model for Bridge Metal Inflation

Adjusted R-squared = 0.8019

Coefficient	Coefficient Value
Current Inflation	0.016406
One-year Lag	0.5848823**
Two-year Lag	1.123542*
Three-year Lag	0.0179932
Four-year Lag	-1.217632
Five-year Lag	-2.337267**
Six-year Lag	-0.8023812
Seven-year Lag	0.0465796
Eight-year Lag	-0.3737389

Table 5. One-year Model for Concrete Inflation

Adjusted R-squared = 0.9572

Coefficient	Coefficient Value
Current Inflation	0.1395201
One-year Lag	-1.519614***
Two-year Lag	-0.5116086
Three-year Lag	2.503226***
Four-year Lag	2.262503***
Five-year Lag	--1.897885***
Six-year Lag	-0.4223272***
Seven-year Lag	1.205452***
Eight-year Lag	1.182867***
Nine-year Lag	0.083875
Ten-year Lag	-0.7083044***

Table 6. One-year Model for Excavation Inflation

Adjusted R-squared = 0.6532

Coefficient	Coefficient Value
Current Inflation	0.2115576**
One-year Lag	0.7713921***
Two-year Lag	1.4417***
Three-year Lag	1.012302***
Four-year Lag	-0.2318157
Five-year Lag	-0.0976973
Six-year Lag	0.1569384
Seven-year Lag	0.5396493***
Eight-year Lag	-0.6027316***
Nine-year Lag	-0.4184159***
Ten-year Lag	-0.3581466***

Table 7. One-year Model for Gravel Inflation

Adjusted R-squared = 0.8538

Coefficient	Coefficient Value
Current Inflation	0.9144879***
One-year Lag	0.085629
Two-year Lag	-0.4462042***
Three-year Lag	0.2090885***
Four-year Lag	0.1666946***

Table 8. One-year Model for Liquid Asphalt Inflation
Adjusted R-squared = 0.8747

Coefficient	Coefficient Value
Current Inflation	-0.0539893
One-year Lag	-0.631438***
Two-year Lag	-0.4010418**
Three-year Lag	0.1580091
Four-year Lag	-0.3117802***
Five-year Lag	-0.5941025***
Six-year Lag	-0.3236497*
Seven-year Lag	-0.5067687***
Eight-year Lag	-0.2076695***
Nine-year Lag	0.4345495***
Ten-year Lag	0.2941244***

Table 9. One-year Model for Reinforcing Steel Inflation

Adjusted R-squared = 0.2075

Coefficient	Coefficient Value
Current Inflation	0.2602333***
One-year Lag	-0.0941637**
Two-year Lag	0.3783683***
Three-year Lag	0.2122048***

Table 10. One-year Model for Structural Steel Inflation

Adjusted R-squared = 0.2542

Coefficient	Coefficient Value
Current Inflation	0.0565554
One-year Lag	0.0961676*
Two-year Lag	0.2694334***
Three-year Lag	0.1669412**
Four-year Lag	-0.422409***
Five-year Lag	0.0016153
Six-year Lag	0.1745753***
Seven-year Lag	-0.0253591
Eight-year Lag	-0.2004288***
Nine-year Lag	0.0662781
Ten-year Lag	0.1681216**

Table 11. One-year Model for Non-supervisor Construction Wages Inflation

Adjusted R-squared = 0.8726

Coefficient	Coefficient Value
Current Inflation	0.6667642***
One-year Lag	0.1807494***
Two-year Lag	-0.0486693
Three-year Lag	0.0092071
Four-year Lag	0.1326483***

Table 12. Two-year Model for Asphalt Inflation

Adjusted R-squared = 0.6441

Coefficient	Coefficient Value
Current Inflation	0.0865813
One-year Lag	-0.1169748
Two-year Lag	0.2413764
Three-year Lag	1.28053***
Four-year Lag	-0.3980527**
Five-year Lag	-0.2293758
Six-year Lag	0.1748494
Seven-year Lag	0.13014
Eight-year Lag	-0.0757889
Nine-year Lag	-0.0062496
Ten-year Lag	0.2020424***

Table 13. Two-year Model for Bridge Metal Inflation

Adjusted R-squared = 0.8108

Coefficient	Coefficient Value
Current Inflation	0.5815759**
One-year Lag	1.110963*
Two-year Lag	0.017242
Three-year Lag	-1.228625
Four-year Lag	-2.381079**
Five-year Lag	-0.8571146
Six-year Lag	0.0133407
Seven-year Lag	-0.3835491

Table 14. Two-year Model for Concrete Inflation

Adjusted R-squared = 0.9752

Coefficient	Coefficient Value
Current Inflation	-1.212945***
One-year Lag	0.0096147
Two-year Lag	2.165011***
Three-year Lag	2.141488***
Four-year Lag	-0.7400149*
Five-year Lag	-1.187271***
Six-year Lag	0.650013***
Seven-year Lag	1.280315***
Eight-year Lag	0.4177155***
Nine-year Lag	-0.4293756**
Ten-year Lag	-0.6988631***

Table 15. Two-year Model for Excavation Inflation

Adjusted R-squared = 0.7195

Coefficient	Coefficient Value
Current Inflation	0.9086748***
One-year Lag	1.889594***
Two-year Lag	1.84102***
Three-year Lag	0.8418157***
Four-year Lag	0.3264437
Five-year Lag	-0.2026471
Six-year Lag	0.5965807***
Seven-year Lag	-0.2706319*
Eight-year Lag	-0.5791451***
Nine-year Lag	-0.7294239***
Ten-year Lag	-0.8285876***

Table 16. Two-year Model for Gravel Inflation

Adjusted R-squared = 0.7329

Coefficient	Coefficient Value
Current Inflation	0.9436184***
One-year Lag	-0.3205142***
Two-year Lag	-0.3378588***
Three-year Lag	0.4688615***
Four-year Lag	0.0922408*

Table 17. Two-year Model for Liquid Asphalt Inflation

Adjusted R-squared = 0.9082

Coefficient	Coefficient Value
Current Inflation	-0.3468098**
One-year Lag	-0.0958974
Two-year Lag	0.6041215***
Three-year Lag	-0.120542
Four-year Lag	-0.4438051***
Five-year Lag	-0.2392907**
Six-year Lag	-0.2289839
Seven-year Lag	-0.113649
Eight-year Lag	0.4737864***
Nine-year Lag	0.3101079***
Ten-year Lag	0.0310262

Table 18. Two-year Model for Reinforcing Steel Inflation

Adjusted R-squared = 0.2165

Coefficient	Coefficient Value
Current Inflation	0.0006751
One-year Lag	0.2858331***
Two-year Lag	0.1833251***
Three-year Lag	0.0589254
Four-year Lag	0.1073176*
Five-year Lag	0.0923132
Six-year Lag	0.1989079***
Seven-year Lag	-0.0477377
Eight-year Lag	0.2259391***
Nine-year Lag	-0.0351615
Ten-year Lag	-0.3758981***

Table 19. Two-year Model for Structural Steel Inflation

Adjusted R-squared = 0.2540

Coefficient	Coefficient Value
Current Inflation	0.1059969*
One-year Lag	0.2742802***
Two-year Lag	0.176589***
Three-year Lag	-0.3952493***
Four-year Lag	-0.022082
Five-year Lag	0.1382345*
Six-year Lag	0.0026476
Seven-year Lag	-0.1955931***
Eight-year Lag	0.0689698
Nine-year Lag	0.175952**
Ten-year Lag	-0.0798005

Table 20. Two-year Model for Non-supervisor Construction Wage Inflation

Adjusted R-squared = 0.8346

Coefficient	Coefficient Value
Current Inflation	0.5882006***
One-year Lag	0.0424684
Two-year Lag	0.0521404
Three-year Lag	-0.0808256*
Four-year Lag	0.0232041
Five-year Lag	0.0955332**
Six-year Lag	0.0291224
Seven-year Lag	0.1817975***

Table 21. Three-year Model for Asphalt Inflation

Adjusted R-squared = 0.9266

Coefficient	Coefficient Value
Current Inflation	0.623938***
One-year Lag	0.8047971***
Two-year Lag	0.4579696***
Three-year Lag	-1.358923***
Four-year Lag	0.3819923***
Five-year Lag	0.9830178***
Six-year Lag	-0.3931773**
Seven-year Lag	-0.0721666
Eight-year Lag	0.0271238
Nine-year Lag	0.2106667***
Ten-year Lag	-0.1181404

Table 22.Three-year Model for Bridge Metal Inflation

Adjusted R-squared = 0.7733

Coefficient	Coefficient Value
Current Inflation	1.258729*
One-year Lag	-0.0307557
Two-year Lag	-1.098292
Three-year Lag	-2.354236**
Four-year Lag	-2.101039**
Five-year Lag	-1.480345*
Six-year Lag	-0.7683151

Table 23. Three-year Model for Concrete Inflation

Adjusted R-squared = 0.9758

Coefficient	Coefficient Value
Current Inflation	1.658261***
One-year Lag	2.181561***
Two-year Lag	0.1784659
Three-year Lag	-1.88529***
Four-year Lag	-1.024796**
Five-year Lag	1.664985***
Six-year Lag	0.3985961**
Seven-year Lag	-0.0513215
Eight-year Lag	-0.0855879
Nine-year Lag	-0.5640969***
Ten-year Lag	-0.0751464

Table 24. Three-year Model for Excavation Inflation

Adjusted R-squared = 0.6614

Coefficient	Coefficient Value
Current Inflation	1.51786***
One-year Lag	1.769771***
Two-year Lag	0.6936903*
Three-year Lag	1.24388***
Four-year Lag	0.8302424***
Five-year Lag	0.8514854***
Six-year Lag	*-0.4322669**
Seven-year Lag	0.1631534
Eight-year Lag	-0.8732952***
Nine-year Lag	-0.9546678***
Ten-year Lag	-0.5066091***

Table 25. Three-year Model for Gravel Inflation

Adjusted R-squared = 0.6354

Coefficient	Coefficient Value
Current Inflation	0.80961***
One-year Lag	-0.2445247**
Two-year Lag	-0.0959825
Three-year Lag	0.2698599**
Four-year Lag	0.2475059**
Five-year Lag	-0.1085274
Six-year Lag	-0.1054309
Seven-year Lag	0.0404724
Eight-year Lag	0.2381238**
Nine-year Lag	-0.3126779***
Ten-year Lag	0.170157***

Table 26. Three-year Model for Liquid Asphalt Inflation

Adjusted R-squared = 0.9362

Coefficient	Coefficient Value
Current Inflation	0.7975568***
One-year Lag	1.46397***
Two-year Lag	0.7807176***
Three-year Lag	0.0674188
Four-year Lag	0.131691
Five-year Lag	0.009731
Six-year Lag	0.3708494**
Seven-year Lag	0.4686251***
Eight-year Lag	0.4130123***
Nine-year Lag	0.1999296***
Ten-year Lag	0.1260933***

Table 27. Three-year Model for Reinforcing Steel Inflation

Adjusted R-squared = 0.2368

Coefficient	Coefficient Value
Current Inflation	0.3020885***
One-year Lag	0.202193***
Two-year Lag	0.0200182
Three-year Lag	0.1229619**
Four-year Lag	0.0211985
Five-year Lag	0.2665666***
Six-year Lag	-0.1572728**
Seven-year Lag	0.1646769**
Eight-year Lag	0.0008757
Nine-year Lag	-0.4829986***
Ten-year Lag	0.3292822***

Table 28. Three-year Model for Structural Steel Inflation

Adjusted R-squared = 0.2493

Coefficient	Coefficient Value
Current Inflation	0.2699705***
One-year Lag	0.193717***
Two-year Lag	-0.3924374***
Three-year Lag	-0.0026169
Four-year Lag	0.130322**
Five-year Lag	-0.0150982
Six-year Lag	-0.1754271**
Seven-year Lag	0.0523618
Eight-year Lag	0.1581329**

Table 29. Three-year Model for Non-supervisor Construction Wage Inflation

Adjusted R-squared = 0.7908

Coefficient	Coefficient Value
Current Inflation	0.4225151***
One-year Lag	0.1425432***
Two-year Lag	-0.0601506
Three-year Lag	-0.00908725
Four-year Lag	0.1167079***
Five-year Lag	0.1011029**
Six-year Lag	0.1858902***

Table 30. Four-year Model for Asphalt Inflation

Adjusted R-squared = 0.9423

Coefficient	Coefficient Value
Current Inflation	0.4661522***
One-year Lag	0.8061687***
Two-year Lag	-0.85374***
Three-year Lag	0.7870027***
Four-year Lag	-0.2768959
Five-year Lag	-1.013611***
Six-year Lag	0.3086197**
Seven-year Lag	0.0539173
Eight-year Lag	0.091168
Nine-year Lag	-0.0299115
Ten-year Lag	0.3580518***

Table 31. Four-year Model for Bridge Metal Inflation

Adjusted R-squared = 0.7507

Coefficient	Coefficient Value
Current Inflation	-1.290785**
One-year Lag	-2.64008***
Two-year Lag	-3.897169***
Three-year Lag	-2.979447***
Four-year Lag	-1.959374**
Five-year Lag	-0.9407605

Table 32. Four-year Model for Concrete Inflation

Adjusted R-squared = 0.9850

Coefficient	Coefficient Value
Current Inflation	0.0427394
One-year Lag	-1.223819**
Two-year Lag	-0.9921275**
Three-year Lag	-0.3222705
Four-year Lag	2.328958***
Five-year Lag	1.677034***
Six-year Lag	0.7165194***
Seven-year Lag	0.3984479
Eight-year Lag	-0.4348178*
Nine-year Lag	0.5462327***
Ten-year Lag	0.874409***

Table 33. Four-year Model for Excavation Inflation

Adjusted R-squared = 0.5478

Coefficient	Coefficient Value
Current Inflation	0.7993706***
One-year Lag	-0.3783302
Two-year Lag	0.875351
Three-year Lag	2.332611***
Four-year Lag	2.067517***
Five-year Lag	-0.4226783
Six-year Lag	0.0877073
Seven-year Lag	0.5005898**
Eight-year Lag	-0.973704***
Nine-year Lag	-0.5264741**
Ten-year Lag	-0.5885793**

Table 34. Four-year Model for Gravel Inflation

Adjusted R-squared = 0.5958

Coefficient	Coefficient Value
Current Inflation	0.361207***
One-year Lag	-0.0866003
Two-year Lag	0.1531747
Three-year Lag	0.4346422***
Four-year Lag	-0.0412275
Five-year Lag	-0.2161275**
Six-year Lag	0.0199547
Seven-year Lag	0.2701123***
Eight-year Lag	-0.2076082**
Nine-year Lag	-0.150829*
Ten-year Lag	0.3294358***

Table 35. Four-year Model for Liquid Asphalt Inflation

Adjusted R-squared = 0.9376

Coefficient	Coefficient Value
Current Inflation	0.3646593
One-year Lag	-0.6241374***
Two-year Lag	-1.229686***
Three-year Lag	-0.4914041**
Four-year Lag	-0.3845382*
Five-year Lag	-0.5912689**
Six-year Lag	-0.3122284
Seven-year Lag	0.2179403***
Eight-year Lag	-0.0556835
Nine-year Lag	0.1019507
Ten-year Lag	0.109658

Table 36. Four-year Model for Reinforcing Steel Inflation

Adjusted R-squared = 0.2160

Coefficient	Coefficient Value
Current Inflation	0.2386943***
One-year Lag	-0.0060705
Two-year Lag	0.1434086**
Three-year Lag	0.0836699
Four-year Lag	0.2141049***
Five-year Lag	-0.0839345
Six-year Lag	0.1190034*
Seven-year Lag	0.028844
Eight-year Lag	-0.4847273***
Nine-year Lag	0.3770993***

Table 37. Four-year Model for Structural Steel Inflation

Adjusted R-squared = 0.2399

Coefficient	Coefficient Value
Current Inflation	0.2034998***
One-year Lag	-0.3015226***
Two-year Lag	0.0388921
Three-year Lag	0.0698062
Four-year Lag	-1.328072*
Five-year Lag	-0.0483374
Six-year Lag	0.0980726
Seven-year Lag	0.1142255
Eight-year Lag	-0.1609503**
Nine-year Lag	0.0349549
Ten-year Lag	0.280616***

Table 38. Four-year Model for Non-supervisor Construction Wage Inflation

Adjusted R-squared = 0.7681

Coefficient	Coefficient Value
Current Inflation	0.416469***
One-year Lag	0.0182808
Two-year Lag	-0.032128
Three-year Lag	0.1145603**
Four-year Lag	0.1405257***
Five-year Lag	0.2119155***

Table 39. Five-year Model for Asphalt Inflation

Adjusted R-squared = 0.9781

Coefficient	Coefficient Value
Current Inflation	0.7585622***
One-year Lag	-0.6672178***
Two-year Lag	0.799972***
Three-year Lag	0.5292041
Four-year Lag	-1.752844***
Five-year Lag	-0.0298873
Six-year Lag	0.3169659**
Seven-year Lag	0.3071849***
Eight-year Lag	0.0464141
Nine-year Lag	0.3580622***
Ten-year Lag	0.1205685

Table 40. Five-year Model for Bridge Metal Inflation

Adjusted R-squared = 0.7649

Coefficient	Coefficient Value
Current Inflation	-0.1115919
One-year Lag	-1.36284***
Two-year Lag	-0.6043951*
Three-year Lag	-0.0875702
Four-year Lag	-0.1770748
Five-year Lag	0.698088

Table 41. Five-year Model for Concrete Inflation

Adjusted R-squared = 0.9919

Coefficient	Coefficient Value
Current Inflation	-0.5061628
One-year Lag	-0.3579121
Two-year Lag	0.0501242
Three-year Lag	2.155799***
Four-year Lag	1.580388***
Five-year Lag	-0.0288169
Six-year Lag	0.0557498
Seven-year Lag	-0.4275387
Eight-year Lag	0.3650538*
Nine-year Lag	0.7346962***
Ten-year Lag	-0.5221445***

Table 42. Five-year Model for Excavation Inflation

Adjusted R-squared = 0.6689

Coefficient	Coefficient Value
Current Inflation	-1.115177***
One-year Lag	3.276848***
Two-year Lag	2.885742***
Three-year Lag	2.830823***
Four-year Lag	0.8307595**
Five-year Lag	0.2585546
Six-year Lag	0.5471118**
Seven-year Lag	-0.6363841***
Eight-year Lag	-0.8528848***
Nine-year Lag	-0.9225996***
Ten-year Lag	-1.266595***

Table 43. Five-year Model for Gravel Inflation

Adjusted R-squared = 0.6036

Coefficient	Coefficient Value
Current Inflation	0.1265149
One-year Lag	0.1367259
Two-year Lag	0.3973942***
Three-year Lag	0.1654789
Four-year Lag	-0.2140509**
Five-year Lag	-0.022363
Six-year Lag	0.2135621**
Seven-year Lag	-0.1887127*
Eight-year Lag	-0.0184516
Nine-year Lag	0.0736378
Ten-year Lag	0.2028898***

Table 44. Five-year Model for Liquid Asphalt Inflation

Adjusted R-squared = 0.9702

Coefficient	Coefficient Value
Current Inflation	-0.7302348***
One-year Lag	-1.44644***
Two-year Lag	-0.4835821**
Three-year Lag	-0.5298924*
Four-year Lag	-0.913536***
Five-year Lag	-0.4547711*
Six-year Lag	0.2039987
Seven-year Lag	-0.1618616**
Eight-year Lag	0.0735975
Nine-year Lag	0.2673291***
Ten-year Lag	0.0665222

Table 45. Five-year Model for Reinforcing Steel Inflation

Adjusted R-squared = 0.1979

Coefficient	Coefficient Value
Current Inflation	0.0165968
One-year Lag	0.1163951
Two-year Lag	0.0862187
Three-year Lag	0.2286326***
Four-year Lag	-0.0937681
Five-year Lag	0.1332901**
Six-year Lag	0.0239946
Seven-year Lag	-0.4465856***
Eight-year Lag	0.33139***
Nine-year Lag	0.1783276**

Table 46. Five-year Model for Structural Steel Inflation

Adjusted R-squared = 0.2426

Coefficient	Coefficient Value
Current Inflation	-0.29917***
One-year Lag	0.0824604
Two-year Lag	0.1212731
Three-year Lag	-0.151082**
Four-year Lag	-0.1718576**
Five-year Lag	0.213287***
Six-year Lag	0.1364645*
Seven-year Lag	-0.182505**
Eight-year Lag	-0.044545
Nine-year Lag	0.2446234***
Ten-year Lag	0.2630184***

Table 47. Five-year Model for Non-supervisor Construction Wage Inflation

Adjusted R-squared = 0.7457

Coefficient	Coefficient Value
Current Inflation	0.2886252***
One-year Lag	0.0511111
Two-year Lag	0.0930327*
Three-year Lag	0.1412172***
Four-year Lag	0.2669037***