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Bid Inflation for Highway and Bridge Projects: Challenges & Solutions—A Report to the Maine Department of Transportation

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Report to the Maine Department of Transportation:

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Acknowledgments and Disclaimers

The views and opinions expressed in this report are solely those of the individual authors. They do not represent those of Maine Department of Transportation or any other individual or organization that has provided information or assistance. We would like to thank the Maine Department of Transportation, the Maine Turnpike Authority, and our survey participants for their contributions to this work.

Executive Summary

Construction input prices have increased dramatically both nationwide and in Maine. According to the U.S. Bureau of Labor Statistics Producer Price Index, the cost of construction materials has increased nearly 50% nationally over the past four years. Our analysis suggests that input prices in Maine largely match the trends observed nationwide. While the data suggest that Maine highway and bridge construction wages levels closely match those seen in New Hampshire and Vermont, we have evidence to suggest that Maine firms are paying more on a per unit basis for liquid asphalt and gravel—two key inputs to road paving work—than its neighbors.

Results from our survey of relevant contractors (16 responses of 27, ~ 60%) shows that labor costs account for nearly 40% of total project costs on average. Most contractors report challenges arising from labor shortages, rapid wage growth, and materials cost inflation. While estimates of weekly wages paid in the construction industry have risen nationwide over from 2015 to 2021, Maine's 27.7% growth in nominal construction wages outpaced the national trend of 19.4% over this same period. At the same time, materials cost increases and the risk of future materials cost increases are also significant.

Results from a statistical analysis of five years of MaineDOT and MTA highway and bridge contract bid data suggests that lack of competition, elevated input costs, and project type (and size) appear to drive higher bid offers. These factors, along with internal cost estimates from MaineDOT engineers, are able to explain nearly all of the variation seen in low-bid offer amounts within our study. Combining the results from our analysis with the sentiment expressed by relevant firms in our survey, it seems reasonable to expect that recent bid offer amounts would exceed historic expectations of the costs for highway and bridge work.

Market conditions are volatile and shifting rapidly, firm uncertainty is increasing, and construction costs are at historic highs. State engineers should expect any given project cost to be well above levels seen for comparable work prior to 2020. Moving forward, we believe the key to incentivizing lower bid offer amounts is to reduce perceived risk and uncertainty for firms.

Combining this lack of competition between bids for high-value projects with general inflationary pressures, supply chain delays, labor availability, and associated added risks, the MaineDOT and its contractors are facing serious barriers to completing highway and bridge projects in a timely and affordable manner. Considering all cost drivers, our analysis provides support to MaineDOT's observations of a general increase in construction costs of approximately 40% across most of its construction project types from 2018 to present, though individual project complexity, size and timing matter significantly.

Summary of Recommendations:

- Consider further adjustments to engineer's estimating procedures in response to current market conditions.

- Consider expediting the timeline to award contracts, as prices continue to rise between the let date and when purchasing of project materials begins. Consider offering daily incentives in bid documents for early completion. Some contractors may offer quicker completion times and accept more risk for the prospect of additional compensation.
- Allowing the advance purchase of project materials whenever feasible would provide time to deliver and insulate contractors from further inflation.
- Consider the temporary inclusion of additional price escalation clauses for additional inputs with the goal of reducing perceived risk to firms bidding into an uncertain future of labor and materials costs.
- Consider all opportunities to stimulate additional bidding competition, including issuing smaller contracts and simplifying contract requirements
- Place additional scrutiny on significant potential firm mergers and acquisitions within the Maine highway and bridge construction industry going forward.

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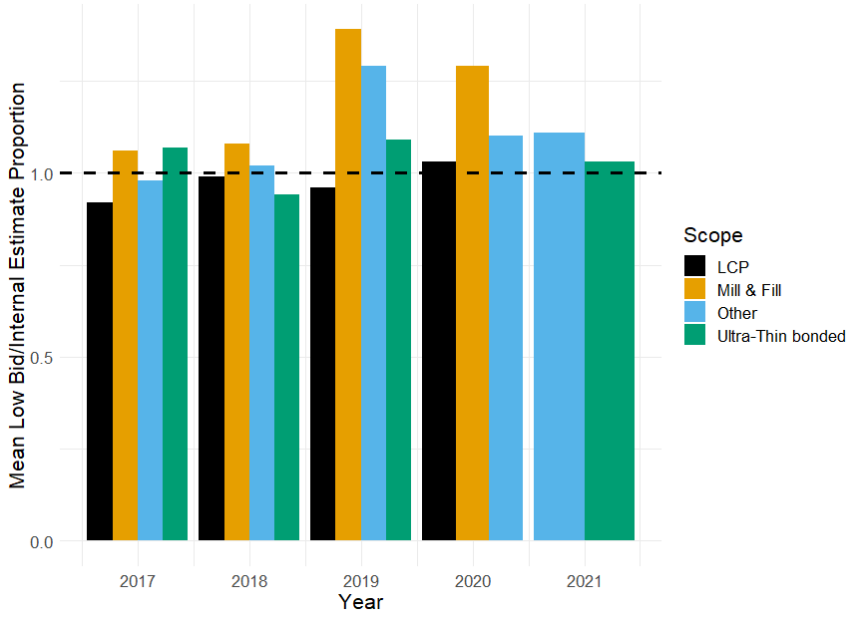
Introduction

The past two years have been a remarkably challenging time for both firms and state authorities in Maine's highway and bridge construction industry. The COVID-19 pandemic has disrupted the supply chains for critical commodities related to paving and heavy construction, and the construction labor market. The result of these dual shocks (supply chain issues and labor market constraints) has been increased costs, delivery delays and shortages in project materials, and a general rise in uncertainty among industry firms. While uncertainty of future costs remains high, we expect firms to bid more conservatively (e.g., higher bid offer amounts), with more delayed projects, and, in some situations, few or no willing bidders.

Trends in Contract Bidding Behavior

Even before the onset of the pandemic in spring 2020, authorities at the Maine Department of Transportation (MaineDOT) began receiving bid amounts that notably exceeded internal engineering estimates and general expectations about the cost of completing key work needed to improve and maintain many of Maine's highways and bridges (Figure 1: Mean Low Bid/Internal Estimate Proportion for MaineDOT Paving Contracts. Source: MaineDOT).[1]

Figure 1: Mean Low Bid/Internal Estimate Proportion for MaineDOT Paving Contracts. Source: MaineDOT



Starting in 2019, MaineDOT lowest bids on paving projects began regularly exceeding internal engineers' estimates of total costs across multiple categories. Although this spread was much

[1] Internal estimates are sometimes adjusted upward in anticipation of bid price increases. Considering this, the price escalations shown may be underreported.

lower in 2021 than 2019, total low bid amounts remain well over internal estimate totals ($10 million in 2021 across all paving project categories, including rejected bid offers).

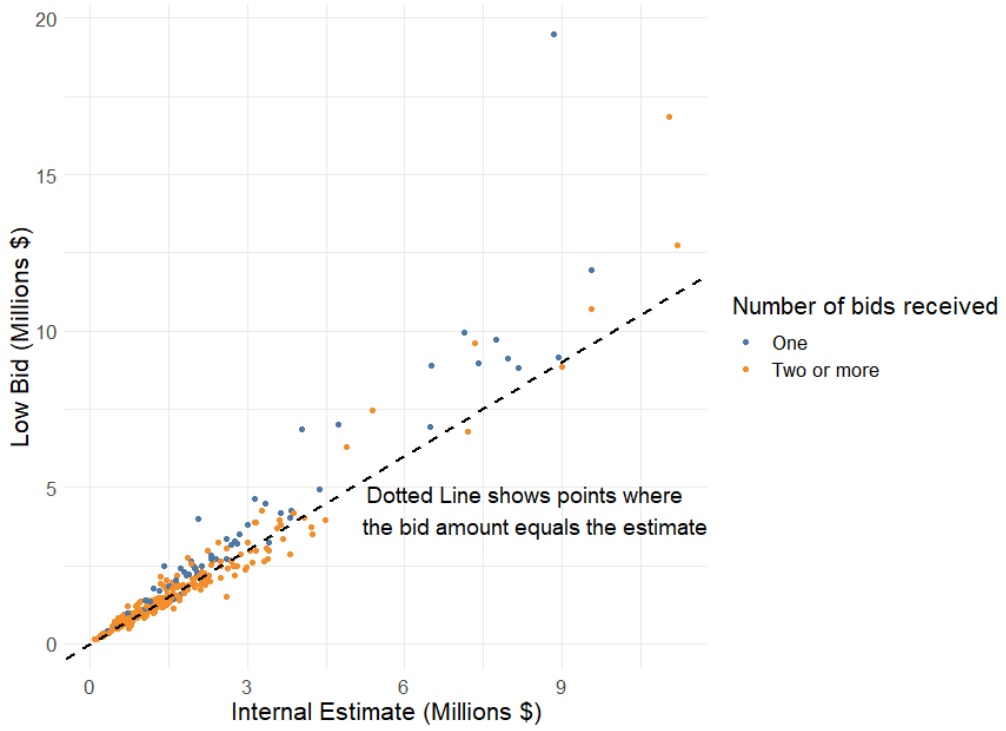
Table 1 combines data provided by both the MaineDOT and the Maine Turnpike Authority (MTA) to examine received bids versus engineering estimates across multiple project types. Over the past 5-7 years, MaineDOT non-interstate paving projects appear to have seen the highest bid amounts relative to internal project estimates. Although bid data for MaineDOT interstate paving contracts are limited, MTA has a notably lower average low bid/estimate proportion. For the MTA, bids for superstructure replacement appear to be come in well below engineering estimates on average.

Table 1: Average Low Bid/Estimate Proportion for MaineDOT (2017-2021) and MTA projects (2015–2022). "Highway" Paving Projects Include Work on I-95, I-295, Route 1, & Route 1A. Source: MaineDOT & Maine Turnpike Authority

Project Type	Agency	Number of Projects	Average Low Bid/ Estimate Proportion
Paving (Interstate)	DOT	6	1.05
Paving (Interstate)	MTA	11	0.96
Paving (non-interstate)	DOT	294	1.08
Bridge Work	MTA	17	1.05
Superstructure Replacement	MTA	4	0.87
Other	MTA	50	1.01

Focusing on MaineDOT paving work, the prevalence of elevated low bid/internal estimate cost ratios is greater among large (high-cost) contracts and in contracts that received only one bid offer (Figure 2). This is consistent with our hypothesis that bid prices for larger, more complex projects are elevated due to contractor's conservative behavior in the face of the uncertain future costs of materials and labor.

Figure 2: Low Bid Offers vs. Internal Engineer Estimates on MaineDOT Paving Contracts. Source: MaineDOT



The average number of bids received *per project* has remained relatively steady over the 2017–2021 period, though there was a notable decrease starting in 2019. In 2021, 11 different firms earned at least one low bid on a paving contract let by the MaineDOT, down from 15 in 2020. As suggested graphically by Figure 2, lack of bid competition for contracts appears to drive higher bid-to-estimate proportions.

In the remainder of this report, we outline our key project objectives and the methodology used to answer our research questions. After addressing our work on each objective, we offer several observations and recommendations.

Project Objectives & Methodology

Objectives

There are four main objectives for this analysis:

1. To better understand the project cost inflation that Maine is seeing in road, highway, and bridge construction and maintenance

2. To identify if there are other states seeing similar levels of cost inflation or if Maine is an outlier
3. To investigate the effect of competition levels on price estimates
4. To identify the causes of the price increases that can be addressed

Methods

To better understand the cost inflation that Maine is seeing in highway and bridge construction, and to determine the extent to which other states are seeing similar levels of inflation, we compile publicly available data on commodity prices and construction employment to analyze trends in input prices. For national data, we rely on commodity price indexes provided by the Bureau of Labor Statistics (BLS), which are frequently used by industry experts such as the Associated General Contractors of America (AGC) to track relevant input trends (Simonson, 2022). For wage and employment data, we rely both on prevailing wage data under the Davis-Bacon Acts of 1931 and government (state and federal) estimates of labor market statistics in relevant industries. Both sources have been used in previous academic research to inform estimates of future highway construction costs (Wilmont & Cheng, 2003).

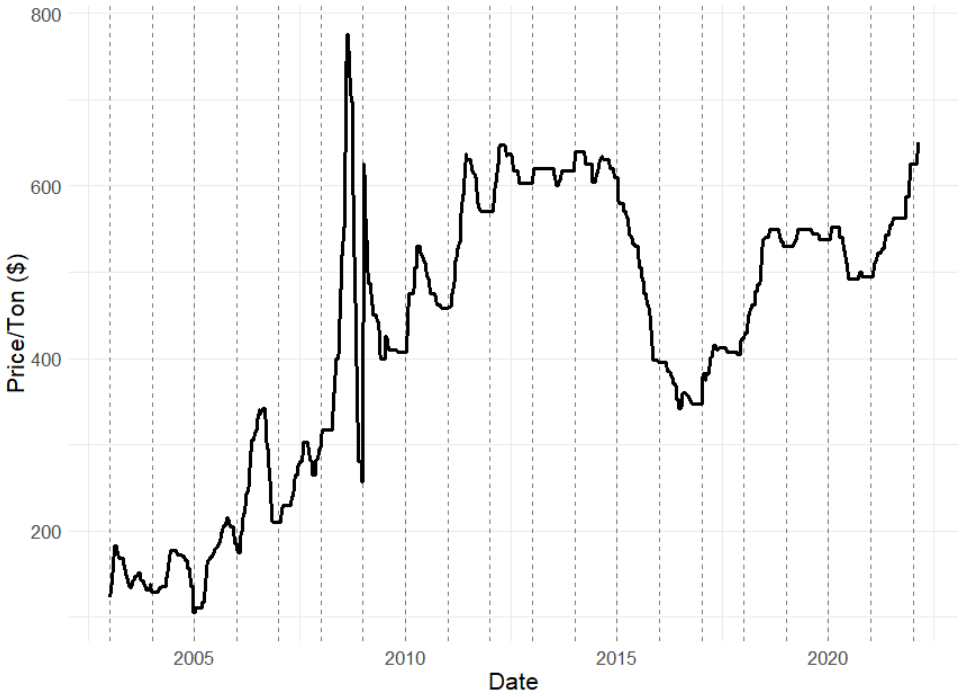
Additionally, we analyze MaineDOT and MTA bid data from 2015 to 2022 and construct a statistical model informed by relevant academic literature to better understand how market conditions and project characteristics affect bid behavior. Finally, we report results of a survey of relevant industry firms to identify their main sources of uncertainty and constraints, as well as to elicit their general market outlook and attitude towards working with the MaineDOT.

Construction Cost Inflation

Supply Side Challenges in Maine

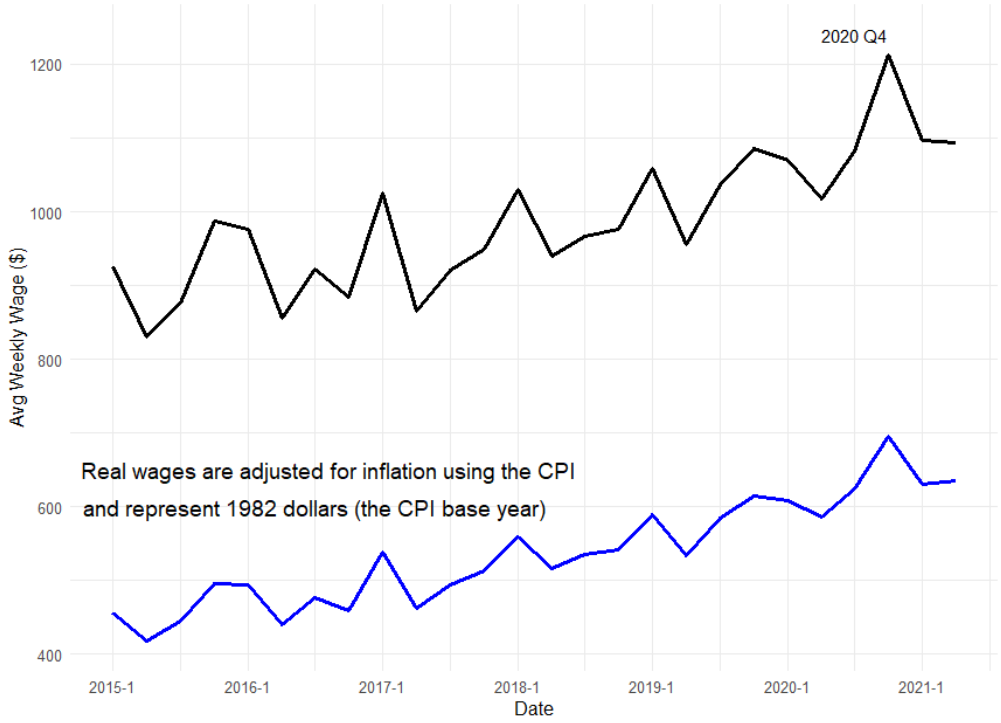
The market for inputs to construction has been remarkably volatile over the six-year period from 2017 to 2022. The cost of key inputs to heavy highway and bridge work, such as steel, and asphalt are decidedly higher today than in 2017, although the latter experienced notable declines at the onset of the COVID-19 pandemic. Focusing in on asphalt price trends in Maine, Figure 3 shows the sharp uptick from lows in 2020 till present (Feb 14, 2022), as well as persistent increase from 2017 lows. In 2021 alone, Maine liquid asphalt prices saw a 30% spike year-over-year, up to around $650 per liquid ton.

Figure 3: Maine Liquid Asphalt Price Data. Dotted Lines Indicate Years. Source: MaineDOT



In terms of labor, recent market conditions have been no less challenging for firms. Since mid-2017, we have seen a consistent increase (controlling for seasonal variation) in Maine wages, both nominal and "real" (adjusted using the national inflation rate) for highway and bridge construction (Figure 4). From summer 2015 to summer 2021, average annual nominal wages paid in Maine's construction industry as a whole increased almost 28%. Alongside rising labor costs, Maine's highway and bridge construction firms have reported difficulty in finding and retaining skilled workers.

Figure 4: Weekly Nominal (black) & Real (blue) Wages in ME Highway, Street, and Bridge Construction. Source: Maine Department of Labor and U.S. Bureau of Labor Statistics



Regional and National Trends

Data from the Bureau of Labor Statistics (BLS) Producer Price Indexes (PPIs) illustrates the severe nature of the current inflationary conditions observed throughout the U.S. in inputs to the nonresidential construction industry. PPIs track inflation from the perspective of the firm through periodic field surveys of relevant firms. As elevated bid levels were first observed by the MaineDOT in 2018, we use 2017 as a baseline to compare with current input price levels.[2]

We focus here on PPIs that track inputs to the construction industry. In this analysis, we examine data that are not seasonally adjusted, as seasonal fluctuations in input prices are relevant for understanding contractor's costs and bidding behavior. Unadjusted data are also of relevance for escalation clauses. Note also that import tariffs are not added to PPI calculations but are incorporated in prices as reported in survey responses by firms. Figure 5 shows two aggregate indexes that track prices of a basket of goods used for inputs to maintenance and repair, and to the construction industry broadly (both residential and nonresidential). The Construction

[2]For PPI indexes, the base year (against which all subsequent years are indexed) is 1982 for most goods and services, or the first year of calculation for newer indexes. Base periods have an index value of 100. We use data from the 2017–2021 period.

Materials Index rose nearly 50% from December 2017 through December 2021, with much of that growth occurring over the previous two years since its dip in spring of 2020. The Inputs to Maintenance and Repair Index has seen a similar increase, though less severe than the Construction Materials Index.

Figure 5: Construction Materials & Inputs to Maintenance and Repair National PPI (not seasonally adjusted). Source: Bureau of Labor Statistics

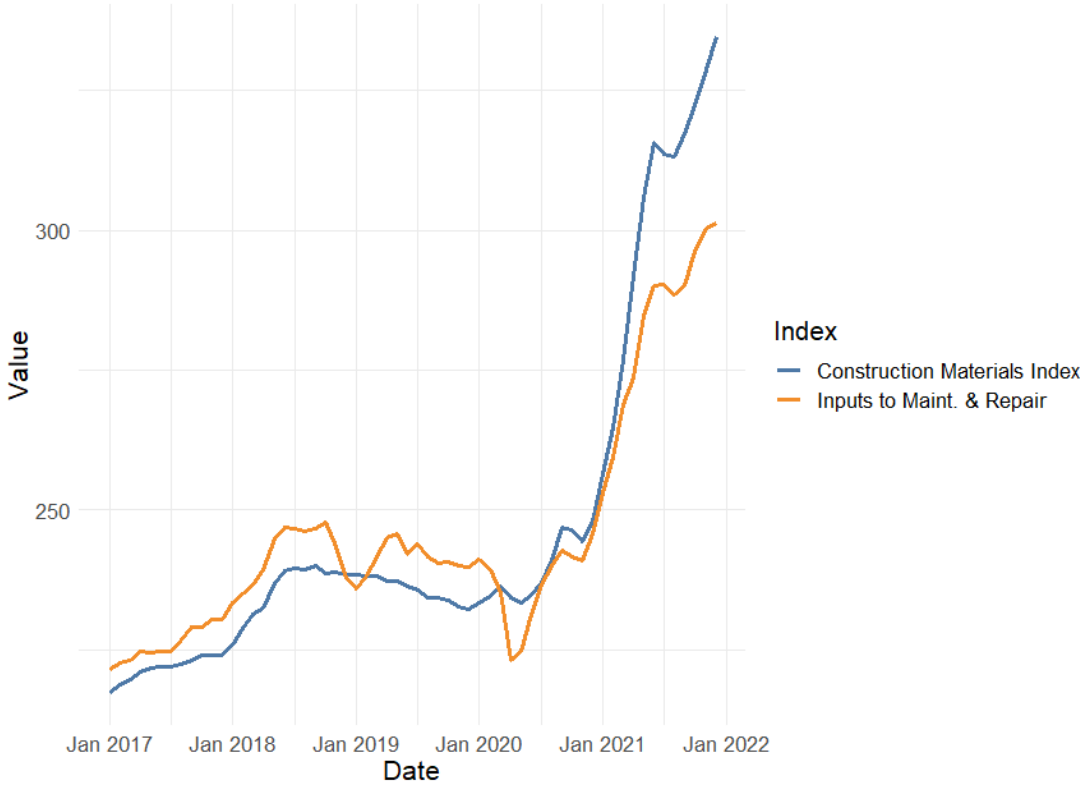
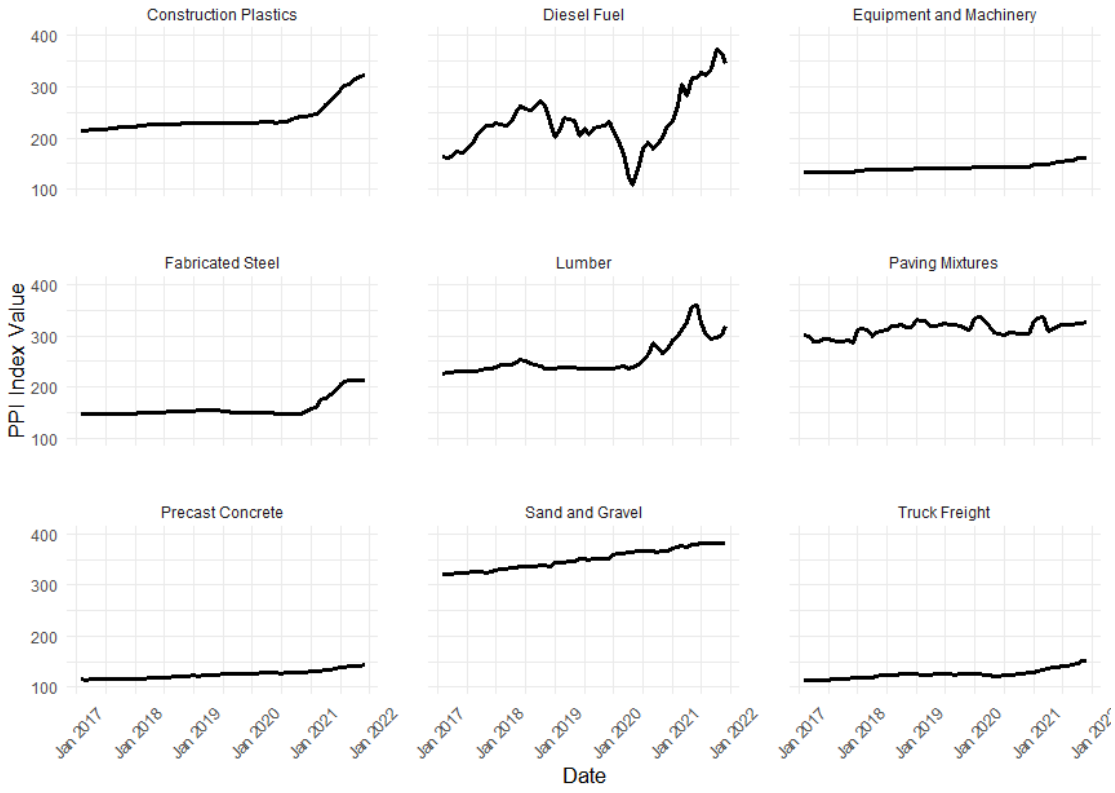


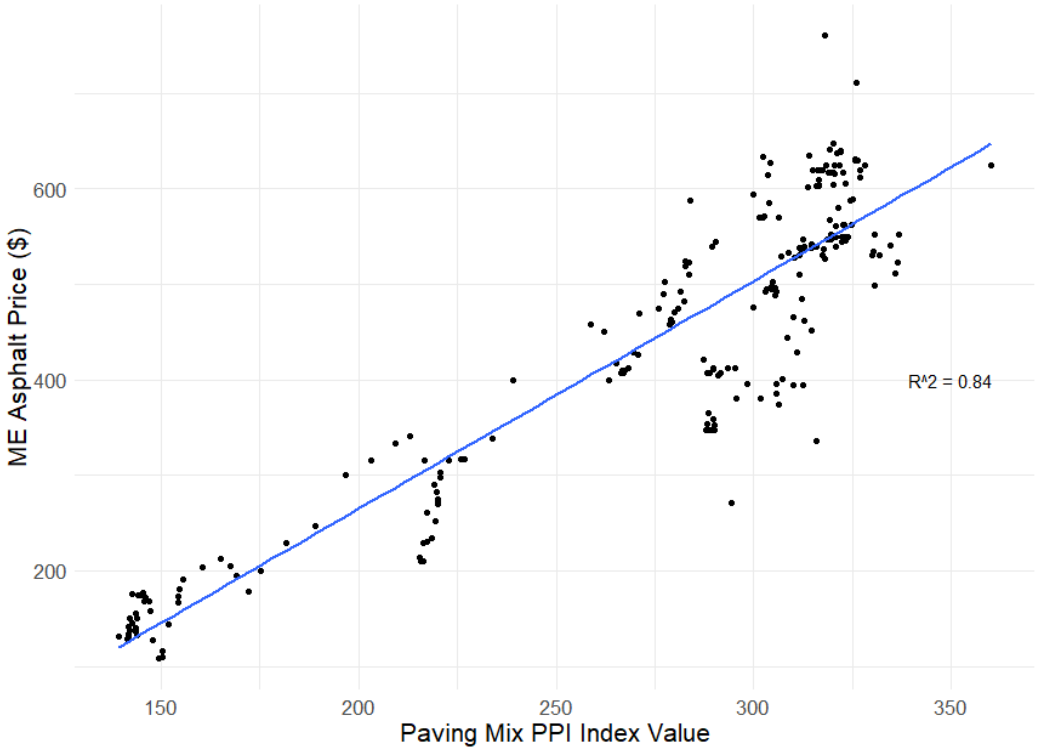
Figure 6 provides a snapshot of recent national trends in materials of particular relevance to highway and bridge construction. These input indexes are regularly tracked by the AGS as well when conducting their industry outlook reports. One of the most volatile inputs currently is diesel fuel, which, as of spring 2022, has risen over 200% from its lows at the beginning of the COVID-19 pandemic.

Figure 6: National Price Trends in Construction-related Inputs. Source: Bureau of Labor Statistics Producer Price Indexes



Complementing this national data, we examine one important input, liquid asphalt, using Maine data. As seen in Figure 7, about 84% of the variation in Maine asphalt price data is explained by national price trends. This suggests that Maine construction firms likely experience producer price inflation similar to the nation as a whole.

Figure 7: ME Liquid Asphalt Prices vs. Paving Mixtures PPI. Blue line is line of best fit. Source: MaineDOT & U.S. BLS Producer Price Indexes



Data comparing Maine producer prices to its neighbors are somewhat limited. However, we can draw upon two data sources. The USGS tracks raw commodity data relevant to the construction industry. Although their data series on asphalt and gravel for use in paving is limited to the 2010–2018 period, Figure 8 shows that prices in Maine were indeed higher on a per-unit basis than in comparison states for much of this time period. The last data point from the USGS suggests that prices in Maine have converged somewhat to those in its neighboring states. However, data on liquid asphalt prices (for use in price escalation clauses) provided by Maine, Vermont, and New Hampshire state agencies show that price increases in Maine have outpaced those of its neighbors in the latter half of 2021 (Figure 9).

Figure 8: Unit Value of Sand & Gravel for Use in Asphalt and Road Base. Dotted Line Indicates Mean Across All Groups. Source: USGS Construction Aggregates Time Series

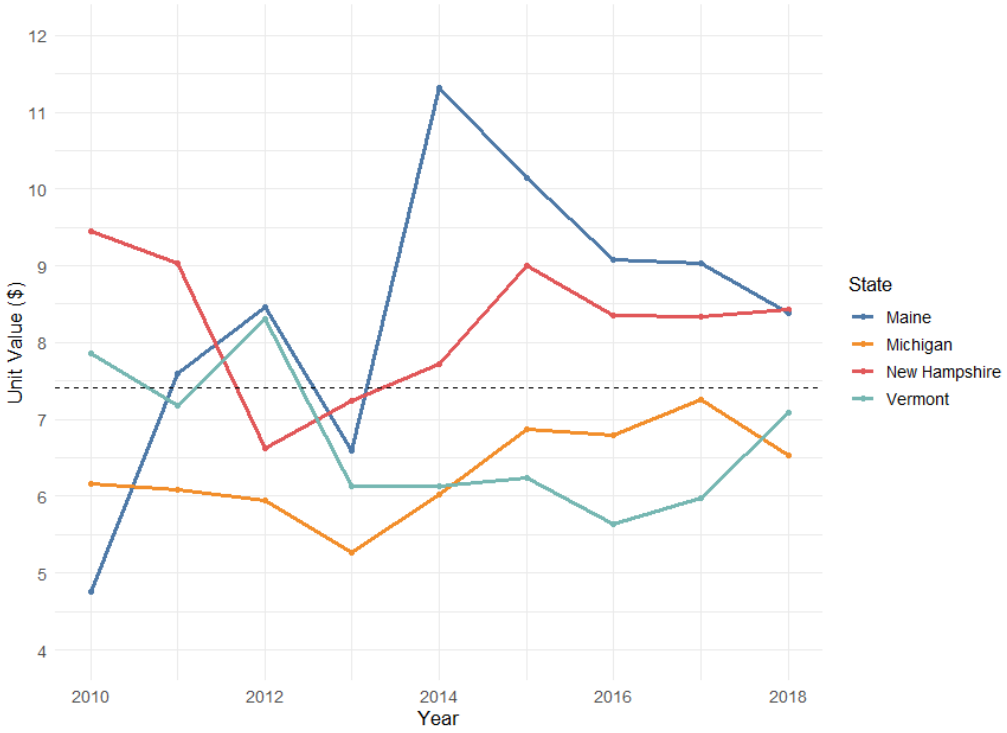
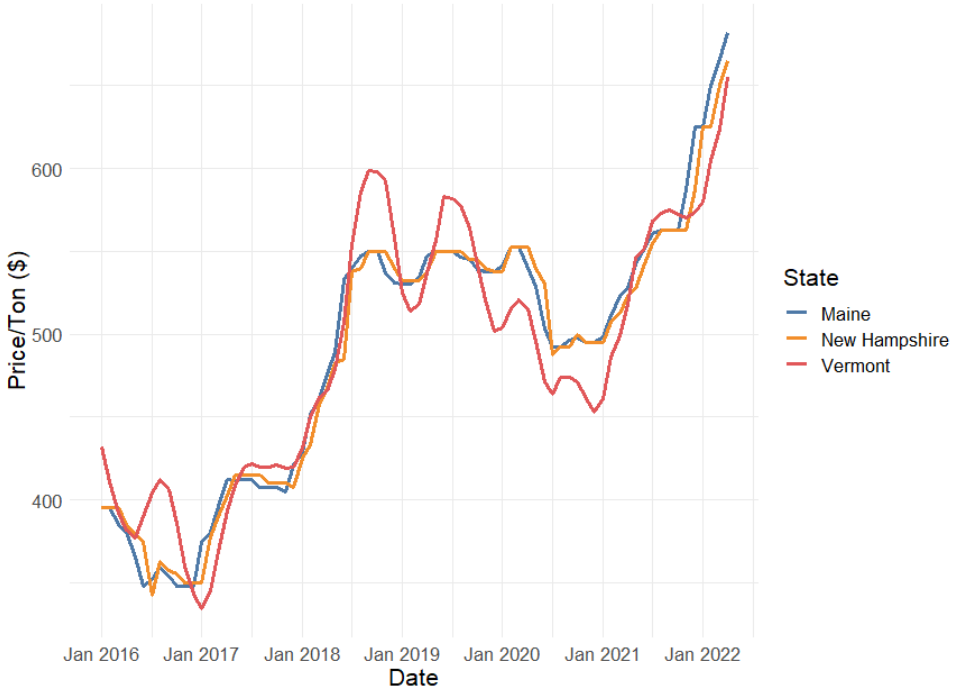


Figure 9: Liquid Asphalt Prices. Source: MaineDOT, NHDOT, & Vermont DOT Price Adjustment Clause Data

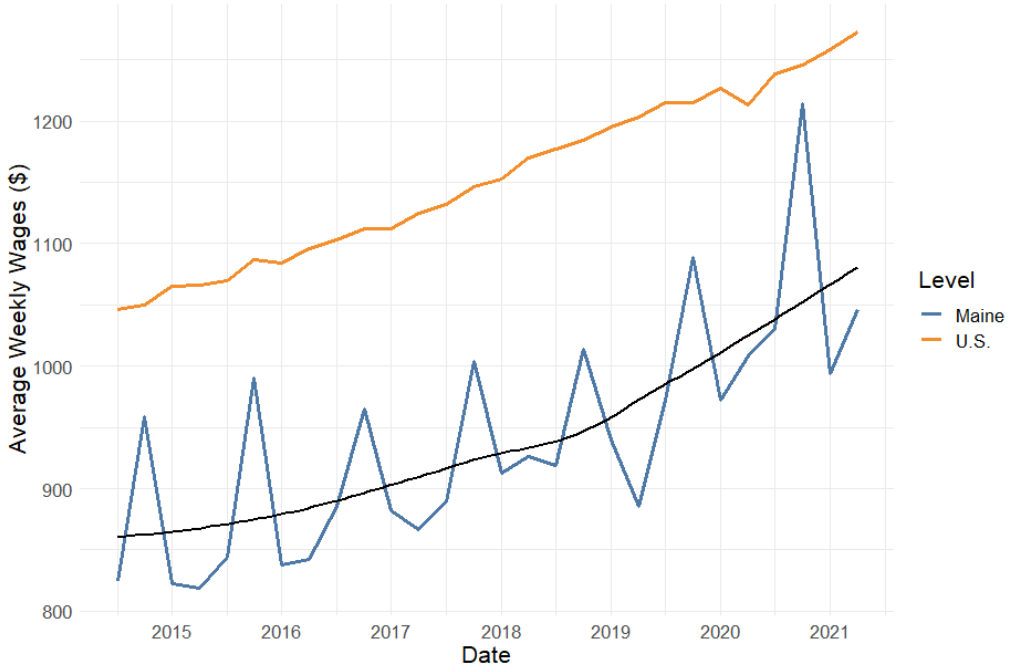


We believe that increases in materials cost and risks associated with anticipated higher future material and labor costs may account for a significant fraction of the rising spread between low bid offers and internal project cost estimates observed over this same period by the MaineDOT. Based on our survey results from Maine paving and bridge contractors, labor costs account for nearly 40% of total project costs, on average. The remaining 60% includes materials, equipment, general overhead, profit, and risk. Given that the Construction Materials Index has risen nearly 50% from 2017 to 2021, then we should expect that total project costs have increased from materials alone in the range of 25%–30% (0.5 *0.6). This simple calculation illustrates that some of the increase in bid offers can be accounted for by upward pressures on materials prices alone. This is before accounting for labor cost increases and constraints, as well as the cost and risks of material cost increases from delays due to ongoing supply chain bottlenecks.

The cost of labor for bridge and highway construction has risen substantially in recent years. While estimates of weekly wages paid in the construction industry have risen nationwide over from 2015 to 2021, Maine's 27.7% increase in nominal growth in construction wages (Figure *10*) outpaced the national trend of 19.4% over this same period.[3]

[3] U.S. construction wage data is provided as a seasonally adjusted measure, while Maine data is not. We use an annual average to compare trends over time, as wage expenditure in construction are seasonal in nature.

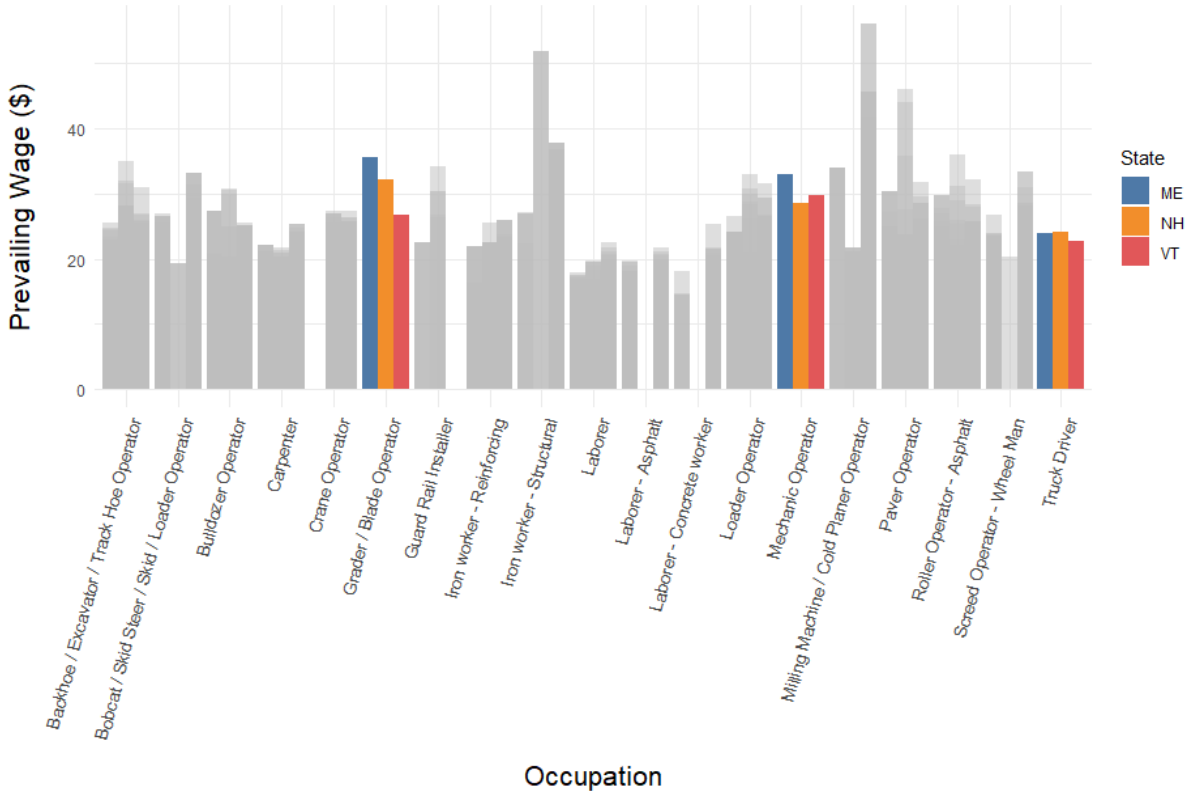
Figure 10: Weekly Construction Wages (nominal). U.S. data is seasonally adjusted, ME data is not. Source: Maine Department of Labor & U.S. BLS



Regionally, prevailing wages for bridge and highway workers in Maine appear to be consistent with those in New Hampshire and Vermont (Figure 11).[4] The prevailing wages for Maine bridge and highway workers exceed those of New Hampshire and Vermont in only three out of the 19 occupations.

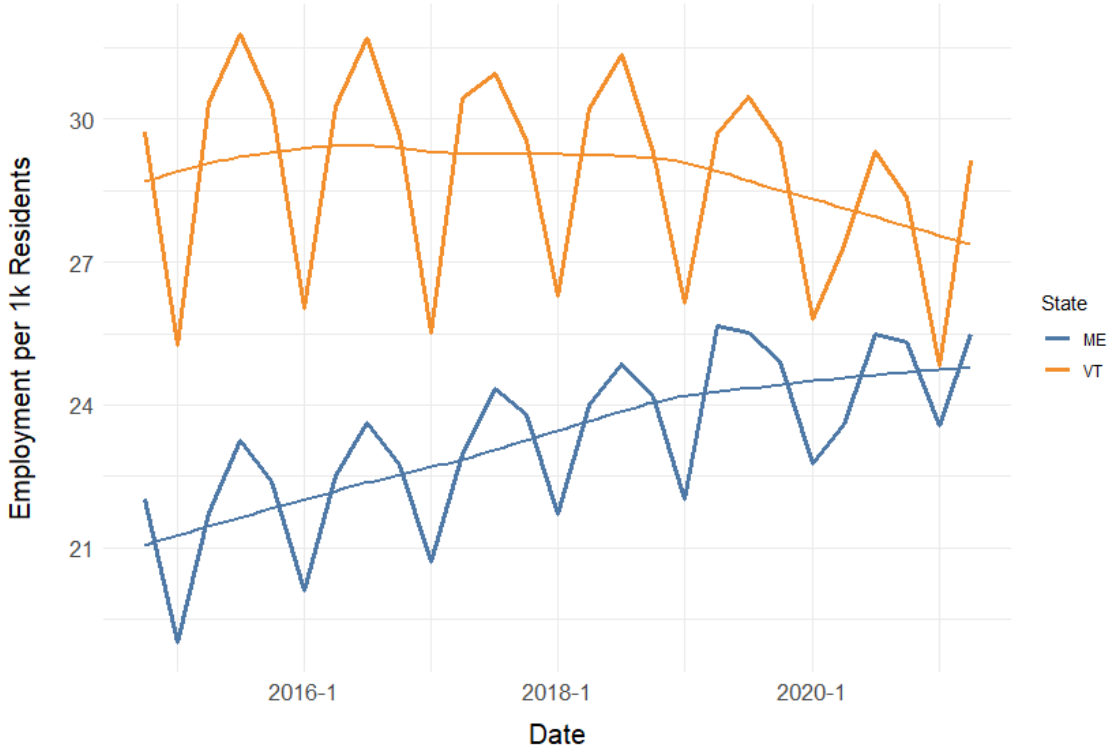
[4] By definition, the prevailing rate is the rate paid to at least 50% of workers in a construction occupation for a local area. If there is no single rate for at least 50% of workers in that occupation, then the prevailing wage is the average rate paid in the area for that occupation.

Figure 11: Prevailing Wages for Bridge & Highway Workers (2021). Highlighted bars show occupations where ME wages exceed other states. Source: U.S. DOL Davis Bacon Act



With the exception of the spring 2020 drop in employment, Maine construction industry employment levels have grown steadily from 2015 to 2021, avoiding the declines seen in Vermont (Figure 12). However, data from the Maine Department of Labor suggests that employment in highway and bridge construction may have taken a hit in 2021. In the second quarter of 2021, employment in the industry was down 2.6% on a year-over-year basis, which may account for some of the upward pressure on wage rates as firms seek to attract skilled workers from other areas of the construction industry, or those simply relying on the expanded unemployment benefits provided during the pandemic. As seen later in our survey results, the supply of skilled labor is on the forefront of many firms' minds as they enter the 2022 construction season.

Figure 12: Quarterly Estimate of Construction Industry Employment (not seasonally adjusted). Smoothed line included to show trend. Source: Maine & Vermont Departments of Labor

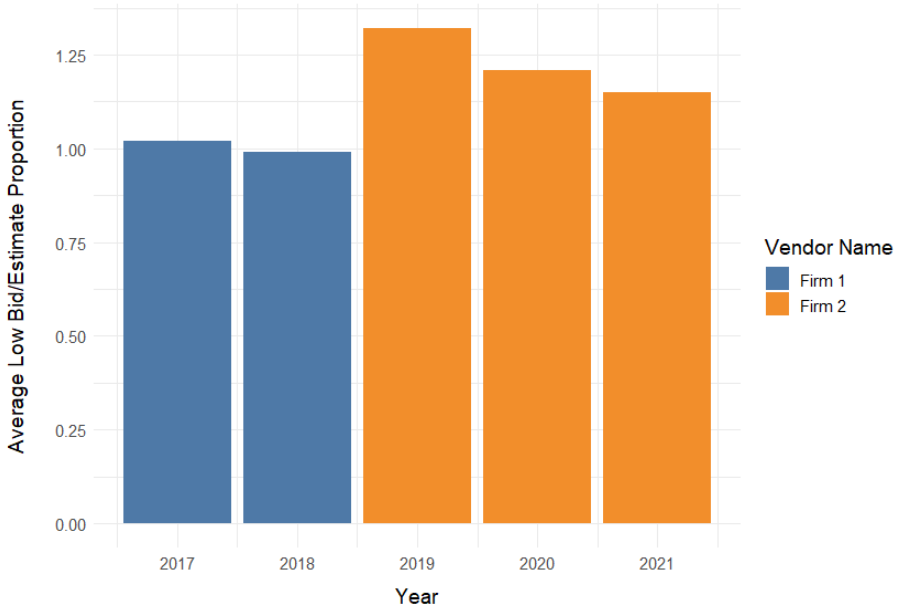


(QCEW Survey)

Competition in Maine's Public Roadways Paving Industry

There were three notable acquisitions in the paving industry ahead of the 2018 and 2019 seasons. Figure 13 focuses on one which occurred ahead of the 2019 paving season. After "Firm 2" acquired "Firm 1" ahead of the 2019 season and entered the Maine paving contract market, they consistently bid on contracts where there was a lack of competition from other firms (as did Firm 1 before the acquisition). From 2019 to 2021, 82% of projects where Firm 2 offered the low bid, there were two total bids or less (for reference, Firm 2 was the low bidder on 54 of the 190 MaineDOT paving contracts let between 2019 and 2021). We do not have evidence to suggest that there is a causal relationship between the acquisition of Firm 1 by Firm 2 and increased bid amounts. That said, the results show that in 2019, Firm 2 low-bid totals exceeded internal estimates by $18 million (note that several bid offers were rejected). It is also worth noting that Firm 1 was the largest paving firm (by number of low bids won) in 2017 and 2018 before its acquisition by Firm 2, who did not bid in Maine's paving market until after acquiring Firm 1.

Figure 13: Average Low Bid/Estimate Proportion on MaineDOT Paving Projects Before/After Firm Consolidation. Firm 2 Acquired Firm 1 for the 2019 season. Source: MaineDOT



The market for paving work on public roadways in 2021 was dominated by three firms, all three of which were involved in significant acquisitions in 2018/2019 (including the acquisition described above). These three firms account for 75% of the number of low bids won in 2021. After completing its acquisition ahead of the 2019 season, Firm 2 accounted for a large share of the Maine roadway paving market in the following years. Firm 2 was awarded 36% of the nearly $400 million dollars awarded by the MaineDOT on paving contracts from 2019 to 2021. Looking back to 2017, however, it appears that market dominance was an issue even before these acquisitions. Just two firms earned the low bid on 50% of all contracts in 2017, out of a total of 14 actively bidding firms that year.

Examining the bids more closely, we find that projects that received only one bid during this time period had a bid offer amount that was 124% of the internal engineer's estimate, on average, which is well above the mean of 104% for non-single bid projects. A t-test of these two groups means (single-bid and non-single-bid contracts) suggests that there is a statistically significant difference between the proportion of low-bid offers to engineer's estimate for single-bid and non-single-bid contracts. For reference, 59 of the 300 MaineDOT paving bids that we examined from 2017 to 2021 received only one bid.

Our analysis shows that larger contracts are more likely to receive only one bid offer.[5] Some 6 different firms earned low bids on these "large" contracts (> $3M) over this period, while 25

[5] Here, we define "large" projects as those with an internal estimated cost greater than 85% of all paving contracts between 2017 and 2021. This number is approximately $3.1 million.

different firms earned low bids on “small” contracts, or contracts with an estimated cost in the bottom quartile of all contracts included in our data. Additionally, 19 of the 45 large contracts (42%) had single bidders. Only 5 of the 75 small contracts had received only one bid. For large projects that only received one bid, the low-bid offer amount is, on average, 15% above internal engineers’ estimates. Even for a contract on the low end of this cost classification (estimated cost around $3 million), this translates to a low-bid offer that is nearly half a million dollars above the MaineDOT’s cost estimate.

Modelling Bid Behavior

Conceptual Framework

For our conceptual framework of construction firm bidding behavior, we draw on previous work in the academic literature. A firm’s decision to bid (and their bid amount) depends on firm expectations and estimation of the true cost, as well as their risk preferences, and their subjective assessment of uncertainty surrounding market conditions (Friedman, 1956).

In sealed bid auctions used for MaineDOT contracts, firms try to strike a balance when determining markup between profits and probability of winning the contract (i.e., maximize expected profit). Sealed bid auctions are a bidding process where parties submit their bid amounts, which are unknown to other participants. The MaineDOT opens all submitted bids for a given contract simultaneously and reports the amounts publicly. In a case study by Skitmore and Pemberton, they found that most firms exhibit risk-averse behavior in a sealed bid auction context (1994). Therefore, they will assign a risk premium to their estimate of the true contract cost in order to protect their margins in the event of input price escalation and hedge against unanticipated project costs. This tells us that if there is more uncertainty in the market and if most contractors are risk-averse, then a larger risk premium is likely to be applied to bid offers. This premium is particularly acute in the absence of price escalation clauses or other risk-reducing mechanisms. In addition, work by Kim & Reinschmidt suggests that there are likely to be fewer bids per contract in a high-uncertainty market environment when firms exhibit risk-averse preferences (Kim and Reinschmidt, 2011). Contracts with fewer bids, according to our data, generally have higher low bid/internal estimate proportions.

Empirical Model

We constructed a statistical model to better understand the main drivers of increased bid offer amounts. We impose that the low bid offer amount for any given project is a function of input costs, the rate at which materials cost are rising, the number of other firms expected to bid on the project, the amount of available labor and other project characteristics (location, season, scope).

Our data comes from paving, bridge, superstructure replacement, and other work contract bids provided by the MaineDOT (2017–2021) and the MTA (2015–2022). We have data for 376 contracts in total. To serve as a proxy for trends in local materials cost, we rely on Maine liquid asphalt prices (in the period directly preceding the contract letting date). However, it is not only

current price levels that matter. If firms perceive prices in general to be rising, they may assume them to rise further during the course of the contract, thereby leading them to increase their "risk premium." We use the PPI inflation rate of the Construction Materials Index (national) to serve as a proxy for firm's perceived inflation levels. We assume that firms have some reasonable expectation of the number of other potential contractors that will also bid on a given project, and therefore we rely on the number of bids received ex-post as an input to our model. Note that for some variables, natural logarithm transformations are performed to normalize the distribution of the data and ensure the reliability of any inferences we draw. This will affect the direct interpretation of some results from Table 2**:** Impact of Market Conditions & Contract Characteristics on Bid Offer Amounts.

Our statistical model uses the following specification:

$$\begin{aligned} ln(low\_bid)_{i,t} = {} & prevailing\_wage_i + number\_employed_{i,t=(t-1)} \\ & + ln(asphalt\_price)_{\,i,t=(t-1)} + construction\_ppi\_inflation\_rate_i \\ & + project\_type_{\,i} + single\_bidder_{\,i} + season_{\,i} \\ & + region_i + ln(internal\_estimate)_i \end{aligned}$$

Where *i* is a firm bidding in time period *t.* This specification comes directly from our conceptual framework outlined above, drawing on work from the construction management and economic literature as well as conversations with relevant experts. Using this model specification, we find that over 96% of the variation in low-bid offer amounts within our dataset can be explained by these factors alone.

Table 2: Impact of Market Conditions & Contract Characteristics on Bid Offer Amounts

	Low Bid Amount (log)
ME Bridge/Highway Employment (lagged)	−0.0001**
	(0.00005)
Single-Bid Contract	0.204***
	(0.025)
ME Liquid Asphalt Prices (log, lagged)	0.518***
	(0.089)
PPI Construction Inflation Rate	0.011**
	(0.005)
Bridge Project	0.134**
	(0.052)
Paving Project	0.106***
	(0.035)
Internal Estimate (log)	0.973***
	(0.010)
N	376
R^2	0.966
Adjusted R^2	0.965
Notes:	***Significant at the 1 percent level.
	**Significant at the 5 percent level.
	*Significant at the 10 percent level.

Lack of competition, elevated input costs, and project type appear to drive higher bid offers. The results from the regression suggest that all else equal, projects that receive only one bid have low bids that are 20% higher on average. A 10% increase in Maine liquid asphalt prices is associated with a 5.18% increase in low-bid amounts. A one percentage point increase (e.g., from 3% to 4%) in the inflation rate of the Construction Materials index is associated with a 1% increase in the low-bid amount. Note that in 2017, the average inflation in the Construction Materials PPI was ~1.2%. In 2021, that number was 7.54%.

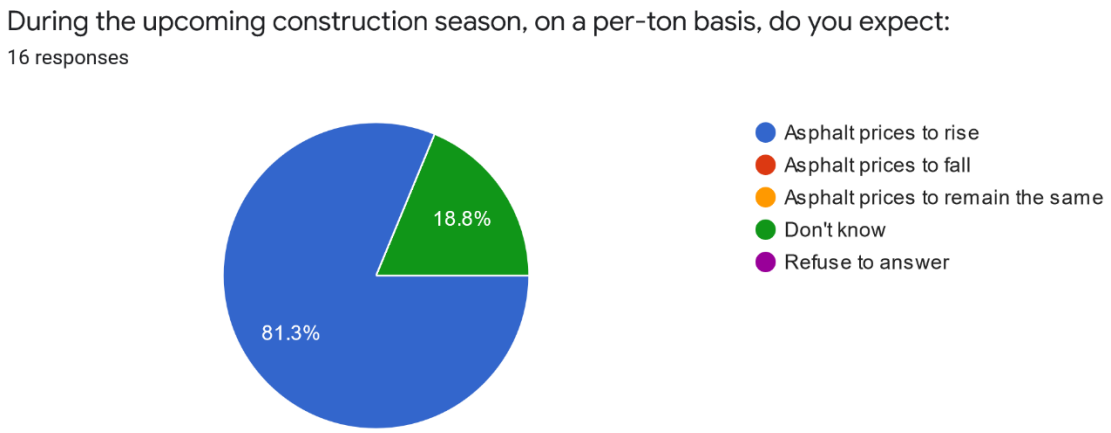
When combining MaineDOT and MTA bid data, we find that both bridge and paving projects receive higher low bids relative to "other" projects (e.g., toll work and superstructure replacement), all else equal. Finally, we find that an increase in the number of persons employed in the Maine highway and bridge industry is negatively correlated with higher low-bid offers, although the effect size is small. No estimate from our bid model is meant to provide a number that gives the precise effect of one input on the bid amount for any given project. We used a least squares regression approach to estimate our model, which has inherent limitations when

interpreting and generalizing results. For example, the price of liquid asphalt is highly correlated with fuel prices, concrete, and other key inputs to construction. Therefore, some of the effect of asphalt prices on bid amounts in our model is also capturing effects from broader market trends. Instead, the most important result from our empirical analysis is that labor force availability and cost, commodity prices, inflation, and level of bid competition largely account for much of the difference observed in low-bid amounts versus internal engineer's estimates by the MaineDOT.

Firm Sentiment

In April 2022, we administered a confidential online survey to relevant firms in the Maine highway and bridge construction industry. Firm contacts were provided by the MaineDOT. These firms primarily bid on paving, bridge, and earthwork contracts for the MaineDOT, and have completed at least one project for the state over the 2017–2021 period. Our survey questions sought to elicit firms' current sources of uncertainty and main drivers of elevated costs. Of the 27 total firms surveyed, we had a response rate of approximately 60%. Most firms report challenges arising from labor shortages, rapid wage growth, and materials cost inflation, which they do not expect to end in the near future. Some 15 of 16 respondents say they expect labor costs to rise during the 2022 season, and 13 expect liquid asphalt costs to rise (Figure 14). Seven firms specifically mentioned labor availability when asked what their greatest source of uncertainty is currently.

Figure 14: Firm Expectations for 2022 Liquid Asphalt Prices in Maine. Source: Internal Survey Responses



When asked "What can Maine DOT do to reduce uncertainty in the bidding process and still ensure that the public receives a good value and predictable outcomes," five firms that responded specifically asked for price escalation clauses on additional materials, and all respondents indicated that the inclusion of such clauses would reduce their perceived level of risk when bidding on contracts. All of our survey respondents report that the amount of overtime hours

needed to stay on pace for projects in 2021 was about the same as in a typical year or slightly greater, with 13 of 16 firms reporting that 10–25% of total hours worked on their projects in 2021 were overtime hours.

One notable finding from the survey relates to actual wages paid in this industry (Table 3). According to the prevailing wage data for bridge and highway work in Maine, the current mean hourly wage is $22.8 (although this average is not weighted by the number of persons typically employed in each occupation within the industry). Quarterly wage estimates provided by the Maine Department of Labor (Figure 1) suggest that the average hourly wage paid in the highway and bridge industry was closer to $28 per hour dollars in mid-2021. Eight of the 16 firms in our survey reported paying a higher average wage when prompted about labor expenditures, which is not an anomaly. However, several of these firms reported paying much more than the $28 per hour estimate provided. Five firms reported seeing at least $30 per hour on average in 2021, with one firming quoting $34 as their current average wage. This reported wage inflation, coupled with the concerns over labor supply, suggest that labor costs and constraints are a significant piece of the puzzle for understanding project cost inflation in Maine.

Table 3: Reported Average Pay for MaineDOT Contractors. Source: Internal Survey Results

Average Pay Reported	Paving	Bridge	Earthwork	Total
< $28/hr	3	1	2	6
> $28/hr	1	5	2	8
Not Reported	1	0	1	2
Total	5	6	5	16

While labor availability is an issue, challenges stemming from employee drug testing do not appear to be a major factor. Only six of 16 respondents reported testing their Maine workforce for marijuana, while 13 reported testing for illegal drugs. The perceived effect of this testing on worker availability is mixed. Several firms suggested that testing for drugs adds some challenge to the hiring process, with one of these firms specifically reporting that testing workers for illegal drugs "dramatically" negatively impacts their ability to hire qualified workers. Four others cited issues specifically in the context of hiring CDL drivers. One-quarter of the respondents reported no difficulty in the hiring process resulting from illegal drug testing.

Overall, firms are calling for flexibility during both the bidding process and after work begins, and for increased communication between agency authorities and contractors. Due to the pace and magnitude at which input prices are fluctuating, some firms say that the response time for awarding bids and for communication during the project put them at risk of facing higher costs than they would with a rapid turnaround. For reference, in 2021, the average interval between contract let date and award date on MaineDOT projects was around 27 days.

Conclusions & Recommendations

Combining the results from our analysis with the sentiment expressed by relevant firms in our survey, it seems reasonable to expect that recent bid offer amounts would exceed historic expectations of the costs for highway and bridge work to the extent that firms are increasing bid amounts in response to perceived risks and cost increases. We did not determine if MaineDOT's engineering estimates in the most recent past (i.e., 2021 and 2022) fully captured the increases in materials and labor. In addition, given the data available, the concerns expressed by survey respondents appear to be responding to actual market conditions. Market conditions are volatile and shifting rapidly, firm uncertainty is increasing, and the cost of construction has never been higher. Nonetheless, our results suggest that industry consolidation is driving an increase in bid costs not reflective of underlying cost increases.

Given this assessment, it's fair to ask what can be done to manage these unprecedented challenges and ensure that vital public infrastructure work is completed in an affordable and timely manner. First and foremost, both realized and anticipated inflation will drive up the cost of projects across all categories. State engineers should expect any given project to cost to be well above levels seen for comparable work prior to 2020.

We believe the key to incentivizing lower bid offer amounts is to reduce perceived risk and uncertainty for firms. The MaineDOT might consider expediting the timeline to award contracts, as prices continue to rise between the let date and when purchasing of project materials begins. In addition, allowing (or requiring) the advanced purchase of project materials by the winning contractor whenever feasible would allow for ample time to delivery and insulate contractors from further inflation. Considering the temporary inclusion of additional price escalation clauses for additional inputs would move risk away from firms and lower the incentive to include large "risk premiums" in their initial contract bids in the effort to protect future margins. If possible, more relaxed project timelines could reduce the requirement for risky nighttime work and the amount of overtime hours required to meet project timelines since overtime hours become increasingly more costly as wages rise.

Bid competition for large contracts is an ongoing problem, particularly on paving projects. A lack of willing and able bidders is unavoidable in some circumstances, particularly on contracts for work in remote areas, or large contracts that only a few firms have the capacity to undertake. However, given the magnitude of the effect of low competition for contracts on bid amounts observed in our work, we argue that addressing this problem should be given top priority in any meaningful plan to tackle escalating project costs for bridge and highway work in Maine. In addition, our analysis suggests there is some evidence that industry consolidation may have contributed to elevated low bid offers starting in 2019. Going forward, MaineDOT should consider all opportunities to stimulate additional bidding competition, including considering smaller contracts and simplifying contract requirements to encourage new entities to enter their pool of bidders.

The MaineDOT has already taken productive measures to work towards addressing this issue by trialing the use of Construction Manager/General Contractor procurement, the "Midcoast Maine Paving Bundle," involving the grouping of smaller paving projects under one contract and soliciting significant input from prospective contractors in the project planning phase. Initiatives like this should remain an emphasis going forward, and state authorities should continue their efforts to improve communication and coordination with contractors during the project planning phase and while work is underway.

None of these suggestions represent straightforward solutions, and some come at significant cost. However, current market conditions are not likely to improve substantially in the near future, and it will take a coordinated effort between the MaineDOT and contractors to ensure desirable outcomes for the industry and for Maine's public transportation infrastructure.

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