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Shovel Ready Projects and Commercial Construction Activity's Long and Variable Lags*

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Abstract

We use microdata on the phases of commercial construction projects to document three facts regarding the sector's time-to-plan lags: (1) plan times are long and highly variable, (2) nearly half of projects in planning are abandoned, and (3) property price appreciation reduces the likelihood of abandonment. We write down a tractable model of endogenous planning starts and abandonment that can match these facts. The model also has the testable implication that supply is more elastic when there are more "shovel ready" projects ready for construction. We use local projections to validate this prediction in the cross-section for US cities.

Keywords: building supply elasticities, commercial real estate, construction, time-to-plan

JEL Classification: R33, E22, E32, L74

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1. INTRODUCTION

Construction activity—or the lack thereof—is critical to macroeconomic outcomes. In the long run, construction adds to the productive capacity of the economy and facilitates an efficient allocation of workers and capital across space (Herkenhoff et al., 2018; Hsieh and Moretti, 2019; Babalievsky et al., 2023). In the short run, construction is resource intensive and highly cyclical, and thus an important driver of aggregate demand fluctuations (Leamer, 2008). Though there is a wealth of work on residential construction, commercial construction is relatively understudied—even though it accounts for around 20 percent of private domestic investment (Brandsaas et al., 2024) and commercial real estate (CRE) is one of the economy's largest asset classes (Ghent et al., 2019). Consequently, CRE market developments can have wide-ranging implications, including for local government finances and the health of the banking sector (Gupta et al., 2022).

One unique characteristic of commercial construction is its long planning horizons (Edge, 2000; Millar et al., 2016), which can cause investment to respond slowly to economic shocks (Edge, 2007).[1] In this paper, we investigate two implications of these long planning horizons for CRE supply elasticities. The first implication is that having "shovel ready" projects that can immediately begin construction is necessary for adding supply in the short run (since it would take years for new projects to complete the planning process). The second implication is that economic conditions can change drastically over the planning horizon and prompt developers to abandon projects before starting construction. Since abandonment decisions affect construction activity faster than decisions about commencing new projects, this abandonment margin can be a key driver of near-term construction activity.

Existing work on such effects is limited, due in part to difficulties measuring construction activity that does not occur. In this paper, we take advantage of unique panel microdata on the phases of US commercial construction projects—including planning, construction, and abandonment or completion—to examine how planning lags affect construction dynamics. The key contribution of our work is to establish that the availability of ongoing projects in planning is an important determinant of commercial building supply elasticities.

In the first part of the paper, we present three stylized facts on planning activity and abandonment

[1] Figure S1 in the Supplementary Materials shows that commercial structure investment is slower to respond to business cycle fluctuations than residential construction or total private investment.

from planning or construction. First, commercial construction projects have long planning horizons. The average time spent in planning for projects that make it to construction is about 1.5 years, roughly similar to average construction times. Second, a significant number of projects in planning (nearly half) are abandoned before beginning construction. Almost all abandonments happen during the planning stage: of the projects that make it to the construction phase, over 99 percent are completed. Third, whether projects advance from planning to construction is dependent on the state of the economy.

We then present a tractable time-to-plan model of building production that matches these facts. In the model, developers optimally choose how much to invest in planning starts and whether to proceed with construction when planning is completed. Projects in planning are options to engage in construction that developers choose to exercise based on prevailing property values and building costs at the conclusion of planning. We show analytically that the model not only rationalizes the three stylized facts, but that it also has an important implication for the supply of commercial buildings: the near-term response of construction activity to price appreciation depends on the availability of projects in planning. Price appreciation can affect construction activity by both stimulating planning starts and causing more projects in planning to advance to construction. Because planning starts are slow to translate into construction activity, this second channel is the main driver of short-term supply elasticities.

In the final part of the paper, we test this model implication by empirically examining cross-sectional differences in the response of construction activity to price appreciation. Specifically, we use local projections to trace out the response of construction starts to commercial price appreciation for metropolitan statistical areas (MSAs) with different initial stocks of projects in planning. We demonstrate that construction starts are increasing in price growth, and this response depends importantly on the stock of projects in planning, as predicted by the model. As further validation, we find similar results for employment growth for the sectors most engaged in commercial construction activity.

This paper is related to work that analyzes cross-sectional determinants of building supply elasticities. The work on this topic has mostly focused on residential housing, showing that regulatory (Mayer and Somerville, 2000; Glaeser et al., 2006; Kok et al., 2014) and geographic (Saiz, 2010; Baum-Snow and Han, 2024) constraints to development affect housing supply elasticities. For commercial construction, we show the importance of the availability of ongoing projects in planning as a determinant of supply elasticities.

More narrowly, our paper lays out new facts regarding the development process for commercial buildings. As with the literature on building supply elasticities, existing work on the construction process mostly studies residential housing construction (see, for example, Glaeser et al. 2005, 2008). Regarding commercial construction, our work builds upon Millar et al. (2016), who use similar data (but from 1997 to 2010) to examine time-to-plan lags for completed projects and how they differ across cities and over time. Our work documents novel facts about the abandonment of commercial construction projects and focuses on the broader implications of these planning lags and abandonment dynamics.

Finally, we contribute to the literature analyzing time-to-build dynamics (Kydland and Prescott, 1982; Christiano et al., 1996), in particular in real estate development (Del Boca et al., 2008). Recent work in this literature builds on Majd and Pindyck (1987) to analyze how the option value of delaying investment (Oh and Yoon, 2020) or discount rate shocks (Fernandes and Rigato, 2023) affect build times. Additionally, contemporaneous work by Oh et al. (2024) shows that long development timelines in residential housing make the short-run housing supply inelastic and affect the business cycle properties of housing. We demonstrate that supply can be moderately elastic in the short run if projects are already in planning, as price changes affect new construction by altering abandonment decisions faster than they affect construction through the initiation of new projects.

The remainder of the paper proceeds as follows. In Section 2, we describe the data and establish the facts on commercial construction that we will use to discipline the model. In Section 3, we present a simple model of the commercial construction process that can match these facts, and we analytically derive how the short-term elasticity of building supply depends on the stock of projects in planning. In Section 4, we test this prediction and demonstrate that the responsiveness of construction activity to changes in prices is indeed a function of the planning stock. In Section 5, we conclude.

2. FACTS ON COMMERCIAL BUILDING CONSTRUCTION

In this section, we first describe the data. We then provide an overview of typical planning and construction timelines, including how often and under what circumstances projects are abandoned.

2.1. Construction Phase Data and Other Data Details

We use data on individual construction projects from 2003 to 2024 collected by Dodge Data & Analytics (Dodge), which is also an input to the Census calculations of monthly construction spending.[2]

The data include monthly information on active construction projects from when Dodge first records the project as being in planning until either the project is abandoned or construction is completed. Each month, Dodge records the current phase of the project, where the phases include pre-planning, planning, final planning, bidding, underway, completed, deferred, and abandoned. Pre-planning indicates a project that is purely at the concept stage, and that an architect has not yet been hired. Moving from pre-planning to planning means that the project has generally already hired an architect who has started to draw up plans. Final planning implies that the project is getting final approvals and should go out for construction bids (the bidding phase) within 4 months. The first month of the under-construction phase (the start) occurs after a contract has been signed between a general contractor and the developer and the project should break ground within the next six months. A project can be deferred indefinitely from any phase in the data. The data do not include information on the reason for the deferral, but possible reasons include going over budget, market conditions worsening, or financing being pulled. A final state for a project is either completed or abandoned. For our analysis, we group projects in pre-planning, planning, final planning, and bidding together. We treat deferred projects as a separate category unless we state otherwise.

Along with the phases, the data include information on the property's type, its square footage, the total cost of construction for the project (or an estimate for that spend for projects in planning or bidding), and detailed geographic information.[3]

[2] In Figures S3 and S4 of the Supplementary Materials we provide comparisons of data series constructed using the Dodge data to other sources.

[3] Additional details on the data are available in Supplementary Materials Section S.2.

2.2. *Summary Statistics*

Figure 1 shows how planning and construction times (top panel) and abandonment rates (bottom panel) differ across projects.[4] These figures demonstrate that planning times are long and outcomes are highly variable—in terms of both timelines and whether projects ever reach construction.

Regarding project timelines, median plan times are roughly comparable to construction times, but they are much more variable. This can be seen in Figure 1a, which depicts the distribution of plan and construction times across property types (left panel) and quintile of construction cost (right panel). Multifamily buildings have some of the highest plan and construction times, and the greatest variability in plan times. However, all property types exhibit wider distributions in plan times than in construction times. Both planning and construction tend to take longer for more expensive projects.[5]

One potential reason that planning times could have such a long right tail is due to developers' options to defer or abandon projects. If economic conditions deteriorate such that the economic viability of the project comes in to question, developers may wait to see if conditions improve, and then abandon a project if they do not. Evidence of this is shown in Figure 1b, which presents a binscatter of an indicator for whether a project in planning ultimately reaches construction against the commercial property price appreciation in the year after the plan start. The figure shows that a high share (on the order of 50 percent) of projects in planning never start construction, but that strong growth in property values in a local market increases the probability that a project successfully advances to construction.

More information summarizing the planning and construction process is in the Supplementary Materials. First, Table S3 provides a transition matrix between different project phases. It shows that nearly all abandonment and deferral occurs during the planning phases of a project, whereas nearly all projects that advance to construction are eventually completed. Second, Table S4 provides additional regressions predicting abandonment, including variables related to project size and factors that are potentially related to local supply elasticities (to be discussed more in Section 4). The starkest finding is that larger projects are more likely to be abandoned and are more sensitive to changes in local property values. Finally, Figure S5 presents maps of abandonment rates and plan

[4]More detailed summary statistics can be found in Supplementary Materials Tables S1 and S2.

[5]Figure S2 in the appendix also provides plan and construction times separately for private and public projects.

rates—the ratio of the number of projects in planning to the number of commercial properties in an MSA—across CBSAs, and Table S5 provides statistics for average planning times, construction times, abandonment rates, and plan rates for the top 50 largest CBSAs in our sample. There is significant geographic heterogeneity, a few examples of which are particularly notable. Plan times and abandonment rates tend to be higher in California and northeastern cities. Most large cities in California have average planning times of around one year, about double that of the typical large city in Texas. California cities also tend to have higher abandonment rates; abandonment rates are above 50 percent for every large city in California and below 50 percent for every large city in Texas.

In short, these statistics show that commercial construction projects have long planning periods (about 1.5 years on a project value weighted basis), and that changes in economic conditions affect whether construction occurs. These facts suggest that new construction requires (1) the presence of projects in planning that can advance to construction in the near term (the planning stock), and (2) economic conditions that motivate developers to advance to construction. To better understand this first fact, Figure 2 decomposes changes in the aggregate number of projects in planning over time into changes from new plan starts (which increase the planning stock) and those from abandonment or construction starts (which decrease the planning stock). The figure shows that the number of projects in planning fell notably during the global financial crisis of 2007–09 (GFC) due to a contraction in planning starts (which fell by over half) and a rise in abandonments (which exceeded construction starts in 2009 and 2010). The planning stock then started to rise in 2013, and it experienced positive growth until 2024 when abandonments increased.

We provide further information on cross-sectional differences in planning behavior in the Supplementary Materials. Figure S6 summarizes how the distribution of plan rates differs across cities and over time. The plan rate rose from under 0.5 percent in the aftermath of the GFC to over 1.5 percent in 2022. In the aftermath of the GFC, few MSAs had a plan rate above 1, but the distribution shifted significantly to the right by 2019 after a long business cycle expansion.

3. PLANNING MODEL WITH ABANDONMENTS

Our goal is to build a model consistent with the facts outlined in Section 2.

In the model, time is discrete, labeled as $t = 0, 1, 2, ...$ There is a representative building producer who optimally decides how much to invest in planning and construction starts. The builder takes as given a particular sequence of interest rates (r_t), rental rates of buildings (r_t^b), and costs of planning starts (ι_t). In the Supplementary Materials, we embed the model into a general equilibrium business cycle model where these variables are endogenously determined. Since these microfoundations are not needed for the main findings, we focus on the problem of developers here.

The production of buildings is subject to two frictions. First, there is a stochastic time lag before building construction occurs. Specifically, firms can invest in planning projects, but only a share λ of these projects can advance to construction in a given period. When the planning horizon is completed, firms draw a cost $\kappa \sim F$ and can choose whether or not to pay κ to produce a unit of building. Firms choose the maximum amount they are willing to pay for a project κ_t^*, resulting in the construction of $\lambda P_{t-1} F(\kappa_t^*)$ buildings, where P_{t-1} is the planning stock chosen in the previous period. Projects with costs above this threshold are abandoned.

Second, firms face adjustment costs in starting projects. The cost of initiating a planning start at time t, denoted ι_t, is increasing in the amount of planning investment, denoted I_t^p. We assume these adjustment costs are external to the firm (reflecting factors such as the supply of permits rather than internal capacity constraints) and are thus reflected in the cost of planning starts, which are taken as exogenous to the developer. This assumption simplifies the first order conditions, but the quantitative estimates are similar with internal adjustment costs (see Supplementary Materials Section S.3).

Consequently, the problem of the developer is as follows:

$$\max_{\{I_{t+s}^p, \kappa_{t+s}^*\}_{s=0}^{\infty}} \quad \mathbb{E}_t \sum_s \left(\prod_{i=0}^{s} \frac{1}{1 + r_{t+i}} \right) \left(\underbrace{r_{t+s}^b B_{t+s-1}}_{\text{Rental Income}} \underbrace{- \iota_{t+s} I_{t+s}^p - \lambda P_{t+s-1} \int_0^{\kappa_{t+s}^*} \kappa dF(\kappa))}_{\text{Planning \& Construction Expenditure}} \right),$$

subject to the laws of motion for the planning and building stock (P_t and B_t):

$$\begin{aligned} P_{t+s} &= (1-\delta_p-\lambda)P_{t+s-1} + I^p_{t+s} \\ B_{t+s} &= (1-\delta_b)B_{t+s-1} + \underbrace{\lambda P_{t+s-1}F(\kappa^*_{t+s})}_{I^b_{t+s}}, \end{aligned} \tag{1}$$

where δ_p and δ_b are the depreciation rates for the planning and building stock, respectively. This problem has the solution:

$$\begin{aligned} \kappa^*_t &= q^b_t \\ q^b_t &= \mathbb{E}_t \frac{1}{1+r_{t+1}} \left(r^b_{t+1} + (1-\delta_b)q^b_{t+1} \right) \\ \iota_t(I^p_t) &= q^p_t \\ q^p_t &= \mathbb{E}_t \frac{1}{1+r_{t+1}} \left(\lambda \int_0^{\kappa^*_{t+1}} (q^b_{t+1}-\kappa)dF(\kappa) + q^p_{t+1}(1-\delta_p-\lambda) \right), \end{aligned} \tag{2}$$

where q^p and q^b are the Lagrange multipliers on the planning and building accumulation constraints, reflecting the values of a unit of the planning and building stock.[6]

The first line shows that developers proceed with construction when the cost of construction is less than q^b_t, which is defined in the second line to be the present discounted value of future rental income (i.e., the value of a unit of B_t). The third line says that developers will invest in planning starts until the value of a unit of the planning stock, q^p_t, is equal to the cost of a start. q^p_t is defined in the last row as the present discounted value of the surplus (building value net of construction costs) expected to be received when the planning stage ends. Taken together, the last two lines imply that there will be more plan starts when property values are expected to be high relative to construction costs.

The model rationalizes the main facts listed in Section 2. First, there are planning lags for commercial construction: the average time-to-plan is $\frac{1}{\lambda}$. Second, there is state-dependent abandonment out of planning: a fraction $\lambda(1-F(q^b_t))$ projects in planning are abandoned per period, meaning commercial price appreciation (higher q^b_t) reduces abandonment.

[6]See the Supplementary Materials Section S.3 for further details on the derivation.

The model also produces an additional implication: the short-run elasticity of supply depends on the planning stock. From (1) and (2), we have that growth in the building stock next period is $\hat{B}_t \equiv \frac{B_t - B_{t-1}}{B_{t-1}} = -\delta_b + \lambda \frac{P_{t-1}}{B_{t-1}} F(q_t^b)$. Differentiating with respect to building values shows that $\frac{\partial \hat{B}_t}{q_t^b} = \lambda \frac{P_{t-1}}{B_{t-1}} f(q_t^b)$. In words, the response of building supply to price appreciation in the short run depends on the ratio of the planning stock to the building stock ($\frac{P_{t-1}}{B_{t-1}}$) and the share of projects in planning that are on the margin of advancing to construction ($\lambda f(q_t^b)$).

Over a longer horizon—as can be seen in the last two lines of (2)—price appreciation also affects building supply by prompting the initiation of new planning starts.

In Supplementary Materials Section S.4, we embed this building sector model into a DSGE model and calibrate it to match the findings of Section 2. Consistent with the testable implication described in this section, we show that construction responds later to TFP-driven property price shocks in markets with a lower initial planning stock. An alternative model with exogenous abandonment overstates gestation lags by shutting down a mechanism by which construction can respond quickly to demand shocks.

The simple structure of this model is useful as it allows us to derive easily-interpreted expressions that link model outcomes to patterns observed in the data. Furthermore, the structure fits easily into a standard DSGE model, allowing us to quantitatively analyze dynamics in a general equilibrium setting. However, this simplicity requires us to abstract from other potentially important mechanisms. For example, uncertainty over future property values could also affect whether projects advance to construction by raising the value of the option to delay construction (Majd and Pindyck, 1987). Given that uncertainty is generally higher during periods of stress (Jurado et al., 2015; Adrian et al., 2019), such effects might exacerbate the response of construction to downward price movements; we indeed find some suggestive evidence of this in the next section.

4. MODEL VALIDATION USING LOCAL PROJECTIONS

This section tests the proposition that the response of construction investment to price appreciation depends on the initial stock of projects in planning. We first outline the methodology and then present the results.

4.1. Methodology

The goal is to test whether the response of construction activity to commercial price appreciation depends on the availability of projects in planning, as was implied by the model in Section 3. The planning stock is measured by the number of projects in planning for a given property type p, in MSA i, as of quarter t, normalized by the number of such buildings in the market at the time (Plan Rate$_{i,p,t}$). Commercial property price appreciation is measured by the year-over-year change in CoStar's commercial property price index for a given MSA-property type-quarter.[7]

Because construction occurs slowly over time, we look at the cumulative effects on construction starts using local projections. The main dependent variable is cumulative construction starts since t (as a fraction of the initial building stock), though we also analyze effects on MSA-level commercial construction employment growth.

Specifically, we estimate the equation:

$$\begin{aligned}\frac{\text{Construction Starts}_{i,p,t,t+h}}{\text{Building Stock}_{i,p,t}} &= \beta^h \Delta \ln(\text{Comrcl. Price Index}_{i,p,t}) \\ &+ \delta^h \Delta \ln(\text{Comrcl. Price Index}_{i,p,t}) \times \text{Plan. Rate}_{i,p,t} \\ &+ \gamma^h X_{i,p,t} + \eta^h_{i,t} + \gamma_p + \varepsilon^h_{i,p,t},\end{aligned} \tag{3}$$

where $h = \{2, 4, ...30\}$ indexes the horizon on which we measure the construction response, $\{\beta^h\}$ traces out the estimated cumulative construction response to price appreciation when no projects are in planning at time t, and $\{\delta^h\}$ traces out the extent to which higher initial planning stock markets are more responsive. $\eta^h_{i,t}$ and γ_p are MSA-quarter and property type fixed effects. The vector of controls $X_{i,p,t}$ includes Plan. Rate$_{i,p,t}$ and measures of recent construction and planning activity.[8] Regressions are weighted by the number of properties in a market (based on CoStar data), and standard errors are two-way clustered by MSA and quarter. Our sample runs from 2005 to 2016; we start in 2005 to ensure that any starts at the beginning of our sample are determined after a planning phase that we can observe, and we end in 2016 so that the three-year response (the time horizon we

[7]We exclude hotels from this analysis due to the lack of consistently-reported price data.

[8]We control for construction starts over the past year (as a share of property stock as of a year before) and four lags of the planning stock and the under-construction stock (the number of projects in an in MSA in planning or under construction, respectively, as a share of the property stock at the time).

focus most on) excludes COVID-related disruptions. That said, in unreported results, we find that the estimates are robust to allowing the sample to run later.

The assumption underlying this methodology is that cross-sectional differences in commercial price appreciation reflect changes in demand rather than supply. Estimates will be downward biased to the extent that supply-related factors drive price appreciation (e.g., impediments to construction would increase commercial prices but reduce construction activity). We take two approaches to mitigate this downward bias. First, we deploy MSA-quarter fixed effects to control for various factors such as labor availability, local regulatory stringency, and costs of construction materials that may affect local supply. Since inputs into construction are fairly similar across property types, within-MSA variation in prices is more likely to reflect demand factors than supply factors. Second, we instrument for $\Delta \ln(\text{Comrcl. Price Index}_{i,p,t}) \times \text{Plan. Rate}_{i,p,t}$ with the interaction of national price appreciation with $\text{Plan. Rate}_{i,p,t}$. This strategy is similar in spirit to Mian and Sufi (2011) and Chaney et al. (2012) in that we exploit heterogeneous effects of national shocks across markets with different supply elasticities. While these estimates could still have a downward bias to the extent that national price trends are driven by supply shocks, this is likely less of a concern than local impediments to construction increasing both abandonment and property prices. Indeed, Table S6 in the Supplementary Materials shows that the relationship between construction activity and changes in national construction costs is more consistent with demand-factors driving construction—construction activity is *higher* following cost growth—though there is some evidence suggesting that supply shocks matter more during the pandemic (after the sample ends).

A related threat to identification comes from the endogeneity of $\text{Plan. Rate}_{i,p,t}$. A high plan rate could be correlated with other factors that affect the elasticity of supply in a market. The direction of such bias is ambiguous: impediments to construction may increase the plan rate (e.g., if hurdles cause it to take longer to get through the planning stage), or decrease it (e.g., if developers do not initiate a plan due to a lack of available land). To address this concern, we add to $X_{i,p,t}$ the interaction of commercial price appreciation with other variables such as land availability and zoning regulations that may affect supply elasticities (Saiz, 2010; Baum-Snow and Han, 2024; Bartik et al., 2023).

4.2. Local Projection Results

How does the availability of projects in planning affect construction activity? If projects in planning mechanically advance to construction and completion, projects in planning will measure future additions to supply. To the extent that these projects are options, projects in planning affect the *elasticity* of building supply, as they will add to the building stock if commercial property prices warrant construction proceeding.

Local Planning Stock and the 3-year Construction Response Table 1 presents estimates of the cumulative response of construction starts to commercial property price appreciation at the three year horizon, and Figure 3 plots the local projection estimates of the response over time. We start by discussing the findings in the table, as they are useful for demonstrating the robustness of the results to different estimation strategies.

The first three columns estimate the effects of planning activity and price appreciation on construction starts omitting the interaction between the main explanatory variables. Column 1 presents OLS estimates using only MSA and property type fixed effects, Column 2 presents IV estimates from the same specification instrumenting for price appreciation with national appreciation for the given property type and Column 3 presents OLS estimates when adding MSA-quarter fixed effects. The estimates in Column 1 indicate that one percentage point higher price appreciation increases construction starts by about 1.2bps (as a share of the building stock). As projects under construction are essentially always completed, this should translate to about a 1.2bp increase in the building stock once construction is completed. That is, the coefficient estimate can be thought of as a measure of the short-term elasticity of commercial building supply.

The estimates are nearly identical in the IV specification (Column 2), but fall by half when the MSA-quarter fixed effects are included (Column 3). One potential explanation for this result is that there is substantial noise in measuring local price appreciation due to the low number of commercial property transactions in certain quarters, and this measurement error accounts for a greater portion of the variation when more granular fixed effects are employed.

Columns 4–6 present the primary findings, where specifications include the interaction of price appreciation with Plan. $\text{Rate}_{i,p,t}$. The IV specification in column 6 also includes the interaction of Plan. $\text{Rate}_{i,p,t}$ with national price appreciation as an instrument. The main object of interest is the coefficient on the interaction term, which estimates how much the availability of shovel ready projects increases short run supply elasticities. The estimates range from 0.9 in the OLS specification with MSA-quarter fixed effects to 1.3 in the IV specification. These results suggest that increasing the plan rate by one standard deviation (1.6 percentage points) increases the supply elasticity by between 1.4 and 2.1bps across the three estimates. Given that the average response to price appreciation was only about 1.2bps, this constitutes a significant proportional change in local supply elasticities.

The last two columns show that the IV estimates are robust to the inclusion of more granular fixed effects. Column (7) adds MSA-quarter fixed effects to control for changes in local conditions and Column (8) adds property type specific slopes (the interaction of property type dummies with Plan. $\text{Rate}_{i,p,t}$ and local price appreciation) to account for differences across property types in the response to price appreciation or the rate at which projects in planning advance to construction. The estimated interaction effects are generally in the same range as in the other specifications. Overall, these results demonstrate that supply is more elastic in the short run when there are projects already in planning that are available to go to construction.

Controls for Other Factors Relating to Supply Elasticities To increase confidence that it is the projects themselves that matter (as opposed to market conditions), we add controls for the interaction of various other market characteristics with price growth in Table 2. To account for growth potentially being more achievable in smaller markets (given the smaller base), we control of the logarithm of the initial property stock. To account for land availability, we control for the commercial-property-stock-weighted housing supply elasticity from Baum-Snow and Han (2024).[9] To account for the regulatory environment, we add the first two principal components from the LLM-generated data on housing regulations from Bartik et al. (2023).[10] The last two columns add controls for price appreciation interacted with MSA dummies, thus accounting for unobserved MSA-level factors affecting supply elasticities. The estimates fall modestly when we include the

[9] Baum-Snow and Han (2024) estimate housing supply elasticities at the tract level based on the share of a tract that is developed, the distance to the CBD, and topographical characteristics around the tract. We aggregate to the MSA level, weighting tracts by their commercial building count from Core Logic.

[10] The authors demonstrate that the first component is associated with factors such as affordability mandates, which are meant to extract surplus in high demand areas, while the second component is associated with exclusionary zoning, such as restrictions on multifamily development.

MSA controls and rise modestly with MSA-specific slopes, but do not differ meaningfully from the main estimates in Table 1. In short, the increased elasticity in markets with more shovel-ready projects appears to reflect the availability of projects that are ready for construction rather than other factors thought to matter for local supply.

Effects Over Time How does the supply response change over time? If new projects quickly enter planning in response to price appreciation, areas with a low plan rate might catch up over time as these new projects start to reach construction. If this process is more frictional, the gap could widen over time as more existing projects in high plan areas have time to complete planning and enter construction.

The local projection estimates in Figure 3 are more consistent with the latter story. The top panel plots OLS estimates along the lines of Column (6) of Table 1, while the bottom panel plots IV estimates along the lines of Column (5). The green line shows the predicted response of commercial construction for a market with an average plan rate, while the the red ones show the response when the plan rate is one standard deviation above the mean. In both the OLS and IV estimates, the gap in the response between high- and average-plan markets increases about linearly over time. In the IV estimates, the supply elasticity grows to about 3bps after 7.5 years in a market with an average plan rate and almost 9bp for a market with a high plan rate. As we saw in Table 1, the elasticities are lower with the OLS estimates, but the difference between high- and average-plan markets is similar. Given that we have only a short time horizon in the data, it is not feasible to estimate longer-run responses to price appreciation. While it is possible that low plan markets are able to add more stock eventually, these results suggest that the availability of projects already in planning is critical for the ability of a market to add supply in the short run.

Heterogeneity by Local Market Conditions The results so far treat the effects of price growth and declines as symmetric. While this may be reasonable for small fluctuations affecting whether marginal projects come to fruition, larger shocks may have asymmetric effects. For example, negative economic shocks might have larger effects if they are associated with either tight lending conditions or high uncertainty (raising the value of the option to delay). To investigate such effects, Figure S7 in the Supplemental Materials estimates Equation (3), but replaces $\text{Price Growth}_{i,p,t}$ with $\text{Price Growth}^{+}_{i,p,t} \equiv \max\{\text{Price Growth}_{i,p,t}, 0\}$ and $\text{Price Growth}^{-}_{i,p,t} \equiv \min\{\text{Price Growth}_{i,p,t}, 0\}$, thus allowing for a differential response to price appreciation when prices are rising and falling. While the difference in effects when prices are rising or falling are not statistically different, we do see that the planning stock matters more for supply elasticities when prices are falling, particularly at shorter horizons. In other words, having a high planning rate seems to amplify the negative effect of price declines more than it amplifies the positive effect of price increases. However, the confidence intervals are wide, so the extent to which supply elasticities vary by local market conditions is uncertain.

Effects On Construction Employment Figure S8 in the Supplementary Materials similarly plots the response of MSA-level construction employment to commercial property price appreciation (aggregating over property types since the employment data is at the MSA level).[11] The left panel presents OLS estimates of the effect of price appreciation in a specification with MSA and quarter fixed effects, while the right presents estimates instrumenting with national price appreciation (and omitting the quarter fixed effects). Each figure shows that commercial construction employment responds more to appreciation in markets with a high plan rate. After 2 years, construction employment increases by 3–4bps (relative to total employment) in high-plan cities, and 2–3bps on average.[12] The difference in employment response by initial plan rate then declines to near zero in the OLS specification and reverses in the IV specification.

5. CONCLUSION

The planning phase for commercial construction is long. Using microdata on the phases of development for CRE construction projects, we show that abandonment during the planning phase is common and is sensitive to changes in local economic conditions. We construct a time-to-plan model consistent with these observations and predict that the response of construction activity to price appreciation depends on the stock of projects in planning. Using a local projections methodology, we find that this relationship indeed holds in the cross-section of U.S. cities.

[11] Employment data come from the Quarterly Census of Employment and Wages. Construction employment is the sum of employment in NAICS codes 2362 (commercial construction), 236116 (multifamily construction), along with all 6-digit codes pertaining to commercial construction contractors (238112, 238122, . . . , 238912, 238992).

[12] Commercial construction employment averages about 2 percent of total employment, so growth in commercial construction employment moves more than 1-for-1 with price appreciation.

These finding have several policy implications. First, the findings speak to the potential for targeting infrastructure investment for economic stimulus. Stimulus should be "timely" so that expenditure occurs when there is still slack in the economy (Summers, 2008), meaning that time-to-plan delays may reduce infrastructure investment's efficacy as stimulus (Leeper et al., 2010; Ramey, 2021). Accounting for abandonment results in a more nuanced prediction: policies targeting commercial construction can work quickly, but only when there are "shovel-ready" projects available. This highlights the importance of early intervention since the abandonment of projects over the course of a downturn could reduce the stock of available projects, as occurred after the GFC.

Second, the findings have implications for policies with a longer-term aim of encouraging development, such as many place-based policies. Since planning and construction can take a few years, policies need to establish incentives for development years in the future to stimulate new projects. This means that programs such as Opportunity Zones—where the benefits to participation phase out quickly over time (Corinth and Feldman, 2024)—would predominantly affect already-planned projects. Stimulating new investment in the areas where little investment was previously planned may require longer-lasting incentives.

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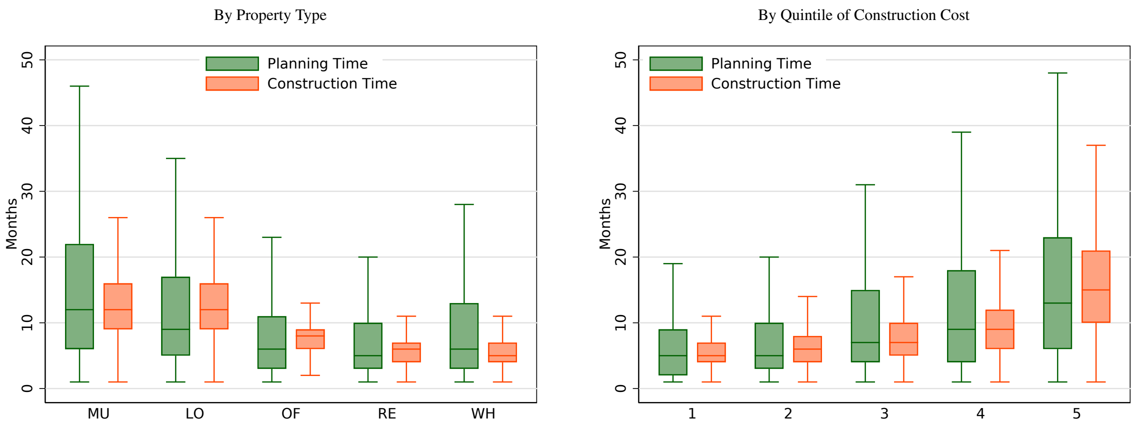
(a) Planning and Construction Times



(b) Probability of Advancing to Construction

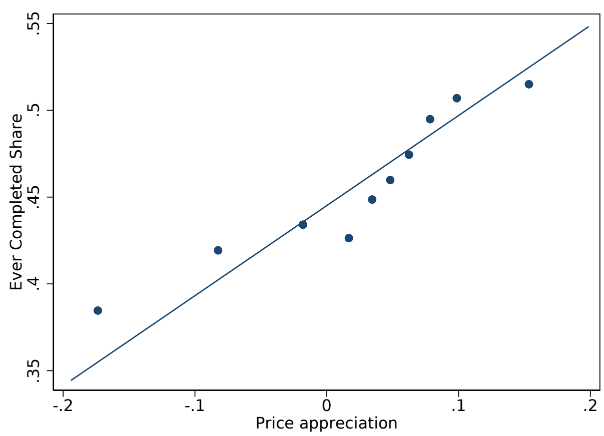


Figure 1: PLANNING AND CONSTRUCTION TIMES BY PROPERTY TYPE AND CONSTRUCTION COST AND ESTIMATES OF THE RELATIONSHIP BETWEEN A PROJECT ADVANCING TO CONSTRUCTION AND PRICE APPRECIATION EARLY IN THE PROJECT'S LIFE. *Note:* Figure 1a plots the distribution of planning (green) and construction (orange) times by property type (left panel) and construction cost (right panel). Property types include multifamily (MU), hotels (LO), office (OF), retail (RE) and warehouses (WH). Figure 1b presents semi-linear regression estimates of the relationship between whether a project eventually advances to construction and the commercial property price appreciation in the first year after a plan is initiated. Price appreciation is measured by CoStar's commercial property price index for the given property type and MSA. The specification controls for the natural logarithm of real project cost and building area, and includes MSA, property type, and quarter-of-plan start fixed effects. Estimates use the Stata "binsreg" command (see Cattaneo et al. 2024). The dots reflect binscatter estimates and the line reflects a linear regression estimate; price appreciation is significant at the 0.1% level when standard errors are two-way clustered by MSA and quarter-of-plan start. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc. and CoStar Suite (US).

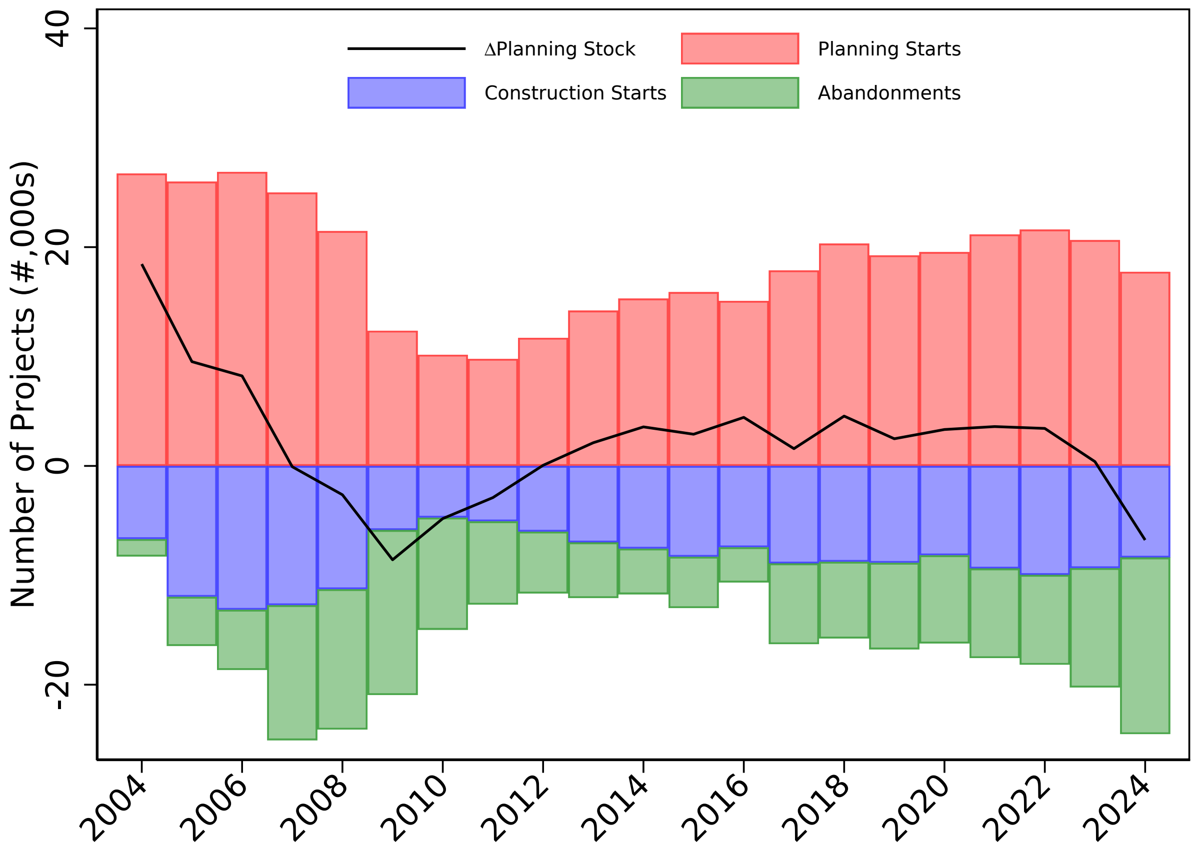


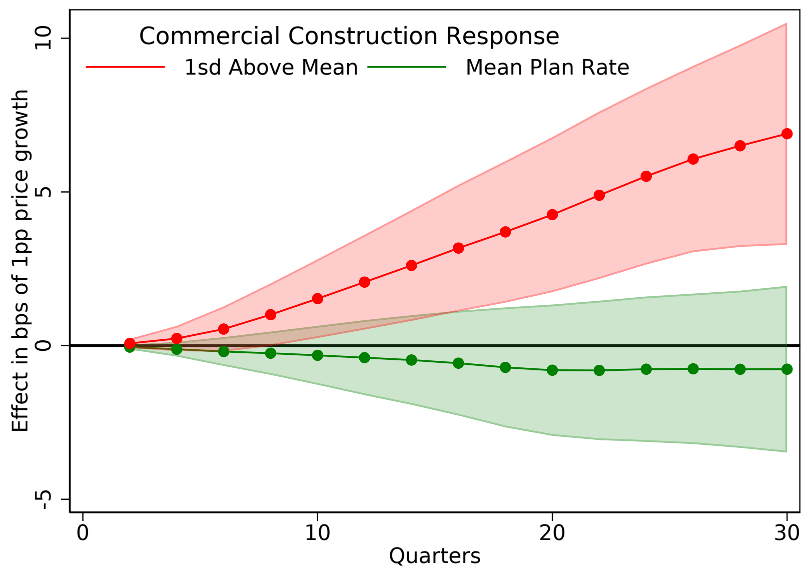
Figure 2: DECOMPOSITION OF CHANGES TO THE PLANNING STOCK. *Note:* This figure shows the components of the change in the stock of projects in planning by year. The black line plots the change in projects in planning, which is equal to inflows minus outflows. The red bars are inflows into the planning stock, which come from planning starts. The blue bars are outflows in the form of construction starts. The green bars are outflows in terms of abandoned and deferred projects. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc.

	3-year Commercial Construction Response							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Plan Rate$_{i,p,t}$	0.67**	0.67**	0.68**	0.63**	0.63**	0.60**	0.59**	
	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)	(0.06)	(0.06)	
Price Growth$_{i,p,t}$	1.19**	1.16**	0.58	0.11	0.10	-1.78**	-2.19**	
	(0.16)	(0.17)	(0.69)	(0.13)	(0.12)	(0.57)	(0.63)	
$\times$Plan Rate$_{i,p,t}$				0.97**	0.93**	1.26**	1.25**	0.95**
				(0.18)	(0.18)	(0.16)	(0.16)	(0.16)
IV?		✓			✓		✓	✓
Lagged Plan/Constr.	✓	✓	✓	✓	✓	✓	✓	✓
Property type FEs	✓	✓	✓	✓	✓	✓	✓	✓
MSA FEs	✓	✓		✓	✓			
MSA-Quarter FEs			✓			✓	✓	✓
Property type specific slopes								✓
Observations	54,228	54,228	54,228	54,228	54,228	54,228	54,228	54,228

Table 1: 3-YEAR CUMULATIVE RESPONSE OF CONSTRUCTION STARTS TO PRICE APPRECIATION. *Note:* This table shows the cumulative 3-year response of construction starts (normalized to the initial building stock) to commercial price appreciation for a given MSA, property type, and quarter. The first three columns present estimates with the plan rate and price appreciation entering independently, while the remaining specifications include their interaction. IV estimates instrument for price appreciation and its interaction with the plan rate with national price appreciation for the given property type and quarter and its interaction with the local plan rate. Fixed effects for each specification are indicated at the bottom of the table; "Property type specific slopes" indicates the presence of property type dummies interacted with the local plan rate and local property price appreciation. Each specification controls for cumulative construction starts over the past year, and four lags of the plan and construction rates (Lagged Plan/Constr.). Standard errors are two-way clustered by MSA and year-quarter. +,*,** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc. and CoStar Suite (US).

	3-year Commercial Construction Response					
	(1)	(2)	(3)	(4)	(5)	(6)
Plan Rate$_{i,p,t}$	0.67**	0.65**	0.66**	0.65**	0.59**	0.59**
	(0.07)	(0.06)	(0.07)	(0.06)	(0.07)	(0.08)
Price Growth$_{i,p,t}$	-1.86**	2.46	-2.23**	0.95		
	(0.60)	(1.91)	(0.68)	(1.74)		
$\times$Plan Rate$_{i,p,t}$	1.31**	1.20**	1.30**	1.21**	1.46**	1.46**
	(0.16)	(0.16)	(0.16)	(0.17)	(0.20)	(0.20)
$\times$ln(Property Stock)$_{i,p,t}$		-0.46^{+}		-0.35	-0.40^{+}	-0.21
		(0.27)		(0.24)	(0.23)	(0.28)
$\times$Housing Elasticity$_i$ (BH24)		-1.46		-1.39		
		(1.02)		(1.09)		
$\times$Regulatory Index, 1st PC$_i$ (BGM24)		0.47^{+}		0.50*		
		(0.24)		(0.21)		
$\times$Regulatory Index, 2nd PC$_i$		-0.64		-0.75^{+}		
		(0.46)		(0.44)		
IV?			✓	✓		✓
Lagged Plan/Constr.	✓	✓	✓	✓	✓	✓
Property type FEs	✓	✓	✓	✓	✓	✓
MSA-Quarter FEs	✓	✓	✓	✓	✓	✓
MSA $\times$ Price Growth					✓	
MSA $\times$ National Price Growth						✓
Observations	38,127	38,127	38,127	38,127	38,127	38,127

Table 2: OTHER POTENTIAL DRIVERS OF SUPPLY ELASTICITIES. *Note:* This table shows the cumulative 3-year response of construction starts (normalized to the initial building stock) to commercial price appreciation for a given MSA, property type, and quarter, controlling for the interaction of price appreciation with other factors that potentially affect supply elasticities. Columns (1) and (3) repeat previous OLS and IV analysis for MSAs where additional factors affecting elasticities are available. Columns (2) and (4) add in interactions of price appreciation with the following variables to the specification: the logarithm of the initial property stock, the commercial-property-weighted housing supply elasticity in the MSA from Baum-Snow and Han (2024), and population-weighted-average of the first two principal components of the housing regulation variables collected by Bartik et al. (2023). Columns (5) and (6) repeat Columns (1) and (3), respectively, but add in interactions of price appreciation with the logarithm of the initial property stock and interactions with market-level (Column (5)) or national (Column (6)) price appreciation with MSA dummies. IV estimates instrument for price appreciation and its interaction with the variables of interest with national price appreciation for the given property type and quarter and its interaction with the set of explanatory variables. Fixed effects for each specification are indicated at the bottom of the table. Each specification controls for cumulative construction starts over the past year, and four lags of the plan and construction rates. Standard errors are two-way clustered by MSA and year-quarter. +,*,** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc., CoStar Suite (US), and publicly shared data from the above-listed papers.



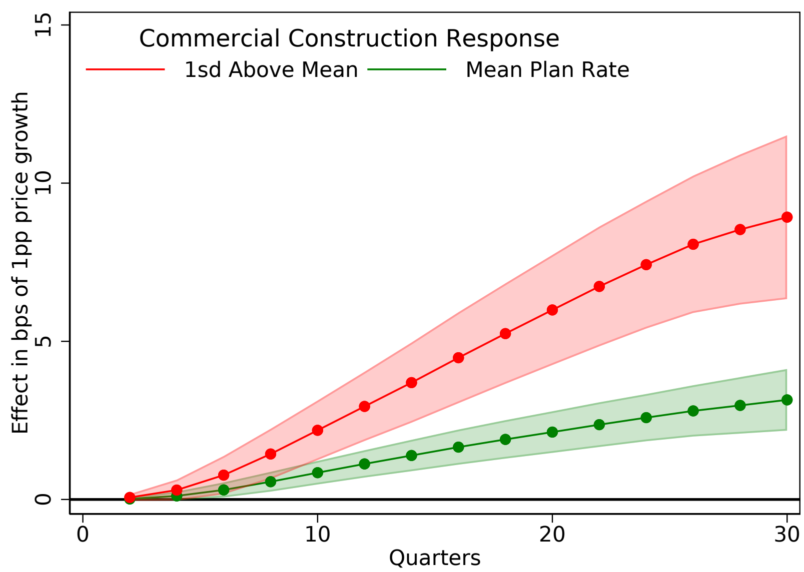


Figure 3: LOCAL PROJECTIONS ESTIMATE OF COMMERCIAL PROPERTY SUPPLY ELASTICITIES. *Note:* This figure shows the cumulative response of construction starts (normalized to the initial building stock) to commercial property price appreciation in a market. The top panel plots the response of construction estimated by OLS, including CBSA-quarter fixed effects (following Column 6 of Table 1), while the bottom panel presents estimates instrumenting for price appreciation with the national appreciation for the given property type (following Column 5 of Table 1). The y-axis presents the cumulative number of construction starts (in basis points) occurring in response to a 1 percentage point increase in commercial price appreciation for a CBSA with an average plan rate (green) or a plan rate 1 standard deviation above the mean (red). The x-axis indexes the number of quarters elapsed since the increase in price appreciation. The shaded regions give 95 percent confidence intervals. Standard errors are two-way clustered by MSA and year-quarter. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc. and CoStar Suite (US).

SUPPLEMENTARY MATERIALS

This document contains the supplementary materials as referenced in the manuscript.

S.1. Supplementary Figures and Tables Referenced in Text

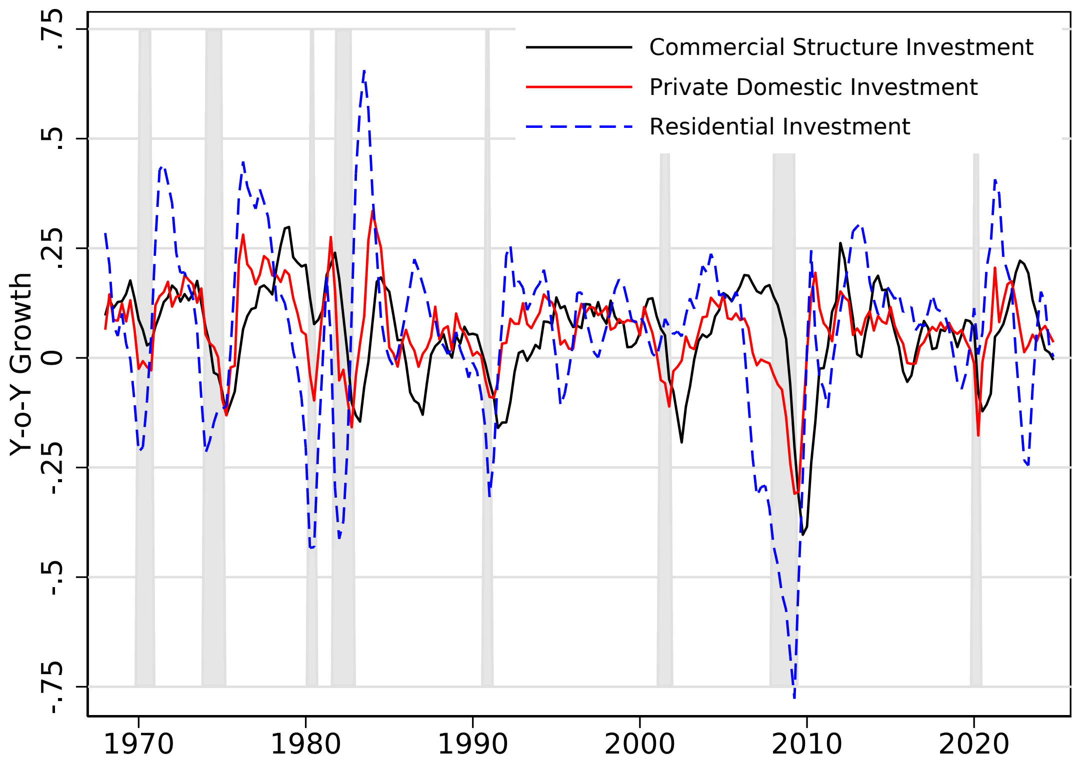


Figure S1: COMMERCIAL VS. TOTAL AND RESIDENTIAL AND PRIVATE DOMESTIC INVESTMENT. *Note:* The figure shows year-over-year changes in investment in nonresidential and multifamily structures (black—which we label as commercial structure investment), gross private domestic investment (red), and single-family housing investment (blue dashed–which we label as residential investment). Commercial Structure investment is calculated from the sum of private investment in nonresidential and multifamily structures (FRED series B009RC1Q027SBEA and C292RC1Q027SBEA, respectively). Total private investment is calculated from FRED series GPDI. Residential investment is calculated as private investment in single-family housing structures (FRED series A944RC1Q027SBEA). Note that nonresidential structures include structure types other than those in the microdata in this paper, such as manufacturing and power. *Source:* Authors' calculations using data from the Bureau of Economic Analysis, retrieved from FRED.

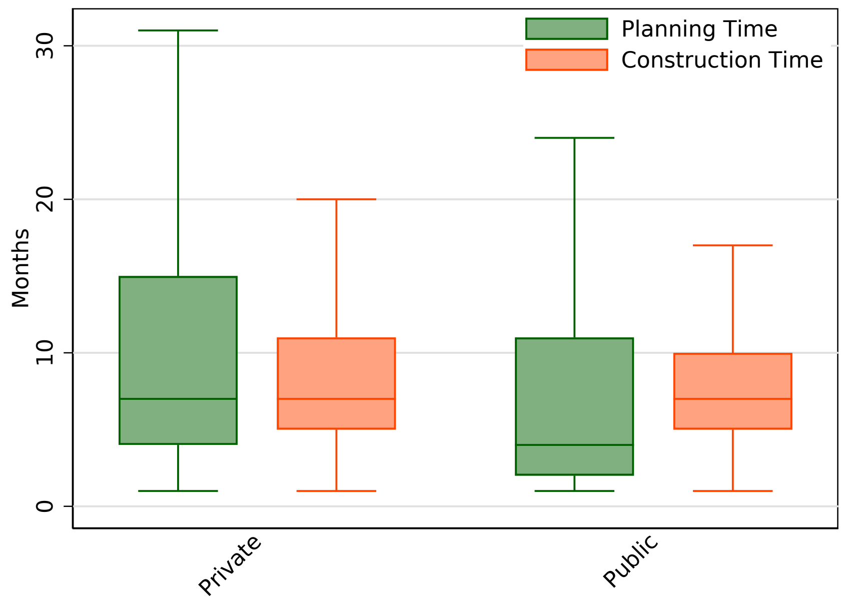


Figure S2: PLANNING AND CONSTRUCTION TIMES BY PRIVATE OR PUBLIC OWNERSHIP. *Note:* This figure plots the distribution of planning (green) and construction (orange) times by whether a project is private or public. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc.

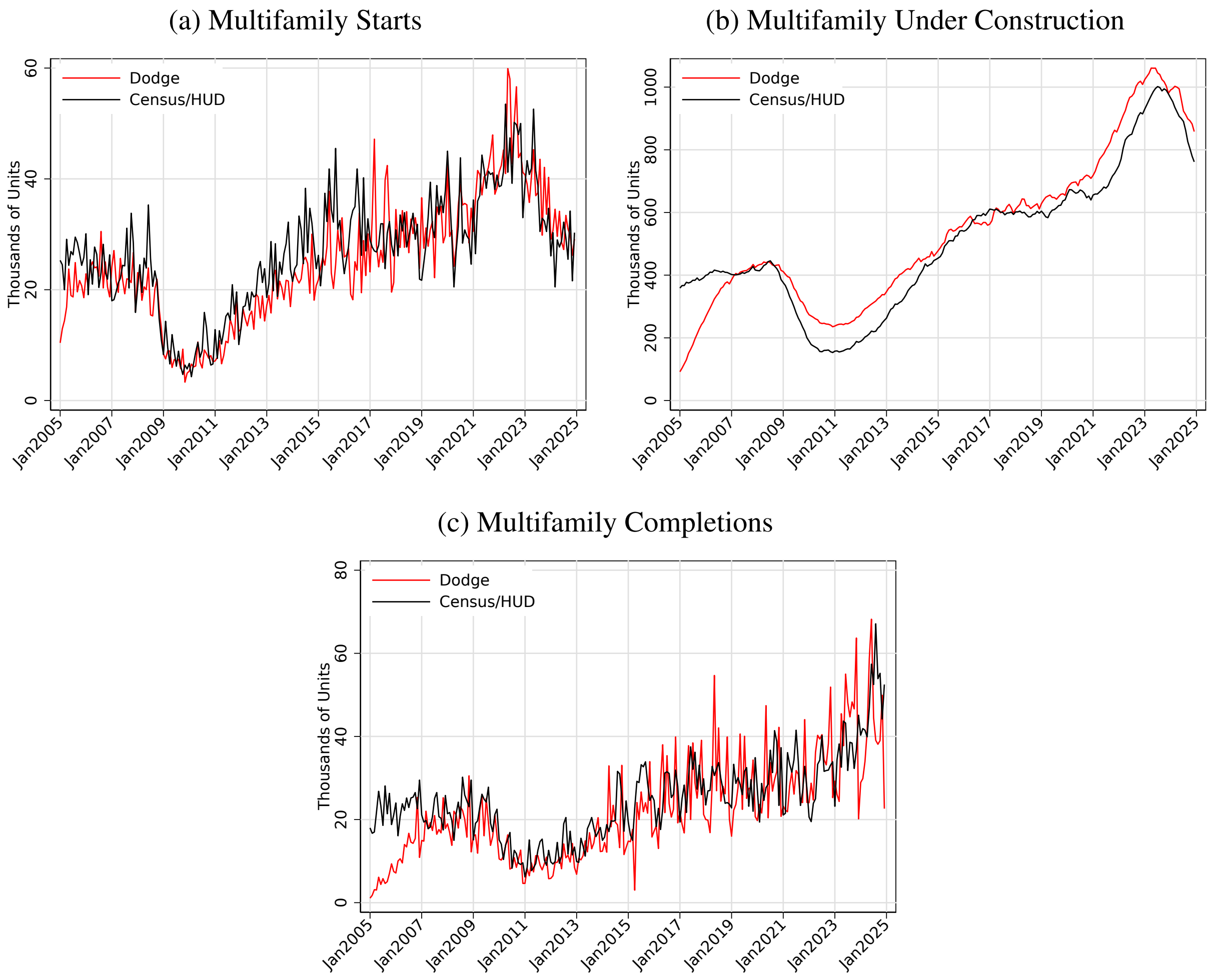
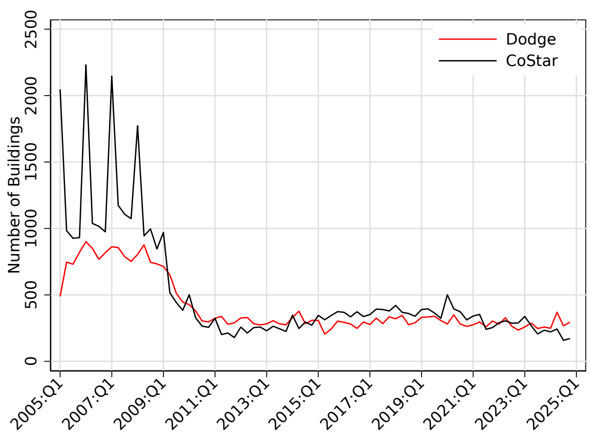
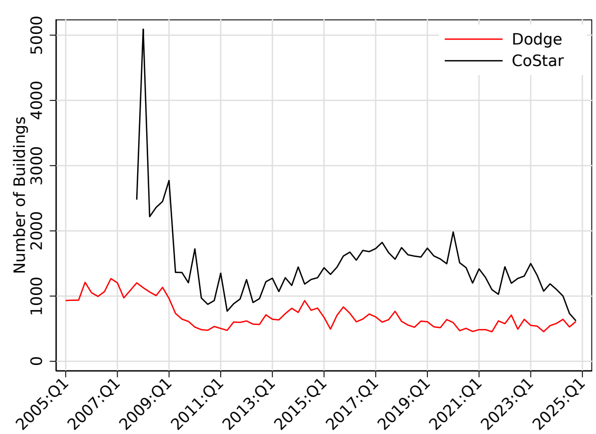


Figure S3: MULTIFAMILY HOUSING STATISTICS. *Note:* We compare data in implied unit starts, units under construction, and unit completions from the Dodge data to reported statistics for buildings with five or more units from the U.S. Census and the Department of Housing and Urban Development. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc. and the U.S. Census and the Department of Housing and Urban Development, retrieved from Haver Analytics.

(a) Office Completions



(b) Retail Completions



(c) Warehouse Completions

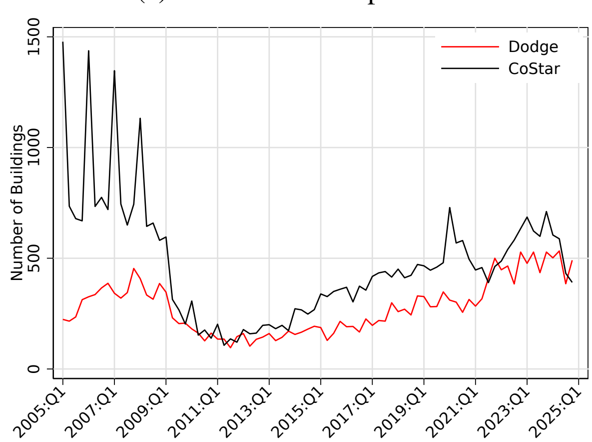


Figure S4: COMPARISON OF COMPLETIONS IN DODGE REAL ESTATE ANALYZER TO COSTAR. *Note:* Warehouses are compared to logistical industrial properties from CoStar. *Source:* Authors calculations using data from Dodge Data & Analytics, Inc. and CoStar Suite (US).

	Unweighted			Weighted			
	Mean	Std	Median	Mean	Std	Median	N
Planning Start to Construction Start (months)	11.7	13.9	7	18.9	19.9	13	179,529
Construction Start to Completion (months)	9.1	6.8	7	18.3	12.2	16	174,433
Planning Start to Abandonment (months)	32.7	18.2	36	34.4	20.7	36	112,432
Planning Start to Completion (months)	20.6	16.4	15	36.0	24.1	30	170,822
Project Construction Value (millions of 2012 USD)	12.7	61.2	3.0				386,648
Building Area (1000s of Sq. Ft.)	104.4	731.2	30.1				386,648
Abandonment Share	0.46			0.47			
Hotel Share	0.05			0.1			
Office Share	0.19			0.2			
Retail Share	0.31			0.11			
Warehouse Share	0.14			0.12			
Multifamily Share	0.3			0.47			

Table S1: SUMMARY STATISTICS FOR ALL PROJECTS. *Note:* This table shows summary statistics for the projects in our sample on an unweighted and weighted (by real project value) basis. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc.

Hotel	Unweighted			Weighted			
	Mean	Std	Median	Mean	Std	Median	N
Planning Start to Construction Start (months)	13.7	14.7	9	19.3	18.5	14	9,018
Construction Start to Completion (months)	13.4	7.9	12	21.0	11.7	19	8,590
Planning Start to Abandonment (months)	32.1	20.2	36	33.2	24.3	36	5,270
Planning Start to Completion (months)	26.7	17.1	22	39.2	22.8	33	8,256
Project Construction Value (millions of 2012 USD)	22.3	106.3	7.8				20,284
Building Area (1000s of Sq. Ft.)	143.8	497.4	68.8				20,284
Abandonment Share	0.51			0.59			

Office	Unweighted			Weighted			
	Mean	Std	Median	Mean	Std	Median	N
Planning Start to Construction Start (months)	9.6	12.7	6	18.3	22.1	11	33,046
Construction Start to Completion (months)	8.6	5.7	8	21.1	13.4	19	32,635
Planning Start to Abandonment (months)	32.6	18.3	36	36.3	22.2	36	22,275
Planning Start to Completion (months)	18.4	15.0	14	38.3	26.4	32	31,994
Project Construction Value (millions of 2012 USD)	14.9	91.4	2.0				71,214
Building Area (1000s of Sq. Ft.)	72.2	268.9	17.1				71,214
Abandonment Share	0.48			0.48			

Retail	Unweighted			Weighted			
	Mean	Std	Median	Mean	Std	Median	N
Planning Start to Construction Start (months)	8.3	10.8	5	11.8	14.9	7	57,193
Construction Start to Completion (months)	5.7	3.1	6	8.9	7.4	7	56,603
Planning Start to Abandonment (months)	33.2	18.8	36	32.9	18.9	36	35,611
Planning Start to Completion (months)	14.2	11.8	10	20.6	18.2	14	56,089
Project Construction Value (millions of 2012 USD)	3.9	35.9	1.1				115,020
Building Area (1000s of Sq. Ft.)	41.3	283.1	11.0				115,020
Abandonment Share	0.44			0.55			

Warehouse	Unweighted			Weighted			
	Mean	Std	Median	Mean	Std	Median	N
Planning Start to Construction Start (months)	10.3	13.0	6	14.0	16.9	8	23,058
Construction Start to Completion (months)	5.8	3.9	5	9.6	6.3	8	22,331
Planning Start to Abandonment (months)	33.3	17.6	36	33.3	19.7	36	18,612
Planning Start to Completion (months)	16.4	14.4	12	23.5	18.6	18	22,098
Project Construction Value (millions of 2012 USD)	10.7	27.8	3.1				57,508
Building Area (1000s of Sq. Ft.)	147.5	365.9	45.2				57,508
Abandonment Share	0.50			0.41			

Multifamily	Unweighted			Weighted			
	Mean	Std	Median	Mean	Std	Median	N
Planning Start to Construction Start (months)	16.6	15.9	12	21.5	20.0	16	57,214
Construction Start to Completion (months)	13.5	8.1	12	20.8	11.9	18	54,274
Planning Start to Abandonment (months)	32.1	17.4	36	34.6	19.6	36	30,664
Planning Start to Completion (months)	29.6	17.7	25	40.8	23.2	35	52,385
Project Construction Value (millions of 2012 USD)	19.1	58.3	8.1				122,622
Building Area (1000s of Sq. Ft.)	155.5	1207.0	75.0				122,622
Abandonment Share	0.45			0.43			

Table S2: SUMMARY STATISTICS FOR PROJECTS BY PROPERTY TYPE. *Note:* This table shows summary statistics for the projects in our sample on an unweighted and weighted (by real project value) basis, broken out by property type. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc.

phase[t]					phase[t+1]				
	Pre-Planning	**Planning**	**Final Planning**	**Bidding**	**Under construction**	**Completed**	**Deferred**	**Abandoned**	**Total**
	Row %	Row %	Row %	Row %	Row %	Row %	Row %	Row %	Row %
Pre-Planning	95.51	1.25	0.10	0.11	0.32	0.13	0.41	2.18	100.00
Planning	0.09	94.81	0.49	0.24	1.77	0.37	0.70	1.53	100.00
Final Planning	0.03	0.80	86.97	2.04	7.59	0.78	0.67	1.11	100.00
Bidding	0.06	0.44	0.41	84.63	11.45	1.09	0.42	1.51	100.00
Under construction	0.00	0.00	0.00	0.00	91.14	8.80	0.03	0.03	100.00
Deferred	0.06	0.12	0.12	0.07	0.38	0.15	96.48	2.62	100.00
Total	13.27	39.44	3.24	3.35	25.53	2.57	11.27	1.33	100.00

Table S3: TRANSITION MATRIX FOR PHASE DATA *Note:* This table shows a transition matrix for the sample of projects considered in this paper. Specifically, each cell (i, j) gives the share of projects that start in phase i in month t transitions to phase j in month $t+1$. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc.

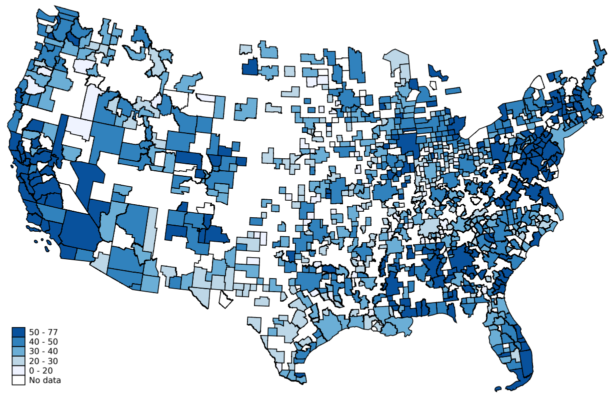
	Abandonment					
	(1)	(2)	(3)	(4)	(5)	(6)
Price Growth$_{i,p,t}$	-54.15**	-43.92**	-46.67**	-8.74*	-53.83**	-25.15*
	(3.45)	(3.40)	(3.59)	(3.82)	(3.95)	(10.82)
Log Real Project Cost			-3.18**	-2.73**	-2.56**	-2.11**
			(0.12)	(0.12)	(0.13)	(0.12)
Housing Elasticity$_i$ (BH24)					-3.60**	-3.69**
					(0.97)	(1.00)
Regulatory Index, 1st PC$_i$ (BGM24)					0.36^{+}	0.49*
					(0.21)	(0.21)
Regulatory Index, 2nd PC$_i$					-0.72*	-0.67*
					(0.28)	(0.28)
Price Growth$_{i,p,t}$ $\times$Log Real Project Cost				-22.27**		-21.76**
				(0.95)		(0.99)
$\times$Housing Elasticity$_i$ (BH24)						17.92
						(11.78)
$\times$Regulatory Index, 1st PC$_i$ (BGM24)						-7.54**
						(2.09)
$\times$Regulatory Index, 2nd PC$_i$						-4.73
						(3.08)
R^2_a	0.101	0.138	0.147	0.151	0.119	0.123
Start Year FEs	✓	✓	✓	✓	✓	✓
MSA FEs		✓	✓	✓		
Quarter FEs		✓	✓	✓	✓	✓
Property type FEs			✓	✓	✓	✓
Observations	286,154	286,154	286,154	286,154	286,154	286,154

Table S4: DETERMINANTS OF ABANDONMENT. *Note:* The dependent variable is an indicator if a project is abandoned. Each observation is one project. Columns (5) and (6) exclude CBSA fixed effects to include CBSA-level measures of housing supply elasticities from Baum-Snow and Han (2024) and Bartik et al. (2023). +,*,** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc., CoStar Suite (US), and publicly shared data from the above-listed papers.

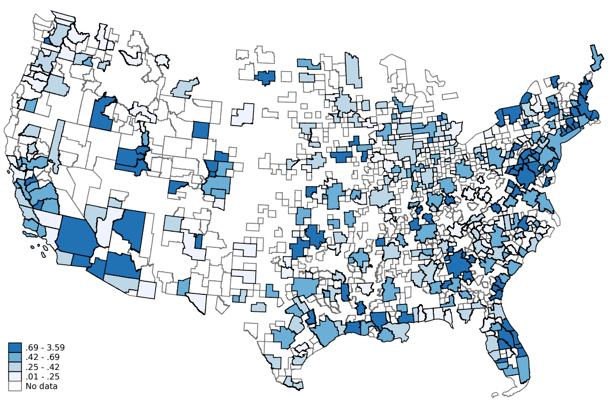
	Planning Time (Months)	*Construction Time (Months)*	*Abandonment Rate (%)*	*In Planning Rate 2011 (%)*	*In Planning Rate 2019 (%)*
New York-Newark-Jersey City, NY-NJ-PA	12	11	37	0.69	1.83
Los Angeles-Long Beach-Anaheim, CA	14	10	53	0.18	0.61
Chicago-Naperville-Elgin, IL-IN-WI	6	7	51	0.27	0.51
Dallas-Fort Worth-Arlington, TX	6	7	45	0.62	1.34
Houston-The Woodlands-Sugar Land, TX	6	6	36	0.50	0.76
Washington-Arlington-Alexandria, DC-VA-MD-WV	13	11	63	1.29	4.15
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	11	8	55	0.46	1.19
Miami-Fort Lauderdale-West Palm Beach, FL	15	8	53	0.62	1.78
Atlanta-Sandy Springs-Roswell, GA	8	7	60	0.75	1.43
Boston-Cambridge-Newton, MA-NH	13	10	47	1.32	2.28
Phoenix-Mesa-Scottsdale, AZ	7	7	48	0.88	1.19
San Francisco-Oakland-Hayward, CA	16	11	55	0.22	0.77
Riverside-San Bernardino-Ontario, CA	10	6	61	0.98	1.31
Detroit-Warren-Dearborn, MI	7	7	56	0.22	0.42
Seattle-Tacoma-Bellevue, WA	13	10	42	0.38	1.71
Minneapolis-St. Paul-Bloomington, MN-WI	8	8	45	0.40	1.42
San Diego-Carlsbad, CA	11	10	56	0.31	0.61
Tampa-St. Petersburg-Clearwater, FL	7	7	39	0.39	0.80
Denver-Aurora-Lakewood, CO	9	8	49	0.62	1.91
Baltimore-Columbia-Towson, MD	11	8	67	1.06	2.67
St. Louis, MO-IL	5	7	44	0.32	0.52
Orlando-Kissimmee-Sanford, FL	9	6	44	0.92	1.88
Charlotte-Concord-Gastonia, NC-SC	7	8	44	0.43	1.25
San Antonio-New Braunfels, TX	5	6	23	0.56	0.65
Portland-Vancouver-Hillsboro, OR-WA	10	9	47	0.32	0.92
Sacramento–Roseville–Arden-Arcade, CA	10	7	64	0.48	1.48
Pittsburgh, PA	8	7	52	0.44	0.81
Austin-Round Rock, TX	7	7	25	0.40	1.15
Las Vegas-Henderson-Paradise, NV	8	7	60	0.41	0.97
Cincinnati, OH-KY-IN	5	8	41	0.46	0.70
Kansas City, MO-KS	6	7	48	0.58	1.21
Columbus, OH	7	8	44	0.65	1.04
Indianapolis-Carmel-Anderson, IN	4	7	31	0.32	0.63
Cleveland-Elyria, OH	6	7	44	0.30	0.33
San Jose-Sunnyvale-Santa Clara, CA	14	11	60	0.62	1.04
Nashville-Davidson–Murfreesboro–Franklin, TN	6	8	29	0.52	1.17
Virginia Beach-Norfolk-Newport News, VA-NC	8	7	54	0.49	1.01
Providence-Warwick, RI-MA	12	7	50	0.56	0.99
Jacksonville, FL	6	6	39	0.32	1.14
Milwaukee-Waukesha-West Allis, WI	7	8	42	0.36	0.46
Oklahoma City, OK	5	6	47	0.83	0.15
Raleigh, NC	11	8	44	0.70	2.15
Memphis, TN-MS-AR	5	6	31	0.26	0.74
Richmond, VA	8	8	55	0.61	1.44
Louisville/Jefferson County, KY-IN	6	7	41	0.53	1.09
New Orleans-Metairie, LA	5	6	37	0.30	0.33
Salt Lake City, UT	6	8	45	0.86	0.48
Hartford-West Hartford-East Hartford, CT	9	7	49	0.75	1.10
Buffalo-Cheektowaga-Niagara Falls, NY	9	7	52	0.87	1.37
Birmingham-Hoover, AL	5	6	56	0.42	0.52

Table S5: CBSA-LEVEL STATISTICS. *Note:* The table displays statistics from the construction data for the 50 most populous CBSAs in our data as of 2020 (sorted by population). *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc.

(a) Abandonment Rate



(b) In Plan Rate 2011



(c) In Plan Rate 2019

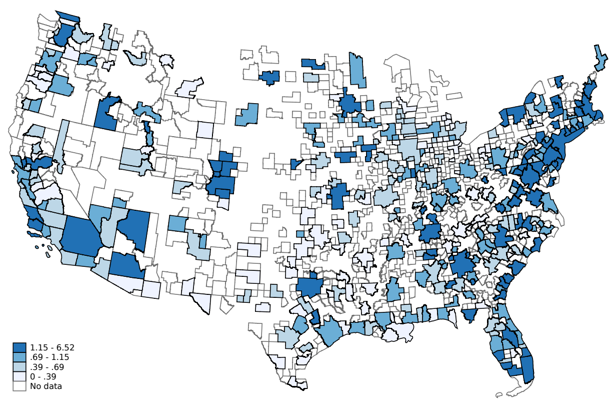


Figure S5: GEOGRAPHIC VARIATION IN ABANDONMENT AND PLANNING RATES. *Note:* Figure S5a is the CBSA-level average abandonment rate across our entire sample. Figures S5b and S5c are the median planning rate in 2011 and 2019, respectively. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc.

	3-year Const. Response		1-year Construction Response			
	2005-2018		2005-2018		2020-on	
	(1)	(2)	(3)	(4)	(5)	(6)
Plan Rate$_{i,p,t}$	0.63**	0.45**	0.13**	0.07**	0.07**	0.06**
	(0.06)	(0.04)	(0.01)	(0.01)	(0.01)	(0.02)
$\times$Price Growth$_{i,p,t}$		1.34**		0.23**		0.07
		(0.18)		(0.05)		(0.07)
$\times$Building Cost Growth$_t$		1.77*		0.60**		-0.01
		(0.66)		(0.14)		(0.15)
Price Growth$_{i,p,t}$	1.30**	0.04	0.19**	-0.02	-0.01	-0.10
	(0.15)	(0.13)	(0.06)	(0.05)	(0.06)	(0.06)
Building Cost Growth$_t$	0.59**	-0.26	0.33**	-0.03	-0.25$^+$	-0.20
	(0.17)	(0.34)	(0.06)	(0.08)	(0.12)	(0.14)
Lagged Plan/Constr.	✓	✓	✓	✓	✓	✓
Property type FEs	✓	✓	✓	✓	✓	✓
MSA FEs	✓	✓	✓	✓	✓	✓
Observations	56,977	56,977	69,177	69,177	23,633	23,633

Table S6: TESTS FOR SUPPLY SHOCKS. *Note:* This table demonstrates that for the sample period in the paper, construction increases when construction costs rise, consistent with fluctuations in costs reflecting construction demand rather than supply shocks. However, there is evidence of construction supply shocks dominating during the pandemic. Building Cost Growth$_t$ is the annual growth in the Turner Nonresidential Building Cost Index, while other variables are as in Table 1. Odd columns add interactions of building cost growth with the planning stock. Columns (1) and (2) study the construction cost at the 3-year horizon for the main sample period, while Columns (3) and (4) study the 1-year response of construction before the pandemic, and Columns (5) and (6) study the 1-year response during the pandemic. +,*,** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc. and CoStar Suite (US).

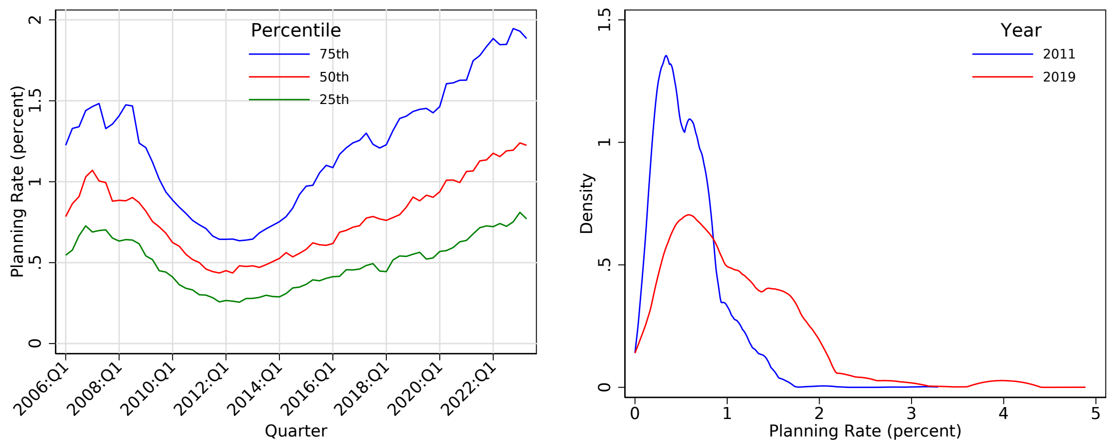


Figure S6: THE DISTRIBUTION OF PLANNING RATES OVER TIME. *Note:* In the left panel, this figure presents time series of various quantiles of planning rates. In the right panel, the figure presents kernel densities of the distribution in 2011 and 2019. MSAs are weighted by number of commercial properties. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc.

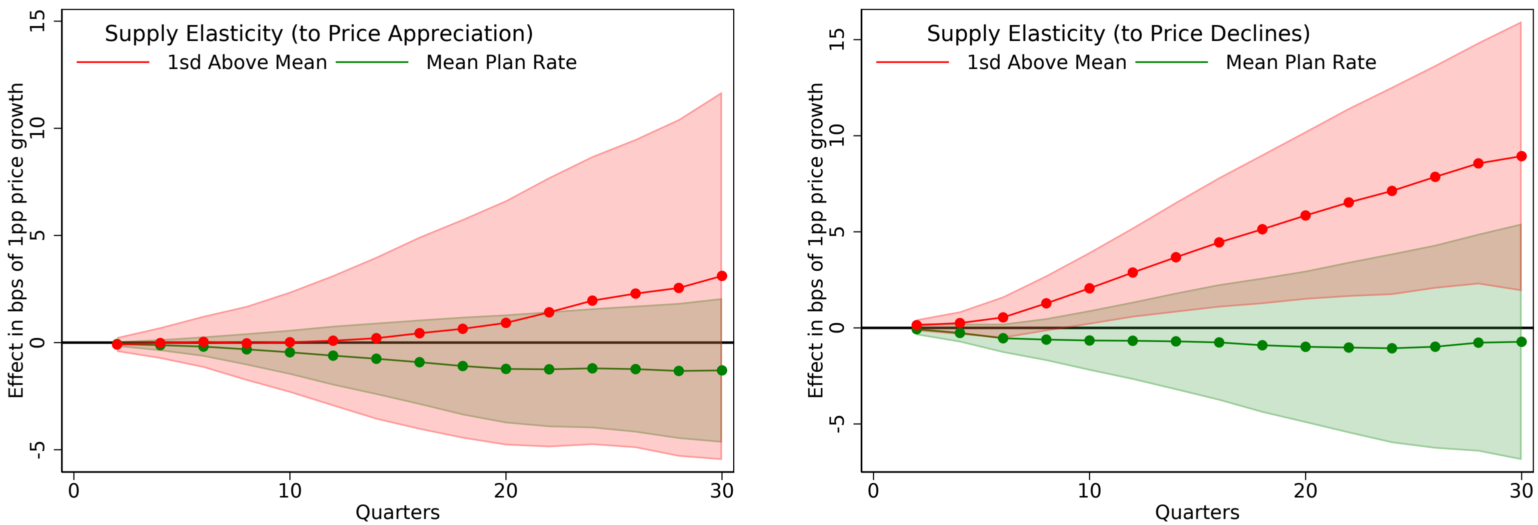


Figure S7: ASYMMETRIC EFFECTS OF PRICE APPRECIATION. *Note:* This table shows the cumulative response of construction starts (normalized to the initial building stock) to commercial price appreciation for a given MSA, property type, and quarter. All variables and specifications are the same as the top panel of Figure 3, but Price $\text{Growth}_{i,p,t}$ is replaced with Price $\text{Growth}^{+}_{i,p,t} \equiv \max\{\text{Price Growth}_{i,p,t}, 0\}$ and Price $\text{Growth}^{-}_{i,p,t} \equiv \min\{\text{Price Growth}_{i,p,t}, 0\}$, thus allowing for a differential response to price appreciation when prices are rising and falling. The top and bottom panel report estimated supply elasticities in markets experiencing positive and negative price growth, respectively. Green and red lines show the estimated response for markets with a plan rate at the mean and one standard deviation above the mean, respectively. Shaded regions show 95 percent confidence intervals. Standard errors are two-way clustered by MSA and year-quarter. +,*,** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc, and CoStar Suite (US).

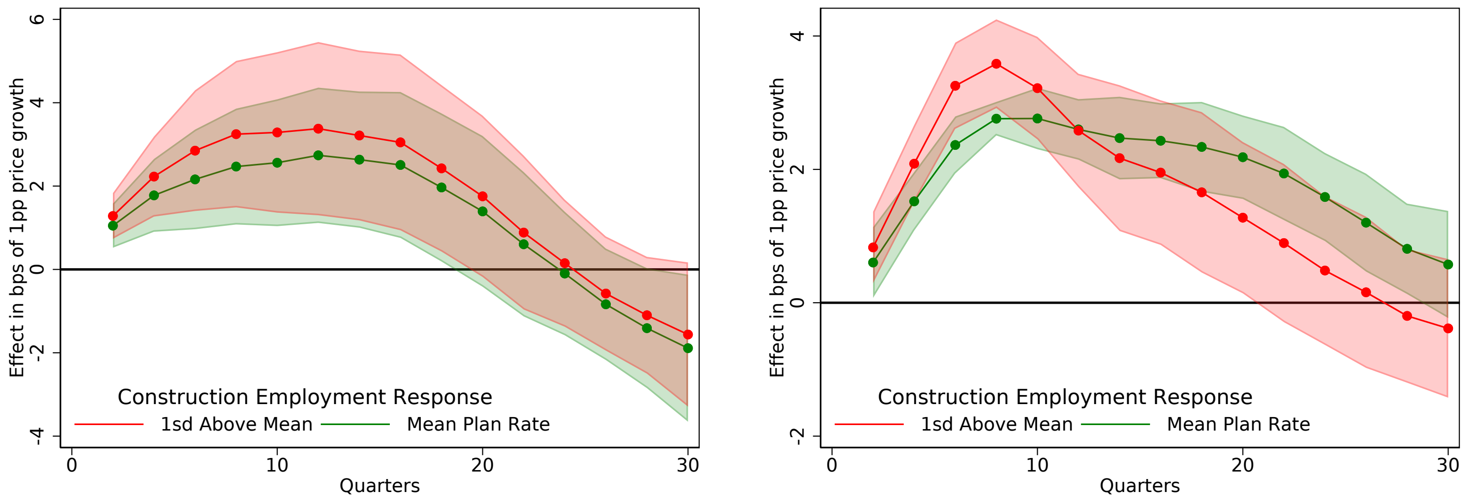


Figure S8: LOCAL PROJECTIONS ESTIMATE OF RESPONSE OF COMMERCIAL CONSTRUCTION EMPLOYMENT TO PRICE APPRECIATION. *Note:* This figure shows the response of commercial construction employment (as a percent of initial total employment) to commercial property price appreciation in a CBSA. The top panel plots the response estimated by OLS, including CBSA and quarter fixed effects, while the bottom panel presents estimates instrumenting for price appreciation with the national appreciation (and omitting the quarter fixed effects). The y-axis presents the increase in construction employment in response to a 1 percentage point increase in commercial price appreciation for a CBSA with an average plan rate (green) or a plan rate 1 standard deviation above the mean (red). The x-axis indexes the number of quarters elapsed since the increase in price appreciation. The shaded regions give 95 percent confidence intervals. All specification control for the number of construction starts over the past year, and 4 lags of the plan rate, the construction rate, and the logarithms of commercial construction employment and total employment. OLS estimates include CBSA and quarter fixed effects, while IV estimates only include CBSA fixed effects. Standard errors are two-way clustered by MSA and quarter. *Source:* Authors' calculations using data from Dodge Data & Analytics, Inc., CoStar Suite (US), and the Quarterly Census of Employment and Wages.

S.2. Additional Data Details

Except as otherwise stated, the additional data cleaning details apply to our data.

We keep commercial real estate projects for the main property types: multifamily (which we group with apartments), hotel, office, retail, and warehouse.

We drop any observations marked as deleted by Dodge. These include projects Dodge has determined as duplicates or that do not meet their criteria for inclusion. We drop data where building area square footage or project value is missing (all other information is always non-missing). We drop any non-US projects. We drop any projects with only one observation. We also drop the small number of observations after the first instance that the project is indicated as completed or abandoned. Additionally, though Dodge typically marks projects as abandoned if they have not been updated in three years in the recent data, in the history, they did not always do so; in turn, we mark any projects that have not been updated in three years as abandoned.

Some projects have information on phases for sub-projects (called "child" projects). We treat child projects as individual projects, but use the information for the planning phase from the master project.

Note that the construction spend is not the value of the building (or the land) but rather the estimated value to be paid to the general contractor (GC) before construction is completed, or the actual spend on the GC if construction is completed. The spend variable only includes construction costs and not design fees or other non-construction costs. We put the construction spend in 2012 dollars using the PCE price deflator.[13]

[13] We use the PCE chain-type price index, available at https://fred.stlouisfed.org/series/PCEPI. We set the date to be the minimum date of the project being completed if it reaches overall completion, being underway if it only gets to the underway phase, bidding if it only gets to the bidding phase, and the latest stage of planning if it gets to the planning stage.

S.3. Additional Theory Details

Developer's Problem The Lagrangian of the developer's problem that we set up in Section 3 is:

$$\mathscr{L} = \mathbb{E}_t \sum_s \Big(\prod_{i=0}^{s}(1+r_{t+i})\Big)^{-1} \Bigg[r^b_{t+s} B_{t+s-1} - \Big(\iota_{t+s} I^p_{t+s} + \lambda P_{t+s-1} \int_0^{\kappa^*_{t+s}} \kappa dF(\kappa) \Big)$$
$$+ q^p_{t+s}\Big(-P_{t+s} + (1-\delta_p-\lambda)P_{t+s-1} + I^p_{t+s} \Big)$$
$$+ q^b_{t+s}\Big(-B_{t+s} + (1-\delta_b)B_{t+s-1} + \lambda P_{t+s-1} F(\kappa^*_{t+s}) \Big) \Bigg],$$

where q^p and q^b are the costate variables giving the shadow value of planning stock and buildings, respectively.

This has the FOCs:

$$\frac{\partial \mathscr{L}}{\partial B_t} = -q^b_t + \mathbb{E}_t \frac{1}{1+r_{t+1}} \Big(r^b_t + (1-\delta^b) q^b_{t+1} \Big) = 0$$
$$\frac{\partial \mathscr{L}}{\partial I^p_t} = -\iota_t + q^p_t = 0$$
$$\frac{\partial \mathscr{L}}{\partial \kappa^*_t} = -\kappa^*_t \lambda P_{t-1} f(\kappa^*_t) + q^b_t \lambda P_{t-1} f(\kappa^*_t) = 0$$
$$\frac{\partial \mathscr{L}}{\partial P_t} = -q^p_t + \mathbb{E}_t \frac{1}{1+r_{t+1}} \left(\lambda \int_0^{\kappa^*_{t+1}} (q^b_{t+1} - \kappa) dF(\kappa) + q^p_{t+1}(1-\delta_p-\lambda) \right) = 0.$$

The first two expressions define the optimal investment amounts as a function of building values. $q^p_t = \iota_t$ means that investors initiate planning starts until the value of a unit of planning equals the marginal cost of a start.[14] The expression $\kappa^*_t = q^b_t$ means that developers choose to proceed with construction projects whenever the cost is less than the value of a building.

The last two expressions define the values of projects in planning and of completed buildings. Combining these conditions over time shows that these values reflect the present discounted value of

[14]This marginal cost is from the perspective of the individual developer. Since there are external adjustment costs, the marginal cost in aggregate is higher.

payouts from planning and construction. For planning, this payout is $\pi_t^p \equiv \lambda \int_0^{\kappa_{t+1}^*} (q_{t+1}^b - \kappa) dF(\kappa)$— that is, the probability of the plan being completed multiplied by the surplus expected to be received from construction, or $\mathbb{E}_t(\max(0, q_{t+1}^b - \kappa))$. For construction, the payout is the rent received on the building, r_t^b. These discounted values are:

$$q_t^p = \mathbb{E}_t \sum_s \left(\frac{1-\delta-\lambda}{1+r_{t,t+s}} \right)^s \pi_{t+s}^p$$
$$q_t^b = \mathbb{E}_t \sum_s \left(\frac{1-\delta}{1+r_{t,t+s}} \right)^s r_{t+s}^b,$$

where $1 + r_{t,t+s} \equiv (\prod_{i=0}^s (1 + r_{t+i}))^{\frac{1}{s}}$.

Adjustment Costs We assume the following functional form for the costs to planning starts: $\iota_t = \iota + \frac{1}{\phi}(\frac{P_t - P_{t-1}}{P_{t-1}})$. This specification implies that costs are quadratic in the number of starts, with ι measuring the steady-state cost of a plan start and ϕ the elasticity of starts with respect to q^p. Combining the first-order condition that $q_p = \iota_t$ with the expression for $P_t - P_{t-1}$ in the planning accumulation equation, we get that: $I_t^p = P_{t-1}(\phi(q^p - \iota) + \lambda + \delta_p)$.

In the first order conditions above, developers take the cost of planning starts to be exogenous. This assumption allowed for simpler and more easily-interpreted expressions in Section 3, and it is likely economically reasonable given that the construction sector is highly fragmented, leaving little room for individual firms to affect input prices (D'Amico et al., 2024). However, we found qualitatively similar results with internal adjustment costs (i.e., when developers accounted for the effects plan starts had on current and future costs of plan starts).[15]

[15] If we keep other parameter values the same, but make adjustment costs internal, we see a smaller difference between the response of high- and low-plan economies, because deviations from the steady state plan rate revert more quickly. If we recalibrate ϕ (in the way we will discuss in Section S.4.2), we find similar effects with internal and external adjustment costs.

S.4. Quantitative Model

Section S.4.1 presents the DSGE model, and Section S.4.2 discusses model calibration. Section S.4.3 presents how the planning stock affects supply elasticities in the model, and Section S.4.4 shows how results differ from an otherwise equivalent model without endogenous abandonment. The table and figures that are referenced in this section are presented at the end of the section.

S.4.1. DSGE Model

The model has the following agents: households, capital producers, building producers (whose problem was defined in Section 3), final goods producers, and a government. Although most of the problem outside of building production is standard, we review their problems in that order for completeness.

Households At time t, a representative household maximizes lifetime utility—which is assumed to be separable and isoelastic—over consumption (of the final good), C_t, and its labor supplied, L_t:

$$\mathbb{E}_t \sum_s \beta^s \left(\frac{C_{t+s}^{1-\gamma}}{1-\gamma} - \frac{\omega}{1+\nu} L_{t+s}^{1+\nu} \right),$$

where $\omega > 0$, $\nu > 0$, and $\gamma > 0$. The household maximizes utility subject to a budget constraint:

$$D_{t+s}^h + C_{t+s} = (1 + r_{t+s}) D_{t+s-1}^h + w_{t+s} L_{t+s} + \Pi_t - T_t, \tag{4}$$

where D_t^h is government debt held by households at time t; r_t is the one-period real return on government debt; w_t is the real wage they are paid for their labor; Π_t are any net profits returned by firms—developers, capital producers, and final goods producers—which households wholly own; and T_t are net taxes paid to the government.

The solution to the household problem thus implies standard labor-income and Euler equations:

$$w_t - \omega C_t^{\gamma} L_t^{\nu} = 0$$
$$C_t^{-\gamma} - \beta \mathbb{E}_t C_{t+1}^{-\gamma} (1 + r_{t+1}) = 0.$$

Capital Producer Problem Capital depreciates at rate δ_k and is rented to firms at rental rate r_t^k. There is thus a representative capital producer that solves the following problem:

$$\max \quad \mathbb{E}_t \sum_s (\prod_{i=0}^{s} \frac{1}{1+r_{t+i}})(r_{t+s}^k K_{t+s-1} - I_{t+s}^k),$$

subject to the capital accumulation equation:

$$K_{t+s} = (1-\delta_k) K_{t+s-1} + I_{t+s}^k. \tag{5}$$

Given there are no adjustment costs to capital investment, the first-order condition (FOC) from the capital producer's problem implies the standard rental rate of capital:

$$r_t^k = r_t + \delta_k. \tag{6}$$

Final Good Sector A continuum of competitive firms produce output Y_t by hiring labor L_t at wage w_t and renting capital and buildings, K_{t-1} and B_{t-1}, respectively, with technology:[16]

$$Y_t = Z_t K_{t-1}^{\alpha} B_{t-1}^{\eta} L_t^{1-\alpha-\eta}, \tag{7}$$

where Z_t is firm productivity, $\alpha \in (0,1)$, and $\eta \in (0, 1-\alpha)$. As in Section 3, buildings are constructed with a separate investment process from capital.

Firms choose the amount of labor to use in production and the amount capital and buildings to rent in order to maximize profits (which are zero in equilibrium):

$$\mathbb{E}_t \sum_s (\prod_{i=0}^{s} \frac{1}{1+r_{t+i}})(Y_{t+s} - w_{t+s} L_{t+s} - r_{t+s}^k K_{t+s-1} - r_{t+s}^b B_{t+s-1}).$$

[16] We follow the convention that variables are dated as of when they are determined. Buildings and capital used at time t are chosen at time $t-1$.

We thus obtain the following FOCs:

$$\begin{aligned} w_t &= (1-\alpha-\eta)Z_t K_{t-1}^{\alpha} B_{t-1}^{\eta} L_t^{-\alpha-\eta} \\ r_t^k &= \alpha Z_t K_{t-1}^{\alpha-1} B_{t-1}^{\eta} L_t^{1-\alpha-\eta} \\ r_t^b &= \eta Z_t K_{t-1}^{\alpha} B_{t-1}^{\eta-1} L_t^{1-\alpha-\eta}. \end{aligned} \tag{8}$$

Government, Clearing, and Equilibrium The government comes into the period with a level of debt D_t, which is all held by households. Government spending, G_t, is exogenously specified and is financed with taxes and new debt issuance. The government thus faces budget constraint:[17]

$$D_t(1+r_t) + G_t = D_{t+1} + T_t. \tag{9}$$

Government debt issuance is equal to household bond holdings such that:

$$D_t = D_t^h. \tag{10}$$

Given a sequence of productivities and government policies ($\{Z_{t+s}, G_{t+s}, T_{t+s}\}_s$) and a set of initial conditions (B_t, P_t, K_t, D_t), a competitive equilibrium is a sequence of prices $\{r_{t+s}, r_{t+s}^k, r_{t+s}^b, w_{t+s}\}_s$ and quantities $\{C_{t+s}, L_{t+s}, Y_{t+s}, K_{t+s}, B_{t+s}, P_{t+s}, \Pi_{t+s}, D_{t+s}, D_{t+s}^h\}_s$ such that households and the producers of capital buildings and final goods all solve their respective maximization problems, households' labor supplied equals firm labor demanded, capital and buildings supplied by capital and building producers are equal to capital and buildings demanded, respectively, building and capital accumulation follow equations (1) and (5), and bond markets clear following equation (10).[18]

[17] We make the standard assumption of non-explosive government debt.

[18] We write all budget constraints as binding, but if these were written as inequalities, they would also need to hold in equilibrium.

S.4.2. Calibration

We present the calibrations for the model parameters in Table S7. The table's parameters are grouped first by the standard macro parameters and then by the novel construction-related parameters.

We calibrate the relative utility weight on labor, ω, and productivity in the steady state, Z, so that aggregate labor supply, L, and aggregate output, Y, are normalized to 1, leading to values of 0.91 and 0.49, respectively. We set government spending, taxes, and government debt to zero. For most of the other standard macro parameters, we follow Gertler and Karadi (2013). Specifically, following their work, we calibrate β to hit a 2 percent interest rate, leading to a value of 0.995 (quarterly), the inverse Frisch elasticity, ν, to 0.276 (which implies a Frisch elasticity of about 3.6), and the capital depreciation rate, δ_k, to 0.025. We set the relative risk aversion parameter, γ, to 1 following Chetty (2006).

Given that we introduce buildings as a second capital input into production, we set the sum of α and η so that the capital share of income (inclusive of both K and B) is the standard value of 1/3. We set the relative income shares to match the estimate from **?** that real estate is about 30 percent of a firm's book assets (i.e., we set these variables to satisfy $\frac{q^b B}{K} = \frac{3}{7}$); this condition gives us that $\alpha = 0.287$ and $\eta = 0.046$.[19]

The other key building and planning parameters are calibrated as follows. We set the hazard from planning to construction, λ, to 0.167 to have a six-quarter average time-to-plan. We set the building depreciation rate, δ_b, to be 0.0062 to match the annual depreciation rate for office buildings used in the national income and product accounts (NIPAs).[20] δ_p is not separately identified from λ and the parameters pertaining to the distribution of construction costs, so we just set it to the same value as δ_k.[21]

Regarding parameters pertaining to the cost of planning starts, we set ι (reflecting the steady-state cost of planning starts) to normalize q^b to 1. ϕ, which reflects how elastic plan starts are, does not affect the steady state but affects how quickly the planning stock responds to shocks. We set this

[19] See Figure 3 in **?**.

[20] The annual depreciation rate for office buildings is 0.0247, which is around the middle of the range of depreciation estimates for private nonresidential structures. See https://apps.bea.gov/national/pdf/BEA_depreciation_rates.pdf.

[21] A higher depreciation rate is equivalent to having a combination of a higher λ, but also an increase in the probability that draws are unfavorable.

to 1.25 so that a 50 percent reduction in P would have a half-life of six years, which is roughly consistent with the post-GFC recovery shown in Figure S6.

We take the distribution for construction costs to be Pareto distributed: $F(\kappa) = 1 - (\frac{s}{\kappa})^a$, where s is the minimum possible cost of construction and $a > 1$ determines how much mass is around this minimum. This makes the probability of abandonment $1 - F(q_b) = (\frac{s}{q_b})^a$ and the expected construction expenditure (if construction goes ahead) equal to $s^a \frac{a}{1-a}(q^{1-a} - s^{1-a})$. We calibrate s and a so that the probability of abandonment is 47 percent (matching the value-weighted abandonment share in Table S2) and construction costs are 85 percent of building values.[22]

S.4.3. Building Supply Elasticities and the Planning Stock

We now present the quantitative results from the model. In Section 4, we showed that construction responds more to commercial price appreciation in localities with a greater stock of projects in planning. We now demonstrate equivalent dynamics in the calibrated model.

Figure S9 plots the response of construction to a 1 percent TFP shock that decays at a rate of 20 percent per quarter in two economies differing only in their initial levels of planning stock. The orange line shows the effect of the shock in a market starting at the steady state, whereas the blue line shows the response for an economy starting at only half of the steady-state level of P.[23] The 1 percent TFP shock initially raises building production by a bit more than a quarter of a percentage point in the steady state, but only by about half this amount for the low planning economy.[24] The effect of the TFP shock on construction then grows over time as developers start to build up the planning stock, resulting in more construction starts over time. However, this process is delayed for the economy with a low planning stock; construction activity does not peak until six years after the

[22] We assume that "soft costs" as a share of building value are similar to those in the NAIOP's report on the economic impacts of commercial real estate investment. The NAIOP estimates that in 2018 developers incurred 31.71 billion dollars in soft costs relative to total expenditure of 207.77 billion dollars. See Table 2 here: https://www.naiop.org/globalassets/research-and-publications/report/economic-impacts-of-commercial-real-estate-2019-edition/researchreportnaiop-2019-fuller-report-online-version.pdf.

[23] Since the economy with a low P would have transitional dynamics even absent the shock, the effect of the shock is $\left(I^b_{t+s}(\{Z'\};P_t = .5P) - I^b_{t+s}(\{Z\};P_t = .5P)\right)/I^b$, where $I^b_{t+s}(\{Z'\};P_t)$ and $I^b_{t+s}(\{Z\};P_t)$ are construction levels that would occur with and without the shock, and I^b and P are steady-state building investment and plan levels.

[24] The increase in the probability that a project advances to construction is roughly similar in both economies, so the difference is that the low planning economy has only half as many planning projects available to advance.

shock (compared with four years under the steady-state initial conditions).

Since TFP shocks drive changes in both building values and construction activity, we can also present these impulses along the lines presented in Figure S10. In Figure S10, we plot the cumulative response of building construction as a share of the building stock, $\left(\sum_{i=0}^{s}\left(I_{t+i}^{b}(\{Z'\})-I_{t+i}^{b}(\{Z\})\right)\right)/B$, normalized by the price appreciation caused by the shock, $(q_t^b - q^b)/q_b$. The left panel plots the cumulative elasticity of construction starts with respect to price appreciation for the low-plan-rate and steady-state economies, while the right panel plots the difference in elasticities.

The effects of the shocks are qualitatively similar to the local projection estimates displayed in Figure 3. The cumulative effect of the price shock rises steadily over time, as in the data, with the effect leveling off after about six years.[25] The rise in construction is slower for the economy with the lower initial planning stock, but the difference levels off after about five years. Altogether, the calibrated model is broadly consistent with the patterns in the local projections, though the model estimates supply as more elastic.[26]

S.4.4. Endogenous vs. Exogenous Abandonments

For our final exercise, we analyze the role endogenous abandonment plays in the model. In Figure S11, we present impulses of construction in response to a 1 percent TFP shock in the baseline calibrated model and an alternative model without endogenous abandonment. In this alternative model, there is just a fixed probability that projects completing planning are abandoned and a fixed cost to undertaking construction. We set this abandonment probability and construction cost equal to the steady-state abandonment probability and (average) construction cost so that the steady states of the two models are identical.[27]

[25] We cannot compute similar estimates of longer horizons in the data, as we have a short time series and thus quickly lose degrees of freedom.

[26] There are a couple of factors that might contribute to this difference in elasticities outside of model misspecification. First, empirical estimates of the supply elasticity would be biased downward to the extent that price changes reflect supply shocks (movements along the demand curve). Second, price appreciation is measured with error since the CRE market is illiquid enough that the price index is based on appraisals rather than transactions.

[27] This exogenous abandonment model can be thought of in terms of the baseline model but with a discrete distribution of construction costs: the cost is arbitrarily high with the probability of abandonment and equal to the average cost of construction otherwise. The important difference between the models is thus whether or not there are projects that are at the margin of being abandoned.

The main takeaway from this exercise is that endogenous abandonment speeds up the response of construction to demand shocks. In the exogenous abandonment model, there is no mechanism to increase construction immediately: construction is just a constant share (the hazard of completion multiplied by the exogenous probability of construction) of the predetermined planning stock. This means that construction only rises because of the initiation of new projects in planning, which eventually translate into new construction. In contrast, with endogenous abandonment, construction rises immediately because of a reduction in the number of projects in planning being abandoned.

Parameters	Value	Description	Target
Standard Macro parameters			
ω	0.907	Labor Disutility	$L = 1$
Z	0.490	Productivity	$Y = 1$
β	0.995	Household Discount Factor	r =2% (annual)
γ	1.0	Coefficient of Relative Risk Aversion	Chetty (2006)
ν	0.276	Inverse Frisch elasticity of labor supply	Gertler and Karadi (2013)
δ_k	0.025	Capital Depreciation	Gertler and Karadi (2013)
α	0.287	K income share	Capital (K+B) share= $\frac{1}{3}$
Construction and Planning Parameters			
η	0.046	B income share	$\frac{q^b B}{K} = \frac{3}{7}$
λ	0.167	Hazard of Completing Planning	1.5-year plan time
δ_p	0.025	Planning Depreciation Rate	Equate to δ_k
δ_b	0.0062	Building Depreciation Rate	NIPA
ι	0.067	Cost of Planning Start	$q^b = 1$
ϕ	1.25	Planning Adjustment Costs	Post-GFC Plan Stock Recovery
s	0.744	Min. Construction Cost (pareto dist.)	15% soft costs to construction
a	2.556	Pareto shape parameter	37% abandonment from planning

Table S7: CALIBRATION. *Note:* This table presents the calibration of the parameters for the model. From left to right, the columns provide the parameter, the calibrated value, a description of what the parameter reflects, and the target.

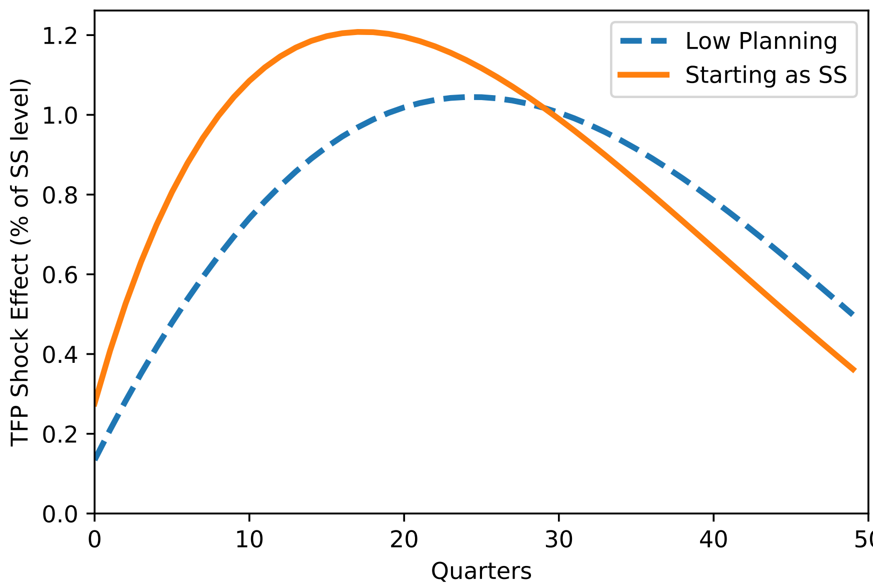


Figure S9: CONSTRUCTION INVESTMENT RESPONSE TO A TFP SHOCK BY PLANNING STOCK. *Note:* This figure shows the impulse response of construction to a 1 percent positive TFP shock. The orange line plots the response in an economy starting at the steady state, while the blue line plots the effect of the shock in an economy with an initial planning stock of half the steady state level . Formally, the blue line plots the sequence $\left(I^b_{t+s}(\{Z'\};P_t = .5P) - I^b_{t+s}(\{Z\};P_t = .5P)\right)/I^b$ and the orange line $\left(I^b_{t+s}(\{Z'\};P_t = P) - I^b\right)/I^b$, where arguments without time subscripts denote steady-state levels and $Z'_{t+s} = Z + .01 \times .8^s$.

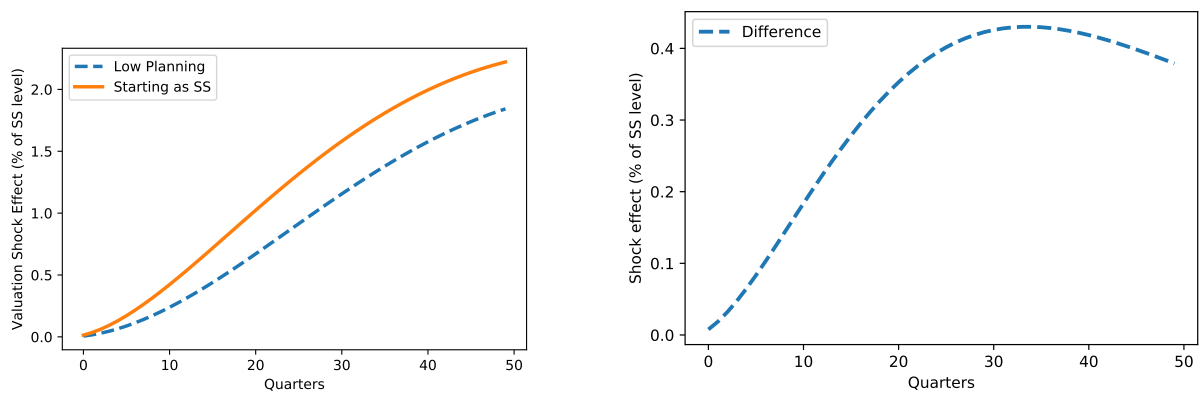


Figure S10: CUMULATIVE BUILDING RESPONSE TO PRICE APPRECIATION. *Note:* This figure shows the cumulative response of building construction (as a share of the steady-state building stock) to a 1 percentage point building value shock. The left figure plots $\left(\sum_{i=0}^{s}(I^b_{t+i}(\{Z'\}) - I^b_{t+i}(\{Z\}))\right)/B$, normalized by the price appreciation caused by the shock, $\left(q^b_t(\{Z'\}) - q^b_{t-1}(\{Z\})\right)/q^b_{t-1}(\{Z\})$. The sequences $I^b_{t+i}(\{Z'\})$ and $q^b_t(\{Z'\})$ are building investment and building values i quarters after the shock to Z, and these functions with respect to $\{Z\}$ give the investment and values that would occur without the shock (which would correspond with steady-state values for the economy starting there). These sequences are plotted for an economy starting at the steady state (orange) and one starting with a P_t of half this level (blue). The left panel shows both responses individually, while the right panel plots their difference (baseline minus low initial planning stock).

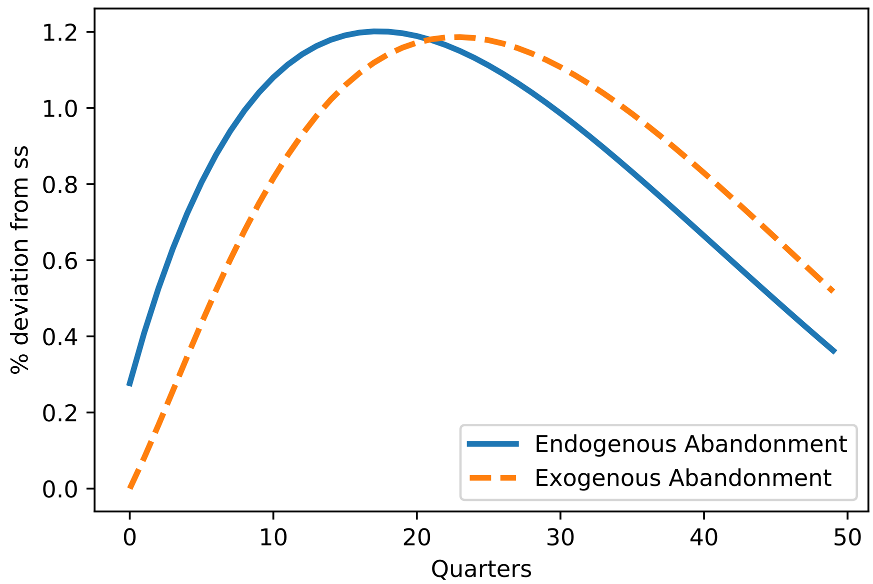


Figure S11: EFFECT OF ENDOGENOUS ABANDONMENT. *Note:* This figure shows the construction response to a 1 percent TFP shock in the model with endogenous abandonment (blue) and a model with exogenous abandonment (orange). The exogenous abandonment model has fixed abandonment rates and construction costs equal to steady-state abandonment rates and average construction costs in the endogenous abandonment model.