The Effect of Uncertainty on U.S. Residential Investment

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Abstract

This paper investigates whether and how uncertainty may influence U.S. residential investment beyond what standard determinants can explain. Using an equilibrium-correction framework with time-varying measures of uncertainty, the study examines the information content of several gauges of uncertainty. Rather than uncertainty having a simple independent effect, we find that higher readings of several—but not all—gauges of uncertainty are associated with a slower adjustment of residential investment growth toward its long-run equilibrium. In particular, we find that the more refined, overall bond risk premium of Gilchrist and Zakrajsek (2012) and the macroeconomic uncertainty measures of Jurado et al. (2015) add significant and more marginal information to a variant of the residential investment equation in the Federal Reserve Board's FRBUS model of the U.S. economy. Our findings support a major theoretical insight of Bernanke (1983a) that increased uncertainty raises the option value of delaying a decision on an irreversible investment until uncertainty abates. Our findings for residential investment are also consistent with findings that greater uncertainty can delay business fixed investment (Bloom et al., 2018; Gulen and Ion, 2016; and Leahy and Whited, 1996).

Key Words: Construction, Uncertainty, Monetary Policy
JEL Codes: R31, E22, E32

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1. Introduction

Although residential investment accounts for a smaller share of aggregate output than business fixed investment, it is the most volatile component of total investment, making it a key driver of macroeconomic volatility (Leamer, 2007). Indeed, housing activity is a well-established leading indicator of the broader business cycles, with downturns in residential fixed investment preceding every U.S. recession since World War II (Leamer, 2007).

Historically, real house price growth, nominal interest rates, demographic factors, credit constraints, and housing supply conditions have been the primary determinants of residential investment in advanced economies (Duca et al., 2021). While these structural factors remain influential, they may not fully explain the extreme volatility observed during recent global episodes, such as the Great Financial Crisis and the COVID-19 pandemic. A plausible contributing factor may be the effects of uncertainty in such episodes. In periods of high uncertainty, households tend to delay consumption and major investments—such as home purchases—while firms scale back hiring and capital expenditures, consistent with precautionary or option-like behavior predicted by economic theory. The more uncertain the future, the more valuable it is to wait, reducing current investment—even if expected returns are positive (Bernanke, 1983a). Although theoretical models emphasize this channel, empirical evidence has often been limited or inconclusive (Bloom, 2014).

Motivated by these considerations, this study addresses the question: To what extent does uncertainty account for changes in residential investment behavior since the mid-1980s? Focusing on the U.S. housing market, it revisits the determinants of residential investment by incorporating different measures of uncertainty into a residential housing construction model and testing different channels through which uncertainty may affect the pace of home building.

The analysis proceeds as follows: Section 2 reviews relevant studies and outlines this study's contribution. Section 3 presents our empirical models and variables, paying attention to different

measures of uncertainty and to different ways that it may alter residential construction. Section 4 reports the estimation results and assesses the effects of uncertainty shocks on residential investment. Section 5 concludes by providing perspective on our findings.

2. Literature Review on Uncertainty and Housing

Housing construction is a classic example of irreversible investment, where high upfront costs, regulatory constraints, and long planning periods limit the ability to reverse decisions. These characteristics make housing particularly sensitive to uncertainty (Christidou and Fountas, 2018). Bernanke (1983a) laid out the theoretical foundation for formalizing how uncertainty affects such investment decisions, demonstrating that when investment is irreversible and future returns are uncertain, agents will optimally delay investments to preserve flexibility. Higher uncertainty increases the option value of waiting, raising the cost of premature commitment. Pindyck (1991) shows that greater uncertainty raises the threshold at which investment becomes optimal, even absent risk aversion, thereby reducing current activity. Dixit and Pindyck (1994) formalized this insight in their real options model, which treats investment opportunities like call options: they should only be exercised when the expected return exceeds the value of maintaining flexibility by waiting.

Building off such theory, empirical research has sought to quantify the relationship between economic uncertainty and housing investment. However, early studies have often relied on imperfect, backward-looking measures of uncertainty. For instance, Holland et al. (2000) and Sivitanidou and Sivitanides (2000) used the standard deviation of REIT returns and FIRE-sector employment as proxies of uncertainty. While intuitive, these approaches conflate realized volatility with true uncertainty, potentially overstating its effect on investment. Subsequent work refines these metrics using GARCH-based models to estimate time-varying volatility. Somerville (2001)

applied this method to Canadian housing markets, while Bulan et al. (2009) used GARCH-derived price volatilities in modeling Vancouver condominium development. While these studies moved closer to capturing forward-looking uncertainty, many still employed two-step procedures: estimating uncertainty separately and inserting it into investment models, which raised efficiency concerns (Miles, 2009). These limitations likely contributed to the mixed findings in early studies, with some finding weak negative effects of uncertainty and others finding insignificant relationships.

Recent studies have made some strides. Miles (2009) uses a GARCH-in-Mean, GARCH-M, approach to U.S. housing starts, directly incorporating forward-looking uncertainty into an investment equation. He finds that uncertainty significantly lowers housing starts, consistent with real options theory, while completions—less discretionary and more path-dependent—were unaffected. Similarly, Christidou and Fountas (2018) find that economic policy uncertainty reduces house price inflation and, sometimes, residential investment growth at the U.S. state level, although speculative markets sometimes offset this effect. Overall, these studies support the view that uncertainty mainly affects the timing of housing investment, particularly via delaying construction.

Despite these contributions, empirical research still faces some limitations. Much of the literature has relied on backward-looking volatility proxies, which often fail to reflect forward-looking expectations that drive investment. Additionally, many studies adopt static specifications, which cannot capture how uncertainty affects both the short-run response and the longer-term adjustment of residential investment. Moreover, few papers have applied systematic uncertainty measures directly to the housing sector, leaving a gap between theory and applied housing research.

Advances in the measurement of uncertainty can address these limitations. We test two types of refinements to measuring uncertainty: improvements in measuring bond spreads and to gauging

macroeconomics uncertainty. Researchers have long recognized that the spread between yields on the Baa-rated corporate bond and long-term Treasury bonds (the "Baa-Treasury spread") provides marginal information for the U.S. macroeconomy and key components of GDP dating back to Friedman and Schwartz (1963), and revived in the more recent literature on credit and financial frictions (*inter alia*, Bernanke, 1983b; Bernanke et al., 1996 and 1999; Bordo and Duca, 2023; and Mishkin, 1991). One drawback of the Baa-Treasury spread is that the Baa yield is an average for seasoned bonds whose maturity varies over time. A second is that the spread combines compensation for both expected default losses and the greater liquidity risk of corporate bonds. Addressing this, Gilchrist and Zakrajsek (2012) create an average spread between the yields on corporate bonds and a maturity-matched Treasury bond (*GZSpread*) and an excess bond premium (*EBP*) equal to *GZSpread* minus the average expected default loss using KMV micro data.

Another advance in measurement concerns macro measures of uncertainty. In older time series literature, researchers used the unemployment rate as an indicator of uncertainty to augment models of U.S. consumption and housing demand (e.g., Aron et al., 2010). However, the somewhat lagging nature of the unemployment rate and its focus on labor market uncertainty limit its usefulness. And while the index of leading economic indicators avoids the former shortcoming of the unemployment rate, it reflects a mixture of variables tracking future economic fundamentals—not just uncertainty. In a major step forward, Jurado, Ludvigson, and Ng (2015) construct forward-looking uncertainty indexes based on the conditional volatility of forecast errors from models tracking a large panel of macroeconomic indicators. These measures capture genuine unpredictability in the economy and align more closely with theoretical definitions of uncertainty.

Taking a different tack, Baker, Bloom, and Davis (2016) created their Economic Policy Uncertainty (EPU) index based on media coverage, tax code provisions, and forecaster

disagreement. While it can be argued that the EPU tracks more exogenous factors stemming from policy, policy reactions have an element of endogeneity. Nevertheless, the EPU index adds marginal information about many important aspects of the economy, such as business investment (see Gulen and Ion, 2016, who devise a similar index of EPU) and bank lending standards (see Bordo et al., 2016). Although widely adopted, the EPU index tends to exhibit more frequent and noisy spikes due to its reliance on newspaper content, limiting its consistency for systematic macroeconomic modeling. Compared to the EPU index, the JLN index has several advantages: it is grounded in actual forecast errors, produces more stable real-time estimates (Rogers and Xu, 2019), and has been successfully applied across international settings (Londono et al., 2019). These characteristics make it particularly well-suited for studying housing investment, where expectations about broader economic conditions play a pivotal role.

This study makes three contributions to the literature on housing and uncertainty. First, it tests whether different measures of uncertainty can help explain U.S. residential investment—an underexplored topic. Second, we explore different ways that uncertainty may empirically affect construction, allowing for a more nuanced analysis of the timing and persistence of uncertainty effects. Third, by embedding uncertainty in a dynamic error-correction framework, the study models both the short-run and long-run adjustment dynamics, hence offering a richer understanding of how uncertainty influences the level and path of housing investment.

3. Modeling Residential Investment

3.1 The Baseline Residential Investment Model

This paper uses a modified version of the Federal Reserve Board's (FRB) error-correction model of the growth rate of residential investment (single- and multi-family units started or improved):

$$\Delta LEH_t - ZEH_t = \alpha_0 + \alpha_1(LQEH_{t-1} - LEH_{t-1}) + \alpha_2\Delta LEH_{t-1} + \alpha_3\Delta LEH_{t-2} + \alpha_4\Delta RME_{t-1} + \alpha_5 D83 \text{ x } \Delta RME_{t-1} \quad (1)$$

To isolate the effects of uncertainty on housing investment, this study restricts the sample period to 1984q1–2025q1, reflecting a structural break in the housing sector's response to interest rates. In the early 1980s, sweeping financial deregulation—including the repeal of ceilings on bank deposit interest rates (Regulation Q), the expansion of adjustable-rate mortgages, and the rise of secondary mortgage markets—reduced the housing sector's sensitivity to traditional monetary transmission channels (Pozdena, 1990). As illustrated in Figure 1, real residential construction per capita is inversely related to real mortgage interest rates, among other factors.

The pre-1984 period was also marked by high and variable inflation, which affected how agents formed expectations. The mid-1980s marked the onset of the "Great Moderation," a period of stable inflation and low economic volatility attributed to improved monetary policy, fewer exogenous shocks, and broader structural changes (Ahmed et al., 2002; Stock and Watson, 2003; and Bernanke, 2004). As a result, economic behavior before and after 1984 structurally differs. Accordingly, we restrict our samples to cover the post-deregulation, post-Volcker disinflation era beginning in 1984q1, we remove the interaction term $D83\text{x}\Delta RME_{t-1,}$ and focus instead on a more policy-consistent era.

The sample includes four recessions: the 1990-01 recession (1990q3–1991q2), the 2001 dot-com bust (2001q2–2001q4), the Great Recession (2007q4–2009q2), and the COVID-19 Recession (2020q1–2020q2). While the 1990-01 and 2001 recessions were relatively mild and driven by corporate investment weaknesses, the Great and COVID Recessions had major implications for housing. The Great Recession was precipitated by excessive leverage, lax mortgage standards, and the rapid growth of subprime mortgage securitization. As home prices began falling in 2006–

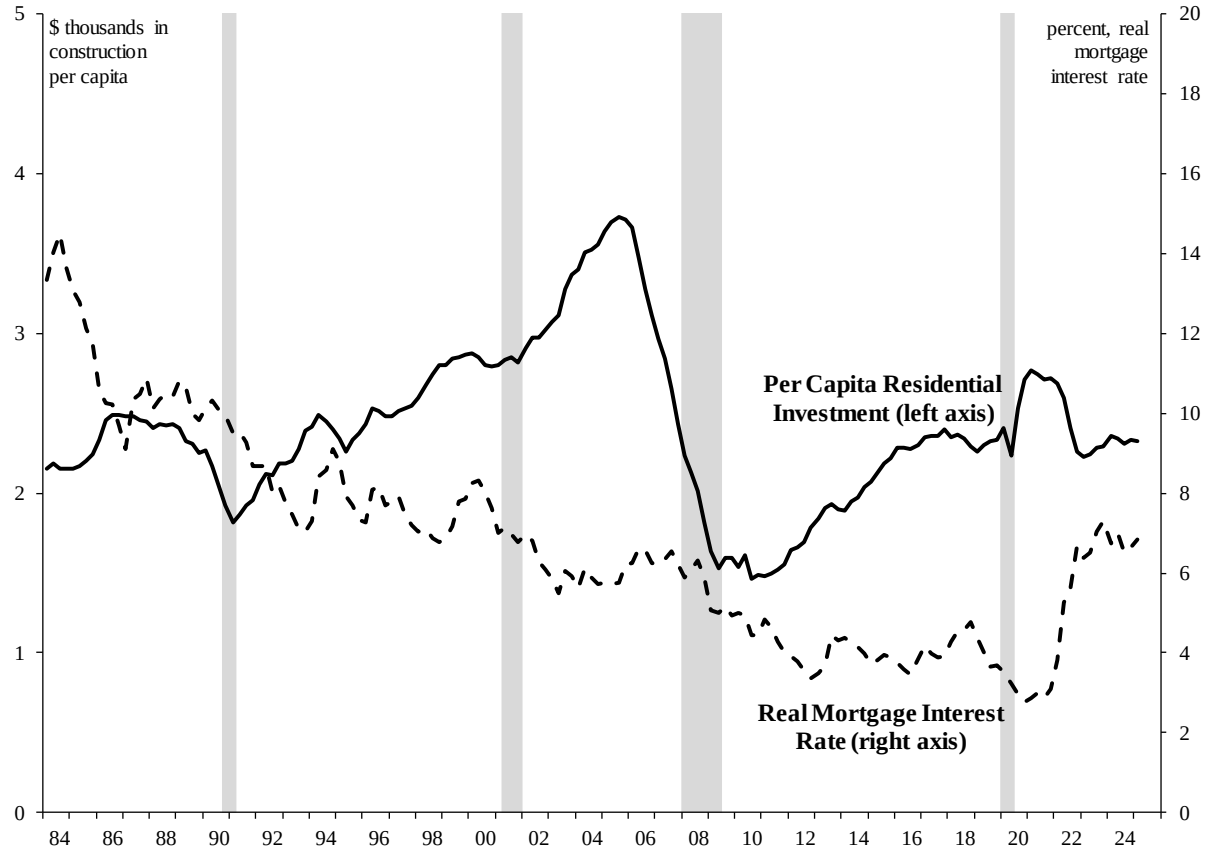


Figure 1. Per Capita Housing Construction and Real Mortgage Interest Rates
(Sources: U.S. Bureau of Economic Analysis and Federal Reserve Board)

2007, defaults surged, triggering widespread financial losses and a severe collapse in residential construction. Residential fixed investment fell by more than 50% from its pre-crisis peak, making housing a key transmission channel for the broader economic contraction. In contrast, the COVID-19 recession triggered an abrupt but temporary freeze in housing activity, driven by unprecedented uncertainty and lockdowns. However, unlike in the Great Recession, housing rebounded quickly due to supportive monetary policy, shifts in remote work preferences, and strong household balance sheets. These two global episodes are particularly critical for understanding how uncertainty influences residential investment across different economic environments.

3.2 Baseline Data and Variables

The baseline model estimates the determinants of residential investment growth, measured as

the deviation of actual growth from its trend, denoted $\Delta LEH_t - ZEH_t$, as follows:

$$\Delta LEH_t - ZEH_t = \alpha_0 + \alpha_1(LQEH_{t-1} - LEH_{t-1}) + \alpha_2\Delta LEH_{t-1} + \alpha_3\Delta LEH_{t-2} + \alpha_4\Delta RME_{t-1} + \alpha_5(COVIDShut_t \text{ x } \Delta RME_{t-1}) + \alpha_6 TaxCred \quad (2)$$

This single-equation, one-stage equilibrium-correction model simultaneously captures residential investment's long-run equilibrium relationship and short-run dynamics. The first line of eq. (2) is identical to the model of the growth rate of residential investment in the Federal Reserve Board Model of the U.S. economy (FRBUS). The term ($LQEH_{t-1} - LEH_{t-1}$) reflects the long-run deviation of actual investment from its equilibrium level, with α_1 indicating the speed of adjustment toward equilibrium.

In the housing equation of the FRBUS model, *LQEH* is the main channel through which long-run factors such as interest rates and permanent income affect housing. The equilibrium log pace of residential investment equals the product of the sum of a time-varying housing share of equilibrium consumption and the sum of housing stock depreciation plus trend output growth. Equilibrium consumption in the FRBUS model is derived from a life-cycle-permanent income view in which long-run consumption is mainly driven by wealth and expectations of permanent labor income. The time-varying housing share of equilibrium consumption is an exponential function of a constant, the relative price of residential investment, and the user cost rate of housing. The relative price of residential investment reflects both housing supply and demand influences on the relative cost of housing, while the user cost rate is essentially the after-tax and depreciation-adjusted real mortgage interest rate.

Short-term influences are captured through lagged changes in residential investment (ΔLEH) and real mortgage interest rates (ΔRME_{t-1}). The model is estimated using ordinary least squares,

which under classical assumptions yields consistent and efficient parameter estimates and facilitates clear inference on the effects of uncertainty and structural shocks. The model is suitable for housing, where rigidities in planning, permitting, and financing lead to sluggish responses and where investment behavior is highly sensitive to policy interventions and macroeconomic volatility.

The main variable of interest, $\Delta LEH_t - ZEH_t$, represents residential investment growth relative to its long-run trend. This "investment gap" isolates cyclical deviations from the structural growth path, providing insights into excess or deficient housing activity relative to fundamentals. Given the high sensitivity of residential investment to credit conditions and expectations, such deviations serve as leading indicators of macroeconomic turning points. The investment gap (Figure 2) exhibits strong cyclicality, sharply declining during major crises such as the 2008 financial crisis and the COVID-19 pandemic, while moderately fluctuating in stable periods like the mid-1990s and mid-2010s. These swings highlight the volatility of construction and its short-run and long-run responsiveness to macroeconomic shocks. The data also display asymmetry—downturns tend to be deeper and more persistent than upswings—consistent with uncertainty and irreversibility inducing sharp delays in investment during adverse conditions.

Key explanatory variables that reflect short-term influences on construction include: (1) changes in real mortgage interest rates, (2) COVID shutdown controls, (3) 2009–2010 tax credit variables, and (4) measures of uncertainty variables, where the baseline model omits the last type of variable. ΔRME_{t-1}, the quarter-over-quarter change in real mortgage interest rates, tracks the nominal cost of borrowing faced by prospective homeowners. The real mortgage rate is defined as the interest rate on 30-year fixed interest rate mortgages minus the 10-year-ahead, expected annual average inflation rate from the Federal Reserve Board Model of the U.S. economy. A rise in real mortgage rates typically increases financing costs, which reduces housing affordability, thereby lowering

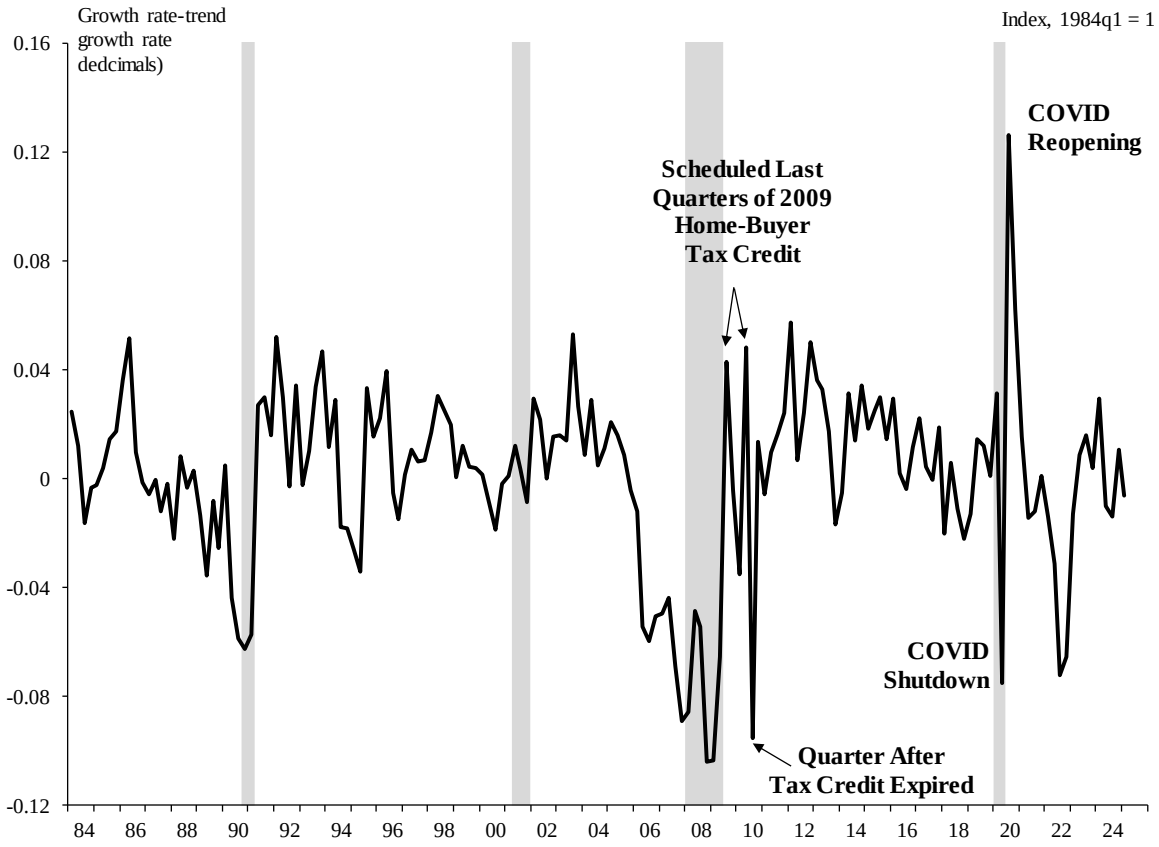


Figure 2. Residential Investment Growth Relative to Trend ($\Delta LEH_t - ZEH_t$)
(Sources: U.S. Bureau of Economic Analysis, Federal Reserve Board, authors' calculations)

housing demand and residential investment. Accordingly, we expect $\alpha_1 < 0$.

To account for major disruptions in the housing market, the second line of the baseline model in eq. (2) adds two variables to the FRBUS housing construction model. The first, *TaxCred*, accounts for the effects of the 2009–2010 First-Time Homebuyer Tax Credit, a policy shock that temporarily stimulated housing demand during the Great Recession. This variable equals 1 in 2009:Q3, when the $10,000 tax credit for first-time homebuyers was introduced to boost housing demand; 0 in 2009:Q4, a transitional period; -1 from 2010:Q1 through 2010:Q3, when the policy was phased out; and 0, otherwise. This variable controls the temporary boost in residential investment induced by the credit and the subsequent decline in demand after its expiration, ensuring that these policy-driven swings are not mistakenly attributed to other fundamental factors.

The second addition to the FRBUS model is an interaction term between the COVID-19 shutdown indicator and changes in mortgage rates (*COVIDShut x* ΔRME_{t-1}), which captures differential effects of real mortgage rate changes during the pandemic. The binary variable *COVIDShut* equals 1 in 2020:Q2 (the peak of nationwide lockdowns), −1 in 2020:Q3 (as shutdown restrictions began to ease), and 0 otherwise. During this period, real mortgage interest rates fell as the Federal Reserve sought to counteract the negative effects of the pandemic by lowering short-term interest rates. Because the decline in interest rates was very large, omitting the shutdown and reopening would conflate the shutdown and reopening with changes in mortgage interest rates, distorting the estimated coefficient on ΔRME_{t-1}. The expected sign of the interaction term is positive—that is, $\alpha_5 > 0$—reflecting that the usual negative relationship between mortgage rates and residential investment was weakened during the pandemic. This likely stems from extraordinary policy support, liquidity injections, and behavioral changes such as increased housing demand due to remote work. A positive and significant coefficient would confirm that pandemic-specific conditions temporarily altered the interest rate–investment transmission channel.

3.3 Uncertainty Data and Variables

We add and test several different measures of uncertainty in non-baseline models. In these models, some include uncertainty with a one-quarter lag to reflect the realistic assumption that investment decisions respond with a delay to changes in uncertainty. Higher uncertainty is expected to lower residential investment relative to its trend, either by delaying the recovery of housing activity after downturns or by exacerbating declines during periods of economic stress.

3.3.1 More Conventional Measures of Uncertainty

Among the more conventional measures of uncertainty we consider are the Baa-Treasury

spread (*BaaTr*) and the VIX (*VIX*). The former is a premium that compensates investors for both expected default losses and the price of risk (or liquidity risk). The latter tracks the implied volatility of the S&P 500 Index (SPX) that the market expects in the coming 30 days. We also tested the overall consumer sentiment index from the University of Michigan (*ConSent*), the overall consumer confidence index from the Conference Board (*ConConf*), and the expectations component of the Conference Board index (*ConfExp*). Of these, *ConfExp* performed best. One concern with using the consumer indexes as gauges of uncertainty is that, because they include expectations of future conditions, they may track expectations of future fundamentals rather than uncertainty, *per se*. This complicates interpreting any marginal information in the consumer confidence gauges.

3.3.2 More Refined Bond Market Measures of Uncertainty

To see whether using micro- and more precise maturity data can improve upon the Baa-Treasury spread as measures of uncertainty, we also test the average bond spread, *GZSpread*, and excess bond premium (*EBP*) from Gilchrist and Zakrajsek (2012) and Favara et al. (2019). As discussed earlier, *GZSpread* tracks the average premium of corporate bond yields over comparable maturity Treasury yields, which is a combination of expected default losses and the price of risk (or liquidity risk), and *EBP* tracks the extent to which *GZSpread* exceeds the average expected default loss on corporate bonds.

3.3.3 Jurado, Ludvigson, and Ng (2015) Macroeconomic Uncertainty Measures

To measure the effect of uncertainty on residential investment growth, we test two uncertainty indices developed by Jurado, Ludvigson, and Ng (2015), which have been characterized as tracking real economic uncertainty (e.g., Londono et al., 2019). The JLN index provides a forward-looking, econometric-based measure of aggregate uncertainty by estimating the unforecastable component

of economic conditions based on a large panel of macroeconomic and financial indicators. Formally, uncertainty is defined as the conditional standard deviation of the forecast error for a given variable y_j at horizon h, based on information available at time t. This can be expressed as:

$$Uncert_{j,t}(h) = \mathrm{E_t}\left[(y_{j,t+h} - \mathrm{E}_t(y_{j,t+h})\right]^{1/2} \quad (2)$$

To construct this index, JLN generate 1-, 3-, and 12-month ahead forecasts for 132 U.S. macroeconomic and financial variables, covering areas such as real output, employment, industrial production, consumption, and asset prices. Forecast error variances are then computed for each series. Using factor-augmented models, they extract a common component representing broad-based macroeconomic uncertainty across the economy. This methodology isolates genuine unpredictability while filtering out fluctuations attributable to normal cyclical variation.

This study utilizes the t-1 lag of 3-month ($Uncert3M_{t-1}$) and 12-month ($Uncert12_{t-1}$) ahead JLN indices to capture short-term and medium-term uncertainty. As shown in Figure 2, both indices are countercyclical, rising sharply during recessions and falling during recoveries. The 3-month ahead index tends to respond more quickly and captures immediate shocks, making it more volatile. In contrast, the 12-month ahead index evolves more gradually, providing a smoothed measure of sustained uncertainty. These differences are particularly evident during global crises, such as the Great Recession (2008–2010) and the COVID-19 pandemic (2020). In both cases, the 3-month index spikes sharply at the onset of the crisis, while the 12-month index rises more moderately but remains elevated for a more extended period, reflecting persistent revisions in economic expectations.

Notably, spikes in macro uncertainty often coincide with, or precede, declines in residential fixed investment, although the response tends to be lagged, particularly relative to the 12-month ahead index. This negative effect is consistent with real options theory, which suggests that heightened uncertainty discourages irreversible investments by increasing the value of waiting for

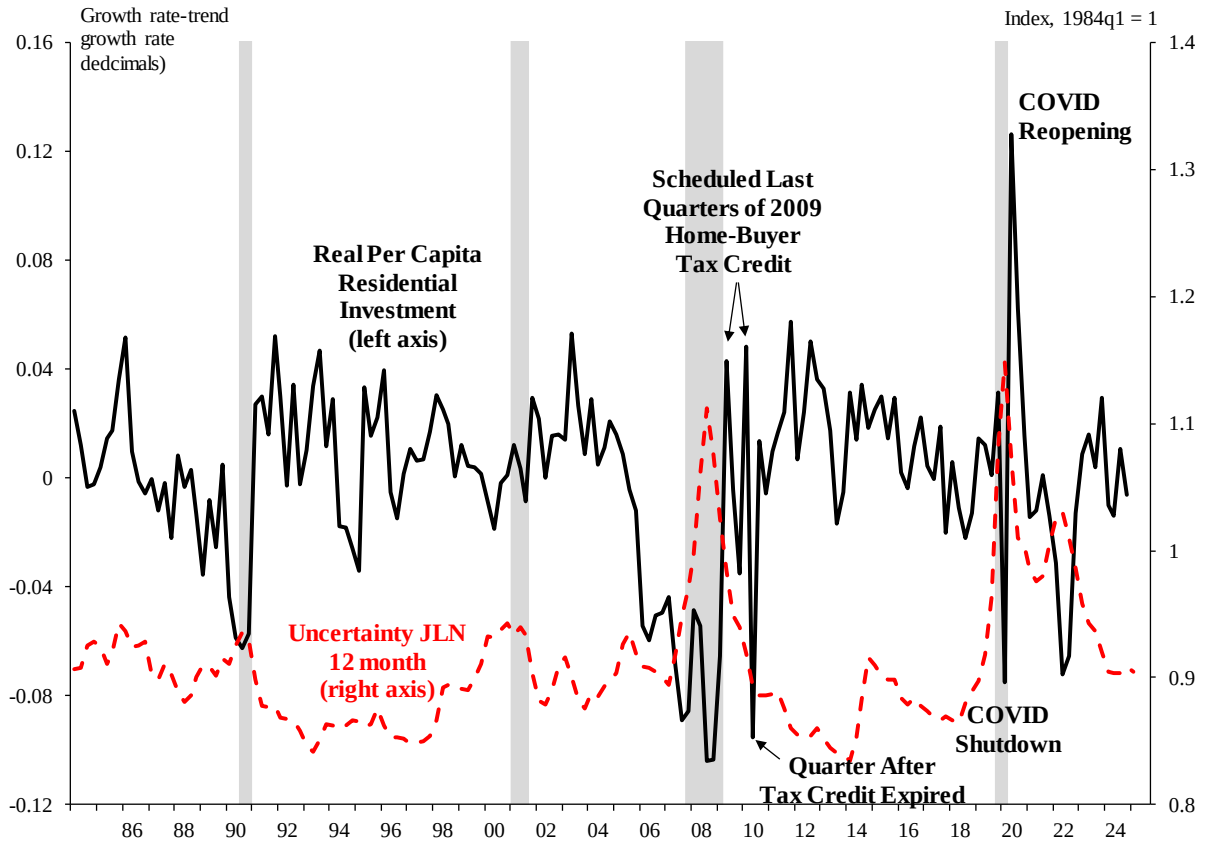


Figure 3. Uncertainty is Inversely Correlated with Residential Investment.
(Sources: Bureau of Economic Analysis and Jurado, Ludvigson, and Ng, 2015)

more information. In the context of housing, this delay is amplified by long planning cycles and time-to-build constraints. By including either of the JLN indexes, the model captures not only immediate disruptions but also persistent behavioral adjustments, offering a more complete picture of how uncertainty influences residential investment dynamics across different time horizons.

3.3.4 Economic Policy Uncertainty

We also test another alternative measure of uncertainty, the Economic Policy Uncertainty (*EPU)* measure of Baker et al. (2016), which uses language model techniques to measure the frequency at which major U.S. newspapers use terminology that can be interpreted as referring to economic uncertainty associated with economic policy (e.g., fiscal, monetary, and regulatory in nature). This measure is less general than other measures of uncertainty (e.g., the JLN measures)

in that it focuses on uncertainty arising from economic policy. In addition, it may also reflect a combination of default and liquidity risk arising from perceptions of how uncertain economic policy is viewed. *EPU* has been found to contain marginal information about U.S. business investment (Bloom et al., 2018; Gulen and Ion, 2016; and Leahy and Whited, 1996), bank credit standards that affect aggregate demand (e.g., Bordo et al., 2017), and house price inflation and residential construction at the state level (Christidou and Fountas, 2018). Compared to the JLN measures, EPU is noisier. In principle, EPU may be more exogenous insofar as it tracks uncertainty about economic policy. On the other hand, the JLN measures arguably are a more comprehensive gauge by measuring uncertainty that does not necessarily stem from economic policy. Among the EPU and JLN measures of uncertainty, the latter may also be preferable because they arguably reflect more marginal information by tracking how major economic indicators are affected by nonsystematic movements in underlying factors.

3.4 Modifying the Baseline Model for Uncertainty

Uncertainty can influence residential investment in several ways, including direct and non-interacted responses on short-run dynamics and by interacting with interest rate effects or the error-correction term. In the last case, uncertainty could affect the speed at which short-term changes bring the levels of construction growth back into line with long-run equilibrium levels. Its effects may also depend on the prevailing interest rate environment, monetary policy regime, or the nature of the underlying economic shocks. To evaluate these mechanisms, this section presents a series of model extensions aimed at capturing distinct ways in which uncertainty may affect construction.

The first model specification tests whether uncertainty acts as a direct, additive shock to residential investment, independent of other model dynamics. In this framework, uncertainty enters the model as a stand-alone explanatory variable:

$$\Delta LEH_t - ZEH_t = \alpha_0 + \alpha_1(LQEH_{t-1} - LEH_{t-1}) + \alpha_2 \Delta LEH_{t-1} + \alpha_3 \Delta LEH_{t-2} + \alpha_4 \Delta RME_{t-1} + \alpha_5(\text{COVIDShut x } \Delta RME_{t-1}) + \alpha_6 TaxCred + \alpha_7 Uncert_{t-1} \quad (3)$$

where the corresponding hypothesis is:

H1: Uncertainty operates as a direct negative shock to residential investment.

If α_7 is significantly negative, it implies that higher uncertainty directly depresses residential investment by increasing the perceived risk of committing to large, irreversible expenditures such as home purchases, even in the absence of immediate changes in borrowing costs or equilibrium conditions. This formulation treats uncertainty as an exogenous, first-order shock to the investment process and serves as a baseline for identifying its independent effect.

The second alternative model explores whether uncertainty slows the convergence of investment toward its long-run equilibrium by interacting uncertainty with the error-correction term:

$$\Delta LEH_t - ZEH_t = \alpha_0 + \alpha_1(LQEH_{t-1} - LEH_{t-1}) + \alpha_2 \Delta LEH_{t-1} + \alpha_3 \Delta LEH_{t-2} + \alpha_4 \Delta RME_{t-1} + \alpha_5(COVIDShut_{t-} \text{ x } \Delta RME_{t-1}) + \alpha_6 TaxCred + \alpha_8 Uncert_{t-1} \text{ x } (LQEH_{t-1} - LEH_{t-1}) \quad (4)$$

where the hypothesis is:

H2: Uncertainty slows the adjustment of investment to its long-run equilibrium.

A significantly negative α_8 would suggest that elevated uncertainty inhibits the speed at which investment corrects toward its long-run trend. Even when housing investment is below its equilibrium level, uncertainty may delay the catch-up process due to elevated risk aversion. This behavior is consistent with real options theory: uncertainty increases the value of waiting, thus postponing investment decisions even when conditions favor expansion.

The third hypothesis assesses whether uncertainty dampens the short-run interest sensitivity of housing investment by interacting uncertainty with the change in real mortgage rates:

$$\Delta LEH_t - ZEH_t = \alpha_0 + \alpha_1(LQEH_{t-1} - LEH_{t-1}) + \alpha_2 \Delta LEH_{t-1} + \alpha_3 \Delta LEH_{t-2} + \alpha_4 \Delta RME_{t-1}$$

$$+ \alpha_5(COVIDShut_t \times \Delta RME_{t-1}) + \alpha_6 TaxCred_t + \alpha_9 Uncert_{t-1} \times \Delta RME_{t-1} \quad (5)$$

where the underlying hypothesis is:

H3: Uncertainty weakens the sensitivity of residential investment to interest rates.

A significantly negative α_9 would indicate that when uncertainty is high—e.g., early in the COVID-19 pandemic—declines in mortgage rates are less effective in stimulating housing investment. This could reflect diminished household confidence, greater employment risk, and tighter credit conditions (Bordo et al.,2017), all of which reduce the effectiveness of traditional monetary transmission mechanisms, consistent with Kohlscheen et al. (2020), who find asymmetric investment responses to interest rate movements under different macroeconomic conditions.

We assess the three aforementioned hypotheses using a time series model of overall U.S. construction. A major advantage of doing so is to understand how uncertainty affects the dynamic behavior of housing construction. In particular, if higher uncertainty induces agents to pause home construction, the pent-up need for construction could accumulate and bolster the pace of building when a jump in uncertainty abates. In the equations above, this is captured by a decline in *LEH* relative to its non-uncertainty adjusted long-run equilibrium pace, *LQEH*. As a result, if *LEH* is depressed by high uncertainty during a prior quarter (*t-1*), the gap or equilibrium-correction term, $LQEH_{t-1} - LEH_{t-1}$, becomes larger and should impart a strong rebound effect when uncertainty abates. Using modifications of a framework like the FRBUS model's equation of residential investment, in which deviations of the pace of construction from its long-run equilibrium can capture such important dynamics. This is particularly the case for various measures of uncertainty for the U.S. economy, which are stationary and exhibit jumps to higher levels that later unwind. Nevertheless, one downside of using our empirical approach is that we are unable to distinguish

whether any estimated uncertainty effects arise because of induced declines in consumer demand for housing versus induced declines in the supply of housing on the part of builders.

4. Empirical Results

This section evaluates the impact of uncertainty on residential investment by analyzing estimates of the revised baseline model and its extended variants. Tables 1-2 and 4-5 present results from seven models, in which one is the baseline and the other six test whether different pairs of uncertainty variables affect home building through one of the three channels laid out in hypotheses 1-3. In each of these tables, Model 1 follows eq. (2), which is the augmented FRB/US equation that incorporates standard determinants of residential investment, including lagged investment growth, the error-correction term, and changes in real mortgage rates, and which is modified to include the COVID-19 shutdown interaction with the lagged change in interest rates and the dummy variable controlling for the 2009–2010 tax credit. Note that the modifications improve the fit of the baseline model and result in the equilibrium correction term changing from marginally significant to becoming significant at the 95 percent confidence level. Models 2 and 3 add the t-1 lag of one of the uncertainty variables following eq. (3) to test for a non-interactive effect of uncertainty (i.e., Hypothesis 1). These are followed by Models 4 and 5 that instead multiply the t-1 lag of one of the uncertainty variables with the t-1 equilibrium correction term, which follows the specification in eq. (4) to test for an interactive impact of uncertainty (Hypothesis 2). Models 6 and 7 instead multiply the t-1 lag of an uncertainty variable by the t-1 lagged change in the real mortgage interest rate to test whether uncertainty alters the interest sensitivity of home construction.

4.1 Baseline and Conventional Uncertainty Variables

Table 1 juxtaposes estimates from the baseline model (Model 1) and models adding conventional measures of uncertainty, specifically the Baa-Treasury spread and the VIX. In all

cases, the residuals are free from significant serial correlation, and the estimated coefficients have the expected signs. In all models, the estimated coefficients have the expected signs, with significant positive coefficients on the equilibrium correction term ($LQEH_{t-1}$-LEH_{t-1}), the tax credit, and two lags of the growth rate of construction. The change in the real mortgage rate is highly significant with a negative coefficient. The interaction term between COVID shutdown and changes in mortgage rates (*COVIDShut* x ΔRME_{t-1}) is positive and statistically significant, with coefficients ranging from 0.545 to 0.553 and t-statistics near 9. This indicates that the usual negative impact of rising mortgage rates on investment was muted during the pandemic—likely due to aggressive monetary easing, liquidity injections, and behavioral adjustments in both consumer and lender responses. Similarly, the First-Time Homebuyer Tax Credit dummy (*TaxCred*) is significantly positive at the 1% level, confirming the effectiveness of targeted fiscal support in stimulating housing demand during the Global Financial Crisis. These core, non-uncertainty findings occur in model variants that include different measures of uncertainty.

Interestingly, the non-interacted *BaaTR* variable is insignificant in Model 2, while the *VIX* is marginally significant with the expected negative sign in Model 3. Nevertheless, the terms that interact either *BaaTR* or *VIX* with the equilibrium-correction term are significant with the expected negative sign in Models 4 and 5, respectively. This finding indicates that higher uncertainty is associated with slower growth of construction to restore an equilibrium pace of building in line with Hypothesis 2. It is also interesting that the estimated speed of the noninteractive equilibrium correction terms is higher in models 4 and 5 than the baseline model. Indeed, the 6 to 7 percent quarterly speeds of adjustment in those cases are much higher than the paltry 1.7 percent speed of the baseline model. However, the product of either uncertainty measure with ΔRME_{t-1} is insignificant in Models 6 and 7, contrary to Hypothesis 3. Of the seven models, Model 5 performs

best, though it is estimated only since 1990 owing to the availability of data on *VIX*.

4.2 Economic Policy Uncertainty and Consumer Confidence/Sentiment Results

Table 2 presents a different set of results, replacing *BaaTR* and *VIX* with *EPU* and *ConfExp*, respectively, where *ConfExp* added the most marginal information of the three consumer confidence gauges. Interestingly, the EPU measure is insignificant in all three uncertainty specifications. *ConfExp* is insignificant as a noninteractive variable (Model 3) and interacted with the change in real interest rates (Model 7). In a slight contrast, it is marginally significant when interacted with the equilibrium correction term (Model 5). Table 3 reports results interacting each of the three consumer gauges tested with the equilibrium correction term over the full sample (Models 1 to 3) and over the sample covered by the VIX (Models 4 to 7). In both samples, the term using *ConfExp* is marginally significant, while the other confidence interactive terms are insignificant.

4.3 Estimation Results Using JLN Measures of Macroeconomic Uncertainty

Returning to the pattern of models in Tables 1 and 2, Table 4 presents results from including the 3-month or the 12-month JLN measures of uncertainty. Both gauges are significant as non-interactive measures of uncertainty in Models 2 and 3, and are highly significant when interacted with the equilibrium correction term in Models 4 and 5. As with the other gauges of uncertainty, when interacted with the lagged change in the real mortgage interest rate, the 3-month JLN measure is insignificant, while the 12-month gauge is marginally significant with the expected negative sign. Of the models, Model 5, which adds *JLN12m* times the equilibrium correction term, has the best fit, and its inclusion boosts the corrected R^2 by about 2 percent.

4.3 Estimation Results Using Refined Bond Spreads to Track Uncertainty

In Table 5, uncertainty is instead tracked with the refined bond spread measures, *GZSpread* and *EBP*. As with the JLN variables, both refined bond spread gauges are significant either as

noninteractive variables (Models 2 and 3) or if interacted with the equilibrium correction term (Models 4 and 5) but are insignificant if interacted with the change in the real mortgage interest rate. Of the two bond premium gauges, the more expansive *GZSpread* is more significant, and its inclusion boosts the corrected R^2 by about 2 percent.

4.5 Models Interacting Uncertainty and Equilibrium Correction, 1990q2 to 2025q1

One issue for testing which uncertainty measure contains the most information is that the prior tables presented results using a 1990q2-2025q1 sample when using the *VIX* versus a full 1985q1-2025q1 sample for the other models. To address this, Table 6 reports results using the 1990q2-2025q1 sample for the baseline model and the variants that interact uncertainty with equilibrium correction for the models that do not use consumer sentiment or confidence gauges. Across the measures of uncertainty, the best fit occurs using the 12-month horizon JLN measure, with models using JLN 3-month uncertainty and the Gilchrist-Zakjarsjek measures performing nearly as well, and with these models clearly outperforming the baseline (Model 1) and *VIX* model variants.

4.6 Models Interacting Uncertainty and Equilibrium Correction, 1990q2 to 2025q1

Given that these uncertainty measures outperform the Δ*VIX* variants, Table 7 reports the full sample results for the non-*VIX* models that interact uncertainty with the equilibrium correction term. Of these models, those using either *GZSpread* or the two JLN variables performed best in explaining the growth rate of construction, and the best fit occurs when the *GZSpread* is used. Across the tables, in most cases, the results support Hypotheses 1 and 2, but not Hypothesis 3. In Models 2 and 3 in Table 4, lagged uncertainty is negative and significant, consistent with Hypothesis 1, while the coefficient on the interactive equilibrium correction term is significant for Models 4 and 5 in that table. This suggests that uncertainty acts as a direct deterrent to residential investment, reinforcing real options theory: households and developers defer irreversible

commitments when the macroeconomic outlook is uncertain. In contrast, the term interacting uncertainty with the change in real mortgage interest rates is always insignificant and does not support Hypothesis 3.

The stronger evidence favoring Hypothesis 2 over 1 reflects that when macroeconomic uncertainty is high, agents delay responding to investment fundamentals, and vice versa. Using *JLN12m* to track uncertainty, Figure 4 plots the time-varying adjustment speed, $AdjSpeed_t = \alpha_1 + \alpha_8 \cdot Uncert_{t-1}$, illustrating that uncertainty meaningfully affects the speed of adjustment. Periods of low macroeconomic uncertainty, such as the mid-1990s and mid-2010s, have a high adjustment speed (heavy line in Figure 2). In contrast, during episodes of elevated uncertainty—most notably the 2008–2009 Global Financial Crisis and the COVID-19 pandemic in 2020—the JLN uncertainty

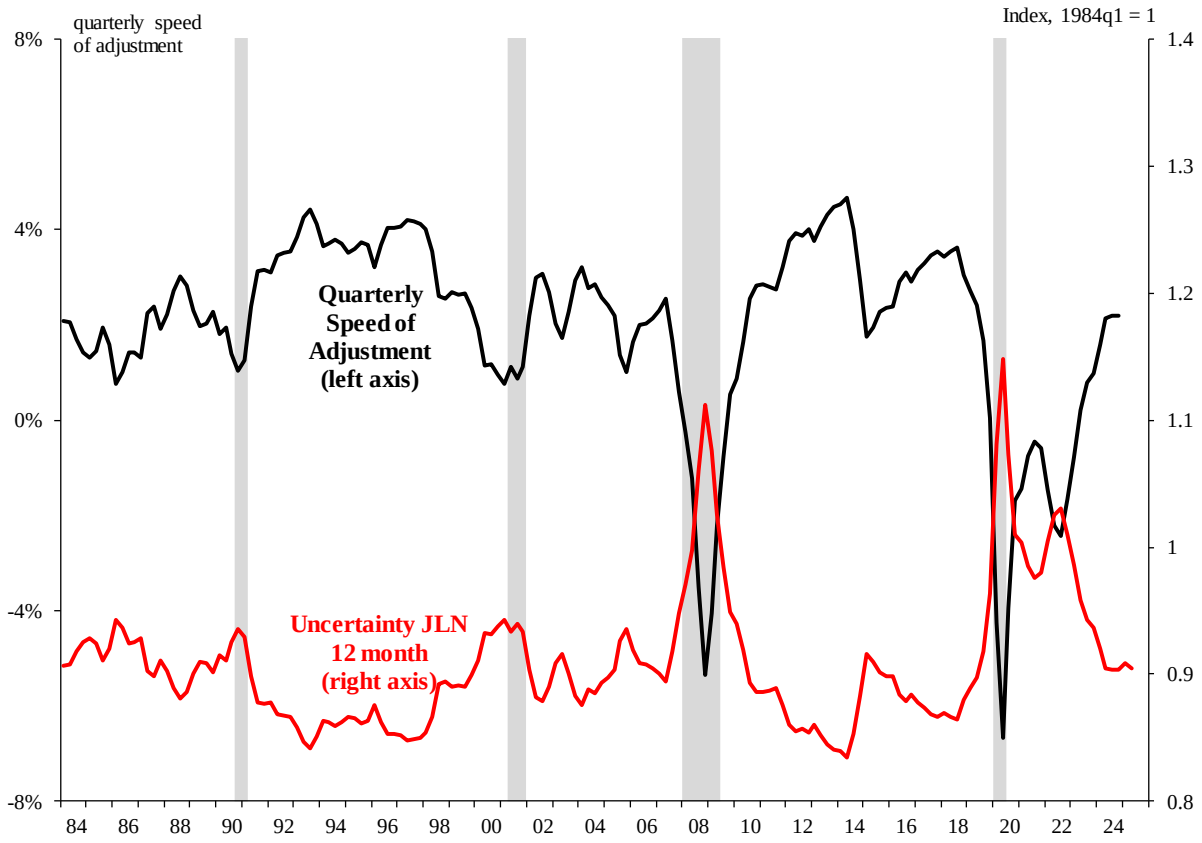


Figure 4. The Role of Uncertainty in Slowing the Adjustment of Residential Investment
(Sources: Jurado, Ludvigson, and Ng (2015) and author's calculations)

index (red dashed line) spikes sharply, while the effective adjustment speed plunges, at times turning negative. These drops imply that when uncertainty is high, the growth rate of residential investment slows in returning to its equilibrium.

When the uncertainty abates, the adjustment process resumes, often leading to a catch-up effect. Because of this delayed adjustment, a large-sized equilibrium correction gap may accumulate during the high-uncertainty phase. Once the adjustment speed returns to its normal level, this gap ($LQEH_{t-1}$-LEH_{t-1}) is multiplied by a restored adjustment speed, triggering a sharp rebound in the growth rate of residential investment (ΔLEH_t) relative to its long-run trend growth rate (ZEH_t), where the deviation of growth from its trend (ΔLEH_t - ZEH_t) is the dependent variable in the models.

5. Conclusion

This study advances the literature on uncertainty and residential construction in finding that while housing investment typically adjusts toward its long-run equilibrium following deviations, this correction process slows significantly when economic uncertainty is high. Uncertainty not only suppresses the overall level of investment in an independent channel but also dampens the speed of adjustment toward equilibrium. We also find that most—but not all—measures of uncertainty add marginal information for the growth rate of overall U.S. housing construction using our slightly modified variant of the residential investment equation from the Federal Reserve's FRBUS model of the U.S. economy.

In particular, we find that the more refined, overall bond risk premium of Gilchrist and Zakrajsek (2012) and the macroeconomic uncertainty measures of Jurado et al. (2015) add significant and more marginal information than other measures of uncertainty. Among the different horizon variants of Jurado et al.'s (2015) macroeconomic uncertainty measures, we find slightly

stronger effects for longer-horizon uncertainty measures—indicating that persistent uncertainty exerts greater influence on investment behavior than short-term fluctuations. By assessing different measures of uncertainty and exploring different channels through which it can affect housing construction, our study offers a more nuanced understanding of how uncertainty reshapes both the level and trajectory of residential investment.

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Table 1: Estimates of Residential Investment Growth

Using Conventional Bond Spreads and VIX

(Sample Period: 1985q1-2025q1 except 1990q2-2025q1 for *VIX*)

Variables	**Baseline**	**Non-Interactive Effect of Uncertainty**		**Equilibrium Correction Effect of Uncertainty**		**Interest Rate Sensitivity Effect of Uncertainty**	
Model Number	1	2	3	4	5	6	7
Uncertainty Measure		*BaaTR*	*VIX*	*BaaTR*	*VIX*	*BaaTR*	*VIX*
	85:1-25:1	85:1-25:1	90:2-25:1	85:1-25:1	90:2-25:1	85:1-25:1	90:2-25:1
Constant	–0.0047**	0.0010	0.0049	–0.0041*	–0.0037+	–0.0044*	–0.0042*
	(–2.72)	(0.15)	(0.88)	(–2.39)	(–1.88)	(–2.53)	(–2.13)
$LQEH_{t-1} - LEH_{t-1}$	0.0167*	0.0209*	0.0188*	0.0668**	0.0622**	0.0179*	0.0170+
	(2.15)	(2.31)	(2.09)	(2.72)	(2.99)	(2.28)	(1.94)
ΔLEH_{t-1}	0.5602**	0.5584**	0.5513**	0.5335**	0.5247**	0.5485**	0.5582**
	(10.02)	(9.98)	(9.19)	(9.42)	(8.59)	(9.57)	(9.41)
ΔLEH_{t-2}	0.1902**	0.1898**	0.1776**	0.1740**	0.1632**	0.1902**	0.1851**
	(3.42)	(3.41)	(3.04)	(3.14)	(2.80)	(3.42)	(3.17)
ΔRME_{t-1}	–0.0227**	–0.0234**	–0.0264**	–0.0234**	–0.0277**	–0.0345*	–0.0479**
	(–5.50)	(–5.57)	(–5.20)	(–5.73)	(–5.48)	(–2.61)	(–3.54)
$COVIDShut \cdot \Delta RME_{t-1}$	0.5479**	0.5512**	0.5540**	0.5450**	0.5492**	0.5478**	0.5532**
	(8.75)	(8.79)	(8.59)	(8.81)	(8.62)	(8.75)	(8.58)
*TaxCred*200910	0.0828**	0.0837**	0.0828**	0.0861**	0.0826**	0.0822**	0.0827**
	(8.06)	(8.11)	(7.82)	(8.39)	(7.90)	(7.99)	(7.81)
$Uncert_{t-1}$	–	–0.0026	–0.0005+	–	–	–	–
		(–0.91)	(–1.76)				
$Uncert_{t-1} \cdot (LQEH_{t-1} - LEH_{t-1})$	–	–	–	–0.0173*	–0.0021*	–	–
				(–2.15)	(–2.53)		
$Uncert_{t-1} \cdot \Delta RME_{t-1}$	–	–	–	–	–	0.0054	0.0011+
						(0.94)	(1.76)
Adjusted R^2	0.6488	0.6484	0.6632	0.6569	0.6713	0.6485	0.6633
S.E. of regression	0.0202	0.0202	0.0208	0.0200	0.0205	0.0202	0.0208
Durbin-Watson Stat	1.9049	1.9175	1.8903	1.9415	1.9262	1.9257	1.9218
BG LM Test (lag 1)	0.4197	0.4868	0.4644	0.6264	0.6755	0.5285	0.6446
BG LM Test (lag 2)	0.5690	0.6134	0.6927	0.6085	0.6956	0.5442	0.4760
BG LM Test (lag 3)	0.2223	0.2033	0.1332	0.2232	0.2614	0.1442	0.1620
BG LM Test (lag 4)	0.1844	0.1905	0.2002	0.1986	0.3224	0.1546	0.1930

Notes: Standard errors in parentheses. +, *, and ** denote significance at the 90%, 95%, and 99% levels, respectively.

Table 2: Estimates of Residential Investment Growth with EPU and the Most Informative Consumer Confidence Gauge

(Sample Period: 1985q2-2025q1 except 1985q1-2025q1 for *ConfExp*)

Variables	**Baseline**	**Non-Interactive Effect of Uncertainty**		**Equilibrium Correction Effect of Uncertainty**		**Interest Rate Sensitivity Effect of Uncertainty**	
Model Number	1	2	3	4	5	6	7
Uncertainty Measure		*EPU*	*ConfExp*	*EPU*	*ConfExp*	*EPU*	*ConfExp*
	85:1-25:1	85:2-25:1	85:1-25:1	85:2-25:1	85:1-25:1	85:2-25:1	85:1-25:1
Constant	–0.0047**	–0.0028	–0.0176	–0.0046*	–0.0040*	–0.0045*	–0.0047**
	(–2.72)	(–0.66)	(–1.37)	(–2.57)	(–2.26)	(–2.55)	(–2.71)
$LQEH_{t-1} - LEH_{t-1}$	0.0167*	0.0175*	0.0218*	0.0178	–0.0571	0.0165*	0.0154+
	(2.15)	(2.07)	(2.36)	(0.77)	(–1.49)	(2.07)	(1.91)
ΔLEH_{t-1}	0.5602**	0.5638**	0.5485**	0.5598**	0.5291**	0.5615**	0.5652**
	(10.02)	(9.97)	(9.61)	(9.75)	(9.18)	(9.98)	(9.97)
ΔLEH_{t-2}	0.1902**	0.1885**	0.1846**	0.1882**	0.1786**	0.1881**	0.1900**
	(3.42)	(3.37)	(3.30)	(3.36)	(3.22)	(3.36)	(3.41)
ΔRME_{t-1}	–0.0227**	–0.0235**	–0.0228**	–0.0232**	–0.0240**	–0.0269*	–0.0371
	(–5.50)	(–5.50)	(–5.53)	(–5.47)	(–5.79)	(–2.15)	(–1.50)
$COVIDShut \cdot \Delta RME_{t-1}$	0.5479**	0.5611**	0.5426**	0.5496**	0.5319**	0.5553**	0.5503**
	(8.75)	(8.17)	(8.64)	(8.37)	(8.50)	(8.32)	(8.75)
*TaxCred*200910	0.0828**	0.0831**	0.0826**	0.0828**	0.0840**	0.0828**	0.0832**
	(8.06)	(8.04)	(8.05)	(8.01)	(8.24)	(8.02)	(8.06)
$Uncert_{t-1}$	–	–0.0000	0.0001	–	–	–	–
		(–0.47)	(1.02)				
$Uncert_{t-1} \cdot (LQEH_{t-1} - LEH_{t-1})$	–	–	–	–0.0000	0.0010+	–	–
				(–0.08)	(1.96)		
$Uncert_{t-1} \cdot \Delta RME_{t-1}$	–	–	–	–	–	0.0000	0.0002
						(0.32)	(0.59)
Adjusted R^2	0.6488	0.6478	0.6488	0.6473	0.6551	0.6475	0.6473
S.E. of regression	0.0202	0.0203	0.0202	0.0203	0.0200	0.0203	0.0202
Durbin-Watson Stat	1.9049	1.9163	1.9181	1.9087	1.9607	1.9195	1.8996
BG LM Test (lag 1)	0.4197	0.4670	0.4927	0.4315	0.7498	0.4857	0.3914
BG LM Test (lag 2)	0.5690	0.6159	0.5917	0.5979	0.4660	0.5945	0.6272
BG LM Test (lag 3)	0.2223	0.2362	0.1796	0.2249	0.1569	0.2235	0.2639
BG LM Test (lag 4)	0.1844	0.2337	0.1759	0.2132	0.1658	0.2074	0.2163

Notes: Standard errors in parentheses. +, *, and ** denote significance at the 90%, 95%, and 99% levels, respectively.

Table 3: Estimates of Residential Investment Growth with Consumer Confidence/Sentiment

Variables	**Baseline**	**Equilibrium Correction Effect of Uncertainty**					
Model Number	1	2	3	4	5	6	7
Uncertainty Measure		*ConSent*	*ConConf*	*ConfExp*	Con*Senft*	*ConConf*	*ConfExp*
	85:1-25:1	85:1-25:1	85:1-25:1	85:1-25:1	90:2-25:1	90:2-25:1	90:2-25:1
Constant	–0.0047**	–0.0041*	–0.0043*	–0.0040*	–0.0041*	–0.0042*	–0.0039+
	(–2.72)	(–2.32)	(–2.44)	(–2.26)	(–2.02)	(–2.10)	(–1.94)
$LQEH_{t-1} - LEH_{t-1}$	0.0167*	–0.0591	–0.0196	–0.0571	–0.0537	–0.0203	–0.0615
	(2.15)	(–0.99)	(–0.78)	(–1.49)	(–0.81)	(–0.76)	(–1.48)
ΔLEH_{t-1}	0.5602**	0.5489**	0.5477**	0.5291**	0.5603**	0.5581**	0.5369**
	(10.02)	(9.72)	(9.73)	(9.18)	(9.28)	(9.30)	(8.70)
ΔLEH_{t-2}	0.1902**	0.1834**	0.1878**	0.1786**	0.1792**	0.1838**	0.1736**
	(3.42)	(3.29)	(3.39)	(3.22)	(3.03)	(3.14)	(2.96)
ΔRME_{t-1}	–0.0227**	–0.0234**	–0.0231**	–0.0240**	–0.0260**	–0.0257**	–0.0269**
	(–5.50)	(–5.63)	(–5.60)	(–5.79)	(–5.09)	(–5.05)	(–5.28)
$COVIDShut \cdot \Delta RME_{t-1}$	0.5479**	0.5472**	0.5417**	0.5319**	0.5493**	0.5438**	0.5328**
	(8.75)	(8.76)	(8.67)	(8.50)	(8.45)	(8.37)	(8.18)
*TaxCred*200910	0.0828**	0.0826**	0.0832**	0.0840**	0.0831**	0.0837**	0.0846**
	(8.06)	(8.06)	(8.14)	(8.24)	(7.80)	(7.88)	(7.99)
$Uncert_{t-1} \cdot (LQEH_{t-1} - LEH_{t-1})$	–	0.0010	0.0006	0.0010+	0.0009	0.0005	0.0010+
		(1.29)	(1.52)	(1.96)	(1.03)	(1.36)	(1.86)
Adjusted R^2	0.6488	0.6503	0.6518	0.6551	0.6581	0.6601	0.6642
S.E. of regression	0.0202	0.0201	0.0201	0.0200	0.0209	0.0209	0.0207
Durbin-Watson Stat	1.9049	1.9270	1.9303	1.9607	1.8920	1.8994	1.9356
BG LM Test (lag 1)	0.4197	0.5368	0.5623	0.7498	0.4887	0.5357	0.7394
BG LM Test (lag 2)	0.5690	0.5553	0.5468	0.4660	0.5366	0.5271	0.4625
BG LM Test (lag 3)	0.2223	0.2225	0.2090	0.1569	0.2203	0.2070	0.1623
BG LM Test (lag 4)	0.1844	0.2020	0.1656	0.1658	0.2304	0.1937	0.1956

Notes: Standard errors in parentheses. +, *, and ** denote significance at the 90%, 95%, and 99% levels, respectively.

Table 4: Estimates of Residential Investment Growth Using JLN Macroeconomic Uncertainty

(Sample Period: 1985q1-2025q1)

Variables	**Baseline**	**Non-Interactive Effect of Uncertainty**		**Equilibrium Correction Effect of Uncertainty**		**Interest Rate Sensitivity Effect of Uncertainty**	
Model Number	1	2	3	4	5	6	7
Uncertainty Measure		*JLN3m*	*JLN12m*	*JLN3m*	*JLN12m*	*JLN3m*	*JLN12m*
	85:1-25:1	85:1-25:1	85:1-25:1	85:1-25:1	85:1-25:1	85:1-25:1	85:1-25:1
Constant	–0.0047**	0.0307*	0.0690*	–0.0043*	–0.0043*	–0.0048**	–0.0049**
	(–2.72)	(2.35)	(2.38)	(–2.53)	(–2.53)	(–2.80)	(–2.83)
$LQEH_{t-1} - LEH_{t-1}$	0.0167*	0.0187*	0.0170*	0.1667**	0.3496**	0.0179*	0.0176*
	(2.15)	(2.45)	(2.23)	(3.42)	(3.26)	(2.31)	(2.28)
ΔLEH_{t-1}	0.5602**	0.5368**	0.5327**	0.5181**	0.5139**	0.5639**	0.5669**
	(10.02)	(9.68)	(9.55)	(9.25)	(9.11)	(10.12)	(10.19)
ΔLEH_{t-2}	0.1902**	0.1580**	0.1556**	0.1453*	0.1401*	0.1833**	0.1823**
	(3.42)	(2.83)	(2.76)	(2.59)	(2.48)	(3.39)	(3.29)
ΔRME_{t-1}	–0.0227**	–0.0225**	–0.0225**	–0.0237**	–0.0236**	–0.0658*	–0.1302*
	(–5.50)	(–5.57)	(–5.55)	(–5.89)	(–5.86)	(–2.29)	(–2.17)
$COVIDShut \cdot \Delta RME_{t-1}$	0.5479**	0.5781**	0.5707**	0.5745**	0.5717**	0.5630**	0.5633**
	(8.75)	(9.28)	(9.18)	(9.34)	(9.31)	(8.92)	(8.98)
$TaxCred_{200910}$	0.0828**	0.0831**	0.0827**	0.0860**	0.0856**	0.0825**	0.0827**
	(8.06)	(8.26)	(8.20)	(8.56)	(8.53)	(8.07)	(8.11)
$Uncert_{t-1}$	–	–0.0453**	–0.0808*	–	–	–	–
		(–2.73)	(–2.55)				
$Uncert_{t-1} \cdot (LQEH_{t-1} - LEH_{t-1})$	–	–	–	–0.1844**	–0.3626**	–	–
				(–3.12)	(–3.11)		
$Uncert_{t-1} \cdot \Delta RME_{t-1}$	–	–	–	–	–	0.0538	0.1162†
						(1.52)	(1.79)
Adjusted R^2	0.6488	0.6629	0.6610	0.6676	0.6675	0.6517	0.6537
S.E. of regression	0.0202	0.0198	0.0198	0.0196	0.0196	0.0201	0.0200
Durbin-Watson Stat	1.9049	1.9349	1.9241	1.9018	1.9018	1.9323	1.9400
BG LM Test (lag 1)	0.4197	0.5876	0.5189	0.4064	0.4087	0.5709	0.6154
BG LM Test (lag 2)	0.5690	0.7232	0.7121	0.6797	0.6808	0.4260	0.3925
BG LM Test (lag 3)	0.2223	0.2509	0.2255	0.2156	0.2125	0.2616	0.2852
BG LM Test (lag 4)	0.1844	0.2151	0.2041	0.1702	0.1719	0.2045	0.2059

Notes: Standard errors in parentheses. +, *, and ** denote significance at the 90%, 95%, and 99% levels, respectively.
† Coefficient becomes insignificant when $Uncert_{t-1} \cdot (LQEH_{t-1} - LEH_{t-1})$ is included in the same regression.

Table 5: Estimates of the Residential Investment Growth Using Refined Bond Spreads

(Sample Period: 1985q1-2025q1)

Variables	**Baseline**	**Non-Interactive Effect of Uncertainty**		**Equilibrium Correction Effect of Uncertainty**		**Interest Rate Sensitivity Effect of Uncertainty**	
Model Number	1	2	3	4	5	6	7
Uncertainty Measure		*GZSpread*	*EBP*	*GZSpread*	*EBP*	*GZSpread*	*EBP*
	85:1-25:1	85:1-25:1	85:1-25:1	85:1-25:1	85:1-25:1	85:1-25:1	85:1-25:1
Constant	–0.0047**	0.0049	–0.0045**	–0.0040*	–0.0038*	–0.0045*	–0.0042*
	(–2.72)	(1.18)	(–2.67)	(–2.36)	(–2.21)	(–2.59)	(–2.39)
$LQEH_{t-1} - LEH_{t-1}$	0.0167*	0.0244**	0.0222**	0.0621**	0.0209**	0.0185*	0.0177*
	(2.15)	(2.91)	(2.84)	(3.83)	(2.72)	(2.34)	(2.28)
ΔLEH_{t-1}	0.5602**	0.5357**	0.5243**	0.5150**	0.5116**	0.5434**	0.5430**
	(10.02)	(9.57)	(9.36)	(9.17)	(8.99)	(9.40)	(9.52)
ΔLEH_{t-2}	0.1902**	0.1756**	0.1674**	0.1641**	0.1586**	0.1894**	0.1839**
	(3.42)	(3.19)	(3.05)	(3.00)	(2.87)	(3.41)	(3.31)
ΔRME_{t-1}	–0.0227**	–0.0247**	–0.0257**	–0.0242**	–0.0244**	–0.0312**	–0.0236**
	(–5.50)	(–5.91)	(–6.18)	(–6.00)	(–5.99)	(–3.64)	(–5.67)
$COVIDShut \cdot \Delta RME_{t-1}$	0.5479**	0.5438**	0.5421**	0.5376**	0.5391**	0.5447**	0.5447**
	(8.75)	(8.82)	(8.86)	(8.82)	(8.82)	(8.70)	(8.73)
*TaxCred*200910	0.0828**	0.0840**	0.0849**	0.0861**	0.0872**	0.0819**	0.0823**
	(8.06)	(8.29)	(8.44)	(8.58)	(8.61)	(7.96)	(8.04)
$Uncert_{t-1}$	–	–0.0051*	–0.0092**	–	–	–	–
		(–2.51)	(–2.88)				
$Uncert_{t-1} \cdot (LQEH_{t-1} - LEH_{t-1})$	–	–	–	–0.0171**	–0.0252**	–	–
				(–3.17)	(–2.98)		
$Uncert_{t-1} \cdot \Delta RME_{t-1}$	–	–	–	–	–	0.0046	0.0092
						(1.13)	(1.43)
Adjusted R^2	0.6488	0.6613	0.6646	0.6683	0.6659	0.6494	0.6511
S.E. of regression	0.0202	0.0199	0.0197	0.0196	0.0197	0.0202	0.0201
Durbin-Watson Stat	1.9049	1.9254	1.9163	1.9550	1.9487	1.9168	1.9253
BG LM Test (lag 1)	0.4197	0.5390	0.4987	0.7181	0.6683	0.4842	0.5304
BG LM Test (lag 2)	0.5690	0.7732	0.7680	0.7331	0.7351	0.5252	0.5476
BG LM Test (lag 3)	0.2223	0.1440	0.1072	0.2098	0.1931	0.1321	0.1326
BG LM Test (lag 4)	0.1844	0.1995	0.1666	0.2113	0.1882	0.1537	0.1565

Notes: Standard errors in parentheses. +, *, and ** denote significance at the 90%, 95%, and 99% levels, respectively.

Table 6: Estimates of Uncertainty Interactive Effects on Residential Investment Growth

(Sample Period: 1990q2-2025q1)

Variables	**Baseline**	**Equilibrium Correction Effect of Uncertainty**						
Model Number	1	2	3	4	5	6	7	8
Uncertainty Measure		*BaaTR*	*VIX*	*EBP*	*GZSpread*	*EPU*	*JLN3m*	*JLN12m*
	90:2-25:1	90:2-25:1	90:2-25:1	90:2-25:1	90:2-25:1	90:2-25:1	90:2-25:1	90:2-25:1
Constant	–0.0043*	–0.0038+	–0.0037+	–0.0031	–0.0039*	–0.0042*	–0.0040*	–0.0038+
	(–2.16)	(–1.93)	(–1.88)	(–1.59)	(–1.99)	(–2.08)	(–2.04)	(–1.96)
$LQEH_{t-1} - LEH_{t-1}$	0.0142	0.0662*	0.0622**	0.0178*	0.0612**	0.0193	0.1665**	0.3541**
	(1.63)	(2.53)	(2.99)	(2.09)	(3.46)	(0.79)	(3.26)	(3.17)
ΔLEH_{t-1}	0.5726**	0.5431**	0.5247**	0.5198**	0.5235**	0.5699**	0.5281**	0.5239**
	(9.67)	(9.03)	(8.59)	(8.64)	(8.77)	(9.38)	(8.90)	(8.79)
ΔLEH_{t-2}	0.1858**	0.1694**	0.1632**	0.1519*	0.1595**	0.1863**	0.1388*	0.1325*
	(3.16)	(2.849	(2.80)	(2.61)	(2.76)	(3.16)	(2.35)	(2.22)
ΔRME_{t-1}	–0.0257**	–0.0265**	–0.0277**	–0.0282**	–0.0270**	–0.0259**	–0.0269**	–0.0271**
	(–5.05)	(–5.25)	(–5.48)	(–5.62)	(–5.44)	(–5.01)	(–5.42)	(–5.46)
$COVIDShut \cdot \Delta RME_{t-1}$	0.5505**	0.5469**	0.5492**	0.5406**	0.5391**	0.5548**	0.5769**	0.5744**
	(8.47)	(8.52)	(8.62)	(8.55)	(8.53)	(8.15)	(9.06)	(9.04)
$TaxCred_{200910}$	0.0834**	0.0867**	0.0826**	0.0880**	0.0865**	0.0836**	0.0866**	0.0862**
	(7.82)	(8.15)	(7.90)	(8.41)	(8.32)	(7.79)	(8.32)	(8.30)
$Uncert_{t-1} \cdot (LQEH_{t-1} - LEH_{t-1})$	–	–0.0178*	–0.0021*	–0.0264**	–0.0172**	0.0000	–0.1867**	–0.3705**
		(–2.10)	(–2.53)	(–3.00)	(–3.03)	(–0.22)	(–3.02)	(–3.05)
Adjusted R^2	0.6579	0.6665	0.6713	0.6773	0.6778	0.6555	0.6777	0.6780
S.E. of regression	0.0209	0.0207	0.0205	0.0203	0.0203	0.0210	0.0203	0.0203
Durbin-Watson Stat	1.8778	1.9164	1.9262	1.9348	1.9270	1.8763	1.8721	1.8759
BG LM Test (lag 1)	0.4108	0.6278	0.6755	0.7277	0.6996	0.4042	0.3961	0.4129
BG LM Test (lag 2)	0.5581	0.6081	0.6956	0.7618	0.7305	0.5304	0.6700	0.6863
BG LM Test (lag 3)	0.2149	0.2275	0.2614	0.2147	0.2183	0.2038	0.2324	0.2385
BG LM Test (lag 4)	0.2169	0.2372	0.3224	0.2390	0.2488	0.2230	0.2168	0.2254

Notes: Standard errors in parentheses. +, *, and ** denote significance at the 90%, 95%, and 99% levels, respectively.

Table 7: Estimates of Uncertainty Interactive Effects on Residential Investment Growth

(Sample Period: 1985q1-2025q1)

Variables	**Baseline**	**Equilibrium Correction Effect of Uncertainty**						
Model	1	2	3	4	5	6	7	8
Uncertainty Measure		*BaaTR*	*ConfExp*	*EBP*	*GZSpread*	*EPU*	*JLN3m*	*JLN12m*
	85:1-25:1	85:1-25:1	85:1-25:1	85:1-25:1	85:1-25:1	85:2-25:1	85:1-25:1	85:1-25:1
Constant	–0.0047**	–0.0041*	–0.0040*	–0.0038*	–0.0040*	–0.0046*	–0.0043*	–0.0043*
	(–2.72)	(–2.39)	(–2.26)	(–2.21)	(–2.36)	(–2.57)	(–2.53)	(–2.53)
$LQEH_{t-1} - LEH_{t-1}$	0.0167*	0.0668**	–0.0571	0.0209**	0.0621**	0.0178	0.1667**	0.3496**
	(2.15)	(2.72)	(–1.49)	(2.72)	(3.83)	(0.77)	(3.42)	(3.26)
ΔLEH_{t-1}	0.5602**	0.5335**	0.5291**	0.5116**	0.5150**	0.5598**	0.5181**	0.5139**
	(10.02)	(9.42)	(9.18)	(8.99)	(9.17)	(9.75)	(9.25)	(9.11)
ΔLEH_{t-2}	0.1902**	0.1740**	0.1786**	0.1586**	0.1641**	0.1882**	0.1453*	0.1401*
	(3.42)	(3.14)	(3.22)	(2.87)	(3.00)	(3.36)	(2.59)	(2.48)
ΔRME_{t-1}	–0.0227**	–0.0234**	–0.0240**	–0.0244**	–0.0242**	–0.0232**	–0.0237**	–0.0236**
	(–5.50)	(–5.73)	(–5.79)	(–5.99)	(–6.00)	(–5.47)	(–5.89)	(–5.86)
$COVIDShut \cdot \Delta RME_{t-1}$	0.5479**	0.5450**	0.5319**	0.5391**	0.5376**	0.5496**	0.5745**	0.5717**
	(8.75)	(8.81)	(8.50)	(8.82)	(8.82)	(8.37)	(9.34)	(9.31)
*TaxCred*200910	0.0828**	0.0861**	0.0840**	0.0872**	0.0861**	0.0828**	0.0860**	0.0856**
	(8.06)	(8.39)	(8.24)	(8.61)	(8.58)	(8.01)	(8.56)	(8.53)
$Uncert_{t-1} \cdot (LQEH_{t-1} - LEH_{t-1})$	–	–0.0173*	0.0010+	–0.0252**	–0.0171**	–0.0000	–0.1844**	–0.3626**
		(–2.15)	(1.96)	(–2.98)	(–3.17)	(–0.08)	(–3.12)	(–3.11)
Adjusted R^2	0.6488	0.6569	0.6551	0.6659	0.6683	0.6473	0.6676	0.6675
S.E. of regression	0.0202	0.0200	0.0200	0.0197	0.0196	0.0203	0.0196	0.0196
Durbin-Watson Stat	1.9049	1.9415	1.9607	1.9487	1.9550	1.9087	1.9018	1.9018
BG LM Test (lag 1)	0.4197	0.6264	0.7498	0.6683	0.7181	0.4315	0.4064	0.4087
BG LM Test (lag 2)	0.5690	0.6085	0.4660	0.7351	0.7331	0.5979	0.6797	0.6808
BG LM Test (lag 3)	0.2223	0.2232	0.1569	0.1931	0.2098	0.2249	0.2156	0.2125
BG LM Test (lag 4)	0.1844	0.1986	0.1658	0.1882	0.2113	0.2132	0.1702	0.1719

Notes: Standard errors in parentheses. +, *, and ** denote significance at the 90%, 95%, and 99% levels, respectively.