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Abstract

Can consumer confidence account for the leading indicator property of household investment over the US business cycle? We find that it does. Consumer confidence leads household investment and housing starts by two and one quarter, respectively. Household investment increases in a persistent manner after a positive confidence shock. The responses of total hours-worked and output also show a persistent increase, and so do real house prices. Confidence shocks account for a substantial share of forecast error variation in household investment, hours-worked and output. They are not related to movements in future supply side fundamentals such as total factor productivity and the relative price of investment. Demand side forces originating in consumers' social and psychological factors are, therefore, relevant for household investment dynamics.

Key words: Consumer confidence; Household investment; Confidence Shocks; Business cycles

JEL Classification: D12, D83, D84, E22, E32

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1 Introduction

A well-known and robust property of US household investment (residential investment plus consumer durables) is that it leads the business cycle by one quarter.[1] The largest cyclical correlation is between current household investment and one period ahead real Gross Domestic Product (GDP) is 0.68 over 1960Q1–2017Q4 (see Table 1). This means that a rise (or fall) in quarterly real Gross Domestic Product (GDP) relative to a long run trend is preceded by a rise (or fall) in household investment. This remarkable fact is also evident from the NBER recession dates where the onset of a decline in economic activity is preceded by a fall in household investment (see Figure 1). While this leading indicator property is useful to policy makers for assessing the future direction of the economy, it has been challenging to provide an explanation for it.[2] Many recent models proposed in the literature have studied distinct channels within a rational expectations framework (see, for example, Ren and Yuan (2014), Kydland, Rupert and Šustek (2016) and Khan and Rouillard (2018)). It is, however, possible that behavioural factors such as evolving consumer confidence have also played a role in sustaining this property of household investment, possibly either through 'animal spirits' reflecting optimism and pessimism over the business cycle or through anticipations about future fundamentals. A heuristic way to describe this potential channel is as follows:

$$\overbrace{\text{Consumer Confidence}}^{\uparrow} \Rightarrow \overbrace{\text{Housing \& Durables}}^{\text{Demand}\uparrow} \Rightarrow \overbrace{\text{House Prices}}^{\uparrow} \Rightarrow \overbrace{\text{Household investment}}^{\text{Supply}\uparrow} \Rightarrow \overbrace{\text{Output}}^{\uparrow} \tag{1}$$

An increased confidence level affects households' demand for housing and consumer durables putting upward pressure on house prices, then house builders and consumer durable firms respond by adjusting investment and production, which in turn affects aggregate output. The objective of this paper is to develop this hypothesis and investigate the empirical support for it.

[1]Each component, i.e., residential investment and consumer durables, also displays this property. Brault and Khan (2020) show that unlike the real interest rate and labour productivity, household investment retains its leading indicator property in the post-1985 data. Leamer (2008) has documented that household investment consistently and substantially contributes to the weakness prior to recessions, and eight of the ten recessions were preceded by severe problems in housing in the past fifty years. Leamer (2015) further stresses the importance of housing for the business cycle.

[2]The early literature on home production features studies that do not reproduce the lead in residential investment over the business cycle (see, for example, Benhabib, Rogerson and Wright (1991), Greenwood and Hercowitz (1991), McGrattan, Rogerson and Wright (1997), and Gomme, Kydland and Rupert (2001)).

There are three reasons that motivate our focus on consumer confidence. First is that the lead of residential investment over GDP originates exclusively from single family structures and 'other structures' but not from multi-family structures (see Table 2).[3] The correlation between current investment in single family structures and one quarter ahead cyclical output is the largest in the sample, indicating the one-quarter lead. A similar pattern exists for 'other structures'. In the post-1985 sub-sample, the leading property of 'other structures' investment has become even stronger, leading output by four quarters. Together with consumer durables, these components of household investment may be affected by optimism and pessimism of a family decision-making unit and/or reflect responses to news about future fundamentals that affects confidence contemporaneously. Second is that many empirical studies (discussed below) have found that consumer confidence has predictive power for a variety of macroeconomic variables. However, to the best of our knowledge, we are first to examine the role of consumer confidence in the context of the leading indicator property of household investment. Third is that there is renewed interest in studying the role of consumer confidence in understanding and interpreting business cycles from a variety of perspectives (we provide a literature review in section 2). However, this body of work has not yet studied the role of confidence for household investment.

We use the University of Michigan's Surveys of Consumers and focus on its Index of Consumer Expectation (ICE) as the measure of consumer confidence in our empirical analysis.[4] There are three 'forward-looking' questions underlying the construction of ICE. These index questions, listed as Q_2, Q_3, and Q_4 in the Survey, are as follows:[5]

- Q_2. *Now looking ahead–do you think that a year from now you (and your family living there) will be better off financially, or worse off, or just about the same as now?*
- Q_3. *Now turning to business conditions in the country as a whole–do you think that during the next twelve months we'll have good times financially, or bad times, or what?*
- Q_4. *Looking ahead, which would you say is more likely–that in the country as a whole we'll have continuous good times during the next five years or so, or that we will have periods of widespread unemployment*

[3] The component 'other structures' in residential investment consists primarily of manufactured homes, improvements, dormitories, net purchases of used structures, and brokers' commissions on the sale of residential structures.

[4] http://www.sca.isr.umich.edu/.

[5] The other two questions are about current conditions. These are presented in the Online Appendix.

or depression, or what?

In constructing ICE, first a relative score is computed (the percent giving favourable replies minus the percent giving unfavourable replies, plus 100) for each of the index questions. Then the relative score is rounded to the nearest whole number. And lastly, using the formula shown below, where the sum of the scores is divided by the base-year value of 4.1134, and 2.0 is added as a constant to correct for sample design changes from the 1950s. Thus, ICE is constructed as follows:

$$\text{ICE} \equiv \frac{Q_2 + Q_3 + Q_4}{4.1134} + 2.0$$

A crucial first step in our empirical analysis is to determine whether consumer confidence leads household investment because if it does not, then consumer confidence cannot be a potential driver of household investment. We proceed in the standard way (see, for example, Blanchard and Watson (1986), Kydland and Prescott (1990) and Cooley and Prescott (1995)) and compute cross-correlations between ICE and the cyclical component of household investment, and define the lead based on the largest cross-correlation (including contemporaneous correlation) in absolute terms. Specifically, we take the natural log of household investment and de-trend it with the Hodrick-Prescott (HP)-filter (using a smoothing parameter of $\lambda = 1600$).[6] Since ICE is stationary, we do not de-trend it.

We find that ICE leads household investment by two quarters over the sample period 1960Q1-2017Q4. This is a remarkable property. It means that when consumer confidence is high, household investment will be high in the near future, followed by an increase in output. In addition, we find that ICE Granger-causes household investment but the reverse causality is not present in the data. This suggests that movements in ICE contain information that can help predict future household investment.

Next, we determine how exogenous variations in ICE affect household investment. For this purpose, we conduct a Vector Autoregression (VAR)-based analysis to obtain the impulse responses of household investment to a one-standard deviation ICE shock. As a baseline, we consider a four-variable VAR that includes ICE, household investment, hours-worked, and output, and use Cholesky decomposition to identify the ICE shock. The evidence that ICE leads and Granger-causes household investment (without reverse causality) supports ordering it first in the VAR. We find that household

[6]Using the recently proposed filter in Hamilton (2018) produces similar results.

investment, hours-worked, and output all increase following the ICE shock. These impact responses are statistically different from zero. The effects on all the three variables build up over time. Both household investment and hours-worked have a hump-shaped response, with the peak responses occurring between one to two years after the shock. The responses are highly persistent, in particular, that of output and are all statistically significant. Variance decomposition results show that confidence shocks account for 46, 38, and 74 percent of the forecast error variance of household investment, total hours worked and output, respectively, at a 40 quarter horizon. The correlations based on historical decomposition conditional on the ICE shock also show that confidence leads household investment. These findings reinforce the empirical support for our hypothesis.

Does household investment play a role in transmitting confidence shocks to the broader economy? To answer this important question, we apply the methodology used in Bernanke et al. (1997), Sims and Zha (2006), Kilian and Lewis (2011), and Bachmann and Sims (2012). We construct a hypothetical impulse response of output to a confidence shock, holding the response of household investment fixed at all forecast horizons. We find that the response of output is lower at all horizons when household investment is forced to not respond to the confidence shock relative to when it is left unconstrained. Thus, consumer confidence influences household investment dynamics which then get transmitted to future movements in output.

We find that confidence shocks do not appear to be related to movements in future fundamentals, specifically, one- and four-quarter ahead Total Factor Productivity (TFP) and the Relative Price of Investment (RPI) that represent supply side drivers of the business cycle. But real house prices rise in response to a confidence shock in a hump-shaped manner, consistent with demand outpacing supply in the housing market in the aftermath of the confidence shock, as described in the channel above (1). Moreover, based on local projections, we also find that the responses of household investment to TFP news shocks are significantly below their responses to ICE shocks at horizons equal and larger than one year after the shocks. Therefore, ICE shocks cannot be confounded with TFP news shocks. These findings suggest that demand side forces originating in consumers' social and psychological factors may be a fruitful direction for studying household investment dynamics and their relationship with the business cycle.

The rest of the paper is organized as follows. In section 2 we present the related literature. In section 3, we provide the construction and sources of the data, the cross-correlations and Granger-causality results between the variables. In section 4, we discuss the effects of ICE shocks on macroeconomic variables of interest. In section 5, we present a variety of robustness checks and section 6 concludes.

2 Related literature

Our paper is related to previous research that examined the lead of household (and residential) investment over output. That literature, however, did not investigate consumer optimism and pessimism as drivers of household investment. Kydland, Rupert and Šustek (2016) study the dynamic behaviour of the US residential investment. They build a model showing that the cyclical properties of long term fixed rate mortgage loans can explain the fact that residential investment leads the business cycle in the US and coincident movement in European countries. Khan and Rouillard (2018) find that severeness of home-owners' borrowing constraints drive the lead of residential investment over output in a multi-agent model. Ren and Yuan (2014) use a dynamic stochastic partial equilibrium model with Total Factor Productivity (TFP) news shocks, collateral constraints and agent heterogeneity to explain the lead of residential investment over output. These recent studies are within the standard rational expectations framework. By contrast, in this paper we explore the role of consumer's beliefs or attitudes as potential drivers of the household investment dynamics over the business cycle. Our analysis is empirical as we are interested in determining whether or not consumer confidence can play a driving role for household investment dynamics.

A large body of the literature studies whether consumer confidence has the ability to forecast the macroeconomic variables, such as output, consumer spending, employment and productions. In early work on the predictive value of consumer attitudes or sentiments, Tobin (1959), Adams (1964) and Friend and Adams (1964) estimated consumption functions and found mixed results. Relatedly, Fuhrer (1993), Carroll, Fuhrer and Wilcox (1994) , Bram and Ludvigson (1998), Ludvigson (2004) and Cotsomitis and Kwan (2006) find that lagged consumer confidence has some explanatory power for current changes in household spending after using control variables. Lahiri, Monokroussos and Zhao (2016) use real time data and find evidence that consumer confidence helps in predicting household expenditures. Moreover, Matsusaka and Sbordone (1995) use a VAR specification to assess the Granger-causality between consumer confidence and economic fluctuations after controlling for economic fundamentals and find that consumer confidence Granger-causes gross national product. On the other hand, Leeper (1992) studies the role of consumer attitudes in forecasting economic activities and finds that attitudes do not improve the forecasting accuracy of production and unemployment when financial variables, stock market price and short term interest rate, are taken into account. Throop (1992) establishes that consumer sentiment is a significant determinant of household's purchases of durable goods. In this paper we study how the consumer sentiment shock affects not only durable goods but, importantly, residential investment. In addition, our focus is on business cycle dynamics of household investment.

Our work also contributes to a recent debate in the literature which aims at determining whether the sources of changes in expectations and their effects on macroeconomic variables are related to news about future fundamentals or to psychological factors.[7] The terminology most often used in the literature for the former component is news shocks, while the latter component takes various names: animal spirits, beliefs, sentiments, expectation shocks, and noisy signals about the future. Using various estimation approaches that involve SVARs, SVECMs and structural models, Barsky and Sims (2012, 2011), Ben Zeev and Khan (2015), and Fève and Guay (2018) emphasize the role of news shocks.[8] Conversely, based on various methodologies, Benhabib and Spiegel (2019), Benhima and Poilly (2021), Blanchard et al. (2013), Chahrour and Jurado (2018), Clements and Galvão (2021), Enders et al. (2021), Hintermaier and Koeniger (2018), Lagerborg et al. (2022), Levchenko and Pandalai-Nayar (2020) and Milani (2011) assign more weight to sentiments. Of particular interest to our work, Hintermaier and Koeniger (2018) present a dynamic model with consumer confidence to study how it interacts with household debt to generate the observed fluctuations in house prices and consumption. Moreover, Enders et al. (2021) display the responses from a local projection à la Jordà (2005) of durables consumption and residential investment among other variables to a purified belief shock. The correlations of real GDP and these two variables conditional on this shock are positive and cer-

[7]Nam and Wang (2019) show that optimism and pessimism shocks, estimated using sign restrictions on stock prices and consumption, are important to explain US output and hours over the business cycle.

[8]Ben Zeev and Khan (2015) stress the importance of investment-specific technology news shocks instead of TFP news shocks to explain the dynamics of aggregate quantity variables.

tainly very high. However, none of these papers examine a transmission channel of confidence shocks on output that relies on household investment which is our objective.

Aastveit, Anundsen and Herstad (2019) find that residential investment is useful in predicting recessions, using both in-sample and out-of-sample tests for 12 Organization for Economic Co-operation and Development (OECD) countries. However, their paper does not consider the role of consumer confidence as a precursor to business cycle movements in residential investment as we do.

The study of confidence has gained increasing attention in recent literature, with scholars developing various frameworks to quantify this important factor. For example, Angeletos et al. (2018) propose a framework that takes into account waves of optimism and pessimism resulting from frictional coordination among agents. This coordination phenomenon arises from the uncertainty about the beliefs of others and is distinct from news about medium-to-long term productivity. In another related work, Angeletos and Lian (2022) introduce a confidence multiplier to account for rational inattention to aggregate economic conditions. These modifications to the standard models shed light on the role of confidence in the business cycle. However, while these studies offer valuable insights, they do not address the lead-lag structure of household investment over the business cycle, which is the focus of our paper.

Although our interpretation of consumer confidence shocks differs, our empirical approach is closely related to that of Barsky and Sims (2012). Estimating a trivariate VAR model, they find that surprise changes in consumer confidence are associated with long-lasting movements in output and consumption of (non-durable) goods and services. The impulse responses of consumption and output to one-standard consumer confidence shocks are hump-shaped and permanent. Our focus, by contrast, is on household investment.[9] Finally, Bachmann and Sims (2012) study the role of confidence in the transmission of fiscal policy change. They find that confidence is part of the transmission of government spending shocks during recessions. We pursue a similar approach and show that household investment is central in the transmission of a consumer confidence shock. More generally, our findings reinforce the importance of behavioral forces over the business cycles recently emphasized in Milani (2017), Chatterjee and Milani (2020) and Cole and Milani (2021).

[9] Barsky and Sims (2012) mainly focus on non-durable goods and mention that the response of consumer durables is similar. As mentioned above, our central focus is on household investment which includes consumer durables.

3 Data and preliminaries

3.1 Data

Our data span the period 1960Q1–2017Q4. We use National Income and Product Accounts (NIPA) Table 1.1.3 of the Bureau of Economic Analysis (BEA) to obtain the quantity series of real gross domestic product (GDP), personal consumption expenditures on durable goods, residential investment, non-residential investment and government consumption expenditure. We obtain total population from NIPA Table 7.1. The housing starts series (Housing Starts: Total: New Privately Owned Housing Units Started), total hours worked, unemployment rate and durable goods (industrial production) are from the FRED database of the Federal Reserve Bank of St. Louis. We use NIPA Table 1.1.4 to obtain price indices of durable goods, residential investment, equipment investment and GDP. We use the federal funds rate as measure of the nominal interest rate when the zero lower bound is not binding. When it is binding, we use the estimates for nominal interest rates from Wu and Xia (2016). The utilization-adjusted series on TFP growth is from Fernald (2014) and we convert it to a log-level series. The stock return is the log difference of real S&P composite stock price index and we obtain the index from Robert Shiller's webpage.[10] We define RPI as the equipment investment price index divided by the GDP price index.

We define household investment as the sum of residential investment and consumption expenditures on durable goods. We provide the details of the household investment construction in the Appendix. We normalize all of these variables by the population. The consumer confidence data is from the University of Michigan's Surveys of Consumers. We mainly focus on the ICE. Finally, we obtain the business confidence index from the OECD database.

Panel (a) in Figure 1 shows the quarterly series of ICE and household investment for the period 1960Q1–2017Q4. The household investment has an overall upward trend with decreases occurring around the NBER recession dates. In particular, household investment decreases heavily during the Great Recession of 2007–2009. Notably, all the recessions are preceded by a fall in ICE and all the major falls in ICE are followed by large decreases in household investment which precede the recessions. Panel (b) shows the relationship between cyclical household investment moves and ICE over the

[10] http://www.econ.yale.edu/ shiller/

business cycles. The cyclical peaks and troughs in household investment follow the corresponding movements in ICE.

3.2 Does consumer confidence lead household investment?

Yes. Table 3 shows the cross-correlation of ICE with macroeconomics variables at various leads and lags (i.e. $Corr(ICE_t, X_{t+j})$ for $j = \pm 4, 3, 2, 1, 0$) for the period 1960Q1–2017Q4. Panel (a) shows that ICE is positively correlated with future cyclical household investment (HI), housing starts, output, hours worked, and business investment. The cyclical components are based on the HP filter. The largest correlation (0.33) between ICE at t and HI is at $t+2$, which implies that ICE leads household investment by two quarters. This is a remarkable property and it provides prima-facie support for the hypothesis described in (1) enabling subsequent empirical analysis in this paper.[11] For other variables, ICE leads housing starts by one quarter, and output, hours worked, and business investment by four quarters. Panel (b) shows that the conclusion regarding the leading property of ICE for household investment remains robust to using an alternative filtering method proposed in Hamilton (2018), with the exception of housing starts where the relationship is contemporaneous.

Finally, to demonstrate the significance of the cross-correlations further, we take an approach similar to that in Kydland, Rupert and Šustek (2016) and implement a block bootstrap procedure with overlapping blocks.[12] Specifically, we examine the cross-correlation functions for the HP-filtered cyclical components of household investment with ICE, output, and business investment. A brief description of the algorithm is as follows: First, we randomly select the size of the blocks to be 20 quarters, which corresponds to the lower bound of the business cycle frequency. Second, we compile these blocks to form artificial series that contain the same number of observations as our sample. Third, we compute cross-correlation functions and record the lead or lag for which this function is maximized. We repeat this procedure 10,000 times and show in Panel a) of Figure 2, the histogram of samples in which each of the three displayed variables, namely, ICE, output, and business investment, is either leading (negative lags), neither leads nor lags (0 lag) or is lagging (positive lags). In about 2/3rd of samples, ICE leads household investment by one quarter. The second figure shows that output lags

[11] By contrast, business confidence index does not lead household investment, since the contemporaneous correlation between the two variables, 0.62, is the largest over the same sample period 1960Q1–2017Q4.

[12] See, for example, Härdle, Horowitz and Kreiss (2003).

household investment by one quarter in nearly 80 percent of the samples. The third figure shows that business investment lags household investment by two quarters in about 75 percent of the samples. In none of the samples, household investment lags either business investment or output. This bootstrap exercise reinforces the patterns of unconditional lead-lag relationship that we report in Table 3 of the paper.

3.3 Does consumer confidence Granger-cause household investment?

Yes. We perform Granger causality tests to check whether or not ICE Granger-causes household investment. We take the natural log for all the variables and use the Akaike Information Criteria (AIC) to choose the lag length of the variables. Table 4 shows the results of Granger causality tests using a bivariate VAR model. The null hypothesis that ICE does not Granger cause household investment is strongly rejected since the associated p-value is 0.001. Moreover, the hypothesis of reverse causality is rejected. That is, household investment does not Granger cause ICE. The tests also show that ICE Granger-causes total hours worked and output but not vice-versa. We also check whether ICE Granger-causes the components of household investment (i.e. residential investment and durable goods). We find that ICE Granger-causes residential investment and durable goods, but conversely, these components of household investment do not Granger-cause ICE. These findings suggest that consumer confidence contains information that can help predict household investment and other macroeconomic variables.

Finally, we conduct one additional check. We first regress output growth on its own lags and lagged household investment. We estimate two sets of regressions that are shown in Table 5, namely, one-lag and two-lags specifications, respectively. The one-lag specification in Panel 1 shows that coefficient on lagged household investment growth decreases from 0.121 to 0.113 when lagged ICE is included in the regression. The coefficient on lagged ICE is statistically significant and $\bar{R}^2$ (the Adjusted-R^2) of the regression is higher when lagged ICE is included. Similarly, Panel II shows that in the two-lagged specification, the coefficient on the first lag of household investment growth decreases from 0.120 to 0.107 when lagged ICE is added. And the first lag of ICE remains statistically significant. These findings are consistent with our premise that information contained in ICE is transmitted to output via household investment.[13]

4 VAR analysis

In this section, we assess the macroeconomic effects of ICE shocks—the exogenous shifts in consumer confidence—using a VAR framework. A key difference relative to the previous literature on confidence shocks is that our main variable of interest is household investment. Since we are interested to see how changes in ICE can propagate to the economy through the household investment channel, we also include hours worked and real GDP in our analysis.

4.1 The effects of consumer confidence shocks

In the baseline case, we consider a four-variable VAR with ICE, household investment, total hours worked and real output.[14] All four variables enter the VAR in log-levels with four lags.[15] We use AIC to choose the lag length. Given our findings in the previous section, we order ICE first in the VAR and use the Cholesky orthogonalization to identify the ICE shock.

Figure 3 shows the impulse responses to an ICE shock. The shaded areas are one-standard-error confidence bands based on the Kilian (1998) bias-corrected bootstrap after bootstrap procedure. A one standard deviation positive ICE shock has a positive impact on household investment, total hours worked and output. These effects are statistically significant at 5 percent level. The impact effects are followed by hump-shaped and highly persistent responses of these variables. The peak response of household investment to a one standard deviation ICE shock is 2.2 percent. The peak responses of output and total hours worked are 0.8 percent and 0.75 percent, respectively. The responses of household investment and output are very persistent; at a horizon of 40 quarters, they remain statistically significant at a 5 percent level. The size of the response of hours worked for the same horizon is not as high, yet it is also statistically significant at a 5 percent level.

[13]Our premise does not rule out other shocks that may contribute to the leading indicator property of household investment. This is reflected in the fact that the coefficient on lagged household investment remains statistically significant after including lagged ICE in the regression.

[14]Total hours worked and output are good indicators of the business cycle.

[15]We follow the common practice in the literature of putting variables in levels in the VAR. First differencing may loose information and it produces no gain in asymptotic efficiency in an autoregressive process (see, Fuller (1976)).

Barsky and Sims (2012) examine the response of non-durable consumption and real output to a confidence shock (using the confidence measure based on sub-question $Q4$ in ICE denoted as E5Y) in a three-variable VAR. They showed that the consumer confidence has powerful predictive implications for the future paths of macroeconomic variables. The impulse responses of consumption and output to a one standard deviation consumer confidence shock are gradually increasing and statistically significant, and remain positive in the long run. Although our variables, except for output, are different from theirs, the response of output is quantitatively similar.

To consider the possibility that our confidence measure may contain information already contained in other variables in the VAR, we put ICE last in the VAR system. Figure 4 displays the impulse responses to one-standard-deviation shock to ICE for this orthogonalization. The impulse responses of household investment, total hours worked and output to ICE shock are not significantly different from reordering the variables in the VAR system. In this case, a positive shock to ICE does not have an initial impact on household investment, total hours worked and output by construction since ICE is ordered last in the VAR. However, a one standard deviation ICE shock still produces a hump-shaped pattern and highly persistent responses of household investment, total hours worked and output. The responses of household investment and output to a one-standard-deviation shock are nearly 0.6 percent at the 40 quarter horizon, and remain statistically significant. These responses are slightly smaller than in the case when ICE is ordered first.

Figure 5 displays the variance decompositions of ICE, household investment and output to an ICE shock from both orderings—ICE at first and last—in the VAR system. When ICE is ordered first in the VAR, the ICE shocks account for around 46, 38, and 74 percent of the forecast error variance of household investment, total hours worked and output at 40 quarter horizons, respectively. When ICE is ordered last in the VAR, the ICE shocks account for 28, 20, and 43 percent, respectively. ICE shocks account for 78 percent and 75 percent of their own forecast error variance, ordering ICE first and last, respectively. Note that the variation in ICE is mostly due to its own shock, which is consistent with our finding that household investment, total hours worked and output do not Granger-cause ICE.[16]

[16] We also consider a different measure of confidence, namely, the Index of Consumer Sentiment (ICS) instead of ICE in the same four variable VAR system. There are no significant differences in the responses of household investment, total hours worked and output across the two shocks. This finding suggests that information content of $Q1$ and $Q5$ in the Surveys of Consumers has little effect on macroeconomic variables.

4.2 Household investment as a business cycle transmission channel

Does household investment play a role in the transmission of confidence shocks over the business cycle? To answer this question, we follow the approach developed in Bernanke et al. (1997) and Sims and Zha (2006) and used in Kilian and Lewis (2011), and Bachmann and Sims (2012).[17] Specifically, we consider an impulse response of output to an ICE shock, holding household investment fixed at all forecast horizons. Comparing this *constrained* impulse response with the actual response of output to a confidence shock provides a measure of how the response of household investment contributes to the propagation of the ICE shock.

Our exposition of the approach below closely follows Bachmann and Sims (2012). We consider the following structural VAR(p) representation (with the constant term suppressed for notational convenience):

$$A_0 Y_t = \sum_{j=1}^{p} A_j Y_{t-j} + \varepsilon_t, \tag{2}$$

where, Y_t is $k \times 1$ vector that contains four variables, namely ICE, household investment, total hours worked and output, A_j is $k \times k$ matrix that includes the autoregressive coefficients, p is the number of lags of the variables and j identifies the order of the lag. Finally, the $k \times 1$ vector ε_t denotes the mutually uncorrelated structural shocks and the A_0 is the $k \times k$ lower triangular impact matrix.

We express the above model in a reduced form as:

$$Y_t = \sum_{j=1}^{p} A_0^{-1} A_j Y_{t-j} + u_t, \tag{3}$$

where the reduced-form shocks, $u_t = A_0^{-1}\varepsilon_t$, and ε_{1t}, ε_{2t}, ε_{3t} and ε_{4t} are the structural ICE shock, household investment shock, total hours worked shock and output shock, respectively. The vector of structural shocks, ε_t, is a zero mean white noise process with covariance matrix $E(\varepsilon_t \varepsilon_t') \equiv \Omega_\varepsilon = I_k$ such that the reduced-form shocks covariance matrix is $E(u_t u_t') \equiv \Omega_u = A_0^{-1} A_0^{-1\prime}$.

We impose restrictions on the impact matrix A_0 in order to uniquely recover the structural VAR as follows:

[17]Using this approach, Bernanke et al. (1997), Sims and Zha (2006) and Kilian and Lewis (2011) shed light on the transmission of monetary policy shocks, and Bachmann and Sims (2012) study the role of consumer confidence in the transmission of government shocks.

$$A_0 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{2,1} & 1 & 0 & 0 \\ a_{3,1} & a_{3,2} & 1 & 0 \\ a_{4,1} & a_{4,2} & a_{4,3} & 1 \end{bmatrix}_{(k \times k)}.$$

We order ICE first, then household investment, total hours worked and output. We employ a Cholesky factorization of the variance-covariance matrix of reduced-form shocks, Ω_u, to implement the identification assumption. Our assumption is that household investment, total hours worked and output react contemporaneously to the ICE shocks, whereas ICE does not react on impact to other shocks in the system. The assumption is valid since household investment leads output and ICE leads household investment, total hours worked and output.

Constrained impulse responses: Does household investment play in the transmission of confidence shocks? To answer this question we follow Bachmann and Sims (2012) and consider a hypothetical scenario where the response of household investment to an ICE shock is constrained to be exactly zero for all horizons. To frame the discussion, it is convenient to consider the companion matrix VAR(1) representation of the VAR(p) process.

$$Z_t = \Lambda Z_{t-1} + U_t, \tag{4}$$

where,

$$Z_t = \begin{bmatrix} Y_t \\ Y_{t-1} \\ . \\ . \\ . \\ Y_{t-p+1} \end{bmatrix}_{(kp \times 1)}, \quad \Lambda = \begin{bmatrix} A_0^{-1}A_1 & A_0^{-1}A_2 & \cdots & \cdots & A_0^{-1}A_p \\ I & 0 & 0 & \cdots & 0 \\ 0 & I & 0 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & \cdots & \cdots & I & 0 \end{bmatrix}_{(kp \times kp)}, \quad \text{and} \quad U_t = \begin{bmatrix} u_t \\ u_{t-1} \\ . \\ . \\ . \\ u_{t-p+1} \end{bmatrix}_{(kp \times 1)}.$$

Let $A_0^{-1}(q)$ be the qth column of A_0^{-1}. The impulse response of variable i to structural shock q at horizon $h = 1, ..., H$ is:

$$\Phi_{i,q,h} = e_i \Lambda^{h-1} A_0^{-1}(q) \tag{5}$$

where, e_i is a selection vector of dimension $1 \times k$, with a one in the i^{th} place and zeros elsewhere. Since our objective is to hold fixed the response of household investment to confidence shocks in the system, we set $\Phi_{2,1,h} = 0$ at each forecast horizon, where the position indicators 2 and 1 denote for household investment and confidence shocks, respectively. We then create a hypothetical sequence of household investment shocks, $\varepsilon_{2,h}$, so that we can shut down the response of household investment at each forecast horizon. We can write this in the following matrix form:

$$A_0^{-1}(2,1) + A_0^{-1}(2,2)\varepsilon_{2,1} = 0 \tag{6}$$

which implies

$$\varepsilon_{2,1} = -\frac{A_0^{-1}(2,1)}{A_0^{-1}(2,2)}. \tag{7}$$

We then calculate the required household investment shocks for subsequent horizons as follows:

$$\varepsilon_{2,h} = -\frac{\Phi_{2,1,h} + \sum_{j=1}^{h-1} e_2 \Lambda^{h-j} A_0^{-1}(2)\varepsilon_{2,j}}{e_2 A_0^{-1}(2)}, \; h = 2, ..., H. \tag{8}$$

Now we use the above household investment shocks series to get the constrained or hypothetical impulse responses of the variables to ICE shocks. These are:

$$\tilde{\Phi}_{i,1,h} = \Phi_{i,1,h} + \sum_{j=1}^{h} e_i \Lambda^{h-j} A_0^{-1}(2)\varepsilon_{2,j}, \; i = 1, ..., k. \tag{9}$$

Figure 6 shows the impulse responses of ICE, household investment, total hours worked and output to an ICE shock. The blue solid lines and the red dashed lines in the figure show the actual and hypothetical impulse responses, respectively. Shutting down the response of household investment at all horizons has significant effects on the other variables in the VAR system. The response of output to confidence shocks without household investment is substantially attenuated and consistently lower than in the presence of the household investment channel at all horizons. The response of output to a one-standard-deviation ICE shock drops to nearly 0.2 percent from 1.4 percent at a 40 quarter horizon when we impose the constraint that the response of household investment is zero at all horizons. The response of total hours worked to ICE shocks is small on impact when the household investment effects are absent. It also subsequently drops at longer horizons without household investment. These results demonstrate that household investment plays a significant role in transmitting confidence shocks to the broader economy.

4.3 Corroborative evidence

As illustrated in the introduction, a plausible channel underlying our finding that household investment plays a significant role in transmitting confidence shocks to the economy goes as follows: a positive confidence shock leads to more spending in houses and durable goods (increasing demand for housing) and putting upward pressure on real house prices; then house builders and consumer durables firms react by investing (producing) more houses and durable goods (increasing supply of housing). The investment on private capital structure then boosts GDP.

We estimate a five-variable structural VAR with ICE, durable goods (consumption), durable goods (industrial production), hours worked and output. Figure 7 shows the results for the period 1985–2017. The direct responses of durable goods, durable goods (industrial production) hours worked and output, when the response of durable goods to ICE shocks is fixed, are lower than the indirect responses of durable goods, durable goods (industrial production) hours worked and output at all horizons.[18] Figure 8 shows that real house prices also increase after an ICE shock. Taken together, these findings provide corroborative evidence for the transmission of confidence shocks and the demand-driven channel we have proposed above in (1).

These results are also consistent with the presence of a housing collateral channel. Since both the stock of housing and house prices rise in response to positive ICE shocks, housing wealth also shifts up. Recent empirical and structural work suggest that there is a positive relationship between housing wealth and consumption (durable and non-durable goods). See Aladangady (2017), Berger et al. (2017), Cloyne et al. (2019), Mian et al. (2013), and Mian and Sufi (2011). These studies find that homeowners extract more equity from their houses, and mortgage refinancing is up when household wealth increases. Therefore, this channel can explain the difference between the actual and hypothetical responses of hours worked and output shown in Figure 6.

4.4 Historical simulation

We have shown that ICE shocks account for a large share of the variance decomposition of hours worked and output—especially for long horizons. Figure 9 shows the importance of changes in ICE

[18] The difference between the production and consumption responses indirectly shows the inventories response.

for business cycles from a different angle by presenting historical simulations. Specifically, we assume that the only structural shocks driving variables are the ICE residuals extracted from the baseline four-variable VAR system. The solid blue lines correspond to the simulated paths, while the red dashed lines are constrained simulated paths. To construct the latter, we proceed in a similar fashion to the construction of constrained impulse responses, *i.e.* we add shocks to household investment in order to cancel out all fluctuations in this variable.

As can be seen for the simulated paths, ICE falls shortly prior to the last three recessions, and affect significantly the dynamics of household investment, hours worked, and output during these recessions. Constraining household investment does not impact much the variations in ICE, which is consistent with the results of the variance decomposition, *i.e.* the variations in ICE almost exclusively emanate from ICE shocks. The household investment channel is at work for the dynamics of hours worked and output, since falls in these variables during recessions are smaller for constrained simulated paths. Therefore, contrary to the news shocks identified by Barsky and Sims (2011), the ICE shocks that we identify are important contributors to the last three recessions. Interestingly, the size of output fluctuations is also significantly reduced for the whole sample period.

We also examine the cross-correlation of household investment with output conditional on consumer confidence shocks, obtained using the baseline four-variable structural VAR with ICE, household investment, hours worked and output. Specifically, we construct these correlations from impulse responses following the method proposed by Gali (1999). Panel I of Table 6 shows the cross correlation (i.e. $Corr(HI_t, Y_{t+j}|ICE^{shocks})$ for $j = \pm 4, 3, 2, 1, 0$) results. The conditional correlation between household investment and output is strongly positive. Household investment leads output conditional on confidence shocks by two quarters. This result is consistent with unconditional cross correlations between the two variables. This finding is not sensitive to ordering ICE last in the VAR (Panel II), and in fact shows an even stronger three quarter lead. Panel III shows that non-ICE shocks also generate the lead of household investment over output, which as we have mentioned earlier, indicates the presence of alternative channels in addition to the ICE channel. Panels IV and V show the conditional correlations for the larger VAR system with five variables in following order consumer confidence, utilization-adjustment TFP (Fernald (2014)), household investment, hours worked and output. The correlations, conditional on both ICE shock and TFP shock, produce the leading property of household investment over output. Lastly, Panel VI shows the covariance ratios which gauge the importance of ICE shocks in accounting for the contemporaneous covariance among household investment and output based on the two VAR specifications, respectively. The ICE shock accounts for slightly more than one-third of the covariance between household investment and output observed in the data. For the larger VAR this share is reduced to 22.22 percent, but remains about two times the share accounted for by the TFP shock.

In a similar manner to the bootstrap procedure employed in constructing the unconditional cross-correlation function in section, we apply bootstrapping to the baseline VAR model. To elaborate, within each of the 10,000 artificial samples we generate, we calculate cross-correlation functions conditional solely on ICE shocks and identify the lead or lag for which this function is maximized. The creation of these samples closely adheres to the methodology outlined in section 2.1 of chapter 12 of Kilian and Lütkepohl (2017). The initial conditions, representing the first four values of endogenous variables, remain consistent across all bootstrap replications. In a specific replication, we randomly draw residuals for each quarter from the residual distribution resulting from the estimation of the baseline model. Based on the estimated parameters of the baseline model and the series of artificial residuals, we recursively generate artificial series for the endogenous variables. Panel (b) in Figure 2 shows that conditional on ICE shocks, ICE mostly has a leading relationship with household investment with over 99 percent of samples showing this pattern. The right figure shows that output has a lagging relationship with household investment in more than 90 percent of the samples by one, two, three, or four quarters.

5 Robustness analysis

We conduct a number of relevant checks and find that our main results reported in Section 4.2 are robust. In particular, (1) Are quantitative findings sensitive to additional variables in the VAR? No, the baseline results are robust to including other macroeconomic variables in the VAR, including term spread, personal consumption expenditures on services, monetary, and fiscal policy variables. Figure 10 shows that term-spread (the difference between the 10-year bond rate and the 3-month bill rate) exhibit a moderate and statistically significant decrease in the short term in response to positive (expansionary) ICE shocks. Importantly, the inclusion of the term spread (positioned as the second variable in our system of equations) does not introduce any significant modifications to the response of household investment obtained in the benchmark case. Furthermore, at a 40-quarter horizon, shocks to ICE contribute nearly twice as much to the variance of household investment and GDP compared to shocks to the term spread. (2) Do confidence shocks reflect future technology developments (or TFP 'news' shocks)? We conclude that they do not. (3) Does the household investment channel for confidence shocks propagate through the labor market? Yes, labor market variables, namely, hours-worked and unemployment respond in ways consistent with a strong output response. (4) Do both components of household investment, namely, residential investment and consumer durables propagate confidence shocks? Yes, both components are relevant for the transmission of confidence shocks. (5) Did ICE shocks play less of a role when the economy is relatively more stable during the Great Moderation period? We find that the persistence of ICE shocks is less for this period leading to shorter and less pronounced responses. All the figures showing the results of the robustness checks mentioned above are available in the Online Appendix.

6 Conclusion

The well known and robust leading indicator property of household investment (consumer durables plus residential investment) has been a challenging business cycle fact to explain. Since single-family homes are the main source of this property for residential investment, it suggests that household investment is likely affected by shifts in consumer confidence at a family decision-making unit level. So far there has been no attempt to connect consumer confidence as source of the leading indicator property. Our paper fills this gap. Using quarterly aggregate data since 1960 and a measure of consumer confidence from the University of Michigan Surveys of Consumers, we show that consumer confidence leads household investment by two quarters and housing starts by one quarter. Household investment rises persistently after positive consumer confidence shock. Both hours-worked and output also increase on impact and the effects are highly persistent, and so do real house prices. The confidence shocks account for over 40 percent of the variation in household investment over long horizons (40 quarters). These shocks account for a substantial variation in output nearly 75 percent of all GDP variation) and about 40 percent of the hours variation. We find that household investment plays a quantitatively important role in the transmission of confidence shocks to the economy. Moreover, confidence shocks do not appear to be related to movements in future total factor productivity and relative price of investment reflecting supply side developments. Our findings, therefore, suggest that demand side forces originating in consumers' social and psychological factors may be a fruitful direction for studying household investment dynamics and their relationship with the business cycle.

References

Aastveit, K. A., Anundsen, A. K. and Herstad, E. I.: 2019, Residential investment and recession predictability, *International Journal of Forecasting* **35**(4), 1790–1799.

Adams, F. G.: 1964, Consumer attitudes, buying plans, and purchases of durable goods: A principal components, time series approach, *The Review of Economics and Statistics* **46**(4), 347–355.

Aladangady, A.: 2017, Housing wealth and consumption: Evidence from geographically-linked microdata, *American Economic Review* **107**(11), 3415–46.

Angeletos, G.-M., Collard, F. and Dellas, H.: 2018, Quantifying confidence, *Econometrica* **86**(5), 1689–1726.

Angeletos, G.-M. and Lian, C.: 2022, Confidence and the propagation of demand shocks, *The Review of Economics and Statistics* **89**(3), 1085–1119.

Bachmann, R. and Sims, E. R.: 2012, Confidence and the transmission of government spending shocks, *Journal of Monetary Economics* **59**, 235–249.

Barsky, R. B. and Sims, E. R.: 2012, Information, animal spirits, and the meaning of innovations in consumer confidence, *American Economic Review* **102**, 1343–1377.

Barsky, R. and Sims, E.: 2011, News shocks and business cycles, *Journal of Monetary Economics* **58**, 273–289.

Ben Zeev, N. and Khan, H.: 2015, Investment-specific news shocks and US business cycles, *Journal of Money, Credit and Banking* **47**(7), 1443–1464.

Benhabib, J., Rogerson, R. and Wright, R.: 1991, Homework in macroeconomics: Household production and aggregate fluctuations, *Journal of Political Economy* **99**(6), 1166–1187.

Benhabib, J. and Spiegel, M. M.: 2019, Sentiments and Economic Activity: Evidence from US States, *The Economic Journal* **129**(618), 715–733.

Benhima, K. and Poilly, C.: 2021, Does demand noise matter? identification and implications, *Journal of Monetary Economics* **117**, 278–295.

Berger, D., Guerrieri, V., Lorenzoni, G. and Vavra, J.: 2017, House prices and consumer spending, *The Review of Economic Studies* **85**(3), 1502–1542.

Bernanke, B. S., Gertler, M., Watson, M., Sims, C. A. and Friedman, B. M.: 1997, Systematic monetary policy and the effects of oil price shocks, *Brookings Papers on Economic Activity* **1997**(1), 91–157.

Blanchard, O. J., L'Huillier, J.-P. and Lorenzoni, G.: 2013, News, noise, and fluctuations: An empirical exploration, *American Economic Review* **103**(7), 3045–70.

Blanchard, O. J. and Watson, M. W.: 1986, Are Business Cycles All Alike?, University of Chicago Press, pp. 123–180.

Bram, J. and Ludvigson, S. C.: 1998, Does consumer confidence forecast household expenditure? A sentiment index horse race, *Economic Policy Review, Federal Reserve Bank of New York, June* pp. 59–78.

Brault, J. and Khan, H.: 2020, The shifts in the lead-lag properties of the US business cycle, *Economic Inquiry* **58**(1), 319–334.

Carroll, C. D., Fuhrer, J. C. and Wilcox, D. W.: 1994, Does consumer sentiment forecast household spending? If so, why?, *American Economic Review* **84**, 1397–1408.

Chahrour, R. and Jurado, K.: 2018, News or noise? the missing link, *American Economic Review* **108**(7), 1702–36.

Chatterjee, P. and Milani, F.: 2020, Perceived uncertainty shocks, excess optimism-pessimism, and learning in the business cycle, *Journal of Economic Behavior & Organization* **179**, 342–360.

Clements, M. P. and Galvão, A. B.: 2021, Measuring the effects of expectations shocks, *Journal of Economic Dynamics and Control* **124**, 104075.

Cloyne, J., Huber, K., Ilzetzki, E. and Kleven, H.: 2019, The effect of house prices on household borrowing: a new approach, *American Economic Review* **109**(6), 2104–36.

Cole, S. and Milani, F.: 2021, Heterogeneity in individual expectations, sentiment, and constant-gain learning, *Journal of Economic Behavior & Organization* **188**, 627–650.

Cooley, T. F. and Prescott, E. C.: 1995, Economic growth and business cycles, *in* T. F. Cooley (ed.), *Frontiers of Business Cycle Research*, Princeton University Press, chapter 1, pp. 1–38.

Cotsomitis, J. A. and Kwan, A. C.: 2006, The usefulness of consumer confidence in forecasting household spending in Canada: A national and regional analysis, *Economic Inquiry* **44**, 185–197.

Enders, Z., Kleemann, M. and Müller, G. J.: 2021, Growth Expectations, Undue Optimism, and Short-Run Fluctuations, *The Review of Economics and Statistics* **103**(5), 905–921.

Fernald, J.: 2014, A quarterly, utilization-adjusted series on total factor productivity, *Working paper*, Federal Reserve Bank of San Francisco.

Fève, P. and Guay, A.: 2018, Sentiments in SVARs, *The Economic Journal* **129**(618), 877–896.

Friend, I. and Adams, F. G.: 1964, The predictive ability of consumer attitudes, stock prices, and non-attitudinal variables, *Journal of the American Statistical Association* **59**(308), 987–1005.

Fuhrer, J. C.: 1993, What role does consumer sentiment play in the US macroeconomy?, *New England Economic Review* pp. 32–44.

Fuller, W.: 1976, *Introduction to Statistical Time Series*, New York: Wiley.

Gali, J.: 1999, Technology, employment, and the business cycle: do technology shocks explain aggregate fluctuations?, *American Economic Review* **89**(1), 249–271.

Gomme, P., Kydland, F. and Rupert, P.: 2001, Home production meets time to build, *Journal of Political Economy* **109**, 1115–131.

Greenwood, J. and Hercowitz, Z.: 1991, The allocation of capital and time over the business cycle, *Journal of Political Economy* **99**(6), 1188–1214.

Hamilton, J. D.: 2018, Why you should never use the Hodrick-Prescott filter, *Review of Economics and Statistics* **100**(5), 831–844.

Härdle, W., Horowitz, J. and Kreiss, J.-P.: 2003, Bootstrap methods for time series, *International Statistical Review* **71**(2), 435–459.

Hintermaier, T. and Koeniger, W.: 2018, Household debt and crises of confidence, *Quantitative Economics* **9**, 1489–1542.

Jordà, Ò.: 2005, Estimation and inference of impulse responses by local projections, *American economic review* **95**(1), 161–182.

Khan, H. and Rouillard, J.-F.: 2018, Household borrowing constraints and residential investment dynamics, *Journal of Economic Dynamics and Control* **95**, 1–18.

Kilian, L.: 1998, Small-sample confidence intervals for impulse response functions, *Review of Economics and Statistics* **80**, 218–230.

Kilian, L. and Lewis, L. T.: 2011, Does the fed respond to oil price shocks?, *Economic Journal* **121**, 1047–1072.

Kilian, L. and Lütkepohl, H.: 2017, *Structural vector autoregressive analysis*, Cambridge University Press.

Kydland, F. E. and Prescott, E. C.: 1990, Business cycles: Real facts and a monetary myth, *Federal Reserve Bank of Minneapolis Quarterly Review* pp. 3–18.

Kydland, F. E., Rupert, P. and Šustek, R.: 2016, Housing dynamics over the business cycle, *International Economic Review* **57**, 323–341.

Lagerborg, A., Pappa, E. and Ravn, M. O.: 2022, Sentimental business cycles, *Review of Economic Studies (forthcoming)* .

Lahiri, K., Monokroussos, G. and Zhao, Y.: 2016, Forecasting consumption: The role of consumer confidence in real time with many predictors, *Journal of Applied Econometrics* **31**, 1254–1275.

Leamer, E. E.: 2008, Housing is the business cycle, *Housing finance and monetary policy*, Federal Reserve Bank of Kansas City.

Leamer, E. E.: 2015, Housing really is the business cycle: What survives the lessons of 2008-09?, *Journal of Money, Credit and Banking* **47**(1), 43–50.

Leeper, E.: 1992, Consumer attitudes: King for a day, *Federal Reserve Bank of Atlanta Economic Review* pp. 1–15.

Levchenko, A. A. and Pandalai-Nayar, N.: 2020, TFP, news, and "sentiments": The international transmission of business cycles, *Journal of the European Economic Association* **18**(1), 302–341.

Ludvigson, S. C.: 2004, Consumer confidence and consumer spending, *Journal of Economic Perspectives* **18**, 29–50.

Matsusaka, J. G. and Sbordone, A. M.: 1995, Consumer confidence and economic fluctuations, *Economic Inquiry* **32**, 296–318.

McGrattan, E. R., Rogerson, R. and Wright, R.: 1997, An equilibrium model of the business cycle with household production and fiscal policy, *International Economic Review* **38**(2), 267–290.

Mian, A., Rao, K. and Sufi, A.: 2013, Household balance sheets, consumption, and the economic slump, *The Quarterly Journal of Economics* **128**(4), 1687–1726.

Mian, A. and Sufi, A.: 2011, House prices, home equity-based borrowing, and the us household leverage crisis, *American Economic Review* **101**(5), 2132–56.

Milani, F.: 2011, Expectation shocks and learning as drivers of the business cycle, *The Economic Journal* **121**(552), 379–401.

Milani, F.: 2017, Sentiment and the U.S. business cycle, *Journal of Economic Dynamics and Control* **82**, 289–311.

Nam, D. and Wang, J.: 2019, Mood swings and business cycles: Evidence from sign restrictions, *Journal of Money, Credit and Banking* **51**(6), 1623–1649.

Ren, Y. and Yuan, Y.: 2014, Why the housing sector leads the whole economy: The importance of collateral constraints and news shocks, *Journal of Real Estate Finance and Economics* **48**, 323–341.

Sims, C. A. and Zha, T.: 2006, Does monetary policy generate recessions?, *Macroeconomic Dynamics* **10**(2), 231–272.

Throop, A. W.: 1992, Consumer sentiment: Its causes and effects, *Economic Review 1*, Federal Reserve Bank of San Francisco.

Tobin, J.: 1959, On the predictive value of consumer intentions and attitudes, *The Review of Economics and Statistics* **41**(1), 1–11.

Wu, J. C. and Xia, F. D.: 2016, Measuring the macroeconomic impact of monetary policy at the zero lower bound, *Journal of Money, Credit and Banking* **48**(2-3), 253–291.

7 Tables and Figures

Table 1: Cross-correlations: Household investment in t with business investment or output in $t+j$

Variable	Rel Std.	$j=-4$	-3	-2	-1	0	1	2	3	4
					Panel I: HP filtered data					
(a) 1947Q1–2017Q4										
Business Investment	1.419	-0.423	-0.322	-0.135	0.105	0.380	0.568	0.660	**0.671**	0.619
Output	4.057	-0.312	-0.156	0.079	0.340	0.584	**0.678**	0.659	0.564	0.447
(b) 1947Q1–1983Q4										
Business Investment	1.682	-0.597	-0.542	-0.352	-0.061	0.300	0.533	**0.633**	0.624	0.544
Output	4.130	-0.483	-0.339	-0.076	0.228	0.525	**0.613**	0.568	0.438	0.297
(c) 1984Q1–2017Q4										
Business Investment	1.018	-0.170	-0.023	0.130	0.280	0.437	0.542	0.611	0.651	**0.653**
Output	4.210	-0.011	0.146	0.329	0.510	0.676	**0.733**	0.722	0.669	0.599
					Panel II: Hamilton (2018)-filtered data					
(a) 1947Q1–2017Q4										
Business Investment	1.380	-0.180	-0.074	0.068	0.229	0.422	0.517	0.587	0.642	**0.650**
Output	4.090	0.042	0.199	0.353	0.517	0.670	0.725	**0.729**	0.713	0.672
(b) 1947Q1–1983Q4										
Business investment	1.387	-0.305	-0.212	-0.072	0.114	0.337	0.495	0.607	0.677	**0.695**
Output	3.524	-0.121	-0.003	0.154	0.331	0.516	0.597	**0.621**	0.614	0.569
(c) 1984Q1–2017Q4										
Business Investment	1.060	-0.059	0.033	0.150	0.268	0.401	0.464	0.503	0.564	**0.572**
Output	4.125	0.053	0.162	0.316	0.485	0.644	**0.689**	0.685	0.669	0.656

Notes: In Panel I, we take logs in levels and de-trend them with the HP-filter ($\lambda = 1600$). In Panel II, we take logs in levels and de-trend them with the Hamilton (2018) filter using and 8-quarter forecast horizon and four lags in the regression specification. The largest correlations indicating the leading property of household investment are shown in bold.

Table 2: Cross-correlations: Components of residential investment in t with output in $t+j$

	Rel Std.	$j=-4$	-3	-2	-1	0	1	2	3	4
(a) 1958Q1–2017Q4										
Single family	9.525	-0.228	-0.059	0.174	0.425	0.635	**0.731**	0.730	0.670	0.590
Multi family	12.438	0.220	0.313	0.399	0.457	**0.469**	0.417	0.327	0.218	0.117
Other structures	3.995	-0.079	0.048	0.163	0.313	0.509	**0.617**	0.593	0.532	0.469
(b) 1958Q1–1983Q4										
Single family	9.538	-0.389	-0.226	0.035	0.340	0.620	**0.705**	0.662	0.550	0.433
Multi family	12.328	-0.008	0.132	0.294	0.440	**0.523**	0.480	0.369	0.223	0.087
Other structures	3.810	-0.234	-0.101	0.028	0.216	0.476	**0.578**	0.466	0.328	0.218
(c) 1984Q1–2017Q4										
Single family	10.955	-0.037	0.110	0.309	0.505	0.647	**0.702**	0.688	0.634	0.563
Multi family	14.780	0.611	**0.617**	0.561	0.466	0.361	0.241	0.1451	0.069	0.025
Other structures	4.575	-0.143	-0.031	0.088	0.231	0.413	0.522	0.601	0.632	**0.647**

Notes: We take logs in levels and de-trend with the HP-filter ($\lambda = 1600$). The largest correlations are shown in bold.

Table 3: Cross-correlations: ICE in t with a variable in $t + j$

Variable	$j = -4$	-3	-2	-1	0	1	2	3	4
				Panel I: HP-filtered data					
Household investment	-0.101	-0.015	0.070	0.174	0.282	0.328	**0.330**	0.318	0.286
Housing starts	-0.002	0.069	0.147	0.234	0.288	**0.296**	0.282	0.250	0.203
Output	-0.271	-0.220	-0.125	-0.011	0.135	0.224	0.278	0.297	**0.314**
Hours worked	-0.227	-0.196	-0.142	-0.064	0.050	0.153	0.228	0.276	**0.303**
Business investment	-0.225	-0.209	-0.165	-0.095	0.014	0.116	0.200	0.264	**0.309**
				Panel II: Hamilton (2018)-filtered data					
Household investment	0.269	0.335	0.388	0.459	0.513	**0.516**	0.475	0.433	0.355
Housing starts	0.302	0.360	0.414	0.476	**0.503**	0.480	0.436	0.370	0.301
Output	0.187	0.251	0.326	0.423	0.536	0.602	0.634	**0.651**	0.627
Hours worked	0.062	0.094	0.141	0.210	0.297	0.366	0.402	**0.422**	0.407
Business investment	0.058	0.079	0.105	0.173	0.255	0.315	0.369	0.427	**0.433**

Note: The sample period is 1960Q1 to 2017Q4. In Panel (a), we take logs of the variables (except ICE) in levels and de-trend them with the HP-filter ($\lambda = 1600$). In Panel (b), we take logs of the variables (except ICE) in levels and de-trend them with the Hamilton-filter. The largest correlations are shown in bold.

Table 4: Granger-causality tests

Explained variables	Explanatory variables	Chi-squared	p-value	Granger-causality
Household investment	ICE	11.000	0.012	**ICE $\rightarrow$ Household investment**
ICE	Household investment	5.704	0.127	Household investment $\not\rightarrow$ ICE
Residential investment	ICE	11.474	0.003	**ICE $\rightarrow$ Residential investment**
ICE	Residential investment	3.603	0.165	Residential investment $\not\rightarrow$ ICE
Durable goods	ICE	22.416	0.000	**ICE $\rightarrow$ Durable goods**
ICE	Durable goods	3.065	0.216	Durable goods $\not\rightarrow$ ICE
Business investment	ICE	11.474	0.003	**ICE $\rightarrow$ Business investment**
ICE	Business investment	3.603	0.165	Business investment $\not\rightarrow$ ICE
Output	ICE	21.236	0.000	**ICE $\rightarrow$ Output**
ICE	Output	0.691	0.708	Output $\not\rightarrow$ ICE
Hours worked	ICE	15.057	0.001	**ICE $\rightarrow$ Hours worked**
ICE	Hours worked	3.482	0.175	Hours worked $\not\rightarrow$ ICE

Notes: We perform bi-variate VAR Granger-causality Wald tests (i.e ICE with household investment, residential investment, durable goods, business investment, output and hours worked). AIC is used for lag selection for each VAR regression. We take natural log for household investment, residential investment, durable goods, business investment, output and hours worked. A variable that Granger-causes another variable at 5% significance level is indicated in bold using a '$\rightarrow$' in the last column.

Table 5: Regression of output on lags on output and household investment, without ICE and with ICE

	ΔY_{t-1}	ΔY_{t-2}	ΔHI_{t-1}	ΔHI_{t-2}	ICE_{t-1}	ICE_{t-2}	Constant	N	$\bar{R}^2$
				Panel I: one-lag specifications					
1	0.049		0.121***				0.004***	229	0.243
	(0.073)		(0.019)				(0.0006)		
2	-0.051		0.113***		0.0002***		-0.008*	229	0.295
	(0.074)		(0.018)		(0.00004)		(0.003)		
				Panel II: two-lags specifications					
3	-0.043	0.134	0.120***	0.025			0.003***	229	0.269
	(0.077)	(0.072)	(0.019)	(0.020)			(0.0006)		
4	-0.110	0.082	0.107***	0.025	0.0002***	0.0001	-0.006*	229	0.307
	(0.077)	(0.075)	(0.019)	(0.020)	(0.0001)	(0.0001)	(0.003)		

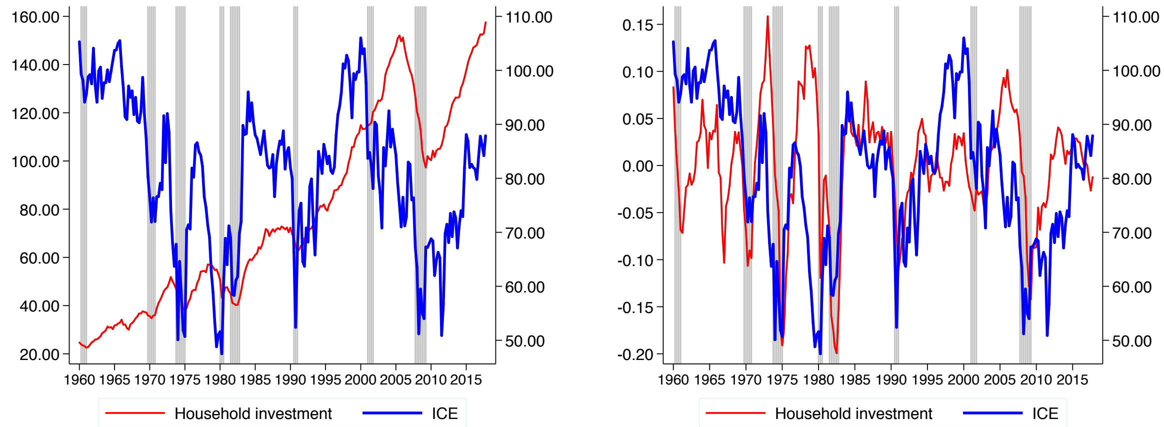
Note: We use ordinary least square method for the regressions. In specification 1, we regress output (Y) growth, on the first lag of output and household investment (HI) growth, respectively. In specification 2, we add the first lag of ICE to specification 1. In specification 3, we regress output (Y) growth, on two lags of output and household investment (HI) growth, respectively. In specification 4, we add the two lags of ICE to specification 3. Standard errors are in parenthesis. N denotes the number of observations. The standard errors are shown in () brackets and p-values are indicated as follows: $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Cross-correlations and covariance ratios between household investment and output conditional on shocks

	$j=-4$	-3	-2	-1	0	1	2	3	4
Panel I: Conditional cross-correlations based on ICE shocks									
$Corr(HI_t, Y_{t+j}\|ICE^{shock})$	0.686	0.746	0.803	0.855	0.895	0.914	**0.916**	0.907	0.891
Panel II: Conditional cross-correlations based on ICE shocks (ICE ordered last)									
$Corr(HI_t, Y_{t+j}\|ICE^{shock})$	0.731	0.773	0.812	0.845	0.873	0.891	0.900	**0.903**	0.901
Panel III: Conditional cross-correlations based on all shocks except ICE									
$Corr(HI_t, Y_{t+j}\|Other^{shocks})$	0.182	0.284	0.397	0.510	0.616	0.670	**0.682**	0.668	0.640
Panel IV: Conditional cross-correlations on ICE shocks (larger VAR)									
$Corr(HI_t, Y_{t+j}\|ICE^{shock})$	0.584	0.679	0.768	0.847	0.905	**0.929**	0.925	0.903	0.870
Panel V: Conditional cross-correlations on TFP shocks (larger VAR)									
$Corr(HI_t, Y_{t+j}\|TFP^{shock})$	0.785	0.836	0.879	0.905	0.927	**0.929**	0.916	0.892	0.892
Panel VI: Covariance ratios									
$Cov(HI_t, Y_t\|ICE^{shock})/Cov(HI_t, Y_t)$	33.86%		Baseline VAR						
$Cov(HI_t, Y_t\|ICE^{shock})/Cov(HI_t, Y_t)$	22.22%		Larger VAR						
$Cov(HI_t, Y_t\|TFP^{shock})/Cov(HI_t, Y_t)$	10.66%		Larger VAR						

Notes: Panels I and II present the cross correlations between household investment (HI) in t with output (Y) in $t+j$ conditional consumer confidence shocks in the baseline VAR system for the period 1961Q1 to 2017Q4. The largest correlations are shown in bold. Panel III presents cross correlations conditional on other shocks (except ICE). Panels IV and V show the same for the larger VAR system with five variables in the following order consumer confidence, utilization-adjustment TFP (Fernald (2014)), household investment, hours worked and output. Panel VI shows the covariance ratios which gauge the importance of ICE shocks in accounting for the contemporaneous covariance among household investment and output based on the two VAR specifications, respectively.

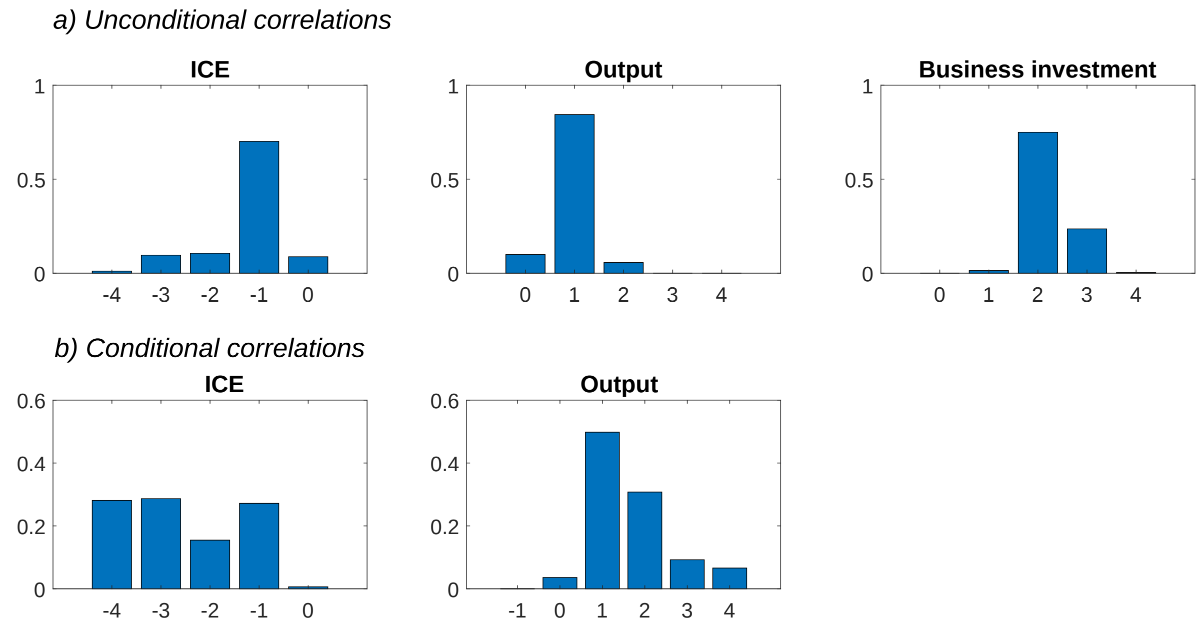
Figure 1: Consumer confidence and household investment



(a) Level **(b)** Cyclical

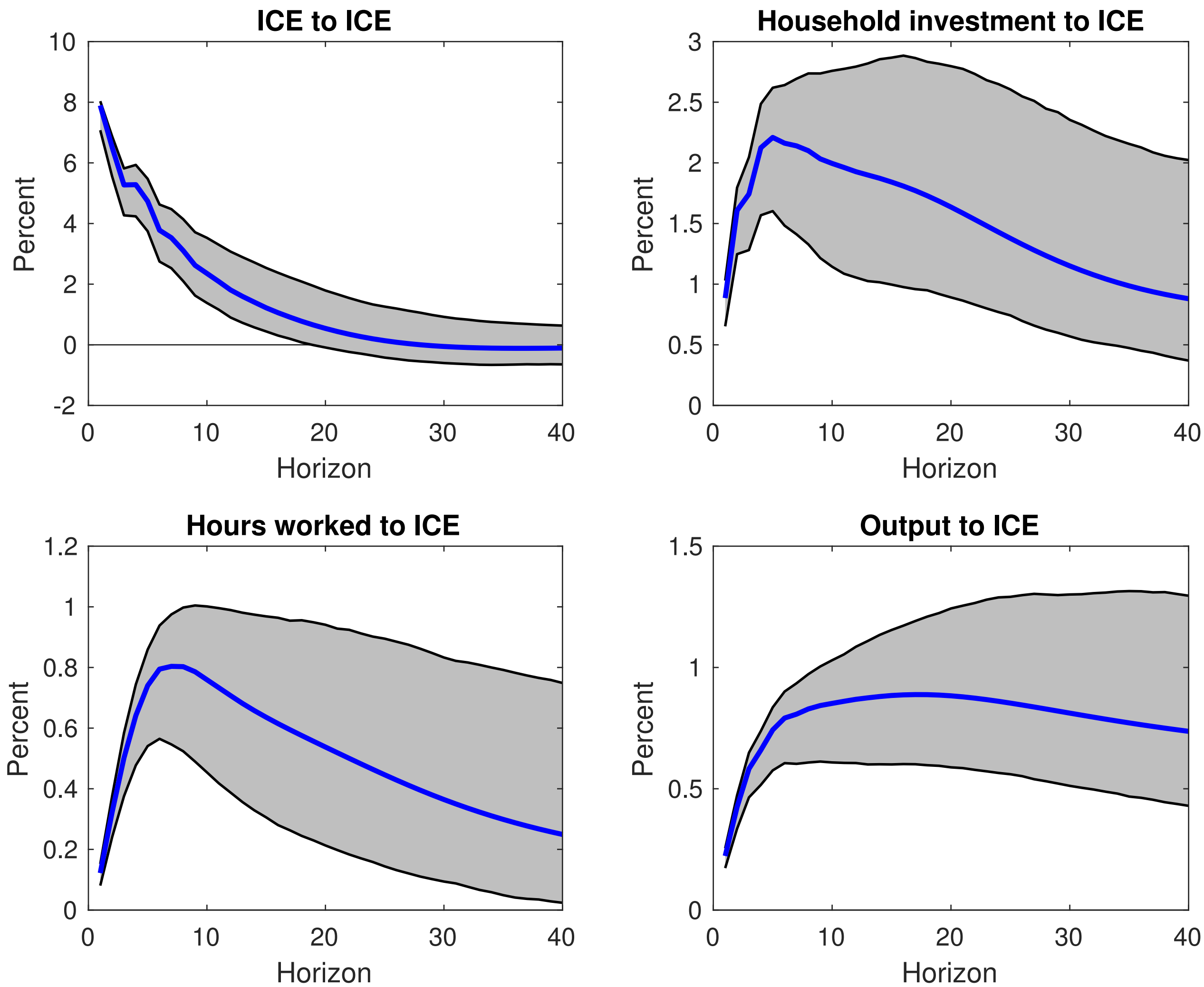
Notes: The NBER recession dates are in grey shading. In Panel (a), the data are in level. ICE and household investment are in right and left scales, respectively. The sample period is 1960Q1 to 2017Q4. In Panel (b), Household investment is logged and de-trended with the HP-filter ($\lambda = 1600$).

Figure 2: The significance of lead-lag patterns of household investment with ICE, output, business investment : a bootstrap procedure



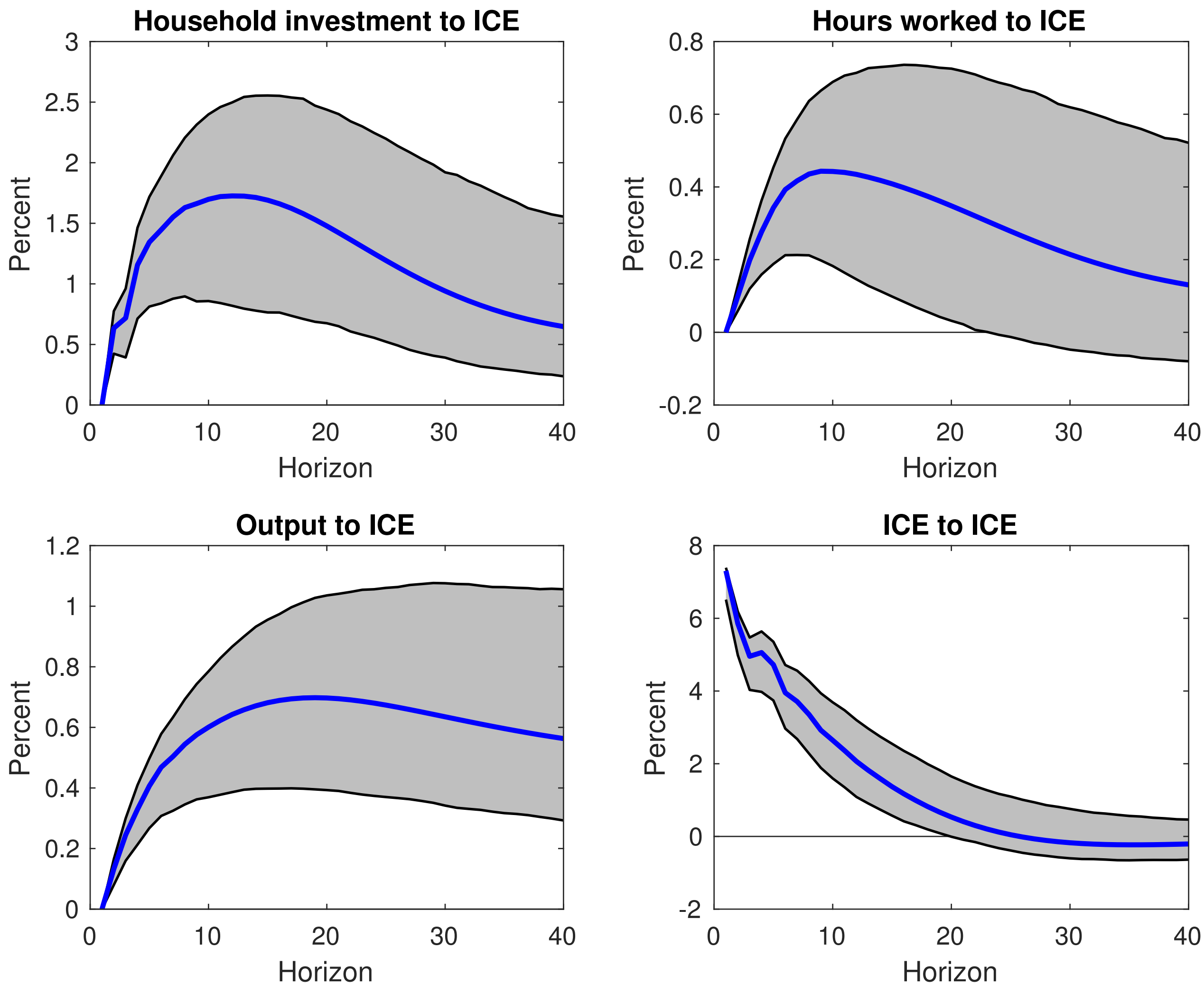
Note: The histogram displays the fractions of 10,000 draws for which each of the displayed variables, namely, ICE, output, and business investment, is either leading (negative lags), neither leads nor lags (0 lag) or is lagging (positive lags). In Panel (b), correlations are conditional on the ICE shock estimated in Section 4.2.

Figure 3: Responses to a one standard deviation consumer confidence shock (ICE ordered first)



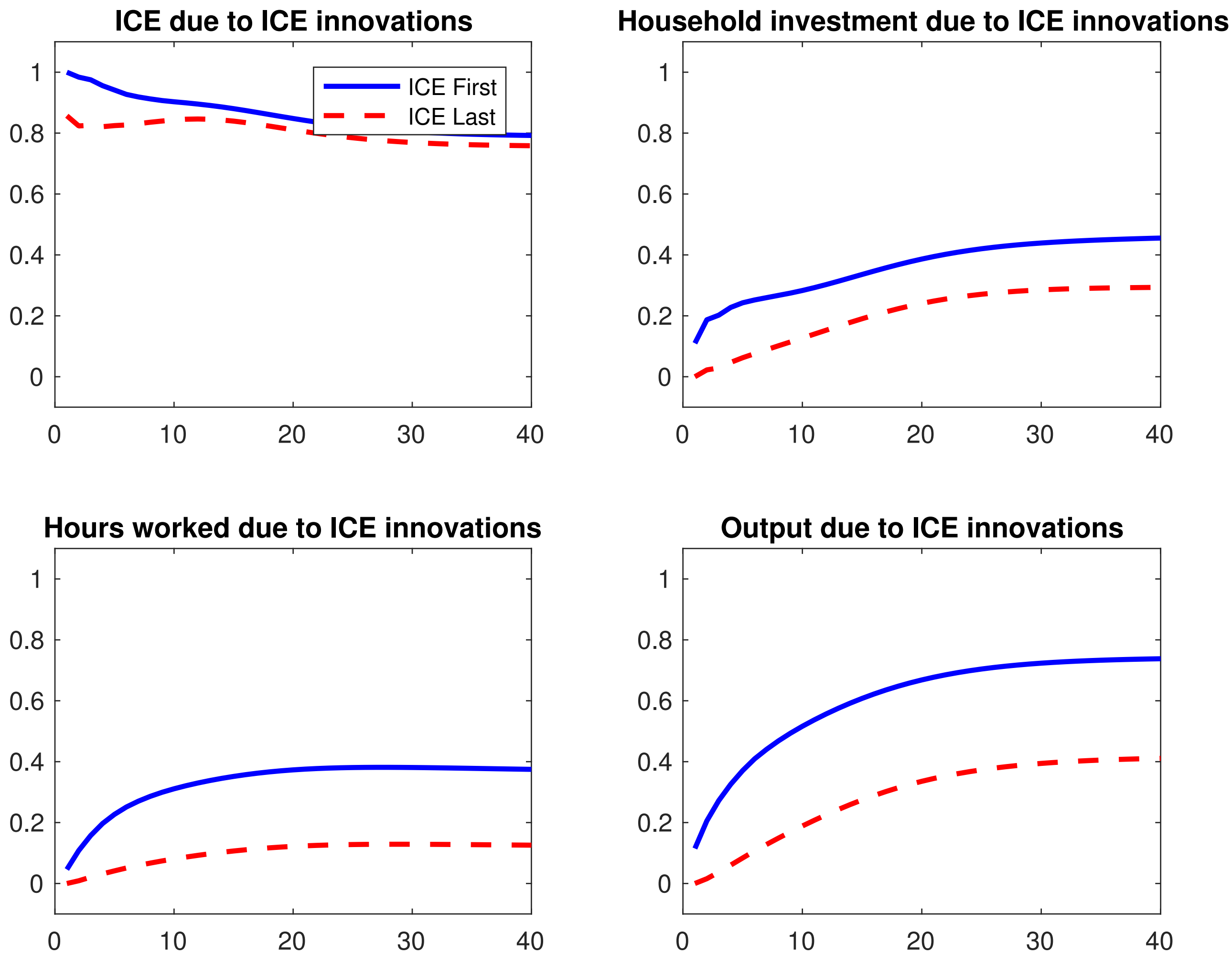
Notes: These are IRFs from a four-variable VAR with ICE, household investment, hours worked and output based on Cholesky identification. ICE is ordered first in the VAR. The grey shaded areas are one standard error confidence bands constructed using Kilian (1998)'s bias-corrected bootstrap after bootstrap procedure. The sample period is 1960Q1 to 2017Q4.

Figure 4: Responses to a one standard deviation consumer confidence shock (ICE ordered last)



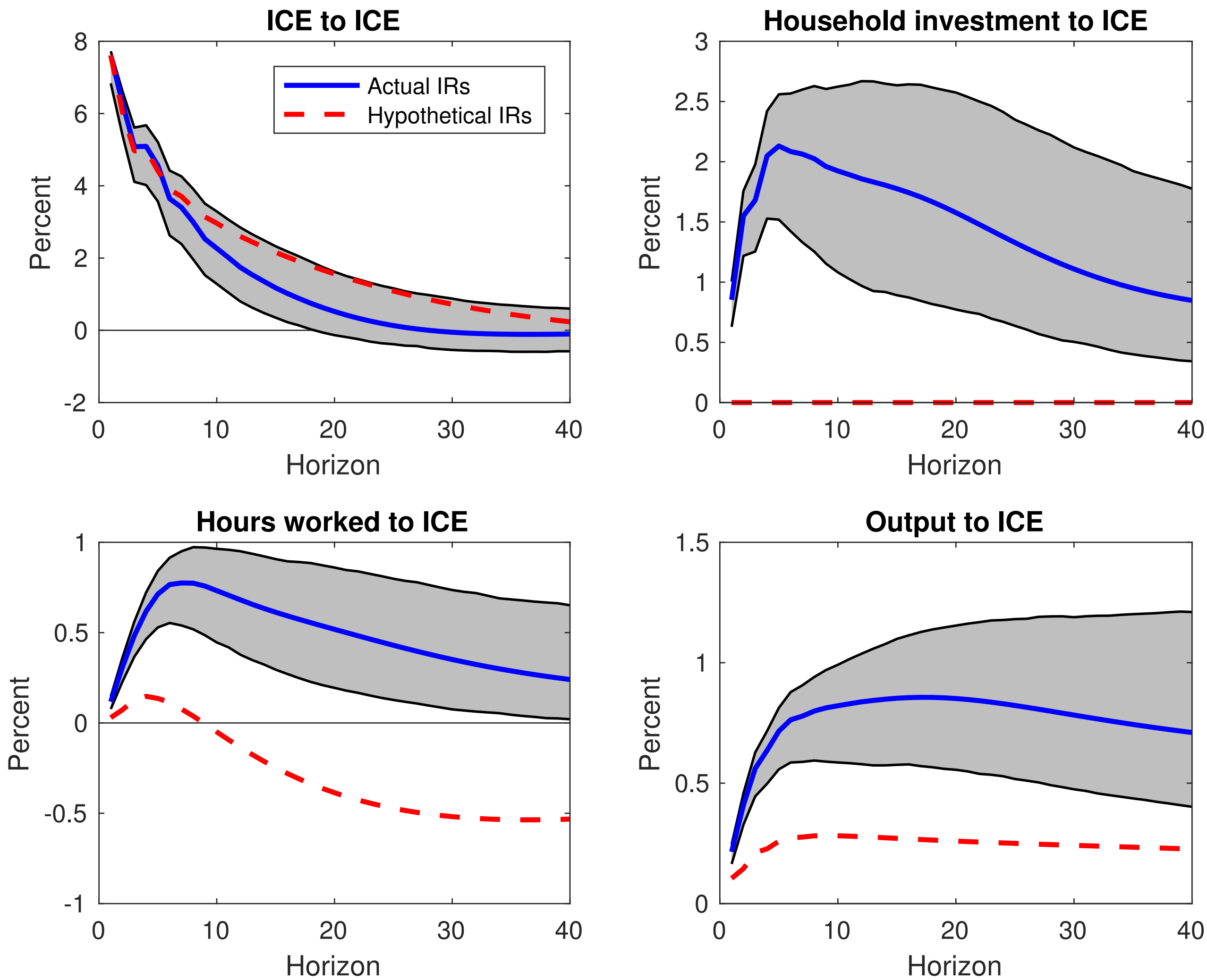
Notes: These are IRFs from a four-variable VAR with ICE, household investment, hours worked and output. ICE is ordered at last in the VAR. The grey shaded areas are one standard error confidence bands constructed using Kilian (1998)'s the bias-corrected bootstrap after bootstrap procedure. The sample period is 1960Q1 to 2017Q4.

Figure 5: Forecast error variance decomposition of confidence shocks



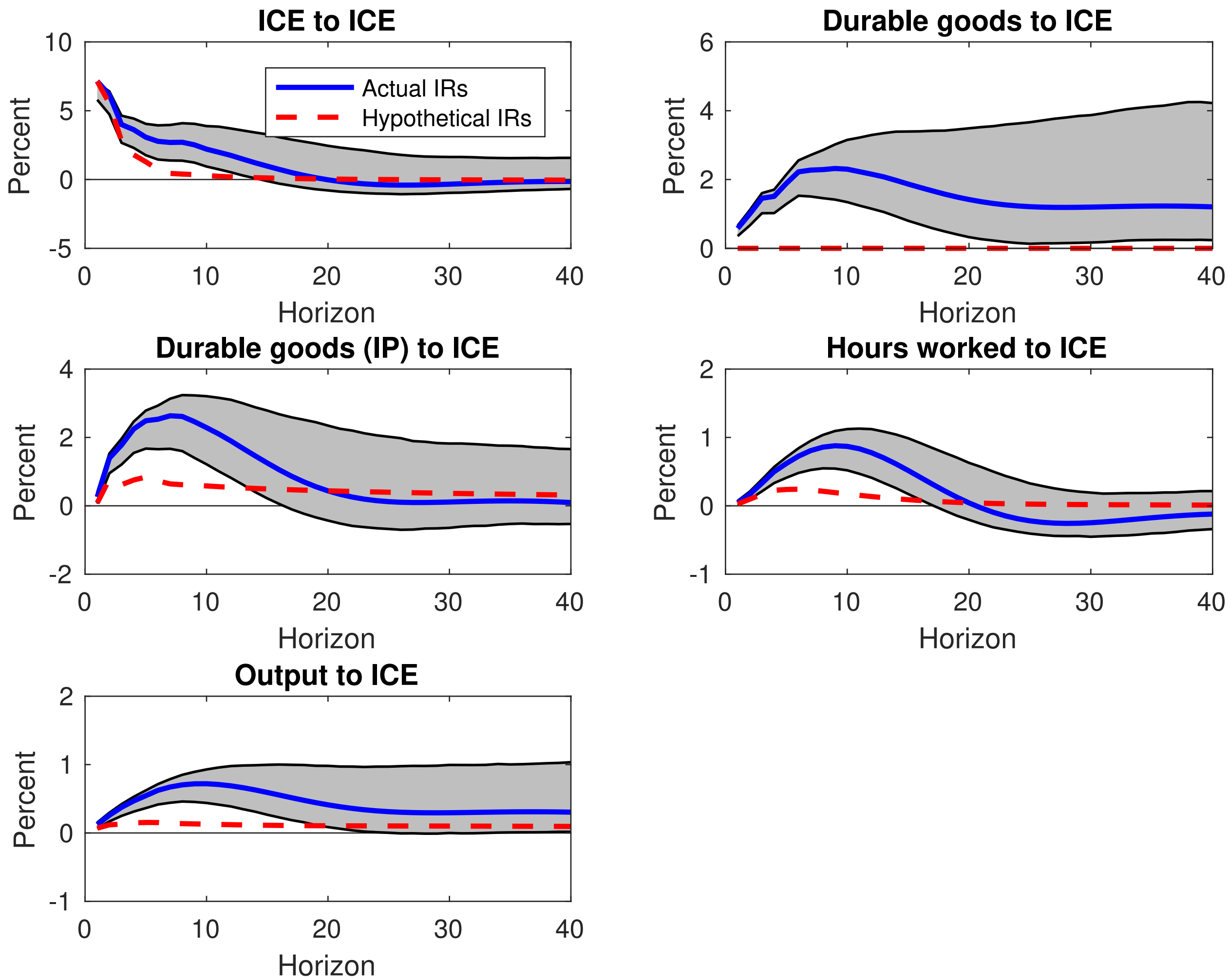
Notes: This figure plots variance decompositions from the four-variable VAR whose impulse responses are shown in Figure 3 and Figure 4 under both orderings. The sample period is 1960Q1 to 2017Q4.

Figure 6: Responses to one standard deviation consumer confidence shock: the role of household investment in the transmission channel



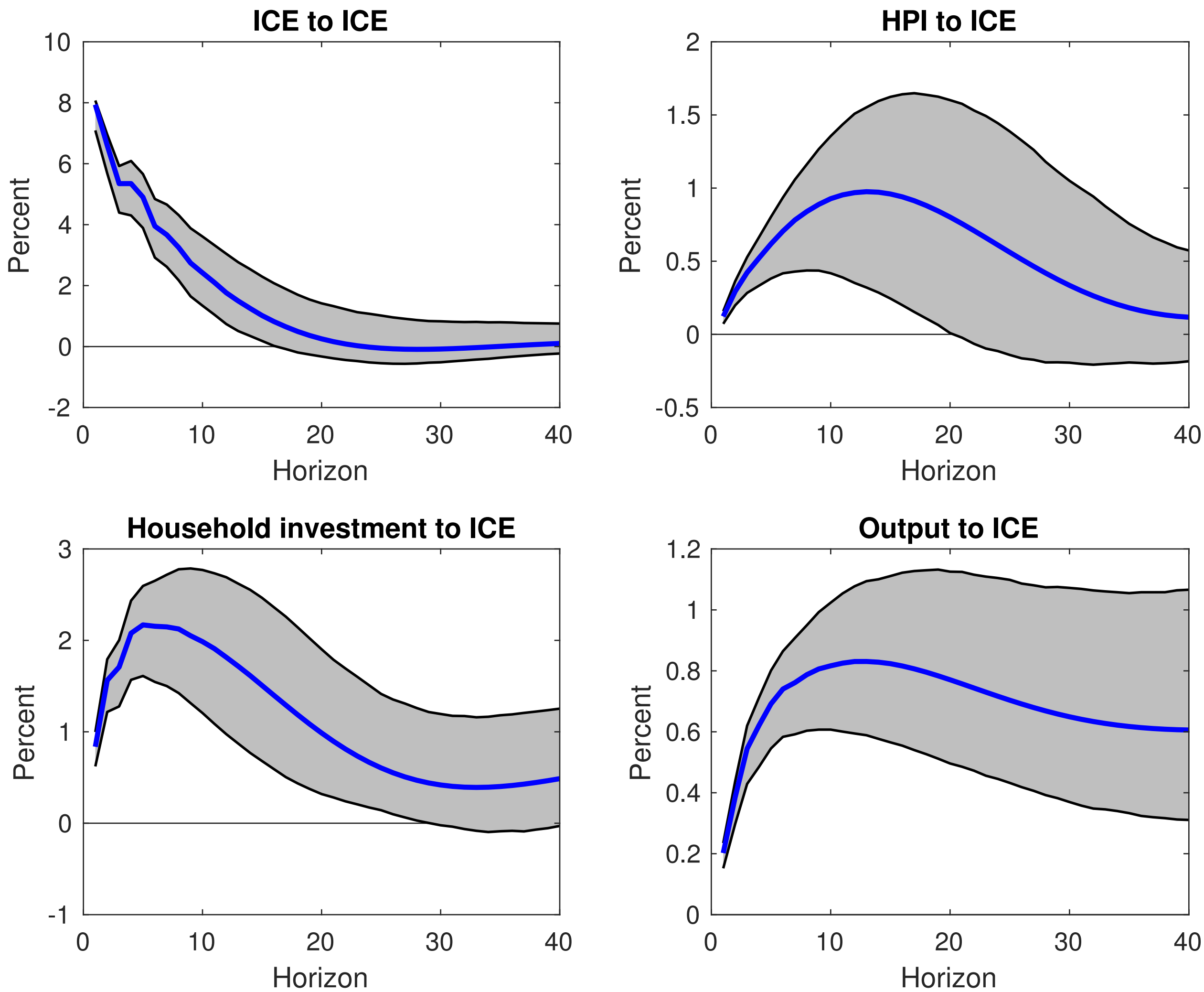
Notes: These are IRFs from a four-variable VAR with ICE, household investment, hours worked and output. The solid lines are actual impulse responses. The grey shaded areas are one standard error confidence bands constructed using Kilian (1998)'s the bias-corrected bootstrap after bootstrap procedure. The sample period is 1960Q1 to 2017Q4.

Figure 7: Responses to a one standard deviation consumer confidence shock: durable goods



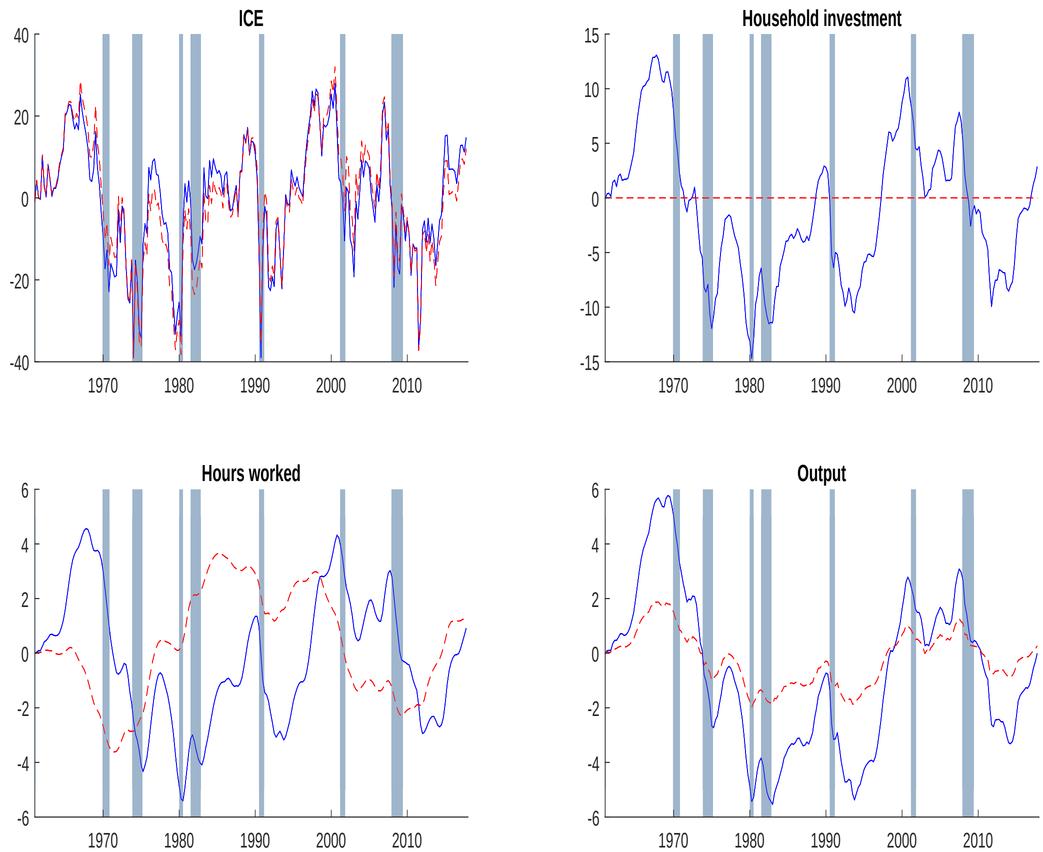
Notes: These are IRFs from a five-variable VAR with ICE, durable goods, durable goods industrial production, hours worked and output. The solid lines are actual impulse responses. The grey shaded areas are one standard error confidence bands constructed using Kilian (1998)'s the bias-corrected bootstrap after bootstrap procedure. The sample period is 1985Q1 to 2017Q4.

Figure 8: Responses to a one standard deviation consumer confidence shocks: Real house prices



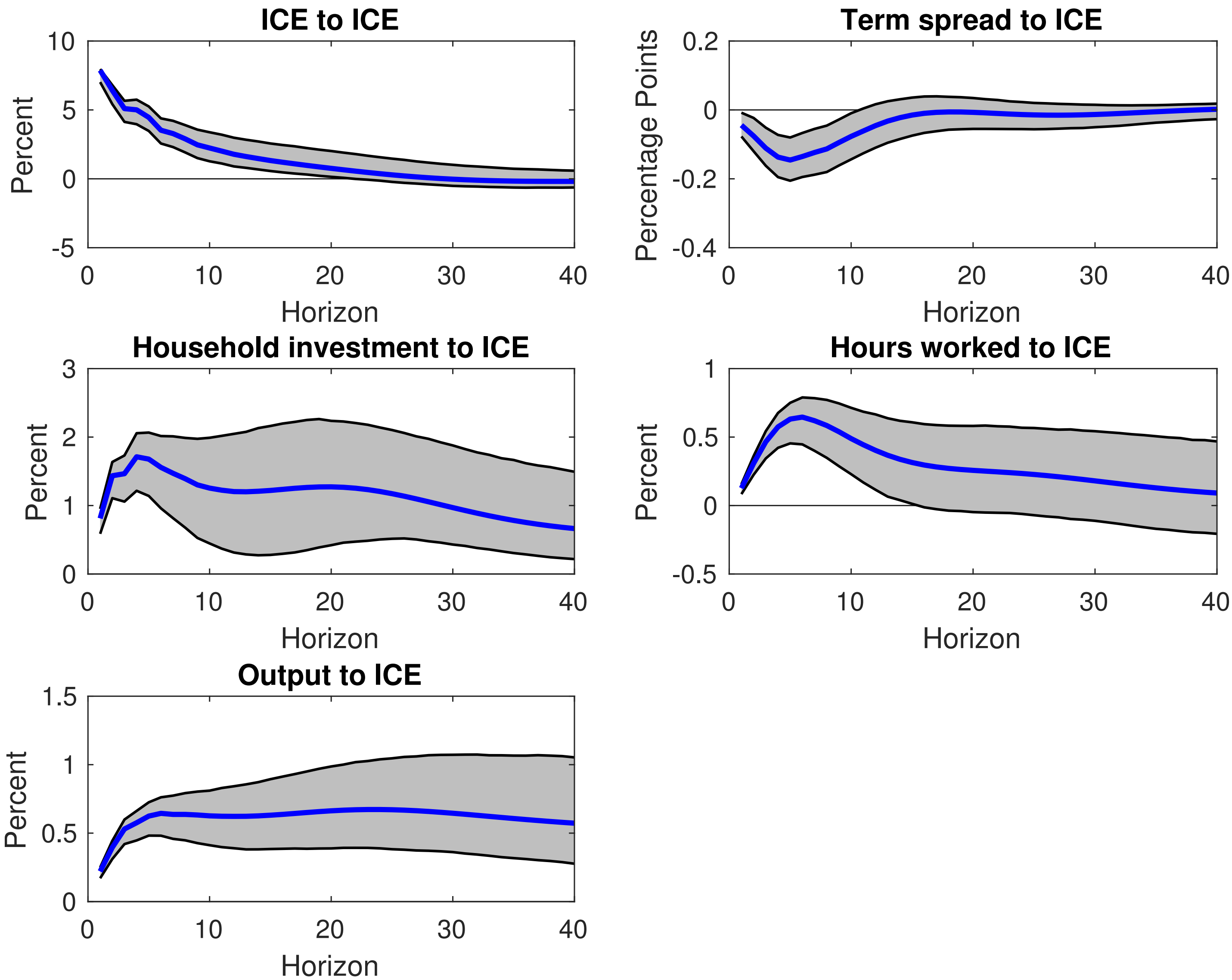
Notes: These are IRFs from a four-variable VAR with ICE, real home price index, household investment and output. The grey shaded areas are one standard error confidence bands constructed using Kilian (1998)'s the bias-corrected bootstrap after bootstrap procedure. The sample period is 1960Q1 to 2017Q4.

Figure 9: Historical simulation of ICE shocks



Notes: The blue solid lines are the simulated series conditional on ICE shocks being the only source of exogenous disturbances. These ICE shocks correspond to the ICE residuals obtained from a four-variable VAR with ICE, household investment, hours worked, and output. The red dashed lines are the constrained simulated paths that we construct by feeding the same four-variable VAR system with household investment shocks that eliminate all fluctuations in household investment. The sample period is 1960Q1 to 2017Q4.

Figure 10: Responses to a one standard deviation consumer confidence shock



Note: These are IRFs from a five-variables VAR with ordering ICE, term spread, household investment, hours worked and output based on Cholesky identification. We take natural log for all variables except for term spread. The grey shaded areas are one standard error confidence bands constructed using the bias-corrected bootstrap after bootstrap. The sample period is 1960Q1 to 2017Q4.