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"Financial and Macroeconomic Uncertainties and Real Estate Markets"

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Abstract

We study the effect of macroeconomic and financial U.S. uncertainty shocks on international housing markets using a multi-country FAVAR model. This approach allows the identification of the effects of different sources of uncertainty on the global economy by imposing natural contemporaneous restrictions on the data generating process, which cannot be used within a single-country perspective. We find that financial uncertainty has an immediate negative effect on most REIT markets around the world lasting between one and three quarters. The effect of macroeconomic uncertainty is diverse. Various countries do not experience a negative effect on REIT markets. Some countries even show a positive response about a year after, suggesting housing markets outside the U.S. may benefit from increases in U.S. uncertainty, arguably due to the investment diversification opportunities they offer during times of economic distress in the U.S. The response of credit to uncertainty shocks resembles the response of REIT returns, but in a lower magnitude. This finding suggests that while housing markets and credit have important feedback mechanisms, housing markets respond also directly to financial uncertainty developments through the expectations channel.

JEL classification: R31, D80, E44, F21, F44, G15.

Keywords: Uncertainty, Housing markets, REITs, FAVAR model.

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1. Introduction

Uncertainty affects housing markets. Real estate developers face uncertainty about their sales and interest risk with their loans. Consumers bear the risk of negative income shocks that can threat their loan repaying capacity and of sharp collateral depreciations. Banks and other lenders may also react forcefully to uncertainty, constraining mortgages to riskier borrowers when uncertainty spikes.

While the potentially powerful impact of generalized uncertainty on shaping economic decisions has long been understood, there is still much to be learned about the effect of different sources of uncertainty (macroeconomic, financial, or policy) on distinct markets and on their main transmission channels. Importantly, the effect of uncertainty on housing markets has not been deeply explored. Existing evidence shows that uncertainty affects housing markets. For instance, Dorofeenko et al. (2014) show that uncertainty shocks can explain the U.S. housing price volatilities, and Strobel et al. (2020) find that uncertainty shocks adversely affect housing prices but not the quantities that are traded in the U.S. Miles (2009) reports that an increase in uncertainty reduces housing starts and housing investment. André et al. (2017) provide evidence on the predictability of national house prices in the US based on the information content of macroeconomic uncertainty. These results go in line with those of the macroeconomics literature, which has gathered substantial evidence documenting a negative relationship between economic activity and macroeconomic uncertainty (e.g., Baker et al., 2016; Berger et al., 2020; Nicholas Bloom, 2009, 2014; Nicholas Bloom et al., 2018; Nick Bloom et al., 2007; Jurado et al., 2015; Nakamura et al., 2017; Nguyen Thanh et al., 2020; Segal et al., 2015)

Various gaps on the relation between uncertainty and housing markets are yet to be filled. On the one hand, the question is open on which type of uncertainty matters more for housing markets, i.e., regarding financial or macroeconomic conditions. On the other hand, more work must be done regarding identification issues. Specifically, modeling the causal effects of uncertainty on housing markets is challenging. Few papers have studied the effect of U.S. uncertainty on housing markets. While specific measures of housing market uncertainty have been recently developed (Nguyen Thanh et al., 2020), it can be argued that a country's housing market directly and indirectly affects that country's uncertainty measures. For instance, housing is the main component of household wealth. Shocks affecting this market are rapidly

transmitted to other markets (Martínez-García and Grossman 2020) and affect both financial and macroeconomic uncertainty.

We contribute to the literature by studying the effect of macroeconomic and financial U.S. uncertainty shocks on major international housing markets. Arguably, these uncertainty measures are contemporaneously exogenous to the selected housing markets, allowing for a better identification of causal effects. Our multi-country approach allows identifying the effects of different sources of uncertainty on the global economy, by imposing natural contemporaneous restrictions on the data generating process which cannot be used within a single-country perspective. It also considers international common cycle factors that have been previously identified and which are key to adequately measure the dynamics induced by uncertainty shocks on housing markets on a global basis. By resorting to a multicounty perspective, which is novel to the literature[5], we contribute to the understanding of the relationship between macroeconomic and financial uncertainty and real estate markets. We are able as well to shed new light about the likely mechanisms determining cross-border uncertainty transmission, which include the international credit markets view, the expectations view that threats investment in housing as a real option, the mechanism that ties together macroeconomic uncertainty and uncertainty about future income, and the portfolio view of real estate markets, that emphasizes the potentially positive effects on international (and local) basis that an uncertainty shock may have on prices, under a relatively fixed supply and given important differentials on the exposure to uncertainty of real estate and other kinds of assets.

An interesting feature of real estate markets is that inventories play a special role which is specific to these markets. During economic downturns, owners tend to delay the selling process to avoid suffering considerable short-selling losses. Therefore, the effect of uncertainty shocks on prices may be delayed. Studies have shown that returns from equity REITs are highly correlated with property prices but offer the informational advantage of responding more rapidly to market shocks (Niskanen and Falkenbach 2010; Highfield et al. 2015). We therefore use quarterly information on market returns from thirteen major equity REIT markets between 1990 and 2015.

[5] Authors such as El-Montasser et al. (2016) employ in their estimations seven advanced markets, but the emphasis is on the bidirectional (Granger) causality within countries, which is different to our approach. Indeed, these authors' approach does not allow identifying a causal relationship, but only bidirectional forecasting power between uncertainties and housing markets in the same country.

Estimations are performed using an international multi-country FAVAR model. Country VAR estimations are performed and international factors describing the cross-country interplay of business, financial, and housing cycles around the world are included in each estimation. Individual VAR models include data on U.S. uncertainty (macroeconomic and financial), REIT returns, credit, output, prices, and interest rates. Moreover, due to the international nature of uncertainty shocks, two global factors are included. The cross-national nature of our dataset permits imposing exogeneity restrictions on the timing of the effect of uncertainty on domestic variables. Indeed, US uncertainty shocks are assumed to be contemporaneously exogenous from the perspective of other individual countries.

Our empirical results indicate that uncertainty shocks significantly affect REIT returns. While effects are heterogeneous, some interesting features are identified. First, financial uncertainty shocks have an immediate negative effect on most REIT markets (except for Switzerland), lasting between one and three quarters. No significant rebound is observed, indicating that the total effect of these shocks is negative and temporary. In contrast, the effect of macroeconomic uncertainty on REIT markets is diverse. On the one hand, various countries do not experience a negative effect after the occurrence of a macroeconomic uncertainty shock. On the other hand, some countries even show a positive response about a year after the occurrence of the shock. This suggests that REIT and housing markets outside the U.S. may benefit from increases in U.S. uncertainty, arguably due to the investment diversification opportunities they offer during times of economic distress in the U.S. Interestingly, the response of credit to uncertainty shocks is like the response of REIT returns, but its magnitude is lower. This finding suggests that housing markets and credit have important feedback mechanisms. However, housing markets are also affected by financial uncertainty directly through the expectations channel.

The rest of the study is organized as follows. Section 2 presents the main mechanisms that have been identified in the literature as important drivers of uncertainty shocks to multinational real estate markets. Section 3 presents a brief overview of the evolution of REIT markets over time. Section 4 describes the data used in this study. The fifth section is methodological. The sixth section presents the main estimation results from our international multi-country FAVAR model. The last section concludes.

2. Uncertainty, real estate markets, and the international transmission of shocks

There are four main ways through which uncertainty impacts real estate markets within and beyond the frontiers of the domestic economy. This section presents them schematically. The effects of uncertainty are initially exposed in the context of a single economy (see for instance Choudhry, 2020). Subsequently, this traditional view is linked with the recently developed literature on international economics for shaping the mechanisms through which uncertainty spillovers from the U.S. affect housing markets globally.

a. From uncertainty to real estate markets, the domestic economic view

On the one hand, according to the expectations channel or the so-called option-value channel, large uncertainty innovations may cause real estate developers to postpone new construction, thus reducing supply. According to this view, firms and households collect new information permanently because they worry about the irreversibility costs involved in the investment process when buying a home. From this point of view, investing in housing is not different than investing in other real projects with high initial costs and irreversibility, and therefore there exists a real option value for investment (Bernake, 1983; Bloom, 2009; Pindyck, 1991). This first mechanism is related to the option value and therefore to the ability of economic agents to construct expectations about the future. Naturally, this ability decreases as uncertainty increases, hence producing delays in new construction projects when uncertainty peaks, as those documented by Bulan et al. (2009).

Second, increased uncertainty about future income might cause households to postpone the home-buying decision. After all, buying a home is one of the most important financial decisions a household makes in its life and entails large transaction and search costs (André et al. 2017). It is known that variations in household income and house prices affect the tightness of households' borrowing constraints (Chen, Michaux, and Roussanov 2020). Housing demand therefore depresses when uncertainty about future income and employment status triggers. Households respond to large income uncertainty by increasing precautionary savings (Giavazzi and McMahon 2020). The tendency of households to respond by reducing consumption of durable goods in the face of uncertainty has been thoroughly documented by Romer (1990) and by many others after her (Bloom, 2014).

Third, the loan and credit channel proposes that increments in uncertainty lead lenders to reduce or deny mortgages to riskier borrowers. Uncertainty about income raises fears among lenders, due to a higher probability of default on mortgages and foreclosures. According to this view, the ability of firms and households to raise capital and finance their investment initiatives is considerably reduced as the creditors tend to expect higher rates of return or simply deny them access to credit. Ball et al. (2009) document for the UK that credit approval processes under uncertainty tend to create further disparity between supply and demand.

In times of high uncertainty and market distress, the combination of these mechanisms causes sharp slowdowns in demand and real estate prices (Ramcharan 2017). However, other studies argue the effect can be the opposite. Concretely, when the inelastic supply of housing is considered, spikes in uncertainty may as well result in higher demand for houses, which in turn, inflate house prices (El-Montasser et al., 2016). This can also be the case if demand for other assets is more sensitive to uncertainty than demand for houses. This channel emphasizes the financial nature of real estate assets, and therefore we refer to this channel hereafter as the portfolio channel.

b. From domestic uncertainty to international markets

The mechanisms exposed above can also operate in international markets. For instance, Fernández-Villaverde et al. (2011) show that when increases in uncertainty in the U.S. are interpreted as a signal of future higher domestic vulnerability in other countries, this large domestic uncertainty may lead to larger precautionary savings in affected countries reducing domestic demand. This mechanism is in line with recent claims by Cesa-Bianchi et al. (2020) according to whom uncertainty must be modeled as a global phenomenon, instead of using a local approach, because common uncertainty shocks to all countries dominate the evolution of domestic markets well above regional and local forces.

In the same line, the literature has extended the credit channel of monetary policy, and the transmission of credit shocks across different countries and markets. For instance (Bruno and Shin 2015b; 2015a) emphasize on the role of financing costs of banks, which are closely tied to the reference policy rate. Hence, if the cost of funding affects decisions on how much risk-exposure a bank is willing to take, monetary policy and other financial shocks, including uncertainty in the U.S., will affect foreign credit markets alike. Baskaya et al. (2017) document that an improvement in global financial conditions leads to lower borrowing costs and

therefore an increase in local lending, while the opposite can be expected from an increase in uncertainty, which is usually associated with a deterioration of financial conditions. Other studies have examined whether credit shocks are transmitted by international banks (Cetorelli and Goldberg 2011), foreign banks' lending elsewhere (Ivashina, Scharfstein, and Stein 2015; Bräuning and Ivashina 2020) or by domestic banks borrowing from foreign banks (Baskaya et al. 2017). Finally, studies on the international transmission of housing market bubbles (Gomez-Gonzalez et al., 2018, Pavlidis et al. 2016), have shown that several bubbles that developed and burst in various developed countries in the 2000s were caused by the U.S. housing bubble whose burst triggered the Global Financial Crisis of 2008-2010. All the above-mentioned cases highlight the importance of credit conditions for the international transmission of shocks across economies, opening the door for a transmission of uncertainty to real estate markets on a multinational basis as well, following the effect on credit markets.

3. Evolution of REIT markets over time 1990 - 2015

REITs are companies that own, operate or finance income-producing properties. They are a vehicle used by project developers to fund largescale real estate properties, by selling shares to the public. By law, a large percentage of their profits (90% in the U.S.) must be distributed as dividends to shareholders. REITs are not directly taxed on their earnings, but their payments are taxable dividend income to shareholders. This feature makes them an attractive investment alternative relative to regular corporate stocks which are subject to double taxation.

To qualify as a REIT a company must meet various requirements, as investing at least three quarters of total assets in real estate, government bonds or cash, earning most of their gross income from rents, interest on mortgages or real estate sales, and having a minimum number of shareholders five years after their existence. Different types of REITs exist, but most are equity REITs, i.e., trusts specializing in owning certain building types.

In the early 1990s REITs had a remarkable performance making them attractive to global investors (Liu, 2010). In the U.S., the number of publicly traded REITs increased from 130 in 1991 to 199 in 1996, while their market capitalization grew from $13 to $89 billion in the same period (Krewson-Kelly and Thompson, 2016). For several years, and until the housing market meltdown of the Global Financial Crisis, REITs markets around the world developed steadily

propelled by increases in house prices in the residential real estate market. In fact, in 2001 the U.S. price index for residential property was 50% higher than in 1990, and between 2001 and 2006 it rose 50% more. Similar figures were observed in other developed countries' housing markets such as Spain, France, Germany, Portugal, and Japan. Steady price growth was promoted by various factors. On the one hand, the period 2001-2007 was characterized by "coordinated" central bank interest rate reductions and loose monetary policy in developed countries (Amador-Torres et al., 2018). These interest rate cuts motivated a search for yield by global investors who lost appetite for safe treasury bonds, due to their low yields. Additionally, the Dot-com bubble crash of October 2002 eroded investors' confidence in the stock market and motivated their search for alternative investments. Many important market players moved their investments towards alternative asset classes, especially towards investment in real estate markets. On the other hand, the economic slowdown experienced in the developed world led to the implementation of various policies aimed at reactivating aggregate demand, including policies for reactivating housing demand. Mortgage interest rate subsidies, for instance, were implemented in the U.S. and abroad.

Packer et al. (2013) describe the period 2001-2007 as the biggest property boom since the 1920s. The housing market crash of 2007 signified a break point in the history of rapid REIT market growth. The collapse in real estate prices implied a significant reduction in the market value of REIT-owned properties. REIT returns became very volatile. Their volatilities were on average superior to those of stocks and other global financial markets. REIT markets were strongly impacted by the housing market meltdown because, as shown by Boudry et al. (2012) using transaction-based price indexes, the relation between REIT and direct real estate returns is very strong.

The REIT and housing market crises lasted until 2010. After that year, REIT markets around the world have been growing and developing at good pace. REIT markets are attractive for investors as they offer diversification benefits in large global portfolios as well as tax advantages in most countries. However, market volatility has increased when compared to the volatility levels observed before the Global Financial Crisis.

4. Data

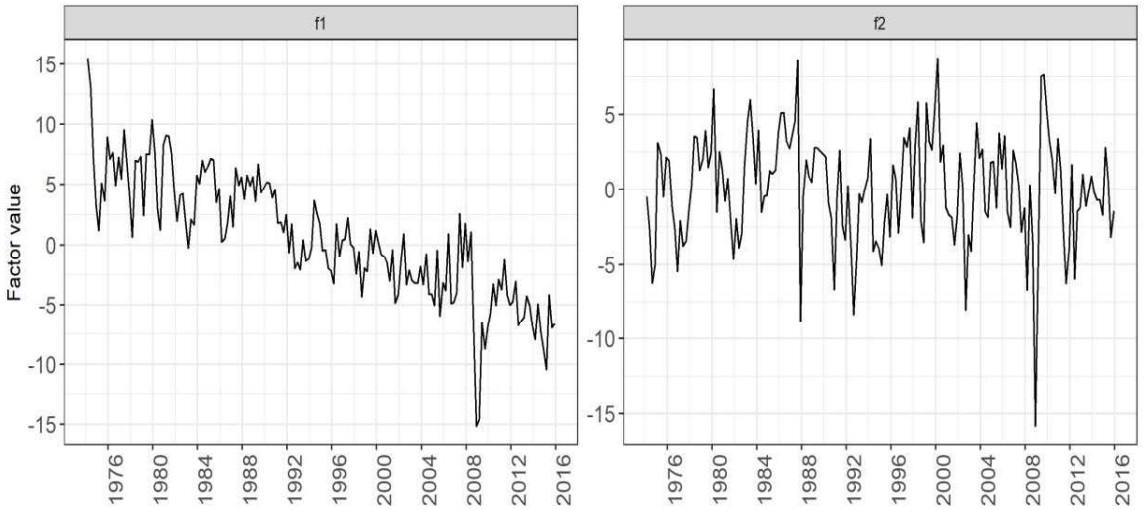
Our sample consists of thirteen developed countries for which quarterly data on REIT equity markets is complete for the period 1990Q1 – 2015Q4[6]. Data from REITs was collected from the European Public Real estate Association (EPRA), represented by thirteen country indexes (Australia, Belgium, Canada, France, Germany, Italy, Japan, New Zealand, Norway, Singapore, Sweden, Switzerland, and The United Kingdom). These indexes are generically denoted by FTSE EPRA NAREIT, followed by the name of the respective country.

The FAVAR also includes information on each country's credit growth, stock prices, economic activity, long-term bond yields and inflation, using the quarterly database recently assembled by Monnet & Puy (2019). Uncertainty indices are estimated as conditional volatilities of the unpredictable component of a set of financial and macroeconomic variables, following Jurado et al. (2015) Ludvigson et al. (2021). Additionally, given the importance of considering the international dimension of uncertainty shocks, we include two global factors that we estimated using all available series for 45 countries in each period at the global level (Figure 1). In all cases we use end of quarter observations for variables with higher frequency in order to match our data series.

Figure 1 shows the behavior of global factors over time. Remarkably, both time series exhibit an important fall around the Global Financial Crisis, as expected. The left-hand side panel shows the first principal component, showing a downward linear trend over time. The second principal component, depicted in the right-hand side panel, presents higher variation and no clear time-trend.

[6] The selected sample period corresponds to the data publicly available at the web page of the European Public Real estate Association (EPRA).

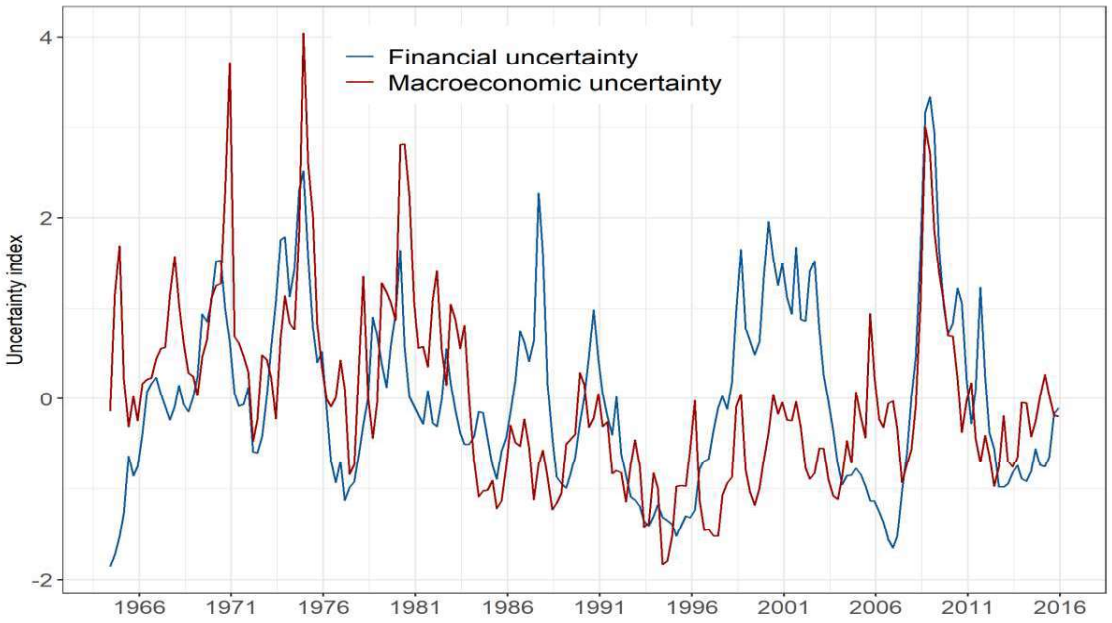
Figure 1: Global factors



Note: the figure shows the two estimated global factors using the first two principal components of the full dataset.

Figure 2 depicts time series for the two uncertainty indices used in this study. Some interesting facts are worth of mention. First, financial uncertainty exhibits higher variation than macroeconomic uncertainty. Second, both series have spikes in times of economic and financial distress. Third, while the highest peaks in macroeconomic uncertainty are reached during the 1960s and 1970s, the highest peak in financial uncertainty corresponds to the Great Recession of 2008 – 2010. Finally, financial uncertainty is more persistent than macroeconomic uncertainty. These facts, which are reflected in a relatively low correlation coefficient (47%) suggest that these two uncertainty measures reflect distinct types of uncertainty and none of them must be used alone as a measure of global (general) economic uncertainty. In this study we include both measures and use dynamic multipliers to study the impact of macroeconomic and financial uncertainty shocks on equity REIT returns.

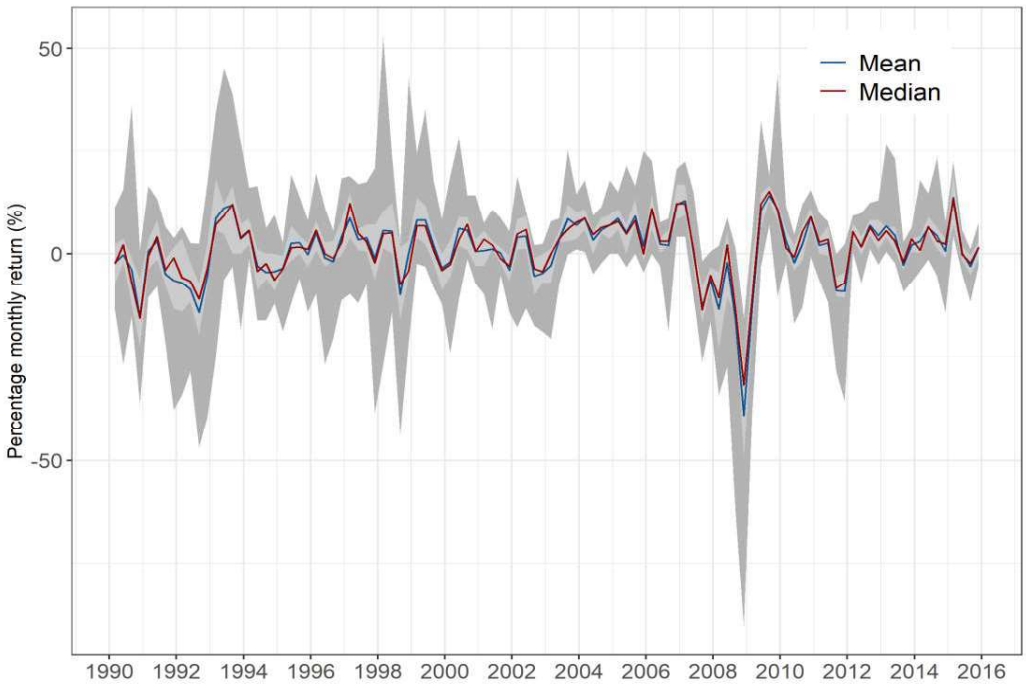
Figure 2: U.S. Macroeconomic and Financial Uncertainty Indices, 1964 – 2015



Note: the figure shows the macroeconomic and financial uncertainty indicators provided by Jurado et al. (2015) and Ludvigson et al. (2020)

Figure 3 shows the distribution of REIT returns for the thirteen countries included in our sample. Mean (blue) and median (red) returns are graphed. Note that both are almost identical over time, with few exceptions in moments of extremely low returns in which mean returns are slightly lower than median returns due to outliers. The dark shaded area corresponds to the range of the distribution at each point in time, while the internal clear shaded area corresponds to returns between the 25th and 75th percentiles of the distribution. While the series of returns shows considerable time variation, clearly dispersion is highest during the Great Recession.

Figure 3: Distribution of Monthly REIT Returns over Time, 1990 – 2015.



5. Methodology

The main objective of this paper is to study the effect of uncertainty on real estate markets. Concretely, the objective is to identify the effect of macroeconomic and financial uncertainty shocks on equity REITs. For a neater identification in which uncertainty shocks are contemporaneously exogenous to REIT market returns, we use measures of U.S. uncertainty that have been recently developed in the literature (Jurado et al., 2015; Ludvigson et al., 2021), using a rich dataset that comprises both real and financial variables. Both indicators seek to encapsulate the unexpected forecasting component of macroeconomic and financial series within a data-rich environment. We test for the effect of the uncertainty indicators on other developed countries' REIT market returns. We employ an international multi-country FAVAR model in which an individual VAR model is estimated for each country. International factors are included in each estimation to link the models one with each other, in a global framework. These factors describe cross-country dynamics of business and financial cycles around the

world and consider the existence of cross-sectional shocks to the dynamics of REIT returns, credit, activity, prices, and other country variables which are affected by these shocks.

a. Multi-country FAVAR model

FAVAR models were first introduced in macroeconomics by Bernake et al. (2005) with the objective of overcoming two main drawbacks of traditional VAR frameworks. First, due to the curse of dimensionality, VAR models allow the inclusion of only a limited number of relevant variables into the model. Therefore, only a limited number of shocks and variable responses can be identified. Second, and more important for this study, VAR models usually lack many controls on the confounding dynamics associated with the included variables, which may result in estimation biases on the subset of the dynamics that is successfully represented. FAVAR models overcome these two important limitations by including a few number of factors that can account for the dynamics of many relevant global variables.

FAVAR models can be easily understood starting from a reduced-form VAR representation for an individual country:

$$Y_{it} = A_i(L)Y_{it-1} + e_{it}, \quad (1)$$

where Y_{it} is an $(M \times 1)$ vector of variables for country $i = 1, \dots N$. $A_i(L)$ is a polynomial in the lag operator of order *d;* e_{it} is a vector of residuals. In this article's application, the variables included in the system are REIT market returns, credit, economic activity, stock prices, inflation, and bond yields. Each country's representation is augmented by the inclusion of a common factor structure that describes multi-country shocks to the same variables across time and countries.

Thus, Y_{it} is a vector of country-specific variables augmented by F_t, a $K \times 1$ vector of unobservable global factors. The multivariate dynamic of (Y_{it}, F_t) is described by:

$$[F_t\, Y_{it}\,] = A_i(L)[F_{t-1}\, Y_{it-1}\,] + V_{it}, \quad (2)$$

where V_{it} is a vector of zero-mean independently distributed error terms whose covariance matrix is Q_i. Equation 2 corresponds to a multi-country factor-augmented VAR model. This

system cannot be directly estimated as factors are unobservable. The factors to be included in the empirical model must be estimated in a first stage using the method of principal components, the method of singular value decomposition, or the Kalman filter. Regardless of the specific factor estimation method, several time-series of observable variables are used in their estimation. Let these observable variables be collected in X_t, and suppose S factors are to be estimated from these variables. Obviously, the number of factors must be at most equal to the number of observable variables used in their estimation. For estimating the unobservable factors, we follow Bernake et al. (2005) and use a two-step procedure. In the first stage, the common components of the global system, C_t, are estimated using the first K principal components of X_t. The cardinality of K is determined using the criterion proposed by Bai and Ng (2007) to determine the number of dynamic or primitive factors in a large dataset. In the second step, these factors are added to the individual country system, $\hat{F}_t = \hat{C}_t$ (non-orthogonalized factors) or extracted from C_t, the variation explained by the observable factors contained in Y_{it}. The latter is done by taking the residuals of a linear projection of C_t onto Y_{it}, and labelling these residuals as the estimated (orthogonalized) factors $\hat{F}_t$.

Replacing F_t by either of the two versions of $\hat{F}_t$ in Equation 2 permits estimating the model's parameters using ordinary least square regressions. Dynamic multipliers are constructed using the MA representation of the system in equation 2. This representation exists under suitable stationary conditions which are identical to those of the traditional VAR model[7].

b. Structural shocks identification

Equation 3 presents the reduced-form VAR representation in terms of white noise innovations, V_{it}:

$$\left[\hat{F}_t \, Y_{it}\right] = \left[\underline{F_t} \, \underline{Y_{it}}\right] + R_i(L)V_{it}, \tag{3}$$

where $\underline{F_t}$ and $\underline{Y_{it}}$ correspond to the unconditional means of the processes, and $R_i(L)$ is an infinite-order polynomial lag operator. By imposing restrictions on the VAR system, structural innovations can be recovered. Let $\tilde{B}_i$ be a matrix of restrictions. Then $\tilde{B}_i^{-1} V_{it} = \varepsilon_{it}$, and

[7] Such standard conditions can be found, for instance, in Lütkepohl (2006).

hence $R_i(L)\tilde{B}_i = \Phi_i(L)$, where ε_{it} is a vector of dimensions $(M+K)\times 1$, containing structural innovations, and $\Phi_i(L)$ are the structural dynamic multipliers of the system:

$$\left[\widehat{F}_t\, Y_{it}\right] = \left[\underline{F}_t\, \underline{Y_{it}}\right] + \Phi_i(L)\varepsilon_{it}\,. \tag{4}$$

We follow Sims (1980) assuming $\tilde{B}_i$ is a triangular matrix deriving from the Cholesky factorization of the variance-covariance matrix in the reduced form model, Q_i. This approach is natural in our case, as due to the multi-country nature of our estimations we can assume that both the international factors and the uncertainty indicators are contemporaneously exogenous to the rest of the system (to the domestic economy variables). For each country i, $\tilde{B}_i$ is given by:

	c	*g*	*s*	*i*	*p*	*hp*	f_1	f_2	u_f	u_r
c	1	b_{12}	0	b_{14}	0	b16	b_{17}	b_{18}	b_{19}	b_{110}
g	0	1	0	0	0	0	b_{27}	b_{28}	b_{29}	b_{210}
s	b_{31}	b_{32}	1	b_{34}	b_{35}	0	b_{37}	b_{38}	b_{39}	b_{310}
i	b_{41}	b_{42}	b_{43}	1	b_{45}	0	b_{47}	b_{48}	b_{49}	b_{410}
p	b_{51}	b_{52}	b_{53}	b_{54}	1	0	b_{57}	b_{58}	b_{59}	b_{510}
hp	b61	b62	0	b64	0	1	$b6_7$	$b6_8$	$b6_9$	$b6_{10}$
f_1	0	0	0	0	0	0	1	0	0	0
f_2	0	0	0	0	0	0	0	1	0	0
u_f	0	0	0	0	0	0	0	0	1	$b9_{10}$
u_r	0	0	0	0	0	0	0	0	$b10_9$	1

where the variables stand for credit (*c*), real activity (*g*), stock prices (*s*), bond yields (*i*), prices (*p*), REIT returns (re) two international common factors (f_1, , f_2), and two uncertainty factors (u_f, , u_r). The identification strategy assumes both observable (uncertainty) and unobservable (estimated) factors, as well as international common factors, are contemporaneously exogenous to country-specific variables.

Note that our identification strategy relies on the assumption that U.S. uncertainties are contemporaneously exogenous to other housing markets around the world, but feedback effects are allowed by our multinational model to operate in subsequent periods. This is less restrictive than the usual assumption made in the past literature that allows uncertainty to be contemporaneously affected by macro variables but not by real estate variables. Given that

there is not clear theory regarding such an ordering (point emphasized by Nguyen Thanh et al.(2020)), we propose to overcome this important limitation by resorting to an international perspective. This strategy is indeed backed-up by the recent literature that documents a dominant role of the U.S. economy regarding its monetary policy, which significantly influences the commonality of business and financial cycles around the world (see for instance Amador-Torres et al., 2018; Jordà et al., 2019; Miranda-Agrippino & Rey, 2020).

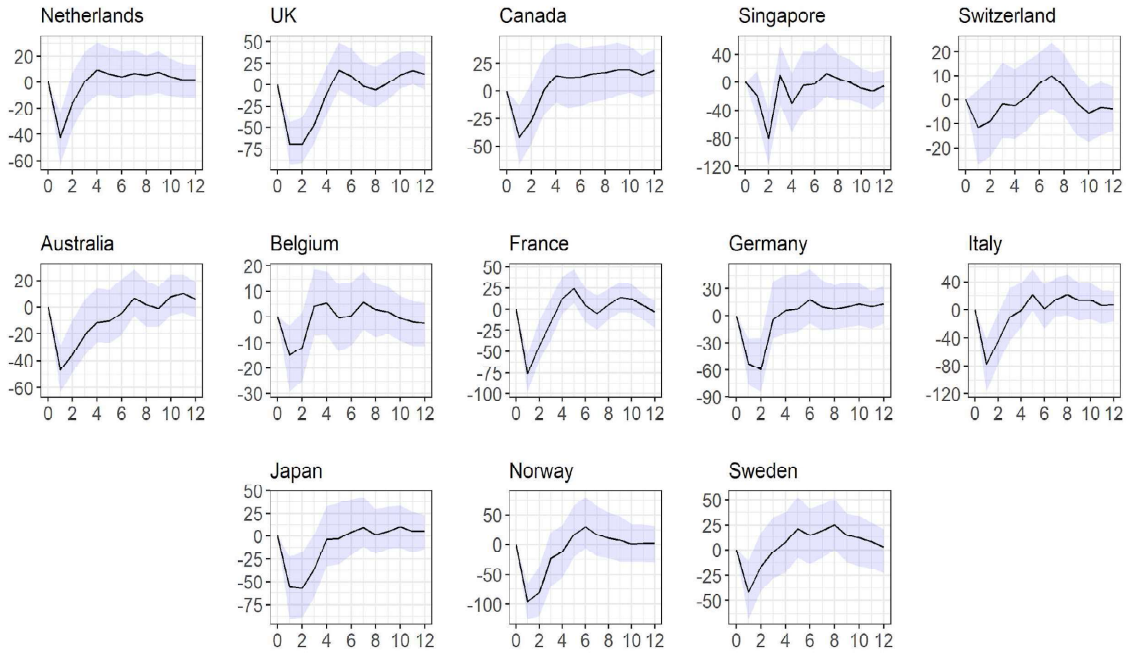
6. Empirical results

We use a FAVAR model to study the effect of macroeconomic and financial uncertainty on equity REIT returns in thirteen developed countries. The model includes other country-specific variables such as credit, output, stock market, interest rate, as well as two global factors, to account properly for occurrence of simultaneous shocks to housing markets over time. The few papers in the literature studying the effect of uncertainty on housing markets do it in the context of a single country, the U.S. Uncertainty measures are built using variables that are closely related to those on which the effect of uncertainty is observed, lifting doubt on the exogeneity of these measures. In our case, we use uncertainty measures estimated using U.S. data and evaluate their effect on other countries' housing markets, allowing a better identification of these effects. Financial and macroeconomic uncertainty indices are used for identifying which type of uncertainty matters more, in each country.

We present our main results in four figures. On the one hand, in Figures 3 we show the dynamics causal effects of a financial uncertainty shock in the REITs of Netherlands, the United Kingdom, Canada, Singapore, Switzerland, Australia, Belgium, France, Germany, Italy, Japan, Norway and Sweden, for which we could assembled a complete data set in our intended sample period. While in Figure 4 we show the responses of credit markets following a financial uncertainty shock in the same countries. Figures 5 and 6 display dynamic causal effects but this time regarding macroeconomic uncertainty. Our results allow us to track not only the impact of uncertainty on housing prices, but also to point-out to likely mechanisms through which uncertainty transits across the global economy. For instance, if the credit channel is important for the transmission of uncertainty shocks, one could expect that after the happening of a financial uncertainty shock, a deterioration of REITs is observed in other countries alongside a

simultaneous deterioration of credit. Macroeconomic uncertainty is arguably more linked to income uncertainty than to the financial channels of uncertainty transmission, and therefore, uncertainty shocks measured using macroeconomic variables would be associated with an increase in uncertainty regarding future economic outlooks and emphasize these mechanisms above the portfolio or credit views.

Figure 4. REITS Response to U.S. Financial Uncertainty Shock

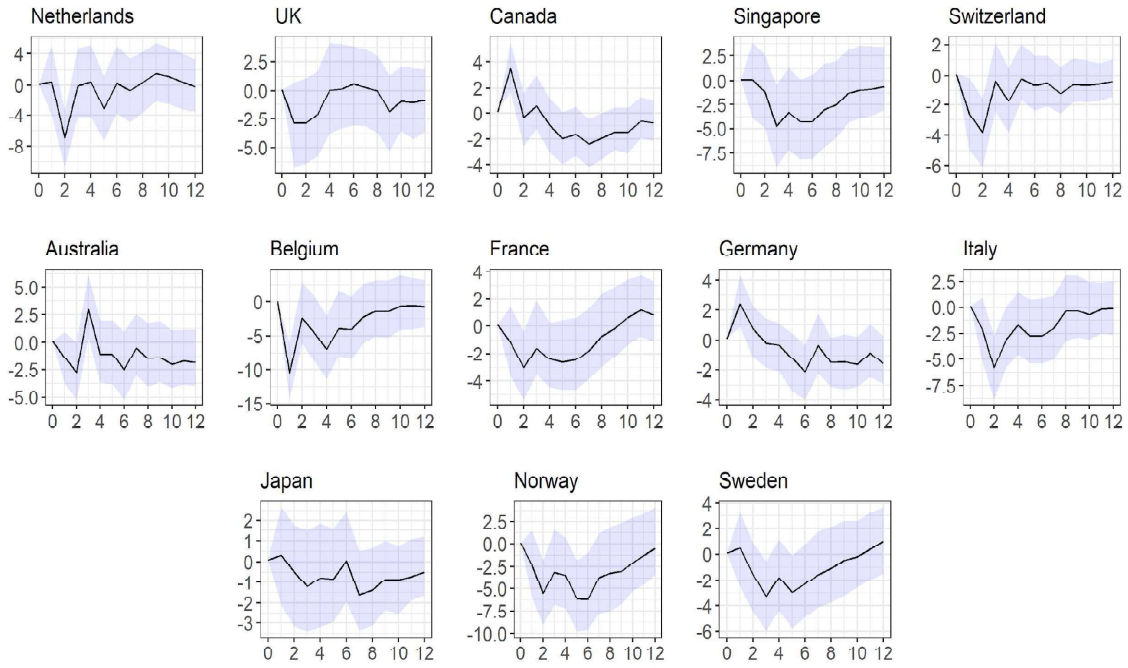


Note: The black line is the mean of the identified IRFs. The horizontal axis is time, measured in quarters. The light-shadow areas are confidence intervals estimated by bootstrapping (16th and 84th percentiles). The estimation period is 1990q1 – 2015q4.

Figure 4 shows dynamic multipliers for the effect of a U.S. financial uncertainty shock on equity REIT returns for our sample of countries. Results are for model specifications in which included factors are orthogonal to each other. No significant differences are observed when non-orthogonal factors are included. The black line in each graph corresponds to the mean value of the dynamic multiplier. The shadowed area comprises confidence intervals estimated by bootstrapping. Every point-value in the confidence interval corresponds to a value between the 16th and 84th percentiles of the distribution. Results indicate that, in all but one country

(Switzerland), REIT market returns diminish immediately after the occurrence of a U.S. uncertainty shock. Responses are especially pronounced for Australia, Germany, France, The United Kingdom, New Zealand, and Norway. Dynamic multipliers show that responses are all temporary, with durations ranging between one and three quarters.

Figure 5. Credit Response to U.S. Financial Uncertainty Shock



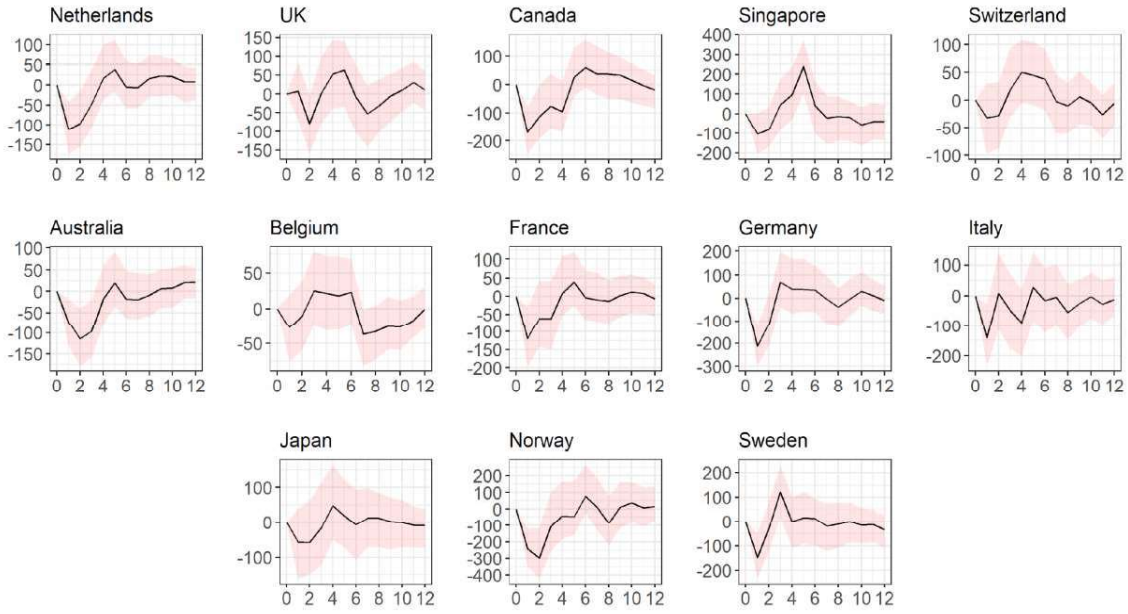
Note: The black line is the mean of the identified IRFs. The horizontal axis is time, measured in quarters. The light-shadow areas are confidence intervals estimated by bootstrapping (16th and 84th percentiles). The estimation period is 1990q1 – 2015q4.

An interesting question deals with the channels through which U.S. uncertainty shocks affect international housing markets. Two transmission channels emerge, namely the credit channel and the expectations channel. On the one hand, U.S. financial uncertainty can affect international credit markets, especially through its impact on bank lending decisions. As shown in Figure 5, the effect of U.S. uncertainty shocks on credit markets is smaller than its effect on REIT markets for the countries in our sample. In various cases the immediate effect is statistically insignificant from a statistical point of view. Therefore, the expectations channel plays an important role. Homebuyers and real estate developers may worry about future credit availability and about future macroeconomic conditions when large uncertainty shocks affect

global markets, reducing the willingness to invest in housing markets. While results of this study do not allow disentangling which channel is more relevant, results suggest that the expectations channel plays a relevant role.

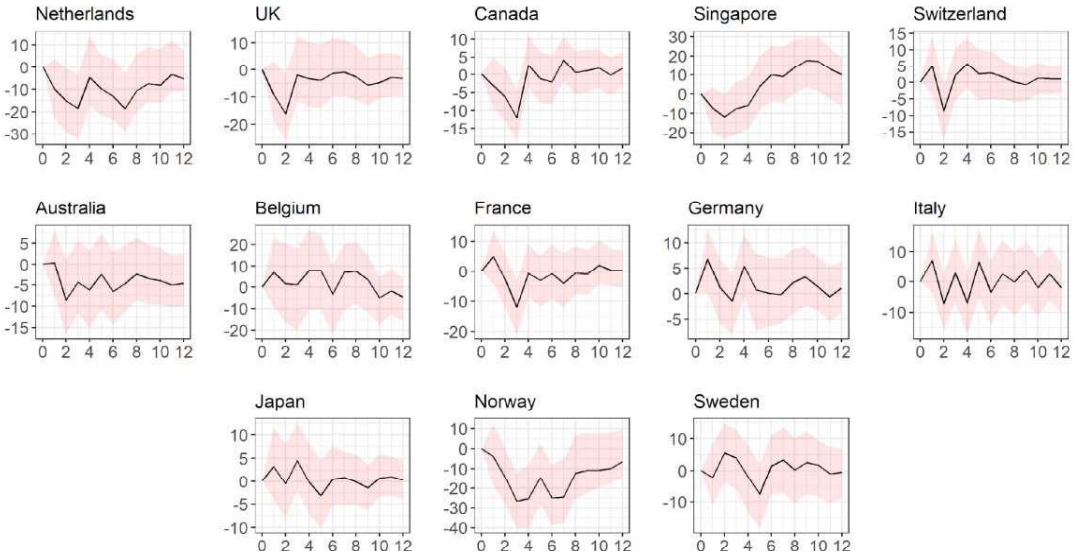
Figure 6 exhibits the response of REIT returns to U.S. macroeconomic uncertainty developments. Interestingly, responses are different in some respects with respect to REIT return reactions to financial shocks. First, immediate responses to macroeconomic shocks are lower and even insignificant in many cases. This result indicates that U.S. macroeconomic uncertainty developments are not initially as relevant as financial uncertainty shocks. Moreover, in some countries the intermediate effect of U.S. macroeconomic shocks is an increase in equity REIT returns. For instance, in Canada and Singapore REIT markets rebound one year after the occurrence of the macroeconomic uncertainty shock. Additionally, in Switzerland REIT markets do not respond to uncertainty shocks in the US at all. This interesting result points-out that international investors can find diversification opportunities within REIT markets when uncertainty shocks occur. Finally, as shown in Figure 7 credit does not respond to U.S. macroeconomic uncertainty developments as strongly as it does when financial uncertainty shocks occur. This result highlights that credit markets are mostly affected by events related to financial uncertainty measures.

Figure 6. REITS Response to U.S. Macroeconomic Uncertainty Shock



Note: The black line is the mean of the identified IRFs. The horizontal axis is time, measured in quarters. The light-shadow areas are confidence intervals estimated by bootstrapping (16th and 84th percentiles). The estimation period is 1990q1 – 2015q4

Figure 7. Credit Response to U.S. Macroeconomic Uncertainty Shock



Note: The black line is the mean of the identified IRFs. The horizontal axis is time, measured in quarters. The light-shadow areas are confidence intervals estimated by bootstrapping (16th and 84th percentiles). The estimation period is 1990q1 – 2015q4.

7. Conclusions

Housing markets are affected by uncertainty, as market participants make long-term decisions based on the current state of financial markets and the economy and on expectations they have on their future development. While the international macroeconomics literature has regained attention for studying the impact of uncertainty on output and credit, much less attention has been given to its impact on housing markets. Few studies have recently appeared, all of them focusing on the U.S.

In this paper we study the effect of two main sources of uncertainty that have been identified in the literature, namely macroeconomic and financial uncertainty, on international housing markets. Our approach offers an important advantage with respect to existing studies. While some uncertainty measures exclude housing market variables, there are several reasons to consider that a country's housing market directly and indirectly affects that country's uncertainty measures. Our multi-country approach allows identifying the effects of different sources of uncertainty on the global economy, by imposing natural contemporaneous restrictions on the data generating process, which cannot be used within a single-country perspective.

Spot prices do not always reflect the true state in housing markets. Real estate sales and development projects can be delayed when uncertainty spikes, and the effect on prices may not occur immediately. We use equity REIT returns instead, which are highly correlated with property prices but offer the informational advantage of responding more rapidly to market shocks (Niskanen and Falkenbach 2010; Highfield et al. 2015)

Estimation results indicate that uncertainty shocks affect REIT returns in our sample of countries. While effects are heterogeneous, some interesting features are identified. First, financial uncertainty shocks have an immediate negative effect on most REIT markets (except for Switzerland) lasting between one and three quarters. No significant rebound is observed, indicating that the total effect of these shocks is negative and temporary. The effect of macroeconomic uncertainty on REIT markets is more diverse. On the one hand, the effect is statistically insignificant for several countries. On the other hand, some countries even show a positive response about a year after the occurrence of the shock. This suggests that REIT and

housing markets outside the U.S. may benefit from increases in U.S. uncertainty, probably due to the investment diversification opportunities they offer during times of economic distress in the U.S. Interestingly, while credit responds to uncertainty shocks, its response is lower than the response of REIT markets. This finding suggests that while housing markets and credit have important feedback mechanisms, the expectations channel is important for the transmission of uncertainty to housing markets.

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