



## Does Bayesian shrinkage help to better reflect what happened during the subprime crisis?

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### ARTICLE INFO

#### Article history:

Accepted 11 December 2012

#### JEL classification:

F47  
C11  
C32

#### Keywords:

Contagion  
Subprime crisis  
OECD housing markets  
VAR/BVAR models  
Bayesian shrinkage

### ABSTRACT

We study the contagion effects of a U.S. housing shock on OECD countries over the period of the subprime crisis. Considering a large database containing national macroeconomic, financial, and trade dynamic variables for 17 OECD countries, we evaluate forecasting accuracy, and perform a structural analysis exercise using VAR models of different sizes: a standard VAR estimated by OLS and a MEDIUM and LARGE VARs estimated by a Bayesian shrinkage procedure.

Our main findings are that: First, the largest specification outperforms the smallest one in terms of forecast accuracy. Second, the MEDIUM VAR outperforms both the LARGE BVAR and the SMALL VAR in the case of structural analysis. So the MEDIUM VAR is sufficient to provide plausible impulse responses, and reproduce more realistically what happened during the subprime crisis. Third, the Bayesian shrinkage procedure is preferable to the standard OLS estimation in the case of an international contagion study.

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### 1. Introduction

The subprime crisis has gripped the U.S. and spread out to many countries all over the world. The current financial crisis is nothing but the result of the American mortgage crisis that leads to many adjustments in housing markets. However, the subprime crisis is not the first turmoil event occurred in the housing markets. Yet, the housing prices' boom during the early 2000s has raised many questions and since that, many studies focused on a possible international transmission of housing shocks across countries (Otrok and Terrones, 2004). So, the last subprime crisis has confirmed the fears of possible contagion effects due to liberalization of markets. In fact, since 2006, the decrease of U.S. housing prices as a result of collapsing residential investments has been followed by a wave of crises and a sharp decrease in housing prices in other economies. This last crisis, which emerged in the USA in the summer of 2006, was followed by a sharp fall in housing prices in Ireland, New Zealand, Spain and the United Kingdom. These almost parallel developments provide evidence in favor of a significant correlation across national housing markets.

There appears to be a large degree of co-movements between very different and distant countries. It seems that the U.S. housing boom and bust has spread to other parts of the world and so confirm that the United States continues to retain its place as the world's principal leading country. Nowadays, there are several possible different explanations of an international transmission of housing prices shocks. The housing prices may be driven by economic or financial fundamentals,<sup>1</sup> the wealth effect,<sup>2</sup> external news,<sup>3</sup> etc.

In this paper, we aim at going further beyond questions of international transmission of housing prices to examine “contagion effects” which are directly associated with crisis events. Here by contagion we mean, as in the case of a pandemic, a process where a sudden change at an important date in local prices in one country affects global prices in other countries. We formulate this idea by saying that contagion may occur when a local shock affects the

<sup>1</sup> The idea is that housing prices are likely to co-move if housing prices are driven by fundamentals, and if the cycles of fundamentals are correlated. See Goodhart and Hofmann (2008).

<sup>2</sup> Decrease in house prices will induce households to reduce their consumption since 5% of the household income is from real estate; e.g. Lettau and Ludvigson (2004) and Case et al. (2005).

<sup>3</sup> News on housing prices in some countries may lead investors and (potential) house buyers to revise their expectations on housing prices in other countries. These revised expectations can be unrelated to changes in fundamentals akin to contagion effects in exchange rates and stock markets during the Asian crisis (Kaminsky and Reinhart, 2000).

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propagation mechanism of a large number of OECD variables. In other words, the investigation of contagion effects is to focus on the changes in the transmission mechanisms of shocks at a critical date. Our analysis is important in terms of policy implications, or even for international investors. In fact, Investors use housing prices index as input for portfolio diversification and selection in housing markets. Portfolio managers look at housing markets fluctuations to infer the trend of each market and make diversification decisions. Comparing the impact of the Subprime crisis on the OECD housing markets provides useful information about possible substitution strategies between housing markets.

Also, policymakers pay a particular attention to housing markets since the housing prices' boom of the early 2000s and especially after the Subprime crisis. Decision making (policy responses and contingency plans) during crisis period, on the basis of the study of shocks transmission during turmoil period, could yield serious consequences for the domestic economies. So, analyzing the links between housing markets is of particular interest for financial players.

The scope of our paper is to contribute to the literature on international transmission. The idea is to examine the contagion effects of a U.S. housing price index shock on OECD countries, and to explore which VAR model better reflects the propagation and magnitude of the changes in the transmission processes, so as to reproduce what happened during the subprime crisis. To our knowledge, no paper in the literature has used such comparison to test and model the contagion effects.

Specifically, in our study, we address the following questions:

1. Is it necessary to deal with a large panel of data when studying contagion effects during the subprime crisis?
2. Which VAR model specification (SMALL, MEDIUM or LARGE) does reflect most faithfully what happened during the subprime crisis, in terms of forecast and structural analysis?
3. In practice, is Bayesian shrinkage a valid alternative to Ordinary Least Squares (OLS) estimation in the case of international transmission study?

To answer these questions we choose different sizes of VAR models to characterize such dynamics for the OECD countries in our panel. Also, we build on the results obtained by [De Mol et al. \(2008\)](#) and [Banbura et al. \(2010\)](#) by setting the degree of Bayesian shrinkage in relation to the cross-sectional dimension of the model, so as to compare the three models.

Our main contributions to the existing literature are: First, the novelty of dealing with a Bayesian shrinkage procedure allows us to study the impact of U.S. housing price index shock on the many OECD financial and economic variables included in our dataset in the form of impulse responses. This is particularly relevant given the most recent crisis which has been characterized by sudden shocks of large magnitude. Researchers, investors, and policy analysts are focusing on robust models allowing the reflection of negative effects on many variables in crisis period.

Second, many economic concepts need more than one variable such as the real activity. So, dealing with a Bayesian shrinkage approach, i.e. the MEDIUM/LARGE Bayesian VARs may be, a priori, a solution to capture many concepts.

Third, another advantage of using this type of VAR models specifications is that impulse responses can be observed both for variables included only in a small VAR, and for large key variables. If housing markets are contagious, economic policy should focus on structural reforms ensuring a stable domestic market in order to limit the amplification of shocks between housing markets.

Fourth, an alternative to analyze relatively large data set is to define a small set of factors (indicators), or group of variables, at a time, FAVAR models, for instance, see e.g. [Christiano et al. \(1996\)](#), [Kim \(2001\)](#) & [Kaabia and Abid \(2012\)](#). However, comparison of impulse responses

across models is problematic. Our approach may be a not neglecting solution for that.

Finally, using different VARs specifications allows us to compare our results to previous findings in terms of forecast and structural analysis, in the case of international transmission process. We aim at going further than just looking at bivariate causal links for two different countries as has been the convention in most of the literature, and considering possible contagion effects from US housing market to OECD economies.

Dealing with a huge database, we will study the impact of the U.S. housing price index shock and analyze the contagion effects on OECD countries. Our database includes the 204 monthly following variables: real GDP, personal consumption, short-term and long-term interest rates, all share price index, effective exchange rates, housing price index, consumer price index, unemployment rate, export and import prices for each of the seventeen considered OECD countries, over the period of 1980: M1–2006: M6.<sup>4</sup> It is worth emphasizing that this sample is larger and more international than related studies.<sup>5</sup>

The main results are: First, the largest specification outperforms the smallest one in terms of forecast accuracy. Second, the MEDIUM VAR outperforms the LARGE BVAR and the SMALL VAR in the case of structural analysis. So the MEDIUM VAR is sufficient to provide plausible impulse responses and reproduce more realistically what happened during the subprime crisis. This result is interesting in proving that a LARGE Bayesian VAR estimated over a hundred variables is not needed and produces worse forecasting, and structural analysis results than the MEDIUM VAR which has not yet been considered in the literature. Third, the Bayesian shrinkage procedure is preferable to the standard OLS estimation, in the case of an international contagion study.

The rest of the paper is structured as follows: [Section 2](#) presents the literature review. [Section 3](#) exposes the empirical framework. [Section 4](#) describes the data and presents the results in terms of forecast and structural analysis. And [Section 5](#) draws the appropriate conclusions.

## 2. Literature review

Most of studies on contagion effects have focused on global financial markets, in general, and on asset market linkages, in particular. Despite much research on the subject, the literature fails in providing consensus on a single definition of contagion. These studies can be broadly classified into several categories, as there is not only one definition of contagion. Surprisingly, the economists are not unanimous on a single definition of contagion. For instance, the most used definition is that of [Eichengreen and Rose \(1999\)](#) and [Kaminsky and Reinhart \(2000\)](#) defining contagion as “a significant increase in the probability of a crisis in a country, conditional on the realization of a crisis in another country”. [Kruger and Osakwe \(1998\)](#) and [Stone and Weeks \(2001\)](#) have developed strategies looking at modeling contagion within a probabilistic, binary choice setting. Also, [Forbes and Rigobon \(2002\)](#) employed the term of “Shift-Contagion” instead of contagion and defined it as “a significant increase in cross market linkages after a shock to an individual country (or group of countries)”. The emphasis here is on testing the shifts in cross market linkages not on “explaining how the shifts occur”. Moreover, [Gravelle et al. \(2006\)](#) distinct between interdependency and contagion and explain the importance of this distinction for researchers, investors and policy makers. In addition, [Favero and Giavazzi \(2002\)](#) propose to detect contagion when identifying many short lived crisis periods

<sup>4</sup> It is considered as a broad measure of financial and economic co-movements.

<sup>5</sup> For example, that of [Stock and Watson \(2005\)](#), or even that of [De Bandt and Malik \(2010\)](#).

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