ISSN: 1576-0162

Prevention of Banking Crises in Advanced Economies With Macroprudential and Fiscal Measures: Case of South Korea

Prevención de crisis bancarias en economías avanzadas con medidas macroprudenciales y fiscales: el caso de Corea del Sur

Emilio Gallego Neira
Universidad Pontificia Comillas (ICADE)
egallego@comillas.edu

Alfredo Arahuetes
Universidad Pontificia Comillas (ICADE)
arahuetes@comillas.edu

Recibido: julio de 2018; aceptado: julio de 2019

Abstract

The main objective of this study is the analysis of the macroprudential and fiscal measures taken by a sample of ten advanced economies, before and after the recent international financial crisis, aiming the prevention of banking crises, as well as the economic effects on those countries with respect to the mitigation of real estate and credit bubbles. Given its particular significance, it has been analysed the case of South Korea's experience, which shows that the extensive use of borrower-related macroprudential measures in particular has contributed to prevent the occurrence of a banking crisis episode since 1999, as it has also been confirmed with an econometric analysis.

Keywords: banking crises; macroprudential measures; fiscal measures; credit bubbles; real estate bubbles.

Resumen

El objetivo principal de este estudio es el análisis de las medidas macroprudenciales y fiscales tomadas por una muestra de diez economías avanzadas, antes y después de la crisis financiera internacional reciente, con el objetivo de prevenir crisis bancarias, así como los efectos económicos en esos países con respecto a la mitigación de burbujas inmobiliarias y de crédito. Dada su significatividad, se ha analizado el caso de la experiencia de Corea del Sur, que muestra que el uso amplio de medidas macroprudenciales de prestatario en particular ha contribuido a prevenir la ocurrencia de episodios de crisis bancarias desde 1999, como también se ha confirmado mediante un análisis econométrico.

Palabras clave: crisis bancarias; medidas macroprudenciales; medidas fiscales; burbujas de crédito; burbujas inmobiliarias.

JEL Clasification: E58, G28.

1. Introduction

Real estate and credit bubbles are tightly connected situations, which have been followed very frequently by episodes of instability and financial crises through the burst of banking crises. In this regard, the bursting of real estate bubles frequently ends up in a recession, especially when the bubles exists for a long period of time (Cerutti, Dagher, & Dell'Ariccia, 2017). Furthermore, it has been concluded that more than two thirds of 46 systemic banking crises, have followed bubbles in the housing market (Crowe, Dell'Ariccia, Igan, & Rabanal, 2011). Banking crises produce systemic risk when the financial instability is so extended that affects the structure and functioning of the financial system, damaging economic growth materially (Hartmann, 2015).

The regulators have put in place control mechanisms to mitigate real estate and credit bubbles, as well as to prevent systemic risk, among which we find monetary and fiscal policies, macroprudencial measures and microprudencial supervision. Out of all these tools, monetary policy has a very wide impact, affecting all the economy as a whole, but it also presents some limitations. Among these, it is not posible to take an action on interest rates by the countries, in contexts such as the European Monetary Union, given that decisions of this nature correspond to the European Central Bank. At the same time, microprudencial supervision of financial entities demonstrated to be insufficient during the recent systemic crisis.

For all the expressed reasons, this study focuses on the analysis of macroprudencial and fiscal measures that aim the prevention of systemic risk and the mitigation of credit and real estate bubbles. There are three objectives in this article. Main objective is the analysis of the macroprudential and fiscal measures taken by ten advanced economies in the period 2000-2012, differenting those taken before and after the start of 2007, year when the recent financial crisis started. The review covers the frequency, width, countercyclicality and sign (expansionary versus restrictive) of the tools implemented. Second objective is the comparison of the economic effects in most and less active countries on the use of these measures. The economic effects being analysed include the ocurrence of banking crises and the mitigation of real estate and credit bubles in the period. Thirdly, this document aims to analyse the case of South Korea, Korea going forward, which is the country that took the highest number of macroprudential and fiscal measures within our countries' sample. In this respect, this study incorporates a detailed review of the market context and policies applied in Korea, as well as an econometric

análisis to evaluate the effectiveness of macroprudential and fiscal measures to prevent the occurrence of banking crises.

There have been several studies in the past which analyse macroprudential and fiscal measures. Many of them deal with the effectiveness of these policies. These analyses mainly develop econometric methodologies and quite often use panel regressions. They have been supported frequently by International organizations such as Bank for International Settlements (BIS) and International Monetary Fund (IMF). In a first group of studies, effectiveness of the measures is analysed in generic terms, using data from a wide group of countries, such as the one conducted by Lombardi and Siklos (2016), who analyse the capacity of macroprudential measures implemented by 46 countries between 1999-2014, when credit grows (Lombardi, 2016). In another article, Bruno *et al* (2016) analyse the impact of macroprudential measures and capital flow controls on credit growth, using a panel regression with data of 12 economies of Asia Pacífic, in the period 2004-2013 (Bruno, Shim, & Shin, 2016). Kuttner and Shim (2013) also evaluate the impact of macroprudential measures on the price of real estate assets and credit magnitudes, from 1980 for a group of 57 countries (Kuttner & Shim, 2013). Finally, Claessens, Ghosh and Mihet (2013) analyse the effectiveness of macroprudential measures to reduce vulnerability on banks' balance sheet, using a panel regresion and a survey to 2800 banks in 48 countries (Claessens, Ghosh, & Mihet, 2013).

A second group of studies assess the measures taken by specific countries. In the case of Korea, Shin (2011) analyses how systemic risk derived from the growth of non deposit financing of banks was mitigated (Shin, 2011). In an analysis related to Hong Kong, Gerlach y Peng (2005) perform a regression to analyse the relation between house prices, bank financing and macroeconomic fluctuations, in the period 1982-2001 (Gerlach & Peng, 2005).

As opposed to the previous econometric studies, the present document goes through the individual analysis of ten advanced economies, as well as a more detailed analysis of Korea. It is worth mentioning that this study also differentiates from others as macroprudential and fiscal measures are analysed by measures types: lender-related, borrower-related and fiscal. This grouping facilitates the drawing of conclusions, as opposed to an analysis of individual measures (reserve requirements, liquidity requirements, provisions, LTV and DTI limits, etc).

In the rest of the document, we firstly review the control measures available to mitigate bubbles and reduce systemic risk. Then, we analyse the experience of ten advanced economies in relation to the use of macroprudential and fiscal measures during the period 2000-2012 and the results obtained by these countries in relation to the following variables: control of house price and household debt growth, and prevention of banking crises. These variables allow us to analyse the mitigation of real estate and credit bubbles, as well as systemic risk. Finally, we go through the experience of Korea including the econometric analysis about the effectiveness of macroprudential and fiscal policies, on the mitigation of banking crises. The documents ends with some conclusions of the analyses performed.

2. Control tools available to mitigate real estate and credit bubbles, as well as to prevent systemic risk

in this section, we analyse the control tools that the financial regulators can put in place to mitigate real estate and credit bubbles, as well as to prevent systemic risk, according to the literature.

The monetary policy has been a very common tool in the past. It is defined as the group of actions taken by the monetary authority to control the availability and cost of financial instruments, in order to comply with objectives of national economic policy (Ali Nasir, Wu, Yago, & Soliman, 2016). Monetary policy may not be successful to mitigate systemic risk and bubbles, and could even foster them, if especulation in the real estate market is not altered but economic activity is reduced, after an interest rates increase. Some authors argue that a wrong assessment or mis-pricing of risks cannot be resolved with monetary policy (Laseen, Pescatori, & Turunen, 2015). Finally, monetary policy is not a tool available to the financial regulators of the countries, as it happens in the case of the European Monetary Union. In this area, the different economic and financial cycles between the countries generate asymetric risks that require additional tools to be applied on top of the common monetary policy (Mencía & Saurina, 2016).

Another control tool used by financial regulators has been the microprudential supervision, consisting on the oversight of the individual components of the financial system (Lim, 2011). It is based on a regulation which aims to force banks to recognise losses in their asset base and to protect deposits, focusing on the individual financial institutions (Galati & Moessner, 2013). In this sense, the microprudential approach establishes a "partial equilibrium" of the system, as opposed to a "general equilibrium" sought by the macroprudential approach (Hanson, Kashyap, & Stein, 2011). Microprudential supervisión is a first line of defence that needs to be complemented by monetary and macroprudential policies (Saurina Salas, 2016) Recent experience has demonstrated that microprudential supervision may not detect a rise of systemic risk, given that this is not apparent until a shock takes place, such a sharp reduction of house prices or credit amounts. Furthermore, the microprudential supervision does not take into account the complex relationships between the operators of the international financial system, that worsened the situation during the recent financial crisis (Roldán Alegre & Saurina Salas, 2013).

Given the limitations of the monetary policy and the microprudential supervision, this study will focus on the fiscal and macroprudential measures, as tools to mitigate bubbles and to prevent systemic risk:

2.1. Fiscal measures

These are the measures taken by the governments in relation to the countries' revenues and expenses, to comply with their financial obligations (Ali Nasir *et al.*, 2016). In this study, we review fiscal measures that are

oriented to the real estate market, to mitigate bubbles, such as the elimination of deductions in the personal income tax due to paid mortgage interests or the increase of indirect taxes over property (Crowe *et al.*, 2011).

2.2. Macroprudential measures

Macroprudential policies are defined as those designed to identify and mitigate risks to the systemic stability, reducing the cost for the economy, derived from problems in the granting of credit (Altunbas, Binici, & Gambacorta, 2016). As its name indicates, macroprudential policies connect prudential and macroeconomic policies, aiming to protect the financial system from the real economy's cycles and preserve financial stability (Haldane, 2013). The main priority of the macroprudential policies is the bubbles' cycles and their burst, given their great impact on systemic risks (Hartmann, 2015). In this sense, the reduction of financial instability and the correct functioning of the financial system will play a key role to promote long term economic growth (Cihák, Demirgüc-Kunt, Feyen, & Levine, 2013).

The use of macroprudential measures aims to tackle two dimensions of systemic risk: (Altunbas *et al.*, 2016): the interconnection between financial institutions of different markets/ countries and the temporary one, which is based on the prociclicality or amplifying effect of the financial system on the economic cycle. This is done by establishing cushions on the banks' balance sheets during economic growth phases that are reverted during recessions (Constâncio, 2015). Macroprudential measures have a double objective: reduce the probability and/or magnitude of bubbles' bursting and strengthen the financial system, to be ready to fight against a bubble burst (Crowe *et al.*, 2011). They may impact credit demand or supply, length of a financial cycle or financial sector resistence to shocks (Claessens *et al.*, 2013).

Before the recent financial crisis, many central banks did not use macroprudential measures against bubbles, due to the costs they cause. However, after the implications of the crisis, central banks have applied an effective macroprudential supervision, focused on the financial stability of the system as a whole and not only on the individual financial institutions (Funke & Paetz, 2012). However, macroprudential measures have not been used very frequently (Claessens *et al.*, 2013). In this regard, previous literature considers that effectiveness of macroprudential measures is not very well known, even though there is consensus about their higher effectiveness on stopping a bubble, in comparison to a resolution of its bursting (Claessens *et al.*, 2013). It is also believed that those countries that have used more macroprudential measures have been more effective on the control of bubbles (Crowe *et al.*, 2011) than those who have not. We will now analyse the two groups of macroprudential measures, depending on their target:

2.2.1. Borrower-related measures

These are measures that mitigate the growth of asset prices or credit amounts (Hartmann, 2015), by establishing credit amount limits over the value of the asset used as a colateral (Loan to value or "LTV" limit) or over the borrowers' income (debt to income or "DTI" limit). These limits produce an impact over credit demand. Recent literature about effectiveness of macroprudential measures suggests that these are the most effective ones to control real estate bubbles (Hartmann, 2015).

The implementation of these limits could impact negatively on less favoured social clases and young population, who could lose access to house financing. In order to mitigate this issue, some countries have just applied these limits to regions with higher house price increases (Korea) or to specific house segments (Hong Kong) (Crowe *et al*., 2011).

2.2.2. Lender-related measures

Lender-related measures produce impact on credit supply (Claessens *et al*., 2013) or generate cushions on banks' balance sheet during growth cycles, increasing banks' resistance and reducing its risk profile. However, these measures do not mitigate assets price growth (Altunbas *et al*., 2016), so their target is more generic. Some authors break these measures down between monetary policies not related to interest rates and prudential policies; the first group include reserve requirements, credit growth limits and liquidity requirements (Shim, Bogdanova, Shek, & Subelyte, 2013).

Lender-related measures are also known as general credit policies and prevailed in the 80s and 90s, in respect of other instruments that were more focused on the real estate market, but its percentage has reduced after year 2000 (Kuttner & Shim 2013). These are the main lender-related measures:

- *Capital regulations*

With these policies, the regulators intend to sthengthen the banks' equity during growth economic cycles, building cushions that are used during recessions. Some authors think that these measures could be improved by applying different weightings to risk types or by demanding further requirements to banks once they have achieved the mīnimum capital required by the regulation (Crowe *et al*., 2011). Capital regulations are the main policies used by the European Union (Constâncio, 2015).

- *Credit provisions*

These could be provisions on specific loans or generic provisions on a portfolio, which include the dynamic provisions on credit during growth economic cycles. Dynamic provisions are mainly used by emerging countries

(Cerutti, Claessens, & Laeven, 2015). They were also used in Spain to strengthen banks' balance sheet after year 2000, when 10% of operating net income of the financial sector was provisioned, however this did not prevent the high credit growth (Crowe *et al*., 2011).As opposed to capital regulations, credit provisions have no threshold that stops its application so they are always applied (Crowe *et al*., 2011).

· *Reserve requirements*

They consist on the maintenance of a percentage of the debt as liquid reserves (either deposits at the central bank or cash), aiming that the banks have available funds to lend (Shim *et al*., 2013). These policies mitigate credit growth, especially the financing to corporations (Cerutti *et al*., 2015).

· *Other*

Among these instruments, authors mention limits to credit growth or to house loans exposure, risk weightings on house financing or liquidity requirements (Shim *et al*., 2013).

3. Macroprudential and fiscal measures as well as economic results achieved by a sample of ten countries

In this section, we review the macroprudential and fiscal measures used by ten advanced economies in the period 2000-2012, analysing frequency and typologies in place of measures, as well as establishing a comparison between policies applied before the recent financial crisis (2000-2006) and onwards (2007-2012).

In order to analyse the frequency of the measures, we take the number of measures implemented in the period 2000-2012 (until June of the last year), according to a BIS database that contains macroprudential and fiscal measures that could be used to mitigate housing-related bubbles (Shim *et al*., 2013). Secondly, we go through the typologies of measures in place as per the MPI macroprudential index in the period 2000-2012, contained in an IMF database (Cerutti *et al*., 2015), that includes three índices by measure type: Borrower-related, Lender-related and Total, which is the sum of the previous two. Each country obtains one unit of the MPI index for each measure type in place such as LTV y DTI limits, dynamic provisions, capital and reserve requirements, etc. As opposed to the BIS database, based on measures against housing bubbles, IMF databas stores measures which cover broader risks. Besides, IMF database does not include fiscal measures focused on the residential market, such as fiscal deductions or indirect taxation for house acquisitions, but it does contemplate special taxes to financial institutions, grouped within the Lender-related MPI.

Our objective is to perform an analysis for ten advanced economies, as this allows us to draw individual as well as group conclusions. The selection of countries in the sample is done among those included in the IMF database that stores MPI macroprudential índices, with higher 2016 GDP per capita than Spain, according to World Banks's data. Out of the mentioned countries, we selected the two American (Canada and United States), and four countries of Europe and Asia/Pacific, respectively, that have had the most and the least macroprudential measures in place, in those geographical areas, according to the Total MPI average index in the period 2000-2012. The final list of selected countries is corrected based on the co-existence of Lender-related and Borrower-related measures (Norway included as an active country in Europe) and on the number of measures taken in the period (Japan, Australia and Sweden included as less active countries in Asia Pacific and Europe, respectively). At the end, we obtain a sample of ten countries from different continents, five that have been more active within their geographical area in the implementation of macroprudential measures during the analysed period (Hong Kong, Korea, Spain, Norway and Canada) and five that have been less active (Australia, Japan, Sweden, United Kingdom and United States). Selection process is summarized in Table 1.

From the analysis of the frequency of the measures taken, we observe that the most active countries have almost doubled the number of measures taken after the recent financial crisis (2007-2012), in respect of the previous years (2000-2006) (Table 2). We observe a very substantial increase of the number of measures taken in Hong Kong, Spain, Norway and Canada. In these countries, there was a very sharp increase of the more focused measures on the housing market (mainly borrower-related macroprudential measures, but also fiscal measures) and a small reduction of the lender-related measures, with a more generic focus. Within the most active countries, Korea maintains the number of measures taken after the recent financial crisis, as it was already very active before, but it also moves from generic-focused (lender-related) measures to housing market-focused measures (borrower-related and fiscal), as the other active countries. Out of the least active countries, United States, United Kingdom and Sweden substantially increase the fiscal measures after the recent financial crisis. However, since then, neither Japan nor Australia have taken any macroprudential or fiscal measure.

We then review the number of measures in place, based on IMF's MPI índices. In this regard, the most active countries within their geographical areas are the ones which have also used the widest types of macroprudential and fiscal measures. Furthermore, these countries have widened the typology of measures used after the recent financial crisis, more than the least active countries. In this regard, the most active countries have increased the average Total MPI index from 2.2 to 3.2 comparing the period 2000-2006 versus 2007-2012 (Table 3). This is due to the substantial increase of measure types in place in Korea, Norway and Canada after the crisis. Spain and Hong Kong have maintained the types of measures in place between the two periods compared.

Table 1. Macroprudential activitiy among countries in the IMF database with higher 2016 GDP per capita than spain (2000-2012)

Sample	Region	Country	Number of measures	MPI Borrower Average	MPI Lender Average	MPI Total Average	OECD	G10	GDP per capita 2016
YES	America	Canada	5	0.77	3.00	3.77	YES	YES	42,157.93
YES	America	USA	5	0.00	2.92	2.92	YES	YES	57,466.79
YES	Asia Pacific	Hong Kong	9	2.00	1.00	3.00			43,681.14
YES	Asia Pacific	South Korea	28	1.46	0.62	2.08	YES		27,538.81
	Asia Pacific	New Zeland	3	0.00	0.00	0.00	YES		39,426.62
	Asia Pacific	Israel	2	0.23	1.23	1.46	YES		37,292.61
YES	Asia Pacific	Australia	1	0.00	1.00	1.00	YES		49,927.82
YES	Asia Pacific	Japan	0	0.00	1.00	1.00	YES	YES	38,894.47
YES	Europe	Spain	10	1.00	2.00	3.00	YES		26,528.49
YES	Europe	Norway	5	0.46	1.00	1.46	YES		70,812.48
	Europe	France	6	0.00	2.15	2.15	YES	YES	36,854.97
	Europe	Belgium	5	0.00	2.00	2.00	YES	YES	41,096.16
	Europe	Italy	4	0.00	2.00	2.00	YES	YES	30,527.27
	Europe	Iceland	19	0.00	1.92	1.92	YES		59,976.94
	Europe	Suitzerland	2	0.00	1.31	1.31	YES		78,812.65
	Europe	Germany	7	0.00	0.46	0.46	YES	YES	41,936.06
	Europe	Austria	2	0.00	0.38	0.38	YES		44,176.52
	Europe	Holand	6	0.00	0.08	0.08	YES	YES	45,294.78
	Europe	Finland	3	0.00	0.00	0.00	YES		43,090.25
	Europe	Ireland	22	0.00	0.00	0.00	YES		61,606.48
YES	Europe	Sweden	4	0.23	0.00	0.23	YES	YES	51,599.87
YES	Europe	United Kingdom	5	0.00	0.00	0.00	YES	YES	39,899.39

Source: Gallego Neira & Martínez de Ibarreta (2019) according to data from World Bank (WB, 2017), BIS (Shim et al., 2013) and IMF (Cerutti et al., 2015)

Table 2. Frequency of the measures taken pre and post crisis (2000-2012)

	Before the crisis (2000-2006)				After the crisis (2007-2012)				Total period (2000-2012)			
Area/ Country	N° Borrower	N° Lender	N° Fiscal	Total	N° Borrower	N° Lender	N° Fiscal	Total	N° Borrower	N° Lender	N° Fiscal	Total
Asia/ Pacific												
Hong Kong	3	0	0	3	6	0	2	8	9	0	2	11
Korea	10	5	2	17	11	1	4	16	21	6	6	33
Japan	0	0	0	0	0	0	0	0	0	0	0	0
Australia	0	1	0	1	0	0	0	0	0	1	0	1
Europe												
Spain	0	3	0	3	3	2	3	8	3	5	3	11
Norway	0	2	0	2	3	1	0	4	3	3	0	6
Sweden	1	0	0	1	1	0	2	3	2	0	2	4
United Kingdom	0	0	0	0	0	0	3	3	0	0	3	3
América												
Canada	0	0	0	0	6	0	1	7	6	0	1	7
United States	0	0	0	0	0	0	4	4	0	0	4	4
Total	14	11	2	27	30	4	19	53	44	15	21	80
Mayor uso	13	10	2	25	29	4	10	43	42	14	12	68
Menor uso	1	1	0	2	1	0	9	10	2	1	9	12

Note: Countries with active use of measures are Hong Kong, Korea, Spain, Norway and Canada. Source: Own ellaboration according to BIS data (Shim *et al.*, 2013).

The Borrower-related MPI index increases substantially for the most active countries of the sample, confirming that these countries not only increase the number of housing market-focused measures taken after the recent financial crisis, but also the number of measures in place (Korea, Norway and Canada). The Lender-related MPI index only increases in Korea, among the active countries of the sample, given that lender-related measures types in place increased, even though fewer lender-related measures were taken in Korea after the crisis. In the other hand, Lender-related MPI index stays the same for the other active countries of the sample (Hong Kong, Norway, Spain and Canada).

In respect of the least active countries of the sample, these have mainly kept the same measure types in place after the recent financial crisis, as the average total MPI index goes from 1 to 1.1, when comparing the periods 2000-2006 and 2007-2012. Similarly, when we analysed frequency of measures implemented, we concluded that these countries only increased fiscal measures after the recent financial crisis, and these measures are not included in the MPI indices.

We have also analysed the results of the countries in the period, in terms of prevention of real estate and credit bubbles, as well as mitigation of systemic risk. We take a look if the countries in the sample have suffered a banking crisis after 2007, based on an IMF database (Valencia & Laeven, 2012), and also compare their house price and household debt over GDP growth in the period 2000-2015.

In first place, we conclude that none of the most active countries except Spain, have suffered a banking crisis after 2007 (Table 4). These countries have also reached lower levels of máximum household debt over GDP ratios, in comparison to least active countries, despite their higher GDP growth (Table 4). However, most active countries except Korea have suffered higher house price growth than the sample average. Furthermore, most active countries except Hong Kong have had a higher household debt over GDP growth than the sample average, in the period 2000-2015.

When we analysed the least active countries of the sample, we observed that three of them (Sweden, United Kingdom and United States) have experienced financial crises after 2007, that have lasted almost until the end of the analysed period (Table 4). Out of the other least active countries, Japan did not suffer a banking crisis in the period, but it had the lowest economic growth in the sample (0.8% average GDP growth in 2000-2015, versus 2.4% of the sample's average). Finally, Australia did not suffer any banking crisis after 2007, but it has reached the highest household debt over GDP ratio and experimented a very high growth, both in house price and household debt over GDP, in the period 2000-2015.

Table 3: Number of macroprudential measures in place, pre and post crisis (2000-2012)

			MPI Borrower Average			MPI Lender Average			MPI Total Average		
Geographical Area	Use of measures	Country	2000-2006	2007-2012	2000-2012	2000-2006	2007-2012	2000-2012	2000-2006	2007-2012	2000-2012
Asia/ Pacific	Greater	Hong Kong	2.0	2.0	2.0	1.0	1.0	1.0	3.0	3.0	3.0
		Korea	1.0	2.0	1.5	0.0	1.3	0.6	1.0	3.3	2,1
	Lower	Japan	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0
		Australia	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0
Europe	Greater	Spain	1.0	1.0	1.0	2.0	2.0	2.0	3.0	3.0	3.0
		Norway	0.0	1.0	0.5	1.0	1.0	1.0	1.0	2.0	1.5
	Lower	Sweden	0.0	0.5	0.2	0.0	0.0	0.0	0.0	0.5	0.2
		United KIngdom	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
America	Greater	Canada	0.0	1.7	0.8	3.0	3.0	3.0	3.0	4.7	3.8
	Lower	United Stated	0.0	0.0	0.0	2.9	3.0	2.9	2.9	3.0	2.9
Total			0.4	0.8	0.6	1.2	1.3	1.3	1.6	2.2	1.8
	Greater		0.8	1.5	1.1	1.4	1.7	1.5	2.2	3.2	2.7
	Lower		0.0	0.1	0.0	1.0	1.0	1.0	1.0	1.1	1.0

Source: Own ellaboration according to IMF data (Cerutti *et al.*, 2015).

Table 4. Results of the countries in the sample (2000-2015)

Geographical Area	Use of measures	Country	Banking crises 2007-2012 (Sí = 1)	Crisis duration (years)	Maximum Household debt over GDP	Household debt max/min	House price max/min	Average GDP growth
Asia/ Pacific	Greater	Hong Kong	0	0	67.10	1.31	3.51	4.3
		Korea	0	0	88.40	1.75	1.92	4.3
	Lower	Japan	0	0	73.30	1.13	1.43	0.8
		Australia	0	0	124.30	1.75	2.98	2.9
Europe	Greater	Spain	1	5	84.00	1.86	2.47	1.7
		Norway	0	0	95.30	1.82	2.46	1.7
	Lower	Sweden	1	5	84.40	1.77	2.84	2.3
		United KIngdom	1	6	97.00	1.50	2.14	1.9
America	Greater	Canada	0	0	97.80	1.65	2.61	2.2
	Lower	United States	1	6	97.70	1.40	1.77	1.9
Total			0.4	2.2	90.93	1.59	2.41	2.4
	Greater		0.2	1.0	86.52	1.68	2.60	2.8
	Lower		0.6	3.4	95.34	1.51	2.23	2.0

Source: Own elaboration according to IMF (Valencia & Laeven, 2012) and BIS data (BIS, 2017).

4. Analysis of south korea's case

Korea is the country that has taken the highest number of macroprudential and fiscal measures within our sample, in the analysed period (Table 2). Korea's measures were mainly implemented after 2002, combined different typologies and helped Korea to avoid suffering banking crises after year 1999. Before then, Korea suffered a banking crisis between 1997 and 1998, according to the IMF (Valencia & Laeven, 2012).

Real house prices had experienced a 50% drop from 1989 until 2001 (Zoli, 2017). In the 2000-2015 period, real house prices stay flat in Korea and nominal prices grow substantially less than the sample's average (Table 4) and that household income (Igan & Kang, 2011). Despite of this, the increase of nominal prices since 2001 was the regulators' argument to perceive a bubble risk and to implement macroprudential measures which were highly focused on the housing market (Chang, 2010).

Korea was a pioneer in the introduction of borrower-related measures, achieving a great success on the control of asset price and mortgage debt growth (Chang, 2010). Borrower-related measures were mainly combined after 2000 with fiscal policies, limitations to the change of land planning, support policies to private construction sector and to public housing, which cause highly-intervened residential and mortgage markets, and pursued the following objectives: house prices stability, support to urban development and access to housing for less-favored social clases (Igan & Kang, 2011). The measures taken were predominantly countercyclical, and more dynamic and restrictive than other countries', due to the risks perceived by the regulators, derived from the banking competition and the market especulation, particularly in Seoul (Chang, 2010).

Up to 1998, Korea had only adopted lender-related measures, with generic focus, such as reserve requirements, which were expansionary and procyclical. After the banking crisis of 1997-98 and particularly after 2002, Korea started to be very active on the implementation of measures to mitigate bubbles and to prevent systemic risk. Among the main measures taken after 2002, Korea starts implementing LTV limits in 2002 and DTI limits in 2005 (Igan & Kang, 2011). It also put in place an increasing of risk weightings for mortgages in 2002, as well as reserve requirements in 2002 and 2006 (Chang, 2010). In fact, between 2002 and the first half of 2012, Korea implemented 33 measures, of which 27 were focused on the housing market and 21 were borrower-related macroprudential measures (11 LTV and 10 DTI limits) with a restrictive (Table 5) and countercyclical profile (Table 6). From 2002, they also adopted 6 lender-related measures (1 reserve requirement taken in 2006, 3 provisions taken in 2002 and 2003, and 2 risk weightings taken in 2002 and 2011) and 6 fiscal measures, taken after 2005.

Borrower-related macroprudential measures (LTV and DTI limits) were established with the objective of improving households' and banks´ resilience to house price volatility (Financial Policy Committee, 2015). These limits were applied in a preventive way and focused on highly speculative áreas and high-

size loans (Chang, 2010). For example, in July 2005, Korea reduces the LTV limit from 60% to 40% in loans for house acquisition in speculative áreas, when the loan term was lower than ten years (Shim *et al*., 2013).

From Korea's experience in the implementation of countercyclical LTV and DTI limits, We can conclude that these tools are more successful than monetary policy to control leverage and house price growth (Chang, 2010). Based on data from a survey in Korea (Igan & Kang, 2011), it was found out that restrictive LTV and DTI limits delay house acquisition decisions, especially in older and more especulative buyers, and that LTV limits impacted house prices. These focused measures on mortgage credit, caused that average mortgages' LTV in Korea was 47.1% in July 2009, versus 74.9% in United States (Chang, 2010). Despite of the positive results achieved, some authors believe that more macroprudential measures will be required as household debt over GDP has risen from 40% in the beginning of the 90s to 90% nowadays (Zoli, 2017).

In order to confirm the conclusions extracted from the analysis of Korea's experience, we also ellaborated an econometric analysis about the effectiveness of macroprudential and fiscal measures in Korea, to mitigate banking crises. This exercise confirms the good results obtained in the use of borrower-related macroprudential measures. Our analysis is based on annual data and a period of 25 years (from 1988 until first half of 2012). We use the dummy variable banking crises as dependent variable, which adopts value of 1 when there is a banking crisis in the year and 0 when there is not. This is based in an IMF database ((Valencia & Laeven, 2012). The three measures types analysed before (borrower-related and lender-related macroprudential measures, as well as the number of fiscal measures) are the independent variables. These are the number of measures in absolute value, without taking into account the expansionary or restrictive sign of the measures, using the data coming from the BIS (Shim *et al*., 2013). The control variables are the GDP growth and house price growth, which data is extracted from BIS databases (BIS, 2017). These control variables will serve to analyse the impact of negative economic and house prices growth on the occurrence of banking crises.

We initially tried to ellaborate the model based on a logistic regression, which is the most suitable option when we try to estimate the probability of meeting a condition at a dummy dependent variable, such as the occurrence of banking crises. However, when we applied the logit command in Stata, we incurred in a perfect failure prediction for the impact of borrower-related macroprudential measures on the occurrence of banking crises, due to the fact that there was no banking crises (zero value) during the years that Korea used this type of measures.

Given the insufficient results obtained with the logistic regression, we applied a linear regression, using the same variables. The ellaborated model shows an R square of 0.514 (Table 7). This analysis concludes that borrower-related measures are effective to mitigate banking crises, with a low p-value, below 0.01. The obtained negative coefficient implies that the increase of borrower-related measures increase of borrower-related measures produces a reduction of banking crises' occurrence.

Table 5: Restrictive versus expansionary profile of measures taken in Korea (1988-2012)

	Borrower-related			Lender-related			Fiscal		
Korea	Total	Restrictive	Expansionary	Total	Restrictive	Expansionary	Total	Restrictive	Expansionary
1988-1989	0	0	0	1	1	0	0	0	0
1990-1999	0	0	0	4	1	3	0	0	0
2000-2006	10	9	1	5	5	0	2	1	1
2007-2012	11	6	5	1	1	0	4	3	1
Total	21	15	6	11	8	3	6	4	2

Source: Own elaboration according to BIS data (Shim et al., 2013).

Table 6: Countercyclicality of the measures taken in Korea (1988-2012)

	Borrower-related		Lender-related		Fiscal	
Korea	Total	Countercyc	Total	Countercyc	Total	Countercyc
1988-1989	0	0	1	1	0	0
1990-1999	0	0	4	1	0	0
2000-2006	10	9	5	5	2	1
2007-2012	11	6	1	1	4	3
Total	21	15	11	8	6	4
		71.4%		72.7%		66.7%

Source: Own elaboration according to BIS data (Shim et al., 2013).

The linear regression model also confirms the uneffectiveness of the lender-related measures (positive coefficient, but with a high p-value close to 0.08), in the same direction as the logistic regression, which did not show statistical evidence. Finally, the linear regression model cannot show statistical evidence about the uneffectiveness of fiscal measures in Korea.

As far as the control variables in the linear regression model, we conclude that GDP and house price growth move in the opposite direction to the occurrence of banking crises (negative coefficient), as we expected, even though statistical evidence is only showed in respect of GDP growth. This means that negative GDP growth mainly (and possibly negative house price growth) favors the occurrence of banking crises.

As a final conclusion of our econometric analysis, we can observe that borrower-related measures (ie, LTV and DTI limits) were highly effective in the mitigation of banking crises, once Korea started using them since 2002. These measures were more effective than generic lender-related measures to mitigate the occurrence of banking crises in Korea. Effectiveness of restrictive borrower-related measures in Korea was also observed by previous studies in respect of delayed house acquisition and house prices controls (Igan & Kang, 2011).

TABLE 7. EFFECTIVENESS OF MACROPRUDENTIAL AND FISCAL MEASURES IN THE MITIGATION OF BANKING CRISES (1988-2012)[1]

	Dependent variable:
	Banking crises (dummy)
	(annual data)
Number of observations	25
R-sq	0.5140
Independent variables:	
Number of borrower-related measures	-0.1548
	(0.05)***
Number of lender-related measures	0.1035
	(0.06)*
Number of fiscal measures	0.0377
	(0.12)
Control variables:	
GDP growth	-0.0517
	(0.01)***
House price growth	-0.4980
	(0.74)

1 ***, **, * indicate statistical significance at 1, 5 and 10% (two-tail) test levels, respectively.

5. Conclusions

When establishing conclusions about the evolution in the period 2000-2012, we observe that the most active countries in each region of the sample -Hong Kong, Korea, Spain, Norway and Canada- have increased the number of macroprudential and fiscal measures used after the recent financial crisis, as well as the macroprudential ones that were in place. These countries have also shifted towards tools which are more focused on the housing sector, such as borrower-related macroprudential (LTV and DTI limits) and fiscal tools. These have replaced more generic-focused measures (reserve and liquidity requirements, limits to credit growth, etc), that prevailed before the recent financial cisis. This conclusion is in line with the trend from 2000, explained by previous literature (Kuttner & Shim 2013). In the other hand, less active countries in each region of the sample –Sweden, United Kingdom and United States- have increased the use of fiscal measures oriented to the housing market.

We then reviewed the results achieved by the countries of the sample in the bubbles' mitigation and systemic risk prevention. We observe then that most active countries in each region have not faced a banking crisis since year 2000, with the exception of Spain, and have achieved lower levels of household debt over GDP in the analysed period, on average. In summary, we can confirm that the most active countries in the geographical areas have used a wider combination of measures and achieved better results on the mitigation of real estate and credit bubbles, as well as on the prevention of systemic risk.

During the analysis of Korea, as most active country on the use of macroprudential and fiscal measures of the sample, we observe that it has implemented a lot of borrower-related tools (LTV and DTI limits) since 2002, after the serious banking crisis suffered during 1998-1999. Since then, the measures taken have been very focused on the housing market and had a restrictive as well as countercyclical profile. The results obtained in Korea have been very positive in relation to the prevention of banking crises as well as on the control of house prices and household debt growth. In this regard, our econometric analysis also confirms that borrower-related macroprudential measures implemented in Korea (such as LTV and DTI limits) were effective in the mitigation of banking crises.

References

Ali Nasir, M., Wu, J., Yago, M. and Soliman, A. M. (2016): Macroeconomic Policy Interaction: State Dependency and Implications for Financial Stability in UK: A Systemic Review, *Cogent Business & Management*, *3*(1), 1154283.

Altunbas, Y., Binici, M. and Gambacorta, L. (2016): *Macroprudential Policy and Bank Risk*, http://lare-efi.u-bordeaux4.fr/IMG/pdf/9_gambacorta_altunbas_binici.pdf.

BIS. (2017): About BIS Statistics, Retrieved January 30, 2018, from https://www.bis.org/statistics/index.htm.

Bruno, V., Shim, I. and Shin, H. (2016): Comparative Assessment of Macroprudential Policies. *Journal of Financial Stability*, Retrieved from http://www.sciencedirect.com/science/article/pii/S157230891630013 4.

Cerutti, E., Claessens, S. and Laeven, L. (2015): The Use and Effectiveness of Macroprudential Policies: New Evidence, *Journal of Financial Stability*.

Cerutti, E., Dagher, J. and Dell'Ariccia, G. (2017): Housing Finance and Real-estate Booms: A Cross-country Perspective, *Journal of Housing Economics*, *38*, https://doi.org/10.1016/j.jhe.2017.02.001.

Chang, S.-T. (2010): *Mortgage Lending in Korea An Example of a Countercyclical Macroprudential Approach*. Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/3989/WPS5505.pdf?sequence=1andisAllowed=y.

Cihák, M., Demirgüc-Kunt, A., Feyen, E. and Levine, R. (2013): *Financial Development in 205 Economies*.

Claessens, S., Ghosh, S.R. and Mihet, R. (2013): Macro-prudential Policies to Mitigate Financial System Vulnerabilities, *Journal of International Money and Finance*, *39*, 153–185.

Constâncio, V. (2015): Financial Stability Risks, Monetary Policy and the Need for Macro-prudential Policy, *Speech by Vitor Constancio, Vice-President of the ECB.Warwick Economic Summit*, *13*.

Crowe, C., Dell'Ariccia, G., Igan, D. and Rabanal, P. (2011): *How to Deal with Real Estate Booms: Lessons from Country Experiences*.

Financial Policy Committee. (2015): *The Financial Policy Committee's Powers over Housing Tools*, Financial Policy Committee, Bank of England (policy statement).

Funke, M. and Paetz, M. (2012): *A DSGE-based Assessment of Nonlinear Loan-to-Value Policies: Evidence from Hong Kong*, Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2049783.

Galati, G. and Moessner, R. (2013): Macroprudential Policy–a Literature Review, *Journal of Economic Surveys*, *27*(5), 846–878.

Gallego Neira, E., & Martínez de Ibarreta, C. (2019). Comparison of advanced economies' performance in bubbles mitigation. *Journal of Financial Regulation and Compliance*.

Gerlach, S. and Peng, W. (2005): Bank Lending and Property Prices in Hong Kong. *Journal of Banking and Finance*. Retrieved from http://www.sciencedirect.com/science/article/pii/S0378426604000445.

Haldane, A. (2013): Macroprudential Policies–when and how to Use them. *International Monetary Fund Conference on Rethinking Macro Policy II: First Steps and Early Lessons, Washington DC, April.(1) The Null Hypothesis Is No Granger Causality. Lending for House Purchase Is Measured as Domestic Credit to Households for House Pu*. Citeseer.

Hanson, S.G., Kashyap, A.K. and Stein, J.C. (2011): A Macroprudential Approach to Financial Regulation, *Journal of Economic Perspectives*, *25*(1), 3–28. https://doi.org/10.1257/jep.25.1.3.

Hartmann, P. (2015): Real Estate Markets and Macroprudential Policy in Europe. *Journal of Money, Credit and Banking*, *47*(S1), 69–80.

Igan, D. and Kang, H. (2011): *Do Loan-to-Value and Debt-to-Income Limits Work? Evidence from Korea; by Deniz Igan and Heedon Kang; IMF Working Paper 11/297; December 1, 2011*, Retrieved from https://www.imf.org/external/pubs/ft/wp/2011/wp11297.pdf.

Kuttner, K.N. and Shim, I. (2013): *Can Non-Interest Rate Policies Stabilize Housing Markets?*

Laseen, S., Pescatori, A. and Turunen, M.J. (2015): *Systemic Risk: A New Trade-off for Monetary Policy?,* International Monetary Fund.

Lim, C. H. (2011): *Macroprudential Policy: what Instruments and how to Use them? Lessons from country experiences*, Retrieved from http://www.imf.org/external/pubs/ft/wp/2011/wp11238.pdf.

Lombardi, D. (2016): Benchmarking Macroprudential Policies: An Initial Assessment. *Journal of Financial Stability*, *27*(December 2016), 35–49, Retrieved from http://www.sciencedirect.com/science/article/pii/S1572308916300924.

Mencía, J. and Saurina, J. (2016): Macroprudential Policy: Objectives, Instruments and Indicators. *Occasional Papers*. Retrieved from https://ideas.repec.org/p/bde/opaper/1601.html.

Roldán Alegre, J. M. and Saurina Salas, J. (2013): Regulación macroprudencial. *Información Comercial Española, ICE: Revista de Economía*, (874), 91–100.

Saurina Salas, J. (2016): *A Practical Approach to Develop Macroprudential Tools*. Universidad de Navarra.

Shim, I., Bogdanova, B., Shek, J. and Subelyte, A. (2013): Database for Policy Actions on Housing Markets, *BIS Quarterly Review, September*.

Shin, H. (2011): Macroprudential Policies beyond Basel III, *BIS Papers*, Retrieved from https://papers.ssrn.com/sol3/Delivery.cfm?abstractid=2002653#page=19.

Valencia, F. and Laeven, L. (2012): *Systemic Banking Crises Database: An Update*, Retrieved from https://www.imf.org/external/pubs/ft/wp/2008/wp08224.pdf.

WB. (2017): GDP per capita (current US$) | Data, Retrieved January 30, 2018, from https://data.worldbank.org/indicator/NY.GDP.PCAP.CD.

Zoli, E. (2017): *Korea's Challenges Ahead-Lessons from Japan's Experience*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2924365.