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INTERNATIONAL SYNCHRONICITY OF HOUSING PRICES

SINCRONIA INTERNACIONAL DE LOS PRECIOS DE LA VIVIENDA

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Abstract

While the synchronization of business cycles has been much studied in the literature, housing prices' synchronization has not. In this paper we study the determinants of the housing prices' synchronicity for a variety of advanced and emerging countries. In order to do so, we rely on Kalemlı-Ozcan et al. (2009)'s definition of synchronicity and on the housing prices indexes provided by the Bank for International Settlements (BIS) and other sources. In particular, we study the relationship of the housing prices' synchronicity and banking integration. Our findings show that, after controlling by macroeconomic and idiosyncratic factors, banking integration positively and significantly affects the synchronicity of housing prices. We also find that this effect is lost during the global financial crisis for the synchronicity between advanced countries, but it remains significant for the synchronicity between advanced and emerging economies.

Keywords: *Housing prices, synchronicity, banking integration.*

JEL Classification: *E32, F32, F41, G10, G12, G15.*

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Resumen

Mientras la sincronía de los ciclos económicos ha sido bastante estudiada en la literatura, la sincronía de precios de la vivienda no lo ha sido. Este trabajo analiza los determinantes de la sincronía de los precios de la vivienda para un conjunto de países avanzados y emergentes. Con este propósito, utiliza la definición de sincronía propuesta por Kalemlı-Ozcan et al. (2009) y la información de precios de la vivienda proporcionados por el Banco de Pagos Internacionales (BPI) y por otras fuentes. En particular, estudia la relación entre la sincronía de los precios de la vivienda y la integración bancaria. Los resultados muestran que, luego de controlar por factores macroeconómicos e idiosincráticos, la integración bancaria se relaciona positiva y significativamente con la sincronía de precios de la vivienda. También encuentra que este efecto se pierde durante la crisis financiera global, en particular para la sincronía entre el grupo de países avanzados, pero sigue siendo importante para la sincronía entre las economías avanzadas y emergentes.

Palabras clave: *Precios de la vivienda, sincronía, integración bancaria.*

Clasificación JEL: *E32, F32, F41, G10, G12, G15.*

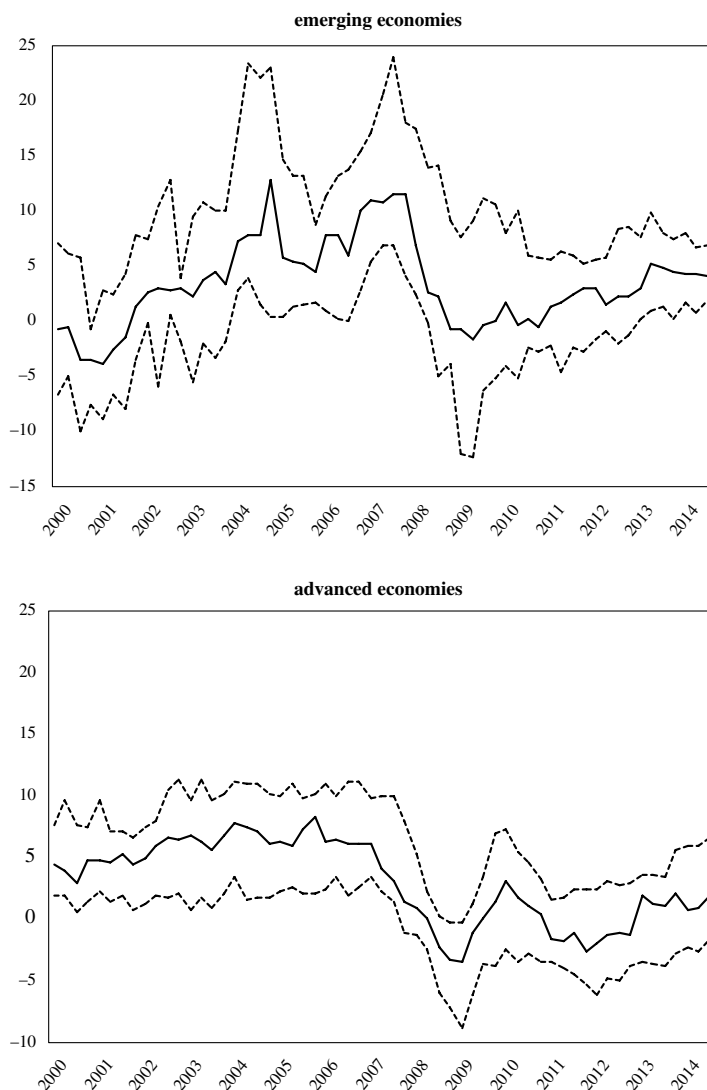
1. INTRODUCTION AND MOTIVATION

The co-movement of housing prices has drawn the attention of researchers ever since the events that occurred during the Global Financial Crisis (GFC, hereafter). However, the literature shows that there has not been a thorough analysis of this issue. Thus, our aim is to shed light on this matter by studying the synchronicity of the housing prices for a panel of emerging and advanced economies. In particular, housing prices across countries have experienced a high degree of co-movement over the past decades. Indeed, before and after the GFC, housing prices increased in the majority of the countries, although more recently have grown at a slower pace than before (see Figure 1). During the GFC this co-movement was partially interrupted, as housing prices growth rates moved down together across different countries, but with a higher dispersion. In fact, despite the strong slowdown observed during that period, real housing prices experienced an expansion of 25% and 50% in advanced and emerging economies, respectively.

The degree by which real housing prices co-moved across countries before the GFC can also be seen when looking at the net number of countries that experienced an expansion, i.e the share of countries that experienced an expansion vis-à-vis those that experienced a contraction. Figure A1 in the Appendix shows precisely this. Right before the GFC, more than 80% of net advanced economies faced an expansion in housing prices. By the end of 2008, at the peak of the crisis, this situation almost completely reversed, since 60% of net advanced economies experienced then a contraction. This

FIGURE 1

ANNUAL GROWTH RATES OF HOUSING PRICES (PERCENTAGES)



Note: The solid line represents the median growth rate of real housing prices for each subgroup of economies. The dotted lines correspond to the 75th and 25th percentiles.
 Source: Authors' own calculations.

high degree of co-movement observed before and during the GFC was also seen in emerging economies, although with less intensity. Contrary, in the aftermath of the crisis, a rising number of emerging economies started to expand their housing prices. On the other hand, the number of advanced economies that expanded and contracted their housing prices was almost the same.

There are few studies that address the issue of co-movements in housing prices and their determinants. Milcheva and Zhu (2015), for example, study the impact of bank integration on the co-movements of housing prices for a sample of advanced countries. Their findings show that countries with higher bank integration tend to have significant co-movement of their respective housing prices. In addition, they find that bank integration explains these co-movements far more than other variables related to economic integration. Hirata *et al.* (2013) and Cesa-Bianchi (2013) find that housing prices are synchronized across countries, and that the degree of synchronization has increased over time. These authors attribute the synchronicity in housing prices to the exposure to common factors, such as the fluctuations of global interest rates and global liquidity.

In this article, we study the determinants of the synchronicity of housing prices across a variety of countries. Our definition of synchronicity relies on the comparison of the annual real-growth rates of housing prices, similarly to the definition used in other studies¹. In particular, we construct a bilateral database of housing prices that distinguishes 3 pairs or sub-groups of countries: (i) advanced-advanced, (ii) advanced-emerging, and (iii) emerging-emerging. This database includes 31 emerging and 22 advanced economies for the 2000.I-2014.IV period. We compare the degree of synchronicity and its dynamic experienced by these sub-groups over the recent past. Then, we analyze the role played by the bilateral banking relationship and other policy variables as determinants of the synchronicity in housing prices.

We show that housing prices of the sub-group of advanced-advanced countries are more synchronized than in the other two sub-groups. However, towards the end of the sample period, the average degree of synchronicity between all sub-groups of countries approaches to the same level. Regarding the determinants of synchronicity, and after running pool regressions with pair-country fixed effects and time fixed effects, we observe that bilateral banking integration has a positive and significant effect over the synchronicity of housing prices, in particular between advanced economies. These results are similar to the findings of Milcheva and Zhu (2015), and are aligned with studies that emphasize the existence of a global financial channel when explaining the dynamic of housing prices (Hirata, 2013; Jara and Olaberria, 2013; Cesa-Bianchi *et al.*, 2015; Cesa-Bianchi, 2013). In addition, we show that output growth rates contribute to a higher synchronicity of housing prices between advanced economies, but reduce it for the sub-group of advanced-emerging countries². Finally, our estimations show

¹ See, for example, Frankel and Rose (1997, 1998); Fatás (1997); Clark and van Wincoop (2001); Calderón *et al.* (2007); Herrero and Ruiz (2008); Kalemli-Ozcan *et al.* (2009).

² Note that these results emphasize the importance of the financial channel over and above the role played by the real channel in the related literature that study the relationship between the synchronicity in

that during the sub-prime crisis, the relative importance of bilateral banking integration as a determinant of synchronicity was lost for the advanced countries.

Thus, the paper is structured as follows. In the next section we define housing price synchronicity and banking integration. Section 3 provides a description of the real housing price index and presents the estimation approach. We present the results in section 4. Finally, section 5 provides some conclusions.

2. HOUSING PRICE SYNCHRONICITY AND BANKING INTEGRATION

What factors explain the covariation of housing prices across countries? According to Milcheva and Zhu (2015), the synchronicity of housing prices depends on the degree of bilateral banking integration. Under these circumstances, cross-border banking flows operate as a banking channel for changes in housing prices in country i to country j due to the expansion of the local mortgage credit supply. More so, when local banks face a slowdown in deposits' growth, they tend to finance mortgage credit by borrowing on the international interbank market. Thus, this global banking channel affects the local housing market when countries are more integrated through their banking business. Similarly, several studies have emphasized that housing price dynamics may be affected by international capital flows (Cesa-Bianchi *et al.*, 2015), particularly if these flows are banking flows (Jara and Olaberría, 2013). The importance of capital flows as a determinant of the dynamics of housing prices increases the possibility of synchronicity, given that these flows strongly depend on external factors that tend to be common across countries, such as the level of international liquidity and the degree of risk aversion.

In this study we go beyond Milcheva and Zhu (2015), as we not only study the synchronicity of housing prices between advanced economies, but also between advanced and emerging economies. In addition, we look into the significance of other relevant policy variables, and study the role played by bilateral banking integration during the GFC.

2.1. Synchronicity of the housing prices' growth rates

Let's define $P_{i,t}$ as the quarterly real housing price index in country i at time t . Thus, following Kalemli-Ozcan *et al.* (2009), we define S_{ijt} as the synchronicity of the housing prices' growth rates between country i and country j at time t , such that S_{ijt} is equivalent to the absolute value of the difference between the annual growth rates of housing prices in country i and j , i.e.:

$$S_{ijt} = -\left| \left(\ln P_{i,t} - \ln P_{i,t-4} \right) - \left(\ln P_{j,t} - \ln P_{j,t-4} \right) \right| \quad (1)$$

output growth and the bilateral trade exposure (Frankel and Rose (1997, 1998); Fatás (1997); Clark and van Wincoop (2001); Herrero and Ruiz (2008); Calderón *et al.* (2007); Kalemli-Ozcan *et al.* (2009)).

Note that S_{ijt} is expressed in negative terms, aiming to sort the synchronicity index in ascending order. In other words, the closer S_{ijt} is to zero, the greater will be the synchronicity, which means that the housing price growth rates of countries i and j are relatively similar. In contrast, the more negative the index is, the less synchronized the housing prices are.

As emphasized by Kalemli-Ozcan *et al.* (2009), measuring synchronicity as in equation (1) has several advantages above other approaches, in particular when compared to the correlation index. First, because S_{ijt} is not affected by the volatility of housing prices, as it is when using the correlations, allowing us to focus purely on the co-movement of housing prices. Secondly, although S_{ijt} is bounded by zero, it could take any negative value, while correlations are bounded by 1 and -1 , which in turn makes it more difficult to maintain the assumption of normality in the errors when estimating the determinants of the synchronicity (see Inklaar *et al.*, 2007).

Figure 2 shows the median of S_{ijt} for the three pairs of countries considered: (i) emerging-emerging (EME-EME), advanced-advanced (ADV-ADV), and advanced-emerging (ADV-EME or EME-ADV). As we can see, the degree of synchronicity between advanced economies is higher than the degree of synchronicity observed among emerging economies, and the synchronicity observed between emerging and advanced countries. Despite this fact, there is a convergence of the degree of synchronicity towards the end of the sample period for all three groups of countries. Another aspect that is worth noticing is the dynamics experienced by the synchronicity of housing prices' growth rates during the GFC. During the GFC housing prices' growth rates of advanced economies were less synchronized, in particular when compared to emerging economies. Nonetheless, between advanced economies, the synchronicity of housing prices also fell, although it remained as the higher synchronized group. These characteristics of the dynamic of S_{ijt} are not only true for the median, but also for different percentiles of S_{ijt} (see Figure A2 in the Appendix, where we plot the 25th percentile and the 75th percentile of S_{ijt} for these groups of countries).

2.2. Banking integration

We now construct a quarterly index of bilateral banking integration between country i and country j at time t (IB_{ijt}) as the sum of the loans and deposits of country i in country j at time t ($Claims_{ijt}$) plus the loans and deposits of country j in country i at time t ($Liabilities_{ijt}$), normalized by the sum of their respective gross domestic products (GDP_{it} and GDP_{jt} respectively). Hence,

$$IB_{ijt} = \frac{(Claims_{ijt} + Liabilities_{ijt})}{(GDP_{it} + GDP_{jt})} \quad (2)$$

FIGURE 2

SYNCHRONICITY OF HOUSING PRICES' GROWTH RATES (PERCENTAGES)



Note: The y-axis shows the median degree of synchronicity of housing prices' growth rates for three different pair of countries.

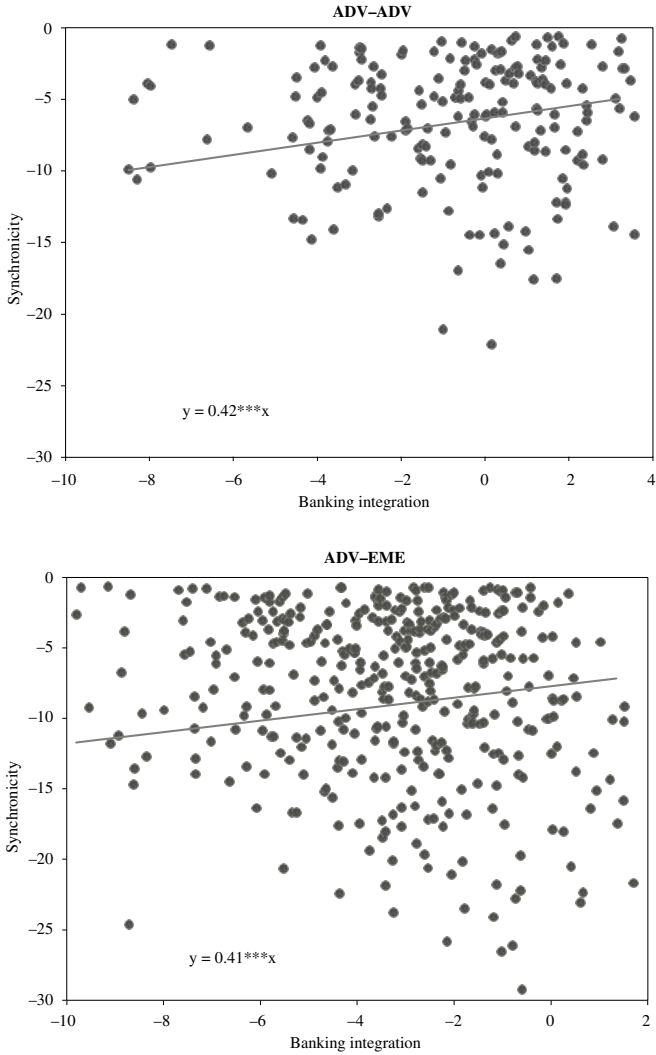
Source: Authors' own calculations.

A first look at the relationship between the synchronicity of housing prices' growth rates and the bilateral banking integration can be seen in Figure 3, where we show the result, at the end of 2010, of regressing S_{ijt} on the natural logarithm of IB_{ijt} when controlling for pair fixed effects and time fixed effects. The relationship is positive and slightly stronger for the sub-group of advanced countries.

Notice that we are not able to construct IB_{ijt} for the pair of emerging-emerging countries because the majority of the countries reporting cross-border banking flows to the BIS are advanced economies. Nonetheless, from the perspective of the advanced countries, we are able to capture claims and liabilities of advanced countries vis-à-vis emerging economies.

FIGURE 3

SYNCHRONICITY OF HOUSING PRICES' GROWTH RATES AND BANKING INTEGRATION (PERCENTAGES)



Note: The solid line shows the result at 2010.IV of estimating a pool, univariate regression, with fixed effects for the pair of countries i, j , and time fixed effects. The dependent variable is the synchronicity of the housing prices, while the control variable corresponds to the natural logarithm of the bilateral banking integration ijt . Significance degree: *** $p < 0.001$, ** $p < 0.05$, * $p < 0.1$

Source: Authors' own calculations.

3. THE DETERMINANTS OF HOUSING PRICES SYNCHRONICITY

3.1. The data

We construct a panel database of quarterly real housing prices for 53 countries (22 advanced and 31 emerging economies), for the 2000.I to 2014.IV sample period³. In order to gain scope and representativeness, we combine several sources of housing prices. In particular, we merge the “Residential Property Price Database,” published by the BIS, the “International House Price Database,” published by the Dallas Fed, and the house prices indexes published by the Organization for Economic Co-operation and Development (OECD)⁴.

Different countries publish different types of housing prices, making its comparison sometimes difficult. For example, housing prices can differ because of the coverage area (national or whole country information versus regional or big cities). In addition, the type of housing or dwelling considered may also differ. For instance, for some countries their index may measure all types of dwellings, while for others it might measure single or family houses, flats, commercial properties, industrial properties, land for residential use and more. In our case, we choose when available, residential housing prices (single or family houses or flats) for the whole country, new and existing. If nationwide prices are not available, we select prices for the capital city or main cities. It is worth noting that our data set is unbalanced. In particular, while most advanced economies present a fully extended data for the sample considered, most emerging countries do not. In any case, as an additional selecting criterion, we chose only countries that have at least 20 observations. Finally, our real housing prices index is CPI-deflected and is normalized at the average level of 2010=100 (see Table A1 in the Appendix for more details).

With respect to the IB_{ijt} index, we use the locational bilateral cross-border bank flows (loans and deposits) collected by the BIS⁵. In particular, we use the amount outstanding (stocks) of cross-border claims and liabilities of loans and deposits of reporting countries vis-à-vis a wide group of advanced and emerging countries.

Other variables we include in our estimations are the GDP growth, capital account openness (Chinn and Ito, 2006), a measure of the flexibility of the exchange rate (Reinhart and Rogoff, 2004), and a measure of financial depth constructed from the IMF's data. More details about these variables and their respective sources can be found in table A2 in the Appendix.

³ Emerging countries: Brazil, Bulgaria, Chile, Colombia, Croatia, Cyprus, Czech Republic, Estonia, Hong Kong, Hungary, Iceland, Indonesia, Israel, Korea, Latvia, Lithuania, Luxembourg, Macedonia, Malaysia, Malta, Mexico, Morocco, Peru, Philippines, Poland, Romania, Russia, Singapore, Slovak Republic, South Africa, Thailand. Advanced countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States.

⁴ See <http://www.bis.org/statistics/pp.htm>, <http://www.dallasfed.org/institute/houseprice/>, and <http://www.oecd.org/statistics/>.

⁵ See <http://www.bis.org/statistics/bankstats.htm?m=6%7C31%7C69> for further details.

3.2. The determinants of the synchronicity of housing prices' growth rates

There is a vast literature that emphasizes that the key drivers of the housing prices' dynamic are idiosyncratic factors, such as economic growth, funding costs and the growth of wages (Capozza *et al.*, 2002; Tsatsaronies and Zhu, 2004; Mikhed and Zemčík, 2009; Adams and Füßs, 2010). These factors may evolve in similar patterns across countries, increasing the chances of co-movement in the housing prices' growth rates. However, other structural factors, such as the depth and flexibility of credit markets, can reduce this level of synchronicity. In fact, as Milcheva and Zhu (2015) explains, economies that face a lower level of loan-to-value ratios in the mortgage market (because of the introduction of caps), or have a fixed interest rate for mortgage loans (due to financial repression), tend to show higher housing price synchronicity. Furthermore, as it was emphasized above, the synchronicity of housing prices might be affected by existing degree of financial linkages across-countries. Therefore, in order to study the determinants of housing price synchronicity across-countries, we control by a set macroeconomic fundamentals, a set of structural controls, as well as by the degree of bilateral banking integration.

In particular, we estimate a bilateral panel model for S_{ijt} with country-pairs fixed effects (α_{ij}) and time fixed effects (γ_t), controlling by bilateral macroeconomic conditions X_{ijt} , bilateral structural controls Z_{ijt} , and the bilateral banking integration IB_{ijt} (in logs), such that:

$$S_{ijt} = \beta_1 \ln(IB_{ijt-1}) + \beta_2 X_{ijt} + \beta_3 Z_{ijt} + \alpha_{ij} + \gamma_t + \varepsilon_{ijt} \quad (3)$$

Where X_{ijt} includes the GDP growth rate, and Z_{ijt} includes structural variables, such as the capital account openness, a measure of the flexibility of the exchange rate, and a measure of financial depth. Also, the bilateral GDP growth rates and the variables within Z_{ijt} are introduced in a multiplicative way, i.e $GDPgrowth_{g_{ijt}} = GDPgrowth_{g_{it}} * GDPgrowth_{g_{jt}}$ and $Z_{ijt} = Z_{it} * Z_{jt}$.⁶ Thus, these variables can be interpreted as a covariation of the underlying variable between country i and j . In addition, as an alternative way to measure this covariance, we construct a variable that measure the synchronicity of X_{ijt} and Z_{ijt} , similarly than in Equation 1. The purpose of this is to serve as a robustness check for our multiplicative method of introducing X_{ijt} and Z_{ijt} in equation (3) (see these results in table A5 in the Appendix). Finally, as stressed below, we apply a log-transformation to IB_{ijt} , because the sample distribution of IB_{ijt} is particular skewed⁷.

⁶ Notice that this estimation strategy has been widely used in the literature, specifically in gravity models that study international trade (Frankel and Rose, 1997, 1998; Fatás, 1997; Clark and van Wincoop, 2001) and more recently, in gravity models for cross-border banking flows (McGuire and Tarashev, 2008; Herrmann and Mihaljek, 2010; Müller and Uhde, 2013).

⁷ Notice that the degree of synchronicity between country i and country j is the same as for country j with country i . Therefore, we run the estimation with half the total country-pairs. This logic also applies for the banking integration variable and all bilateral controls.

4. RESULTS AND ROBUSTNESS CHECKS

4.1. Results

Table 1 and 2 show the results for the pool estimation of the determinants for the synchronicity of housing prices' growth rates for the subgroup of advanced economies (ADV-ADV) and the subgroup of advanced and emerging economies (ADV-EME), respectively. For all our estimations we have included country-pairs fixed effects and quarterly time fixed effects. As can be seen in columns (1) to (6) in both tables, higher bilateral banking integration is associated to higher synchronicity in housing prices' growth rates, even after controlling for the GDP growth rate of country i and j , and the controls included in Z_{ijt} .

The impact of economic growth is positive and statistically significant for the subgroup of advanced economies, which indicates that, among this subgroup of countries, the dynamic of GDP growth rates tends to move in the same direction, making the synchronicity of housing prices increase. In contrast, housing price synchronicity between advanced and emerging economies is negatively related to economic growth, although this relationship is not significant. The latter reflects that

TABLE 1
DETERMINANTS OF THE HOUSING PRICE SYNCHRONICITY,
ADVANCED-ADVANCED SUB-GROUP

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\ln IB_{ijt-1}$	0.471*** (0.0965)	0.475*** (0.0968)	0.429*** (0.0967)	0.471*** (0.0970)	0.584*** (0.0965)	0.527*** (0.0965)	
$GDPGrowth_{ijt}$		0.0653*** (0.0099)	0.0690*** (0.0099)	0.0650*** (0.0099)	0.0440*** (0.0099)	0.0474*** (0.0099)	0.0492*** (0.0098)
$\ln Openness_{ijt}$			-2.608*** (0.7420)			-3.063 (0.739)	-3.306 (0.748)
$\ln ERA_{ijt}$				-1.008 (0.9270)		-1.367 (0.948)	-1.469 (0.950)
$\ln FinDepth_{ijt}$					-4.465*** (0.355)	-4.557*** (0.355)	-4.557*** (0.355)
$\ln IB_{ijt-1} * N$							0.546*** (0.0959)
$\ln IB_{ijt-1} * SP$							0.172 (0.123)
Observations	9,363	9,363	9,363	9,363	9,363	9,363	9,363
R-squared	0,215	0,219	0,220	0,219	0,232	0,234	0,236
R-sq adj	0,192	0,197	0,198	0,197	0,210	0,212	0,213

Note: This table reports OLS regression estimations with country-pairs i, j fixed effects and time fixed effects for the 2000-q1-2012q3 sample period. The LHS variable corresponds to S_{ijt} . Robust p-values are included in parentheses. Significance degree: ***p<0.001, **p<0.05, *p<0.1. N is a dummy that reflects the time of no crisis (normal times), while SP is a dummy that stands for the financial crisis period, 2008.IV-2009.II.

Source: Authors' own elaboration.

TABLE 2

DETERMINANTS OF THE HOUSING PRICE SYNCHRONICITY,
ADVANCED-EMERGING SUB-GROUP

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\ln IB_{ijt-1}$	0.553** (0.0965)	0.558** (0.0968)	0.553** (0.0967)	0.546** (0.0970)	0.637*** (0.0965)	0.634*** (0.0965)	
$GDPGrowth_{ijt}$		-0.0122 (0.0154)	-0.0207 (0.0155)	-0.0138 (0.0154)	-0.0117 (0.0152)	-0.0229 (0.0153)	-0.0208 (0.0153)
$\ln Openness_{ijt}$			-1.607*** (0.459)			-1.831*** (0.441)	-1.767*** (0.441)
$\ln ERA_{ijt}$				-1.577 (0.972)		-1.373 (0.961)	-1.334 (0.965)
$\ln FinDepth_{ijt}$					-2.777*** (0.760)	-3.025*** (0.767)	-2.888*** (0.767)
$\ln IB_{ijt-1} * N$							0.444*** (0.241)
$\ln IB_{ijt-1} * SP$							3.103*** (0.619)
Observations	4.154	4.154	4.154	4.154	4.154	4.154	4.154
R-squared	0,375	0,375	0,377	0,376	0,378	0,382	0,388
R-sq adj	0,327	0,327	0,329	0,328	0,330	0,334	0,340

Note: This table reports OLS regression estimations with pair i, j fixed effects for the 2000-q1-2012q3 sample period. The LHS variable corresponds to S_{ijt} . Robust p-values are included in parentheses. Significance degree: *** $p < 0.001$, ** $p < 0.05$, * $p < 0.1$. N is a dummy that reflects the time of no crisis (normal times), while SP is a dummy that stands for the financial crisis period, 2008.IV-2009.II.

Source: Authors' own elaboration.

the dynamic of economic growth between these economies contributes to dissimilar growth rates in housing prices among emerging and advanced countries, but it has a non-significant effect on housing price synchronicity.

As for the structural variables considered in our estimations, we found a negative and significant effect on housing price synchronicity of both the openness and the financial depth –measured as the banking credit level over GDP–. These results are similar for both advanced and emerging countries. In contrast, the exchange rate regime variable does not show a significant effect on housing price synchronicity.

In addition, we evaluate whether there is a distinct effect of banking integration on housing price synchronicity during the crisis period. In particular, column 7 of Tables 1 and 2 show the effect of the crisis interacted with the degree of banking integration. The results show that, for the subgroup of advanced economies, there is no positive effect of banking integration over housing price synchronicity during the crisis period. On the contrary, as for the synchronicity between advanced and emerging economies, there is an increase in the significance of banking integration during the crisis period, and it is also significant during normal times, although less powerful. The latter reflects that during the GFC the volume of banking integration fell steeply

(see Figure A3 in the Appendix), as housing price synchronicity stood high for the advanced economies subgroup, but decreased for the mixed subgroup (see Figure 2).

4.2. Robustness checks

Finally, we provide some robustness checks to support our main finding which is that housing prices synchronicity and bilateral banking integration are positively related. We do so by constructing an alternative measure of synchronicity, and by assessing the issue of persistence in our estimations. Columns 1 to 3 of Table 3 show the robustness checks for the subgroup of advanced countries, while columns 4 to 6 use the subgroup of advanced-emerging countries.

TABLE 3

DETERMINANTS OF THE HOUSING PRICE SYNCHRONICITY, ROBUSTNESS CHECKS

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Rho	Sync A	Sync Q	Rho	Sync A	Sync Q
$\ln IB_{ijt-1}$	0.0278*** (0.009)	0.577*** (0.193)	0.180*** (0.048)	0.0340** (0.014)	0.907 (0.630)	0.278** (0.129)
Observations	9,363	2,257	9,363	4,154	1,000	4,154
R-squared	0,365	0,241	0,315	0,465	0,399	0,331
R-sq adj	0,347	0,155	0,295	0,424	0,207	0,279
Country Group	ADV-ADV	ADV-ADV	ADV-ADV	ADV-EME	ADV-EME	ADV-EME

Note: In this table, Rho stands for the 5-year rolling window correlation; Sync A stands for the annual synchronization measured as the last data observed in the fourth quarter of each year; and Sync Q stands for the synchronization index based upon the quarterly change of the housing prices instead of the annual change. We include pair i,j fixed effects and time fixed effects for all the estimations. Robust p-values are included in parentheses. Significance degree: *** $p < 0.001$, ** $p < 0.05$, * $p < 0.1$.

Source: Authors' calculations.

When using a 5-year rolling window correlation as our measure of synchronicity (Rho) instead S_{ijt} , we still find that banking integration has a positive and significant impact on Rho in both subgroups of country pairs. To deal with the persistence issue, we first run the same regressions than in columns (6) of tables 1 and 2, but now keeping only the last quarter in every year ($SyncA$). Second, we construct a synchronicity of housing prices based on quarterly changes instead of annual changes ($SyncQ$), and run again the same specification than in columns (6) of tables 1 and 2. In all our specifications, banking integration remains to be positively related to the synchronicity of housing prices, and in almost all of them its statistical significance is above 5%.

5. CONCLUSIONS

In this article, we study the synchronicity of housing prices' growth rates between different countries pairs. We find that housing prices are highly synchronized among advanced countries than for the subgroup of advanced-emerging and emerging-emerging countries. Nonetheless, they converge to similar level of synchronicity toward the end of our sample period.

We also provided evidence that the synchronicity of housing prices' growth rates is positively and statistically significantly related to bilateral banking integration. Our findings support this evidence for the subgroup of advanced-advanced countries, as well as for the advanced-emerging economies. Further, we show that, in spite of the strong relationship found between bilateral banking integration and the synchronicity of housing prices, this relationship might be lost during times of financial stress. Finally, we find that economic growth works as a source of further synchronicity of housing prices for advanced economies, while it acts in the opposite direction for advanced-emerging countries, though the effect is not significant.

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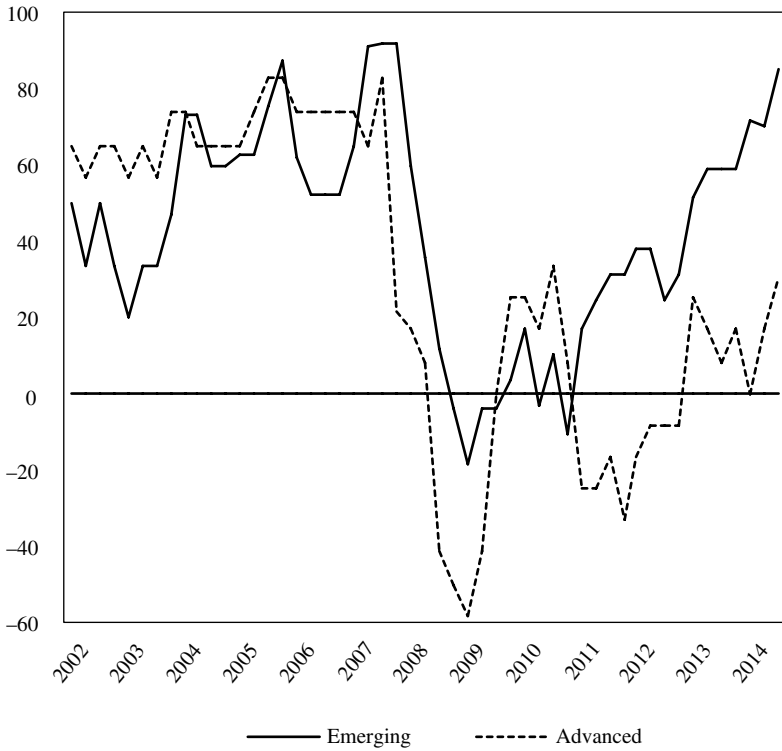
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APPENDIX

FIGURE A1

FREQUENCY OF THE HOUSING PRICE EXPANSIONS

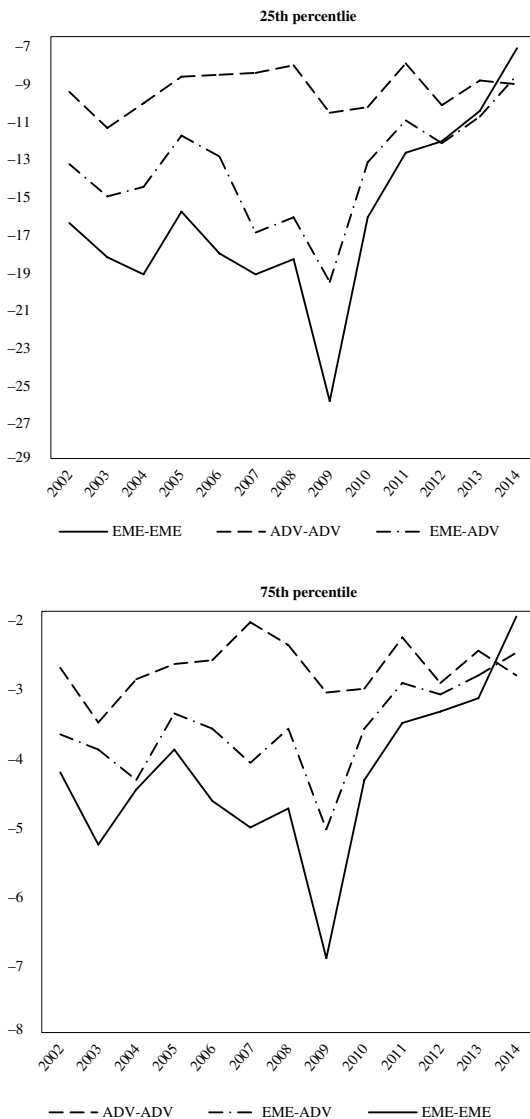


Note: This figure shows the difference between the numbers of countries that experienced an increase in housing prices, minus the number of countries that experienced a decrease, as percentages of the total number of countries within each sample.

Source: Authors own calculations.

FIGURE A2

SYNCHRONICITY OF HOUSING GROWTH PRICES' GROWTH RATES (PERCENTILES)

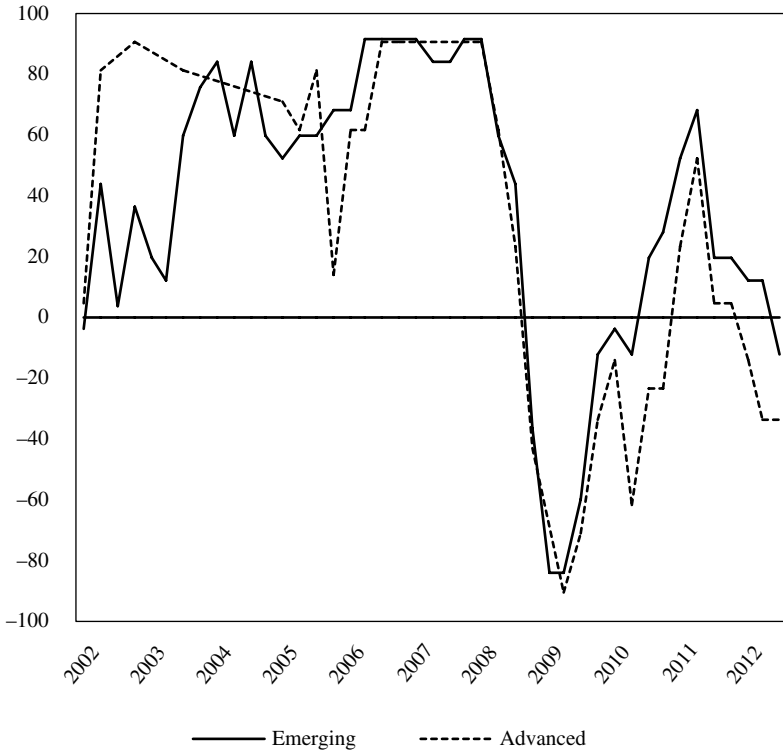


Note: The y-axis in both figures shows the 25th and the 75th percentile of the degree of synchronicity of housing prices' growth rates for three different pair of countries.

Source: Authors' own calculations.

FIGURE A3

FREQUENCY OF BANKING FLOWS EXPANSIONS



Note: This measures the number of countries that expand (positive growth of the banking flows) less those that are in contraction (negative growth of the banking flows).
 Source: Authors' own calculations.

TABLE A1

LIST OF COUNTRIES, COVERAGE, SOURCE AND TYPE OF HOUSING PRICE INDEX

Country	obs	start	end	source	coverage	type
Australia	100	1990	2014	BIS	Big cities	Families
Austria	100	1990	2014	BIS	Capital City	Families
Belgium	100	1990	2014	BIS	Nationwide	Families
Brazil	56	2001	2014	BIS	Nationwide	Properties
Bulgaria	24	2009	2014	BIS	Nationwide	Flats
Canada	100	1990	2014	OECD	Nationwide	Properties
Chile	51	2002	2014	BIS	Capital City	All
Colombia	100	1990	2014	BIS	Big cities	All
Croatia	100	1990	2014	Dallas	Nationwide	Properties
Cyprus	52	2002	2014	BIS	Nationwide	Properties
Czech Rep.	40	2004	2013	BIS	Nationwide	Families
Denmark	100	1990	2014	Dallas	Nationwide	Families
Estonia	40	2005	2014	BIS	Nationwide	Families
Finland	100	1990	2014	OECD	Nationwide	Properties
France	100	1990	2014	Dallas	Nationwide	Properties
Germany	100	1990	2014	Dallas	Nationwide	Families
Greece	85	1993	2014	BIS	Big cities	Flats
Hong Kong	100	1990	2014	BIS	Nationwide	Properties
Hungary	32	2007	2014	BIS	Nationwide	Properties
Iceland	37	2005	2014	OECD	Nationwide	Properties
Indonesia	52	2002	2014	BIS	Big cities	Properties
Ireland	100	1990	2014	OECD	Nationwide	Properties
Israel	100	1990	2014	Dallas	Nationwide	Properties
Italy	100	1990	2014	Dallas	Big cities	Properties
Japan	100	1990	2014	OECD	Nationwide	Urban
Korea	100	1990	2014	Dallas	Nationwide	Properties
Latvia	36	2006	2014	BIS	Nationwide	Properties
Lithuania	65	1998	2014	BIS	Nationwide	Properties
Luxembourg	100	1990	2014	Dallas	Nationwide	Families
Macedonia	40	2005	2014	BIS	Capital City	Flats
Malaysia	64	1999	2014	BIS	Nationwide	Properties
Malta	59	2000	2014	BIS	Nationwide	Properties
Mexico	40	2005	2014	BIS	Nationwide	Properties
Morocco	36	2006	2014	BIS	Nationwide	Properties
Netherlands	100	1990	2014	Dallas	Nationwide	Families
New Zealand	100	1990	2014	BIS	Nationwide	Properties
Norway	100	1990	2014	Dallas	Nationwide	Families
Peru	68	1998	2014	BIS	Capital City	Flats
Philippines	28	2008	2014	BIS	Capital City	Flats
Poland	34	2006	2014	BIS	Capital City	Flats
Portugal	98	1990	2014	OECD	Nationwide	Properties
Romania	24	2009	2014	BIS	Nationwide	Families
Russia	56	2001	2014	BIS	Urban areas	Properties
Singapore	68	1998	2014	BIS	Nationwide	Properties
Slovak Rep.	40	2005	2014	BIS	Nationwide	Properties
Slovenia	32	2007	2014	BIS	Nationwide	Families
South Africa	100	1990	2014	Dallas	Nationwide	Families
Spain	100	1990	2014	Dallas	Nationwide	Properties
Sweden	100	1990	2014	BIS	Nationwide	Families
Switzerland	100	1990	2014	BIS	Nationwide	Families
Thailand	28	2008	2014	BIS	Nationwide	Properties
United Kingdom	100	1990	2014	BIS	Nationwide	Properties
United States	100	1990	2014	BIS	Nationwide	Families

Source: Information gathered from the BIS, the Dallas Fed, and the OECD.

TABLE A2

VARIABLE DESCRIPTION

Variable	Source	Description
Assets	BIS	Cross-border claims (loans and deposits) from country i to country j
Liabilities	BIS	Cross-border liabilities (loans and deposits) from country i to country j
GDP Growth	World Bank	GDP annual growth rate
Openness	Chinn and Ito (2006)	Capital account openness, de jure
ERA	Reinhart and Rogoff (2004)	Exchange rate regime (1 monetary union and 6 free floating)
Fin Depth	BIS and IFS	Outstanding private credit as percentage of GDP

TABLE A3

CORRELATIONS

	S_{ijt}	$\ln IB_{ijt}$	$GDP\ Growth_{ijt}$	$\ln Openness_{ijt}$	$\ln ERA_{ijt}$	$\ln Fin\ Depth_{ijt}$
S_{ijt}	1					
$\ln IB_{ijt}$	0.15	1				
$GDP\ Growth_{ijt}$	-0.1541	-0.1112	1			
$\ln Openness_{ijt}$	0.1006	0.306	-0.0566	1		
$\ln ERA_{ijt}$	0.0052	-0.1025	0.0575	-0.2151	1	
$\ln Fin\ Depth_{ijt}$	0.1517	0.4741	-0.1537	0.2037	-0.0627	1

Source: Authors' own preparation.

TABLE A4

DESCRIPTIVE STATISTICS (IN PERCENTAGE)

Statistic	Advanced-Emerging					Advanced-Advanced				
	Avg	Sd	p50	p25	p75	Avg	Sd	p50	p25	p75
S_{ijt}	-10.09	1.60	-9.90	-10.86	-8.81	-6.65	1.00	-6.47	-7.39	-5.99
IB_{ijt}	0.20	0.03	0.20	0.18	0.23	1.81	0.36	1.83	1.54	2.07
$\ln IB_{ijt}$	-3.35	0.18	-3.31	-3.49	-3.21	-1.03	0.16	-1.04	-1.14	-0.90
$GDP\ Growth_{ijt}$	11.54	7.74	11.01	5.85	17.62	6.27	5.06	3.83	2.91	9.90
$Openness_{ijt}$	2.43	0.41	2.43	2.08	2.80	5.55	0.14	5.60	5.48	5.65
ERA_{ijt}	4.76	0.24	4.78	4.56	4.92	3.69	0.09	3.77	3.60	3.77
$Fin\ Depth_{ijt}$	9.40	0.38	9.30	9.03	9.77	10.16	0.35	10.19	9.84	10.48

Source: Authors' own preparation.