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## ► To cite this version:

Yasmine Zouari, Aya Nasreddine. Housing in the Greater Paris Area as an Inflation Hedge?. 29th Annual European Real Estate Society Conference, ERES, Jul 2023, London, France. <10.15396/eres2023\_11>. <hal-04956272>

**HAL Id: hal-04956272**

**<https://hal.science/hal-04956272v1>**

Submitted on 19 Feb 2025

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# Housing in the Greater Paris Area as an Inflation Hedge?

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## Abstract

In this article, we use the framework of inflation beta to test the capacity of physical residential real estate to hedge against inflation and its components, and compare it to the inflation hedge ability of various financial assets. Specifically, the housing asset is represented by the residential market in the communes of the “Grand Paris” metropolis between 1996 and 2017 with the different components of inflation. We start by analyzing the residential market in this area, its fundamentals, characteristics and dynamic. Then, applying the hierarchical clustering technique, we divide the Greater Paris area into five homogenous groups of communes and test its hedging ability using both correlation and regression analysis. Residential assets are confirmed to be a hedge against inflation, particularly against its unexpected component and thanks to its capital return rather than the rental return. On the other hand, the listed real estate does not provide the same hedging properties and thus cannot be considered as a substitute for this aim.

**Keywords:** *Direct housing, “Grand Paris” metropolis, listed real estate, inflation, hedging ability, asset management.*

## I. Motivation

Following a sustained period of historically low inflation, the recent upsurge in prices has vividly highlighted the impact inflation can wreak on finances. Indeed, from early 1990’s until 2021, inflation in France was more or less under control or balanced. However, it experienced recently a quite important growth. The harmonized consumer price index (HICP) reached 7.1%<sup>1</sup> in October 2022. Over the long run, high or even low inflation has an impact on investors’ wealth and households’ purchasing power. In such context, inflation hedging should remain an important goal to reach. We believe real and inflation-linked assets can provide investors with a powerful hedge against further upside shocks. Indeed, several studies pointed out real estate as a potential asset class

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<sup>1</sup> According to INSEE (*Institut National de la Statistique et des Études Économiques, France*).

for the inflation hedging nexus (Fama and Schwert (1977), Fogler et al. (1985), Ben-Shahar (2003), Rubens et al. (1989), Anari and Kolari (2002), Le Moigne and Viveiros (2008), Park and Bang (2012), (Christou et al. (2018), Salisu et al. (2020), Taderera and Akinsomi (2020)), among others). Specifically, the importance of the relationship between house prices and inflation is highlighted in that, in most countries, residential real estate is the principal asset held in private portfolios (Hong et al. (2013)). Another characteristic that makes real estate a potential hedge against inflation is the increase of construction costs in line with inflation, as well as rent evolution, either because they are pegged to inflation or simply because of the rising price of assets (Fisher and Sirmans, 1994). Breitenfellner et al. (2015) and Christou et al. (2018) show that, while rising general prices are transmitted to real estate price via construction input prices, tight monetary policy in times of inflation reduces liquidity flow to the real estate market to cause lower prices and hence returns on real estate investment. This is in line with the current context in France experiencing an increase in interest rates coupled with higher construction material and energy prices.

There is mixed evidence on whether real estate provides a good inflation hedge, possibly because of the time-varying relationship between house prices and its predictors, including inflation, as suggested Risse, Gupta, and Nyakabawo (2016) or given the dynamic nature of the studied housing market and the transformations it has gone and is going through. Asset classes react differently to inflation due to their varying characteristics. For instance, Atil et al. (2014) and Bahmani-Oskooee and Ghodsi (2016) show that the relationship between macroeconomic and financial variables are nonlinearly related. Moreover, Salisu et al. (2020) conduct a comparative analysis of inflation hedging properties of stocks, gold and real estate investment trusts (REITS)<sup>2</sup>. Authors show that inflation hedging is asset-specific. Their results show that real estate and stock returns are confirmed to be a good hedge against inflation, while nominal returns on gold investments defy Fisher's hypothesis (1930)<sup>3</sup>. Their findings are valid even after accounting for asymmetry and structural breaks. Besides, literature documents that real estate hedging potential may also be episodic (Wu and Pandey (2012); Obereiner and Kurzrock (2012); Amonhaemanon et al. (2013)); time varying (Christou et al. (2018)) and could differ across sectors (Taderera and Akinsomi (2020)). The exhaustive literature studying the inflation hedging nexus of real estate leads thus to mixed findings depending on the considered real estate asset (listed or physical, commercial or housing...) and depending on the market fundamentals of the studied area. The diversity of the elements/components that need to be considered when examining the hedging effectiveness of housing against inflation makes the task somewhat arduous. Hedging ability may differ markedly due to differences in methodologies, housing asset (direct or indirect asset), housing prices (transaction based or appraisal based), housing return components (price, rent or total return), inflation components (actual,

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<sup>2</sup> US listed real estate.

<sup>3</sup> Fisher (1930) theory states that the expected nominal interest rate should move in sync with expected inflation.

expected or unexpected inflation), horizons (short run or long run), etc. Despite this, strong empirical evidence exists in favor of a positive relationship between housing returns and inflation, making the residential asset an interesting asset to hold to hedge against inflation. In this paper, we test the inflation-hedging ability of housing in the communes of *Île-de-France*<sup>4</sup>.

## II. Housing in the Greater Paris area: A particular case

Besides two major events that would have a long-lasting impact on the whole environment of the Greater Paris area,<sup>5</sup> namely the “*Grand Paris Express*” project<sup>6</sup> and the 2024 Olympic Games, we believe that the studied area has structurally relevant features (market fundamentals for investments) that we highlight in the current section. Indeed, residential market is characterized by a high level of heterogeneity, and there is global consensus on the fact that this is an issue since it partly leads to market illiquidity. But we have a different idea about the heterogeneity of the market. Actually, we believe that the existence of various micro-specific local markets, on one hand, creates low correlation between assets (Hoesli and Lizieri 2007), and, on the other hand, it allows investors to enhance their chances to find the property that meets their requirements at all levels (characteristics, prices, costs, rents, etc.). However, this assumes a thorough knowledge of the local markets’ specificities (such as housing market evolution and population), the changing market environment and amenities (such as transport, urban renewal). Due to the limited and costly access to information, it seems unreasonable to expect such expertise on every local market due. Thus, we identified some key points we consider to be crucial when selecting future investments’ localizations.

### a. Market size

The first key point is the size of the market. Each dwelling may represent an investment opportunity at a given time. But housing stock is not infinite, so it is important to target upstream the housing market areas with important inventories of dwellings.

Since we focus in this article on direct investment in housing in the *Greater Paris* area, we start by considering the weight of this housing market relative to the overall housing market in France.

Figure 1 displays the weights of each region<sup>7</sup> in France in terms of number of dwellings (more precisely, apartments, as we are interested in this type of housing). Our study zone is the region *Île-de-France*, which appears to be first ranked in terms of relative weight (27% of the French housing stock is located in *Île-de-France*) and number of apartments (with near 4 million units).

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<sup>4</sup> Greater Paris area formed of 150 communes that comprises Paris proper but also some suburbs around it.

<sup>5</sup> The geographical representation of Greater Paris area is in appendix 1.

<sup>6</sup> The “*Grand Paris Express*” project is a structural one; it is actually the largest transport project in Europe.

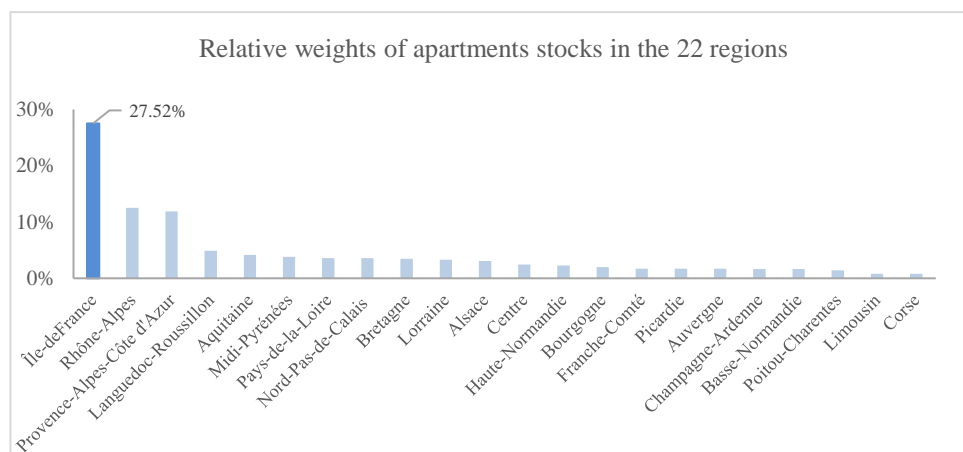
<sup>7</sup> Due to the period of the study and the scale of available data, we present here the former administrative division of France consisting of 22 metropolitan regions instead of the newest one consisting of 13 metropolitan regions.

As the *Greater Paris* project does not cover the whole region of *Île-de-France*, results were refined to the departmental level in order to focus the analysis on the departments concerned by the project. Figure 2 displays the relative weight of the French departments. Weights range from 9.06% for the largest stock in Paris proper (department number 75) to 0.08% in the department of *Creuse* (department number 23). For practical reasons, we represent only the fourth quartile of departments, i.e., departments with the greatest stocks (24 of the total 96 departments).

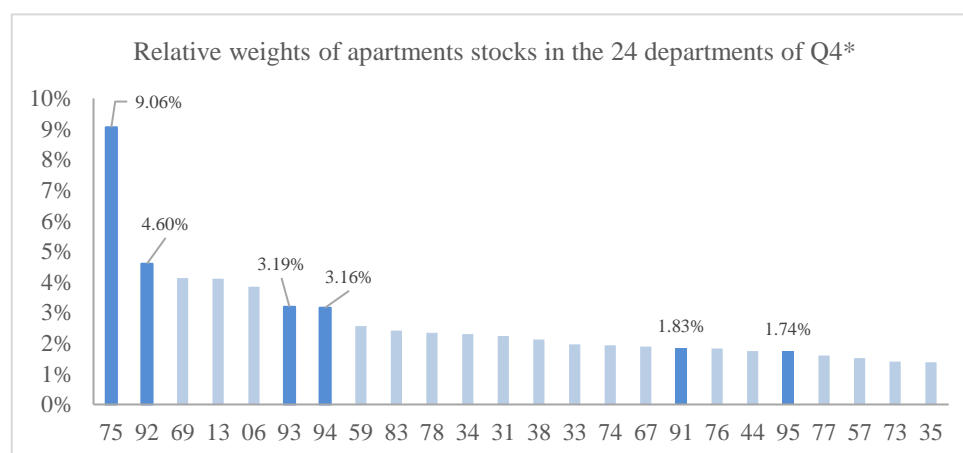
Once again, the departments of interest performed well. Paris proper ranks first (9.06% of the total stock of apartments is located within Paris proper), followed by its inner suburbs: department of *Hauts-de-Seine* (92) with 4.6%, *Seine-Saint-Denis* (93) and *Val-de-Marne* (94) holding, respectively, 3.19% and 3.16% of the overall housing market stock.

To conclude, the different housing markets we are interested in are among the largest ones in France, which provides investors some insurance about the availability of stocks and existence of various investment opportunities.

**Figure 1.** Relative weights of apartments stocks at the regional level



**Figure 2.** Relative weights of apartments stocks at the departmental level



Source: INSEE, 2014 \*The fourth quartile Q4 is composed of the 24 first departments in terms of stock, and highlighted histogram bars correspond to the Greater Paris region departments

The second key point we identified is the pattern of housing tenure. Actually, after assessing the overall and local housing market sizes, it is important to examine more closely the tenure choices within these markets. The different status of occupation identified by INSEE are homeowners, private sector tenancy, social housing tenancy and free lodging. Intuitively, but also according to Hoesli and MacGregor (2000), the weight allocated to property in institutional portfolios is inversely related to the importance of the residential owner-occupied sector. Therefore, the involvement of institutional investors in the rental housing sector varies from country to country. For instance, Spain, Italy, and the United Kingdom, which are characterized by high levels of homeownership (respectively 83%, 73% and 68%), are also characterized by a lack of institutional investment in housing.<sup>8</sup> In contrast, in countries such as the Netherlands, Germany or Switzerland (with only about 40% homeownership), allocation of institutional funds to private rented housing is significant. This negative relation between the size of the owner-occupied sector and the allocation toward housing does not apply exclusively to institutional investors. It is equally true for any buy-to-let investment, since corresponding expected return is composed, of course, of a capital gain but also an income return. Investors (individual or institutional) are thus concerned with the steadiness of future cash-flows (rents), which is partly shaped by supply and demand for property space. To lower the degree of uncertainty of future cash-flows and thus the risk level of an investment, location choice should be driven by the extent to which a property can be rented as quickly and easily as possible. One basic way of proceeding is to target areas characterized by a high proportion of renters to owners, low home purchase power and low vacancy rates.<sup>9</sup>

### **III. Methodology and results**

#### **a. Data**

This section seeks to present the asset classes included in the simulated portfolios. The latter include investments in housing real estate, stocks, bonds, and cash. The physical residential markets in 150 communes in Paris and the Parisian first-ring suburbs are considered potential asset classes. More precisely, investors can buy (either to occupy or rent) collective housing (apartment) in one or several communes. In order to consider this particular asset class within a multi-asset portfolio, we need to compute the total return of housing in these communes. For that purpose, two different

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<sup>8</sup> This is partly due to the high share of owners in these countries, there are in addition cultural facts towards housing investments particularly in the United Kingdom according to Joaquim Montezuma in his study « Housing investment in an institutional portfolio context », 2003.

<sup>9</sup> The metropolis of Greater Paris is a major center of higher education, which results in a high representation of the students and also the young workers. These two particular categories of population are emblematic of the current situation in the metropolis that we are seeking to demonstrate: high proportion of renters compared to owners, with a low home purchasing power, and a low vacancy rate due to the important demand.

databases are used. The first is provided by the chamber of Notaries<sup>10</sup> in *Île-de-France*. It contains the average annual sale price of collective housing in each of the 150 communes between 1996 and 2017. The second database is developed by CLAMEUR (*Connaître les Loyers et Analyser les marchés dans les Espaces Ruraux et Urbains*), a private observatory of the rental market in France. It provides annual rent levels in all French cities between 2000 and 2017. As rent data series start only from 2000, we manage to align all the data over the period 1996–2017 and extend the rental database to start from 1996. This was possible thanks to OLAP (*Observatoire des Loyers dans l'Agglomération Parisienne*), a public observatory of rental markets that specializes in the Greater Paris area and provides valuable information about rents since 1991.<sup>11</sup>

We end up with 127 communes that provide investment opportunity, and for which the calculation of the total return for the whole period is possible.

There is a widespread practice of considering a decomposition of real estate returns into income returns and capital gain (or loss) (Graff and Cashden 1990). Based on this idea, the housing asset was represented in this study by a specifically constructed annual<sup>12</sup> total return from 1997 to 2017. It is the sum<sup>13</sup> of capital return and rental return. Because of missing data on operating expenses, managing cost of housing portfolio and measures of potential vacancy rate impact on the level of renting income, we could not consider these measures in the computation of housing total returns. As we do not have enough information to allow us to discount locally the different housing returns, we consider the gross housing total return instead of applying the same constant discount rate<sup>14</sup> to all communes.

In this study, the physical residential markets in 127 communes in Paris and the Parisian first-ring suburbs are considered as potential asset classes. However, the significant number of communes

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<sup>10</sup> The number of housing transactions per year in Île-de-France is very important; it ranges between 150 000 transactions and 220 000 transactions, which represents in average 16% of all transactions in France. Compared to other regions, Île-de-France is first ranked and captures the most important share of transactions. This represents an extra guarantee of the reliability of the housing index produced by the notaries of Île-de-France. Source : <http://www.cgedd.developpement-durable.gouv.fr/prix-immobilier-evolution-a-long-terme-a1048.html>

<sup>11</sup> CLAMEUR and OLAP databases are different on two levels: First, at a geographical scope, CLAMEUR gives rental levels for all French cities (including communes in our area of study), whereas OLAP gives only an aggregated index for the Paris agglomeration. The second difference is the start date of the indexes; while CLAMEUR series start in the year 2000, OLAP provides a longer series by starting in 1996. That is why, we thought about using OLAP data from 1996 to 2000 to extrapolate the rents of the studied communes to get longer series.

<sup>12</sup> Data related to the rental market is collected on an annual basis, which constrains us to use the annual periodicity for all our series, even if other data are available at a finer temporal scale (quarterly, monthly or even daily basis).

<sup>13</sup> In our case, the housing total return for each of the 127 communes is computed as follow:

$$\begin{aligned} \text{Housing total return}_t &= \text{Rental return} + \text{capital return} \\ \Leftrightarrow HTR_t &= \frac{R_t}{P_{t-1}} + \frac{P_t - P_{t-1}}{P_{t-1}} \end{aligned}$$

Where  $R_t$  is the average level of rent per square meter in a commune during year  $t$ , and  $P_t$  and  $P_{t-1}$  are the average transaction prices per square meter in a commune during the years  $t$  and  $t-1$ .

<sup>14</sup> This is done for example in the study of Hoesli and Hamelink (1997). For operating expenses, they subtracted 150 basis points from the rental return in two swiss housing markets.

would make the analysis and graphic representation laborious. Among these 127 residential markets, some have characteristics in common, either structural or conjunctural, which makes them quite homogeneous and thus comparable from an investor standpoint. Given these reasons, we simplified the analysis by clustering the 127 communes into five homogenous groups using ascending hierarchical classification (AHC). This technique calculates dissimilarities between objects before grouping the ones that minimize an agglomeration-selected criterion and maximize the intergroup variance. This progressive grouping of a large data set produces a binary clustering tree, called a dendrogram, which allows us to visualize the nodes and hierarchy of partitions so that we can truncate the tree at the level we choose in order to get a suitable number of classes. In our case, the grouping of the communes is based on eight variables belonging to three different sets: Housing market fundamentals, housing market dynamism and investors' standpoint. Appendix 1 details the description of the variables used in the AHC and Appendix 2 displays the list of communes into each group. Figure 3 illustrates the five groups of communes. A detailed list of the communes within the five obtained groups is available in appendix 3.

**Figure 3.** The five groups of communes

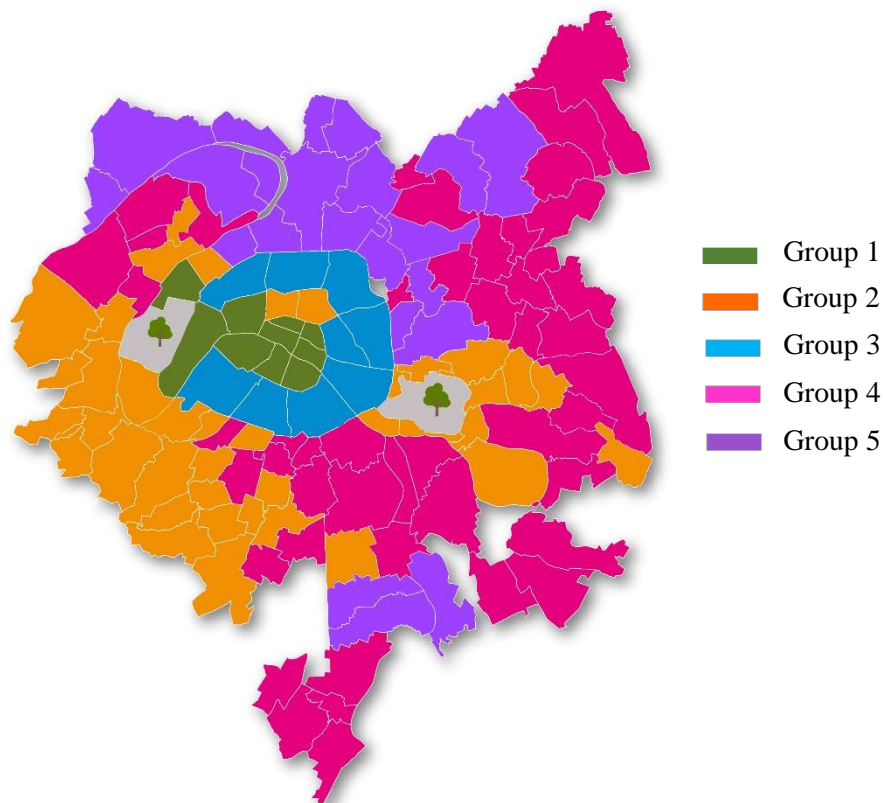




Table 1 gives some statistical information about the centroids of each group.

**Table 1.** The five groups' centroids for the eight descriptors used in the AHC

Group	Price	Rent	Stock	Income	Population	Return	Risk	Sharpe ratio
1	7 098 €	22,9 €	31 810	56 524 €	52 525	11,09%	7,01%	1,088
2	3 717 €	16,0 €	23 085	33 442 €	39 318	11,11%	7,08%	1,082
3	5 129 €	19,4 €	115 291	26 925 €	174 740	12,08%	7,11%	1,214
4	2 564 €	12,9 €	22 062	21 687 €	38 883	11,56%	8,50%	0,962
5	2 249 €	13,2 €	27 733	16 113 €	49 296	13,65%	9,55%	1,079

#### b. Correlation analysis

The inflation-hedging feature can be examined by analyzing the correlation between asset classes' returns and inflation<sup>15</sup>. Table 2 presents these correlations over the sample period. Stocks are negatively and significantly correlated with inflation (-0.54), meaning that they do not provide any hedge against inflation. Even more, they act as a perverse hedge against inflation. Bonds are positively correlated with inflation, but the coefficient is low and statistically insignificant (0.38). This is also the case for cash, which is positively but non-significantly correlated with inflation (0.3). On the contrary, housing exhibits a significant co-movement with inflation. We notice that the five housing groups' total returns are positively correlated with inflation. Considering that total return is composed of two components—capital return and income return—we sought to investigate which one drives this considerable hedge against inflation.

<sup>15</sup> The Consumer Price Index is used as a proxy for inflation.

**Table 2.** Correlation between inflation and various assets' returns (1997 – 2017)

	<b>Inflation</b>
<b>Stocks</b>	-0.5365*
<b>Bonds</b>	0.3085
<b>Cash</b>	0.3846
<b>Group 1 – Total return</b>	0.6253*
<b>Group 1 – Capital appreciation</b>	0.6601*
<b>Group 1 – Income return</b>	-0.0533
<b>Group 2 – Total return</b>	0.6377*
<b>Group 2 – Capital appreciation</b>	0.6781*
<b>Group 2 – Income return</b>	-0.0484
<b>Group 3 – Total return</b>	0.6415*
<b>Group 3 – Capital appreciation</b>	0.6778*
<b>Group 3 – Income return</b>	-0.0288
<b>Group 4 – Total return</b>	0.5783*
<b>Group 4 – Capital appreciation</b>	0.6122*
<b>Group 4 – Income return</b>	-0.0540
<b>Group 5 – Total return</b>	0.5661*
<b>Group 5 – Capital appreciation</b>	0.5964*
<b>Group 5 – Income return</b>	-0.0155

\* Significant at 5%.

According to the results in Table 2, the five housing groups' total returns correlations with inflation seem to be driven by their capital return components: significant positive correlations are found for capital returns, and negative insignificant ones for income returns. These results are similar to those recorded in Canada by Le Moigne and Viveiros (2008), who found that capital return was the main source of inflation exposure for total real estate returns between 1973 and 2007. We notice that this result is coherent since the rental return calculation consists of a ratio between the rent and the house price. On one hand, rents are strictly regulated<sup>16</sup> in this tense area. Moreover, rents were first indexed

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<sup>16</sup> Decree No. 2015-650 of June 10, 2015, adopted pursuant to the ALUR law.

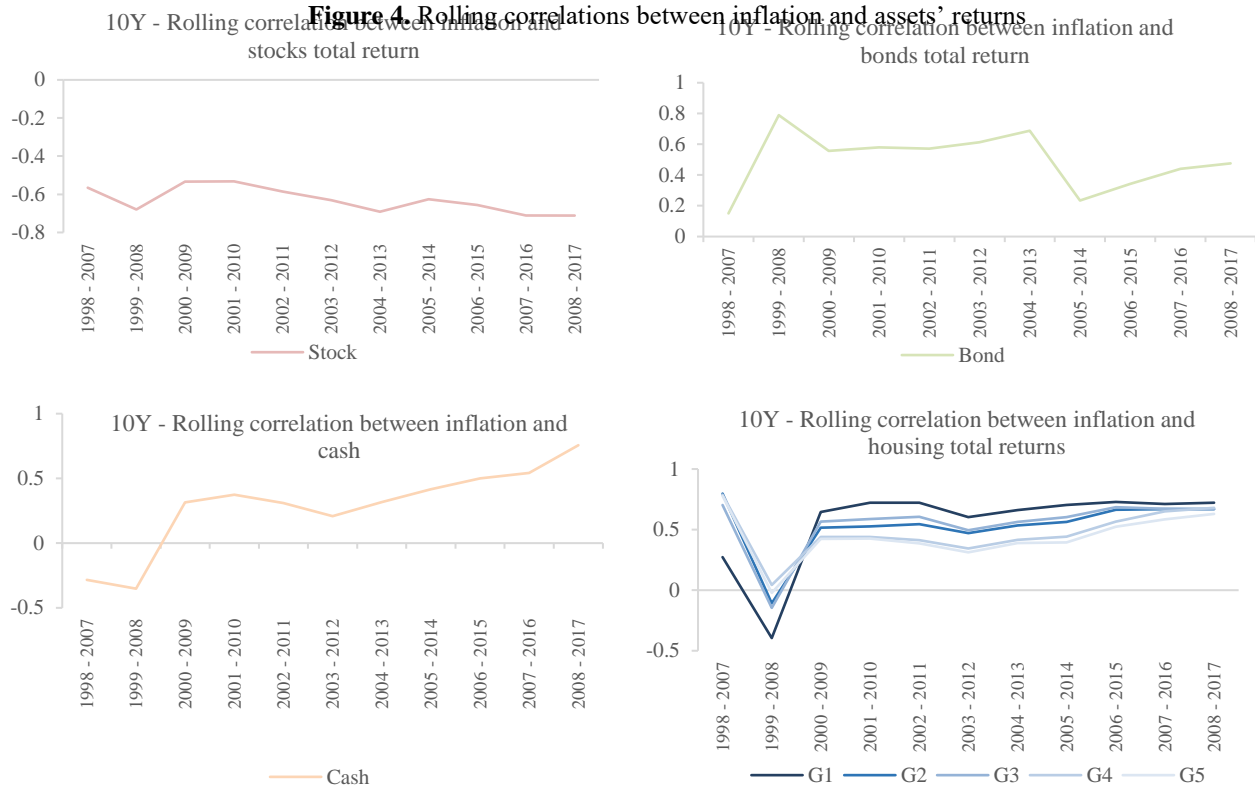
to the ICC (Index of Construction Cost), then to the IRL (*Indice de Révision des Loyers*), which until 2008 was only partly based on the Consumer Price Index (proxy for inflation)<sup>17</sup>. On the other hand, houses prices are indexed and positively correlated with inflation. Then their rapid growth compared to the rents results in a decrease of rental return, explaining thus the negative correlation found between rental return and inflation.

Correlation between inflation and various assets returns may not be stable over time, just as any other correlation between two asset classes' returns. Effective hedging may hold on one sub period but not on the next (Le Moigne and Viveiros 2008). Indeed, there is mixed evidence on whether real estate provides a good inflation hedge, and this mixed evidence could possibly be because of the time-varying relationship between house prices and its predictors, including inflation, as suggested by Anari and Kolari, 2002, Bork and Møller, 2015, and Pierdzioch, Risse, Gupta, and Nyakabawo, 2016. Therefore, it is important for an investor to examine the hedging effectiveness of an asset on different sub periods. In our case, rolling correlations between stocks, bonds, cash, five groups housing assets and inflation are displayed in figure 4. Rolling correlation between inflation and bonds returns ranges between 0.15 and 0.78. The first two subperiods 1998 – 2007 and 1999 – 2008 have witnessed the greatest change in the correlation level. Although correlation over the whole sample period is not significant, it is interesting to notice that it starts to decrease since 2009 was included in the subperiods and bottomed out at 0.23 during the period 2005 – 2014. Cash also has insignificant correlation with inflation; however, the rolling correlation shows a trend towards a sustained upward co-movement, with some periods of volatility (2003 – 2012). Correlation coefficients were between -0.31 and 0.75. Housing assets experienced the same pattern than cash with inflation, but four of the five housing groups assets show more stability in the rolling correlation coefficients, ranging from -0.14 for the minimum to 0.62 for the highest correlation. Furthermore, it is interesting to notice that there is a persistent negative correlation between stocks return and inflation. At no time there has been the slightest positive correlation between the two. It might be surprising particularly when we think of the phenomenon of a mild inflation that is capable of rapidly stimulating capital formation and in turn increasing corporate profitability. Fama (1981) tackled the question and relied on the theory of demand for money to explain this negative correlation between returns on stocks and inflation. He actually argued that the relationship is not a direct one. He first established a negative relationship between inflation and real activities (measured by GDP and

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<sup>17</sup> The index IRL was initially composed for 40% of the index of construction cost (ICC) and the price index for housing maintenance and improvements (IPEA), and for 60% of the consumer price index (proxy of inflation). Then its composition has changed since 2008 to be based only on the annual moving average of the consumer price index.

industrial production). This means that growth and inflation are negatively correlated<sup>18</sup>. At the same time, the evolution of the stock market anticipates the increase in activities, meaning that activities and stocks returns are positively correlated. According to Fama (1981), these two independent relationships explain the negative relationship between inflation and the stock market.



### c. Regression analysis

In order to complete the correlation analysis, we evaluate the effectiveness of the French housing asset's ability to hedge inflation using the beta inflation measure. We run a regression designed to quantify the relationship between the five housing groups' returns and the change in inflation level. Since some authors criticized the use of conventional statistical methods especially when the stationarity of the series is not proved (Chaudhry et al. 1999), we run stationarity tests for all times series used in the study. We find indeed some of them exhibiting autocorrelation (cash, housing

<sup>18</sup> We note that this relationship is well documented in the literature. Early work has mixed results; for example, the study conducted by Paul *et al.* (1997) involving 70 countries over the period 1960-1989, reported no causal effect between inflation and growth in 40% of the panel, a bidirectional causality in 20% of the panel and unidirectional causality in the rest of the panel. Relationships were positive in some cases and negative in others. More affirmative works about the negative relationship between inflation and growth are conducted by Robert and Alexander (1997) for example. They conducted a study on a panel of OECD countries and found that positive effect of inflation on the growth rate of GDP is largely outweighed by the negative effects. Gillman *et al.* (2004) also conducted an empirical analysis using a sample of APEC and OECD countries. They found that for the latter countries there is a negative and significant inflation-growth effect. Barro (1995) investigated the link between inflation and economic growth using a larger sample of more than 100 countries from 1960 to 1990. He showed that there is a significantly negative relationship between inflation, and economic growth and investment.

groups 4 and 5). As a consequence, we run all regressions in first differences. In this part, we examine the effectiveness of the various asset classes as hedges against actual, expected, and unexpected inflation. We followed the approach proposed by Fama and Schwert in 1977. They used a two-factor model in which the asset return is the dependent variable, and both expected and unexpected inflation are the independent variables:

$$R_t = \alpha + \beta(E(\text{inf}_t)) + \gamma(\text{inf}_t - E(\text{inf}_t)) + \varepsilon_t \quad (1)$$

Where  $R_t$  is the return of an asset in period  $t$ ,  $E(\text{inf}_t)$  is the expected inflation for period  $t$ ,  $(\text{inf}_t - E(\text{inf}_t))$  is the unexpected inflation which is the difference between actual and expected inflation for period  $t$  and  $\varepsilon_t$  is the error term.

The asset is a greater positive hedge against inflation as the coefficients  $\beta$  and  $\gamma$  increase. Therefore, according to the coefficients  $\beta$  and  $\gamma$ , one can assess either the asset is a complete, partial, perverse or over hedge against expected and unexpected inflation. In our case, the Consumer Price Index is used as a proxy for actual inflation. We decomposed actual inflation into the expected and the unexpected components, according to two methodologies. We firstly assumed that expectations are perfect, and the only independent variable is the actual inflation (Gültekin, 1983, Hamelink and Hoesli, 1997). The initial model is thus reduced to a one-factor model as follow:

$$R_t = \alpha + \beta(\text{inf}_t) + \varepsilon_t \quad (2)$$

Where  $R_t$  is the return of an asset in period  $t$ ,  $\text{inf}_t$  is the actual inflation for period  $t$  and  $\varepsilon_t$  is the error term. Regressions of various assets returns on inflation are displayed in Table 3. Housing assets appear to be an over hedge against inflation, with a significant coefficient higher than 1 for the 5 groups of communes. Cash displays a small and insignificant link to inflation. The latter provides no hedge against inflation. Stocks react negatively to inflation, the coefficient is negative and statistically significant, meaning that stocks are a perverse hedge against inflation. A significant positive coefficient is associated to bonds which also makes it a candidate for inflation hedging.

**Table 3.** Regression results of various asset classes on inflation

Variables	Stocks	Bonds	Cash	G1	G2	G3	G4	G5
Inflation	-19.89 *** (-4.01)	4.76** (2.17)	0.31 (1.48)	3.94 *** (2.96)	3.13 *** (2.91)	3.65 ** (2.83)	2.36 ** (2.36)	2.46 ** (2.11)
Constant	-0.005 (-0.101)	-0.006 (-0.273)	-0.002 (-1)	-0.001 (-0.077)	0.0 (0.036)	0.001 (0.077)	0.000 (0.05)	0.001 (0.09)
R <sup>2</sup>	0.47	0.21	0.11	0.33	0.32	0.31	0.24	0.20

\*\*\* p-value <1%; \*\* p-value < 5%; \* p-value < 10%.

To conclude, we would like to emphasize that according to the results, all the housing groups tend to directionally compensate for inflation. Table 2 and table 3 exhibit positive and significant correlations and regression coefficients between inflation and housing groups returns. We notice however that the hedging power is more important for housing groups 1, 2 and 3. This difference of hedging ability among housing groups is explained by the composition, the size of the groups and the intrinsic characteristics of the communes. The first three groups are the smaller and the most homogenous groups. They are all located in Paris proper and in its inner suburbs. Thus, communes in these three groups are mature, and already experienced the highest price increase over the last three decades (+200% to +420% of price increase over the studied period). In the contrary, groups 4 and 5 are larger groups, composed mainly by communes that are currently experiencing a strong progress in gentrification, facing higher demand due to the housing affordability and the urban renewal and shifting (Olympic Games 2024: commune of Saint-Ouen, Grand Paris Express project: commune of Clichy (Metro Line 14) or Bangeux (Metro Line 4), etc.), compared to the inelasticity of offer, although construction in these communes is very active. These two groups may exhibit now a lower hedging ability, though existent, but in the future, they are expected to provide as much hedge as the remaining groups.

For the second part of the methodology, we followed the assumption of Hamelink and Hoesli (1997): the expected inflation is inferred from past actual inflation. The unexpected component is the difference between the two. By assuming that expected inflation at a time  $t$  is a linear function of the expected inflation at time  $t-1$ , we get this relation:

$$inf_t = \alpha + \beta(inf_{t-1}) + \varepsilon_t \quad (3)$$

Where  $inf_t$  is the expected inflation for period t,  $inf_{t-1}$  is the actual inflation for period t-1 and  $\varepsilon_t$  is the error term. The regression leads to the outcome illustrated in Table 4. The constant is significant at 5% level while the lagged inflation Inflation\_L1 is insignificant. This means that inflation in period t cannot be explained significantly by inflation in period t-1. The R-squared of the regression is low (0.08) and indicates a poor fit of the model<sup>19</sup>.

**Table 4.** Autoregressive model of inflation rates

Variables	Inflation
Inflation_L1	0.29 (1.65)
Constant	0.01 ** (2.5)
R <sup>2</sup>	0.08
*** p-value <1%; ** p-value < 5%; * p-value < 10%.	

Using the estimates for inflation from the equation (3) above, we compute the values of expected inflation (fitted values) and the unexpected inflation (actual inflation minus expected inflation). The values of inflation components are presented in table 5 and the results of the regression (equation 1) are displayed in table 6. Our asset classes behave differently toward expected and unexpected inflation. For expected inflation, all of them appear to be poor hedge with statistically insignificant coefficients. For unexpected inflation, the housing assets (specifically groups one, two and three) exhibit a strong beta to inflation which is consistent with conclusions frequently drawn from the empirical literature concerning the ability of housing to provide the strongest hedge against inflation, compared to other asset classes. Further, cash and bonds are found to provide respectively no hedge and an over hedge against unexpected inflation. Stocks act as a perverse hedge against unexpected inflation. We confirm thus the finding of Salisu et al. (2020) on the US market that demonstrate that assets react differently to inflation due to their varying characteristics. However, in their study, they use US REITS as real estate asset class whereas we consider physical housing of the « Grand Paris » metropolis in ours. The next section aims to extend our study to also consider French listed real

<sup>19</sup> We ran the regression for two subperiods: 1997 - 2007 and 2007 – 2017. Results on the first subperiod are significant and indicates that the inflation rate is highly correlated with its lagged value (coefficient 0,53; p-value 0,05 and R-squared 0,43). The model loses its explanatory power only in the second subperiod, which is characterized by the occurrence of temporary events that might disrupt the economic activity, such as the financial crisis and the quantitative easing. For that reason, we assume that in normal conditions, current inflation could be explained by previous inflation rate.

estate (Sociétés d'Investissement Immobilier Cotées, noted SIIC hereafter), which are the equivalent of REITS on the US market).

**Table 5.** Actual inflation rates and expected and unexpected inflation rates derived from the autoregressive model

Date	Actual inflation	Expected inflation	Unexpected inflation
1998	0.00669	0.01412	-0.00742
1999	0.00578	0.01237	-0.00659
2000	0.018	0.01211	0.00589
2001	0.01811	0.01561	0.00251
2002	0.01915	0.01564	0.00351
2003	0.02177	0.01593	0.00583
2004	0.02341	0.01668	0.00673
2005	0.01875	0.01715	0.00160
2006	0.01903	0.01582	0.00321
2007	0.01602	0.01590	0.00012
2008	0.0316	0.01504	0.01656
2009	0.00102	0.01949	-0.01847
2010	0.01739	0.01075	0.00664
2011	0.02291	0.01543	0.00748
2012	0.02218	0.01701	0.00517
2013	0.0099	0.01680	-0.00690
2014	0.00611	0.01329	-0.00718
2015	0.00087	0.01221	-0.01134
2016	0.00305	0.01071	-0.00766
2017	0.01162	0.01133	0.00029

**Table 6.** Regression results of various asset classes on expected and unexpected inflation

Variables	Stock	Bond	Cash	G1	G2	G3	G4	G5
Exp_inf	-13.86 (0.58)	6.75 (0.65)	-6.43 (-0.65)	-6.83 (-1.21)	-4.49 (0.96)	-5.95 (1.07)	-3.13 (0.71)	-6.62 (-1.31)
Unexp_inf	-19.20*** (-3.27)	5.00 * (1.96)	0.20 (0.84)	2.74 ** (1.99)	2.28 * (1.99)	2.58 * (1.89)	1.75 (1.63)	1.45 (1.16)
Constant	-0.01 (-0.09)	-0.01 (-0.39)	0.00 (-1)	-0.01 (-0.41)	0.00 (-0.3)	0.00 (-0.25)	0.00 (-0.36)	0.00 (0.09)
R <sup>2</sup>	0.48	0.22	0.16	0.47	0.43	0.43	0.31	0.34

\*\*\* p-value <1%; \*\* p-value < 5%; \* p-value < 10%.



#### **d. Inflation hedge ability: Securitized real estate VS physical residential real estate**

Even though indirect real estate investment is outside the scope of our study, we test the hedging ability of real estate investment trusts (REIT). Actually, investment in real estate can be made not only through direct ownership of buildings, but also through investment in listed or non-listed real estate funds. Advantages of investing in securitized real estate are numerous. Among others, the exposure to real estate with a low entry value and transactional costs, an improved liquidity compared to direct ownership of buildings and the access to diversification benefits. In addition, due to reporting transparency requirements, the listed real estate market is more informationally efficient than direct real estate market. Given these differentiating characteristics, direct and indirect real estate may exhibit different reaction to economic shocks, and a comparison between REITS and direct housing in terms of inflation hedgeability seems legitimate.

Gyourko and Linneman (1988) find that REITs are a partial hedge against actual inflation and expected inflation, but not against the unexpected component of inflation. Yobaccio *et al.* (1995) confirmed this finding by studying four types of REITs (equity, mortgage, hybrid and composit index) over the inflationary period 1972 – 1992. They found that REITs have some hedging capability against expected inflation and do not possess any hedging capability against unexpected inflation.

To test the hedging ability of listed real estate in the French context, the Euronext IEIF SIIC index is selected to represent French indirect listed real estate investment. It is produced by the IEIF (*Institut de l'Epargne Immobilière et Foncière*) since December 2002 on a daily basis. It measures the performance of all property companies' stocks listed on Euronext's regulated markets in Paris and which have opted for the tax-transparency regime SIIC. We consider the annual frequency from 2002 to 2017 to match our initial database that already includes the four other asset classes (stocks, bonds, cash, and direct housing). Table 7 depicts that over the tested period, SIIC returns correlate strongly with stocks returns rather than with real estate returns. This can be explained by the particular case of securitized properties in some countries, that instead of reflecting the underlying physical markets, behave more like classical financial assets (MacKinnon and Al Zaman 2009; Hoesli and Oikarinen 2012, Liu et al., 1997). Concerning the hedging ability of SIIC against inflation, the insignificant correlations between SIIC returns and inflation (actual, expected, and unexpected) depicted in tables 7 and 8 suggest that indirect real estate investment does not provide protection against inflation. This is contrary to the hedging ability of direct housing (table 2, table 3 and figure 4.). An insight that corroborates this observation is the low and insignificant correlation found between SIIC and direct housing returns. Our results are thus different from Salisu et al.(2020) who find that US REITS are a good hedge against inflation. Our finding may also seem contradictory to Hoesli and Oikarinenc (2012) who demonstrate similar characteristics and high correlation

between REIT and direct returns over the mid to long horizon. However, their results stand only over the long horizon and when controlling for property type. In our study, the tested SIIC index<sup>20</sup> is predominately composed of commercial real estate (insignificant weight of housing), while the physical direct real estate considered is the particular case of housing in the Greater Paris area.

**Table 7.** Correlation between various asset classes returns and inflation, 2003 - 2017

	Stocks	Bonds	Cash	Group 1	Group 2	Group 3	Group 4	Group 5	SIIC	Inflation
<b>Stocks</b>	1									
<b>Bonds</b>	-0.4336	1								
<b>Cash</b>	-0.1937	-0.0778	1							
<b>Group 1</b>	-0.3125	0.0640	0.6725*	1						
<b>Group 2</b>	-0.0136	0.0562	0.5901*	0.9193*	1					
<b>Group 3</b>	-0.1218	0.0474	0.5883*	0.9593*	0.9847*	1				
<b>Group 4</b>	0.1453	0.0101	0.6237*	0.8096*	0.9575*	0.9086*	1			
<b>Group 5</b>	0.1403	0.0104	0.6527*	0.7948*	0.9446*	0.8935*	0.9890*	1		
<b>SIIC</b>	0.8192*	-0.2308	-0.1050	-0.1734	0.1024	-0.0025	0.2733	0.2661	1	
<b>Inflation</b>	-0.4655	0.3752	0.5846*	0.7609*	0.6842*	0.7083*	0.5886*	0.5704*	-0.2787	1

\* p-value < 5%.

**Table 8.** Correlation between SIIC and the decomposed inflation, 2003 – 2017

	SIIC	Expected inflation	Unexpected inflation
<b>SIIC</b>	1		
<b>Expected inflation</b>	0.293	1	
<b>Unexpected inflation</b>	-0.372	-0.02	1

#### IV. Conclusion

Over a long period, even low inflation has an impact on investors portfolio value and households' purchasing power. In 2022, inflation is back to France and becomes a topical question. This study provides an overview of the role of direct housing as an inflation hedge. Given both ongoing and future infrastructure projects and transportation network expansions, the Greater Paris area is currently experiencing a genuine urban renewal that strongly contributes to its growing attractiveness. Moreover, housing market fundamentals as analyzed in the study seem to be favorable to direct investment in housing. With an important stock of dwellings and a considerable rental market size, a buy-to-let housing investment is encouraged since the vacancy risk, which may lead to irregular cash flows, is reduced. Using data from 1996 to 2017, this study evaluates the hedging effectiveness of four asset classes: stocks, bonds, cash, and direct housing. The latter is represented by the potential

<sup>20</sup> The detailed composition of the index is available in the following link: <https://www.boursophile.com/meilleures-foncieres-cotees/#lcade>

investment opportunities in the 127 communes of the studied area, that we gather into five homogenous groups using the AHC technique.

Our study is assessing the inflation hedge effectiveness by analyzing the correlation between assets' returns and inflation and by using the inflation beta sensitivity. Positive relationship is found between direct housing returns and the CPI, making the residential asset interesting to hold to hedge against inflation compared to the other asset classes. We further study whether the assets performance covary with expected and unexpected inflation, both of which are estimated from the headline inflation figures using a statistical technique. In our case, the hedging ability concerns only the unexpected component of actual inflation. In fact, coefficients for expected inflation are mixed in sign and statistically insignificant. Results show that housing groups display different inflation sensitivities, where three housing groups act as a highly positive hedge against unexpected inflation. Further, cash and bonds seem to provide, respectively, no hedge and an over hedge against unexpected inflation. Stocks act as a perverse hedge against unexpected inflation and provide no significant hedge against expected inflation. Also, indirect listed real estate demonstrates little correlation with inflation, which makes us reject its hedging ability contrary to physical residential real estate. We thus confirm that inflation hedging is asset-specific.

Finally, knowing that the price of a property is estimated, among other things, by discounting the expected cash flows of the latter, two things would then have to be monitored: both the increase in the discount rate and the increase in rents due to inflation. If the increase in rents does not compensate for the increase in rates, inflation may end up diverting demand in favor of assets other than real estate: if inflation pushes up interest rates on the rise, then savers-investors can choose to focus on liquid and low-risk assets instead (monetary, bonds). This topic will be pursued in future research. The implications of the paper can be summarized for different spheres as follows:

- For practitioners: Given the importance of inflation consideration, especially when a structurally higher inflation is occurring, we have carried out this research on how investors can protect their wealth against inflation. Today, the upward pressure on prices is particularly acute in Europe<sup>21</sup>. But inflation has not developed evenly across the continent. While it has been growing in the double digits in most countries for the last months (average inflation in Europe is 10,9% in October 2022), inflation in France has been better contained (7,1%), making it the lowest inflation rate in Europe. France is also first ranked for the third year in terms of attractiveness for foreign direct investments<sup>22</sup>. These two signals encourage the European investors' move to diversify away from domestic real estate and to hedge against inflation in a country exhibiting robust real estate markets' fundamentals. Moreover, France is experiencing a shift in its urban

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<sup>21</sup> The heavy dependance of European countries on Russia for gas and vital commodities, the fiscal policy, the growth versus inflation trade-off faced by European countries, etc. are some explaining factors of the current high inflation.

<sup>22</sup> EY Attractiveness surveys are widely recognized as a key source of insight into Foreign Direct Investment.

framework; institutional investors are inclined to over invest in dynamic areas and become part of a virtuous circle whereby the metropolization process is accelerated and overall housing investments are securitized. Paris becomes the world's leading commercial real estate investment<sup>23</sup> market in 2019 ahead of New York, Los Angeles and London. In our study, we also give argument about the interest of investing in the Grand Paris housing market as well, this time not only for its perceived lower risk profile and stronger fundamentals, but also for its inflation hedging property, specifically when compared to other European and non European countries. To conclude, investors should consider more inflation-sensitive assets in their portfolio allocation, because assets such direct housing in Grand Paris tend to cope better with unexpected inflation shocks.

- For society and households: Inflation effectively takes a chunk out of the purchasing power of money and thereby erodes the real value of people's finance. Investors and households who seek protection from inflation erosion should invest in direct housing, and in particular within areas that are experiencing an effective metropolization process.
- For research: The inflation topic Although several research exist that question the hedging property of real estate, very few concentrate on physical residential assets and our study is the only one that targets the "Grand Paris" area. Residential assets of the "Grand Paris" communes are confirmed to be a hedge against inflation and particularly against its unexpected component thanks to its capital appreciation rather than income one. Also, we show that the listed real estate in France (SIICs) does not provide the same hedging properties contrary the US REITs who demonstrate this ability. Listed real estate could thus not be used interchangeably with housing to protect from inflation in the French market.
- For teaching : In an asset and portfolio management course, it is interesting to precise that the asset class "Real estate" gathers different types of strategies and sub-asset classes; each holding specific properties. Saying real estate can prevent from inflation erosion is very vague and imprecise. Our study as well as the literature aforementioned help understand that real estate is composed of different types of exposures and markets, and this conditions the effectiveness of the investment decisions and the hedging inflation nexus.

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<sup>23</sup> <https://www.jll.fr/fr/espace-presse/paris-n-1-mondial-du-marche-investissement-immobilier-entreprise>

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**Appendix 1.** Description of variables used in the Ascending Hierarchical Classification (AHC)

Variables		Description	Source
<b>Housing market fundamentals</b>	Price	Transaction-based prices of collective houses between 1996-2017 in 150 communes	- The chamber of Notaries in Île-de-France
	Rent	Rents of houses between 2000-2017 in 150 communes, completed by the index of rent in Paris between 1996- 2000	- CLAMEUR ( <i>Connaître les Loyers et Analyser les marchés dans les Espaces Ruraux et Urbains</i> )  - OLAP ( <i>Observatoire des Loyers dans l'Agglomération Parisienne</i> )
	Stock	Numbers of collective houses in 127 communes in 2009 and 2014  & annual number of households between 1996-2017	- INSEE ( <i>Institut National de la Statistique et des Etudes économiques</i> )  - DGFP ( <i>Direction Générale de la Finance Publique</i> )
<b>Housing market dynamism</b>	Population size	Annual population size between 2000-2014 in 127 communes, completed by annual population size at a departmental level between 1996-2000, and 2014-2017	- INSEE ( <i>Institut National de la Statistique et des Etudes économiques</i> )  - OXFORD ECONOMICS
	Income	Annual medium income in 127 communes between 2003-2015, completed by annual medium income at a departmental level between 1996-2002 and 2016-2017	- DGFP ( <i>Direction Générale de la Finance Publique</i> )  - OXFORD ECONOMICS
<b>Investor's profile</b>	Total return	Annual total return between 1996-2017 in 127 communes composed by capital gain & income return	- The chamber of Notaries in Île-de-France
	Risk	Variance and standard variation of the annual total return in 127 communes	- CLAMEUR  - MACROBOND
	Sharpe ratio	The excess residential return in 127 communes over the yield of OAT 10years adjusted to their risks.	- BNPPRE calculation

## Appendix 2. Detailed list of communes in the five housing groups resulting from the AHC.

Group 1	Group 2	Group 3	Group 4	Group 5
1 <sup>st</sup> District	9 <sup>th</sup> District	11 <sup>th</sup> District	Athis-Mons	Clichy
2 <sup>nd</sup> District	10 <sup>th</sup> District	12 <sup>th</sup> District	Juvisy-sur-Orge	Gennevilliers
3 <sup>rd</sup> District	Antony	13 <sup>th</sup> District	Morangis	Villeneuve-la-Garenne
4 <sup>th</sup> District	Bois-Colombes	14 <sup>th</sup> District	Savigny-sur-Orge	Aubervilliers
5 <sup>th</sup> District	Boulogne-Billancourt	15 <sup>th</sup> District	Viry-Châtillon	Aulnay-sous-Bois
6 <sup>th</sup> District	Bourg-la-Reine	17 <sup>th</sup> District	Asnières-sur-Seine	Bagnolet
7 <sup>th</sup> District	Châtenay-Malabry	18 <sup>th</sup> District	Bagneux	Le Blanc-Mesnil
8 <sup>th</sup> District	Châtillon	19 <sup>th</sup> District	Colombes	Bobigny
16 <sup>th</sup> District	Chaville	20 <sup>th</sup> District	La Garenne-Colombes	La Courneuve
Neuilly-sur-Seine	Clamart		Malakoff	Épinay-sur-Seine
	Courbevoie		Nanterre	Montreuil
	Fontenay-aux-Roses		Puteaux	Pantin
	Garches		Bondy	Pierrefitte-sur-Seine
	Issy-les-Moulineaux		Le Bourget	Romainville
	Levallois-Perret		Drancy	Saint-Denis
	Meudon		Gagny	Saint-Ouen
	Montrouge		Les Lilas	Stains
	Le Plessis-Robinson		Livry-Gargan	Orly
	Rueil-Malmaison		Neuilly-Plaisance	Villeneuve-le-Roi
	Saint-Cloud		Neuilly-sur-Marne	Villeneuve-Saint-Georges
	Sceaux		Noisy-le-Grand	Argenteuil
	Sèvres		Noisy-le-Sec	Bezons
	Suresnes		Les Pavillons-sous-Bois	
	Vanves		Le Raincy	
	Ville-d'Avray		Rosny-sous-Bois	
	Bry-sur-Marne		Sevran	
	Cachan		Tremblay-en-France	
	Charenton-le-Pont		Villemomble	
	Fontenay-sous-Bois		Villepinte	
	L'Haÿ-les-Roses		Alfortville	
	Joinville-le-Pont		Arcueil	
	Nogent-sur-Marne		Boissy-Saint-Léger	
	Le Perreux-sur-Marne		Champigny-sur-Marne	
	Le Plessis-Tréville		Chennevières-sur-Marne	
	Saint-Mandé		Chevilly-Larue	
	Saint-Maur-des-Fossés		Choisy-le-Roi	
	Saint-Maurice		Créteil	
	Thiais		Fresnes	
	Vincennes		Gentilly	
			Ivry-sur-Seine	
			Le Kremlin-Bicêtre	
			Limeil-Brévannes	
			Maisons-Alfort	
			Sucy-en-Brie	
			Villejuif	
			Villiers-sur-Marne	
			Vitry-sur-Seine	