

Is the office market overvalued? A general framework applied to France¹

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Abstract

We develop a general framework for assessing the stance of office prices with respect to their fundamentals. Applying the model to France, we show that constrained office supply and low interest rates mainly explain the high level and upward trend of office prices in recent years. Nonetheless, we find that the office market is only slightly overvalued in France in the late year 2017, between 0% and 10%. Lastly, we stress the usefulness of the framework for financial stability purposes and we evaluate the effect of the Brexit on office prices in the Paris Region.

Keywords: commercial real estate, overvaluation, office market, error-correction model

JEL classification: C32, E31, R30

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1. Introduction

In the aftermath of the 2007-2008 financial crises, the commercial real estate market has gained renewed attention. Indeed, motivated by a strong correlation between commercial property prices and banking crises (Antoniades, 2015), several institutions in charge of financial stability have launched projects aiming at a better understanding of the functioning of the commercial real estate market (Financial Stability Board, 2013; European Systemic Risk Board, 2015). Among the four main commercial real estate sub-markets (offices, retail, industrial buildings and residential properties), offices play a key role as their prices are strongly related to the economic juncture and financial risks.

Yet, little interest has been paid to the understanding of office prices developments, and especially the early identification of booms and bursts. To do so, it is crucial to identify the determinants of prices. Given the high heterogeneity of commercial real estate markets across regions and countries in general, it makes more sense and interest to focus on a specific market where concerns arise for office prices sustainability.

For that purpose, we develop a general methodology for quantifying the valuation of office market with respect to their determinants. We focus our assessment on a particular geographical market that is France, where commercial real estate prices and especially office prices have increased very dynamically over the recent years.

[Chart 1]

Indeed, in France, since 2011, the investment in commercial properties has been relatively dynamic. The market players (insurance, investment funds, sovereign funds, etc.) mainly invest in office spaces (61% of the total investments in 2017), and to a lesser extent in the retail sector (17%). Those investments are essentially concentrated in Ile-de-France – Paris region, this area accounting for 76% of total investments realized in 2017.

[Chart 2]

The vacancy rate of offices remains somewhat high although it has decreased in the last two years: 6.5% of the offices located in Ile de France are vacant at the end of 2017.

[Chart 3]

This feature is striking insofar as the increase of vacancy rates as of 2006 should have led to lower prices, while it seemed to have only little impact on price evolution. As an illustration, since 2010, office prices are characterized by a sustained upward trend while vacancy rate has stabilized at a high level since 2009. What is more, a high vacancy rate of office properties to rent should drive the rents down. However, over the recent juncture, rents seem relatively inert to vacancy rates developments. Moreover, while prices fundamentally depend on the income generated by real properties, namely by rents, yet over the recent years we may observe concomitantly a strong upward trend in prices and stable rents levels. Those paradoxes illustrate the complexity of office prices formation and valuation.

[Chart 4]

This study seeks to identify the interrelationships between office prices and their fundamentals. Our specification is derived from a theoretical model proposed by Wheaton, Torto and Evans (1997). In this context, the offices price dynamics are explained by GDP, rents, immediate office supply, office stock and interest rates level. In order to quantify the office prices overvaluation, we rely on the Hansen (2005) method: it is therefore computed as the deviation of office prices from their fundamentals, which determines a time-varying equilibrium price.

Our contribution to the existing literature is threefold. First, we shed light on the prominence of office prices, considered as a variable of interest per se and not as an explanatory variable for the real office market investment. Second, we develop an original methodology for quantifying the overvaluation of offices prices. Third, we bring to the debate an assessment of offices prices sustainability in France, which may result in sectoral macroprudential measures.

The remainder of the paper is organized as follows: section 2 develops the related literature and the variables of interest. Section 3 presents the data. Section 4 elaborates on the baseline model. Section 5 presents the overvaluation estimates and their interpretation. Section 6

expands on two case studies: the relevance of the overvaluation for financial stability purposes and the effect of the Brexit on office prices in Paris region. Section 7 concludes.

2. Related literature and variables of interest

Theoretical models that aim at modelling the office market differ substantially from those representing the residential real estate market.

In the literature, different types of specifications have been considered and in particular simultaneous equations models, in which the rent for offices, and not the price, plays a central role. Indeed, unlike the residential market, on which the markets of owners and tenants are coincident, two commercial real estate markets are cohabiting (DiPasquale & Wheaton, 1992, Wheaton, Torto et Evans 1997): a market of investors and a market of users.

These markets interact through two channels, the channel of rents and the channel of office buildings:

- On the short term, the office stock is stable, hence the rent level depends on economic conditions and more specifically on the expected number of employees, which determines the demand for workspaces from user companies;
- Prices are set on the investors market, but are intrinsically linked to the levels of interest rates and rents on the user companies market⁴. The investment decision depends alternatively either on the profitability of office investments with respect to other market investments, or on the future income generated by the rents with respect to the interest rate. These are the two alternative means allowing for the modeling of the investment decision. Thus, a change in economic conditions induces a variation of rents and consequently of prices;
- Prices also influence rents through the office construction. Building projects are launched only if they are deemed cost-effective, namely if the expected selling prices

⁴ In case markets are efficient, rents and demand of real property of the user companies adjust to equalize supply and demand on the users market.

are higher than the cost of construction. Therefore, an increase of prices induces a rise in construction which increases the stock of available offices resulting in a decline of rents. The dynamics of prices and rents are consequently closely entangled.

These dynamics have been modeled and tested by Wheaton, Torto and Evans (1997), Hendershott, Lizieri and Matysiak (1999), Fuerst (2005), and Malle (2010) on London, New York and Paris region markets. These models enable to understand the interactions between the various determinants of the office market but also to simulate the paths of the endogenous variables using different scenarios. Nevertheless, any explicit variable counting for office price itself is never modelled and prices appear only implicitly as an explanatory variable in the equation modeling the supply of commercial real estate property. This does not allow any empirical assessment about the level of prices, and hence makes this modelling unable to detect overvaluations of offices, which may nonetheless materialize in booms and bursts and hence constitute a major financial stability issue.

Different models in which office prices are involved as dependent variables have nevertheless been developed: from a theoretical model of supply and demand, Dobson and Goddard (1992) propose market equilibrium equations. Rents and prices are explained on the basis of contemporary lagged observations of employment, of real interest rates and of residential real estate prices. In order to model the offices construction market, Tsolacos, Keogh and McGough (1998) consider the market equilibrium equations for those markets of offices for users on the one hand and investors on the other hand. The variations of rents are therefore explained by the variations in GDP, employment and new constructions, whereas the office price variations are explained by the variation in rents, price of shares, real interest rates and new constructions. These models applied to the Anglo-Saxon markets lead to the same results: an increase in the volume of constructions lowers the rents while a rise in employment leads to an increase in the rents. In addition, the prices are positively correlated with rents and negatively to interest rates.

Finally, an empirical vector model based on macroeconomic variables (GDP, private sector investment and credit to private sector) has also been tested by Davis and Zhu (2010) on 17 countries, including France. The evolutions of GDP affect the prices of commercial real estate; the causality seems reversed for credit to the private sector.

Nevertheless, the question of the equilibrium prices of offices is scarcely dealt with: only rents are sometimes assessed in relation to their equilibrium values (Fuerst, 2005) but in simultaneous equations models, based on strong assumptions as far as the interactions between those variables are concerned.

The dynamics modeled by Wheaton, Torto and Evans (1997) seem relevant to the office market, in particular in France:

- On the offices users market, the stock of occupied offices represents the demand for offices: the demand for offices in the long term depends positively on the number of employees and negatively on the past level of rents⁵. In France, the increase in real estate prices and rents over the 2000's is coincident with a rise in employment. The increase in employment has resulted in an increase in the stock of occupied offices, while the increase in rents does not seem to have significantly discouraged, at least on the short-term horizon, companies to implant in those places (it has not induced any strong delocalization of headquarters for instance over that period);

[Chart 5]

- On the offices users market, the level of rents depends on the demand for offices, thus of the vacancy rate: a significant number of unoccupied offices on past periods increases the negotiation margin of occupying companies and pulls the rents downwards. Indeed, in France, the rents and the offices immediate supply are negatively correlated;

[Chart 6]

⁵ Of the assumption of a working space for each employee of constant size, an increase in the number of employees induces a proportional increase in the offices demand. This is nevertheless not verified in practice, an increase of the employment is generally accompanied by a rise in rents, the surface area of the work space for an employee decreases during a growth period and increases during a crisis period. This phenomenon is in part attributable to the rigidity of the rental market. Indeed the leases entered into by companies are at least of 9 years with the possibility for the tenant to terminate it according to a triennial periodicity.

- The offices stock is renewed by new buildings, which depend on the gap between the price level and the construction cost. In France, the offices construction starts are positively correlated to an increase of the price gap between the price and the costs of construction. Thus, while the market appeared in overheating, the peak of put in construction has been achieved in 2007;

[Chart 7]

- The prices depend on the rents level and the nominal interest rate⁶. During the crisis, the relative preservation of prices is explained by the resilience of rents and the significant decrease in interest rates.

[Chart 8]

3. The data

Among the determinants of prices, the logarithm of the GDP in volume, the logarithm of the rent index of the offices in the Ile-de-France, the logarithm of the immediate supply of offices in Ile-de-France region in m^2 , the logarithm of the office stock in Ile-de-France in m^2 and the interest rate of 6-month Euribor are chosen to model the evolutions of the logarithm of the offices price index.

While GDP and employment appear strongly correlated in line with the aggregate Okun's law (Ball et al., 2017), we prefer to retain GDP in the remainder of the paper. As a matter of fact, we need to take account of expected employment and it is recognized that GDP anticipates the evolution of employment, as it constitutes a reasonable approximation of companies' business expectations (ECB, 2016). This choice is also driven by our specification choices, as several papers (McGough and Tsolacos, 1999; Davis and Zhu, 2011) recommend to use GDP rather than employment in empirical frameworks, as it better captures building restrictions and international arbitrage and trade-offs with residential property prices. In addition, the

⁶ Some authors (Fuerst, Malle) also include the availability of capital measured by the spread of term (gap between a long-term and a short-term interest rate). This variable has a negative impact on new constructions.

index of construction costs has not been retained as the evolution of this index is strongly correlated with prices.

[Chart 9]

The need for deep enough historical series leads to mix different sources:

- An index mirroring the evolutions of economic rents has been constructed. For this purpose, the economic rent index of offices in Ile-de-France is built from different sources: the series are extracted from IEIF (Institut de l'Épargne Immobilière et Foncière) publications of BNP Paribas Real Estates time series for the period Q1 1996-Q4 2012. For the Q1 2013-Q4 2017 period, the index has been constructed by relying on facial rent values and the proportion of accompanying measures (fiscal measures) in the facial rent, both of which are actually published since 2012⁷. The use of economic rents instead of taking facial rents permits to include economic-relevant prices rather than facial prices. Indeed, their evolutions are quite different. Nevertheless, no time series of this indicator is available. While our estimation method might bias our result, additional results relying on facial rents will also be presented;

[Chart 10]

- The historical series of immediate supply of offices and office park in Ile-de-France is also rebuilt from publications of the IEIF, Immostat and BNPParibas Real Estate;
- The offices price index in France is based on the series released by the ECB and acquired from MSCI/IPD (Investment Property Databank). The historical series for the period Q1 1994-Q4 1998 result from a quarterly smoothing of an annual index based on appraised values, while the quarterly index also using the prices of transactions is used from 1999;
- The quarterly GDP in volume corresponds to the series published quarterly by INSEE;

⁷ <http://www.immostat.com/single-post/2018/05/07/Les-mesures-daccompagnement-au-T1-2018>

- The series of 6-month Euribor interest rates is the quarterly average of the daily series published on the Banque de France website.

In light of structural breaks occurring at some point over the period, we restrict the sample to the 2003 Q1 – 2017 Q4 period, which is quite short but reasonable for the chosen specification, and ensures a realistic stability of the model.

The correlations between the variables are consistent with the intuition; especially, we find that the prices are slightly and positively correlated with the rents, the GDP, and negatively and significantly correlated with the interest rates. As already said, GDP and employment are strongly correlated (not presented in the Table); hence, employment is disregarded from the remainder of the empirical work.

[Table 1]

4. Baseline VECM model

Baseline model specification

The aim of this study is not only to propose a model to describe the different interactions mentioned above but also to propose a measure of the overvaluation of the prices of offices, that is to say the deviation of the office price dynamics from its fundamentals. To this end, an error correction model encompassing the historical series of the determinants listed above over the period 2003 Q1 – 2017 Q4 is envisaged.

These series are non-stationary and integrated of order 1. The existence of a unit root is tested with the help of a Dickey-Fuller test and a Phillips-Perron test.

[Table 2]

As the economic series are not stationary, we are not allowed to use conventional models. In order to circumvent this problem, it is generally recommended to work in first differences. Nevertheless, a model based only on differentiated data may be incomplete; in this case, the presence of common trends to several variables would be ignored. The vector error-correction

models (VECM) allow to work from the first differences while preserving the information such that the common trends, thanks to the estimation of cointegration relationships.

In this framework, the model chosen is a VECM of order 2, as indicated by the selection criterion of Akaike Information Criteria and Schwarz Information Criteria, with one cointegration relationship.

[Table 3]

The number of cointegration and the inclusion of non-deterministic terms relationships were determined using a Johansen test. The Johansen test leads to favor a model with a constant added in the short term relationship, inducing the assumption of a linear trend in level:

$$\Delta Y_t = c + \alpha \beta^T Y_{t-1} + \sum_{k=1}^2 \Phi_k \Delta Y_{t-k} + u_t \quad (1)$$

Y_t represents the vector of the selected dependent variables: $Y_t = (\log_GDP_t, \log_PRICE, \log_RENTS, \log_STOCK, \log_SUPPLY, EUR6_t)$ and u_t the residuals⁸. 1 cointegrating relationship is represented by the term $\beta^T Y_{t-1}$ so that $\beta^T Y_t = \varepsilon_t$ where ε_t is stationary.

The rank of co-integration equals to 1, while six variables have been considered in this model, there has at most 5 stochastic common trends to the considered variables.

Results from the main model

In the cointegration long-term relationship, GDP depends positively on office prices and negatively on interest rates and office supply, which is consistent with the theory and the economic intuition.

⁸ The autocorrelation of the residuals is tested using a Portmanteau test. The hypothesis H_0 that residuals are independently distributed is not rejected when considering 12 lags at a 5% threshold .

On the short-run, among our variables of interest, it is also interesting to note that the office prices depend positively on the economic juncture through the GDP and on the rents, which is consistent with the theory. The offices rents depend positively on prices, and negatively on office stock and supply. The office stock depends positively on GDP. Office supply depends negatively on GDP and prices, and positively on interest rates. Finally, interest rates depend positively on GDP.

[Table 4]

Given the model specification, it is difficult to interpret directly the estimated coefficients. Thus, and more interestingly, the interactions between the different variables can also be approached using the impulse function response of a variable following an impact on another variable. As a first step, it is necessary to perform an ordering of variables. Indeed, the residuals variance matrix is first decomposed by factorization of Cholesky. The considered order is the one above $Y_t = (\log_GDP_t, \log_PRICE_t, \log_RENTS_t, \log_STOCK_t, \log_SUPPLY_t, EUR6M_t)$. Thus, a shock on GDP has no immediate impact on other variables but only after one or more quarters. Similarly, a shock on prices does impact immediately neither rents nor office supply, but after one or more quarters. These assumptions are validated using Granger causality tests.

[Table 5]

This being carefully carried out, the impulse response results provide interesting insights. Chart 11 represents the impact of a positive shock of 1 standard deviation of each variable on the 6 endogenous variables of the VECM. The impulse response is more relevant to the economic analysis as it provides outcomes separating each variables shocks from others, and also provides an insight on the short-run in addition to long-run shocks.

[Chart 11]

The interrelationship between rents and prices is in line with DiPasquale & Wheaton (1992) and Wheaton, Torto and Evans (1997), among others. Regarding the offices prices, we find that a positive shock on the GDP (via the rise of the demand for offices), as well as a positive shock on the rents (through the investment channel), has a positive effect on office prices,

both on the short and on the long-term, alike Davis and Zhu (2010). An increase in the supply of offices yields a negative impact on rents and prices both on the short-run and on the long-run: as the projects are financed by investors only if they are deemed cost-effective, thus if the selling prices are higher than the cost of construction, a rise in construction consecutive to an increase of the price increases the stock of available offices inducing a decline of rents, and therefore prices. The dynamics of prices and rents are consequently closely entangled. Finally, an increase in the interest rate leads to a decrease of the offices prices on the long-term because it lowers the value of the investment in offices in comparison with other market products. Results on rents are quite similar to the ones on prices and corroborate Tsolacos, Keogh and McGough (1998), namely we find that a positive effect of the economic juncture leads to a rise in the demand for offices and hence a rise in rents, and that a rise of interest rates weighs on the long-term levels of rents but proves more neutral on the short-term because they might be compensated by fiscal measures. We also do find that an increase in prices (inducing an increase in construction) would lead to a decrease of rents, but the effect would be very small and limited on the very short-term. Finally, on the offices users market, a significant number of unoccupied offices on past periods increases the negotiation margin of occupying companies and pulls the rents downwards.

Regarding the effect of various variables on the office market real variables, our results confirm those of Wheaton, Torto and Evans (1997) to a large extent. For instance, we find that a positive shock on GDP and hence employment, which conveys an increase in the demand for offices, induces a positive effect on office stock. Nonetheless, this effect is observed only on the short-term. We must recognize that the period under study is quite different from the one studied in seminal papers, and the interrelationships between variables might prove different. Digitalization of labour processes, new methods for office space optimization, notably in the manufacturing and services industries, may have triggered, on the long-run, a negative effect on office stocks. In addition, given the inertia of the office market adjustment, a positive growth shock may also induce a decrease of the office surface per employee, which is observed in practice over the period. Regarding the other impulse response functions, a positive shock on rents makes the offices market more profitable and sustains investment, and hence an office stock hike, while it does not discourage firms to implant there, and especially does not foster delocalization. Moreover, increasing the office supply induces an increase of offices stock on the long-term.

[Chart 12]

The shock of various variables on interest rates is quite intuitive and consistent with the Taylor rule, with positive shocks on GDP and prices (and rents to some extent) yielding an increase of the nominal interest rates. A positive supply shock, which may result in a decrease of prices afterwards, leads to an interest rate cut.

All those results tend to validate the model.

Interpretation of the results

We also provide the variance decomposition of various variables with the same specification assumptions. Regarding the offices prices, on the short-run rents and GDP explain a major fraction of the variance, while on the long-run the interest rates and office supply dominate. GDP also appears as the main driver of rents over the short-run, and offices supply on the long-term.

[Chart 13]

As a result, it appears that the combination of long-lasting low interest rates and stable, and even decreasing on the end of the studied period, office supply may have been the source for a robust increase in the offices prices, while not departing strongly from the trend stemming from the fundamentals.

It is also relevant to provide a quantification of the results thanks to the impulse response function dynamics. We find that, all other things kept equal, a 100 basis point permanent hike in the interest rates would result in a -9% permanent decrease of office prices, with a maximum effect attained after 10 quarters. The effect of an exogenous GDP shock is quite massive: a decrease of GDP by 1% results in the long run in a decrease of office prices by 6%, with a maximum observed after 6 quarters.

A rise in rates would impact the capitalization rate and property prices. New and more profitable investment opportunities would appear on the market, and real estate would be

cheaper to compete with other asset classes in the portfolios. However, as well as falling, a rise in rates would not translate into an equivalent increase in capitalization rates.

Two other scenarios could impact price levels and weaken investors. A first scenario would be a macroeconomic downturn and sudden entry into recession. This scenario could, for example, result from the materialization of the global economic risks that have been visible for a few months (escalation of protectionist measures, geopolitical risk, and increase of oil prices). Such a situation would penalize demand for commercial real estate and force investors to lower their rental forecasts. This would translate into lower prices for commercial real estate. In the context of the office pricing model described earlier, the effect of lower rents on the price level would be relatively low, in the range of 1: 1: a 1% decrease in rents would result in a decrease office prices by 1% over four quarters, and will continue thereafter.

An alternative scenario would be a runaway construction sector. The existence of excessive price levels leads to a distortion of agents' incentives for these assets and a sub-optimal allocation of capital. This is exacerbated by the mismatch between order and delivery of a project that can lead to massive overinvestment - this was the case in Spain during the crisis. This could lead to a situation of oversupply and downward revision of rent paths. This in turn would affect price levels and could spread to all real estate sectors and their owners. The model shows that the 1% increase of the supply of offices - all things being equal - would very gradually lead to a decrease of the prices of 0.9% at a relatively distant horizon, of the order of 10 quarters

Robustness checks

In order to make those results as robust as possible, we run two robustness checks.

First, instead of using the actual rents, we estimate exactly the same model but with the facial rents. The impulse response functions obtained tend to confirm our main results.

[Chart 14]

Second, we re-estimate the VECM model on the same period but with an exogenous dummy variable counting for the crisis period (Q3 2008 – Q4 2017). We draw the same impulse

response function as in the main results and got in general the same results, which tend to support the robustness of our main results.

[Chart 15]

5. Office prices overvaluation

Measurement of the overvaluation of office prices

The Granger representation permits us to rewrite equation (1) so that variables are represented not in first differences but in levels. This representation has been stated by Engle and Granger (1987) and Johansen (1991), while the exact definition of the closed formula is attributable to Hansen (2005). This representation consists in decomposing the series in a trend component and a cyclical component. The trend component is composed not only of a constant term and a deterministic component that can grow linearly over time, but also a stochastic component, representing the non-stationary variables. The cyclical component represents the transitional impact of shocks. Taking the formulas previously used, the formula proposed by Hansen (2005) can be written as:

$$Y_t = T_t + C_t \quad (2)$$

The trend component T is defined by:

$$T_t = C \sum_{s=1}^t u_s + \tau(t) + A_0 \quad (3)$$

The first term represents the stochastic component. The second represents the deterministic component and the third represents the constant. The matrix C, the term τ and the matrix A_0 can be calculated from the parameters estimated for the VECM.

Moreover, the cyclical component is written:

$$C_t = C(L) u_t = \sum_{i=0}^{\infty} C_i L^i u_t \quad (4)$$

With $C(L)$ a polynomial delay, as previously the terms C_i can be calculated from the parameters estimated for the VECM. In the following estimation, we consider a range of values for the lags polynomial, going from 8 to 14 quarters, which provide the confidence interval for the overvaluation estimate.

Within this framework, the overvaluation of the price is defined as the stochastic component defined as the first term of equation (3), which captures the variation that cannot be explained by the trend and the cyclical variation alone.

Estimate of the overvaluation

The VECM model being estimated, the evaluation of the potential overvaluation of the price series is carried out along the lines presented in Section 3. Results are presented in Chart 16.

Prices are considered to be overvalued when the gap between the logarithm of the index and its trend component is positive. Interestingly, the estimations provide an assessment on the prices undervaluation in the mid-1990s, which correspond to the resorption of the dramatic burst in prices following the commercial real estate crises in France in the early 1990s (Nappi-Choulet, Maleyre and Maury, 2007). Under this assumption, prices would have been overvalued between 2005 and 2009. Since then, prices appear to be close to the equilibrium.

At the very end of the sample, the estimate gets out of undervaluation, and is even significant on the last observation, pointing out some new risks for the sustainability of the offices market, but with a magnitude that appears, to a large extent, reasonable (5% on average and 10% for the 5th percentile).

[Chart 16]

Robustness of the overvaluation

Nevertheless, these results should be taken with great caution, looking at the estimated parameters over the different samples considered, we can see that the estimated values of the parameters of the model have evolved since 2008, a model taking into account this structural change could be considered.

The results could be due to a learning phenomenon of the model. Indeed, we strongly suspect that prices have been overvalued since 2008, but the part of the sample on which prices may be overvalued keeps growing, inducing an alteration of the estimated parameters and of the path of the estimated trend.

To evaluate this point, we estimate the same model but on truncated samples, considering that the specification, a VECM of order 2 with 1 cointegration relationships, still holds. The first sample considered for estimation is the sample up to Q3 1998, the following ones included an additional quarter until we reach the full sample (2000 Q2). From the 8 simulated trajectories for the prices overvaluation, we build an interval. From these results, it seems that office prices may have been overvalued since 2006, the largest spreads between prices and their trend is observed in 2007 and 2015. The spread between the lower limit of the interval and the office rent prices was around 25% at the end of 2015. In late 2017, this spread became positive, indicating a very recent surge in overvaluation, around 4% in Q4 2017.

[Chart 17]

6. Two case studies

Usefulness of the overvaluation estimates for policy purposes

The indicator computed on the basis of our model should constitute a sign for market disequilibrium on the office market and, hence, economic crises and recessions. In order to evaluate the policy use of the indicator, we plot on the same Chart the recession index for France as released by the OECD and a disequilibrium indicator computed as the absolute value of the overvaluation estimate. We also add a smooth disequilibrium index which is the average of the last three past observations of the index.

[Chart 18]

The correlation between variables seems quite high, with periods of high disequilibrium corresponding, or even anticipating recessions. In order to quantify the relevance of the smooth disequilibrium index for financial stability purposes, we estimate a very simple probit

model, where the recession occurrence is explained by the smooth disequilibrium index and a constant over the 2003Q3 – 2017Q4 period. The smooth disequilibrium variable coefficient proves significant at the 10% level.

[Table 6]

From the profit estimation, it is straightforward to derive the probability of recession based on the overvaluation estimate.

[Chart 19]

One notices that the probability of crisis as derived from our model matches reasonably well the actual recession periods, and even the strongest rises in the indicator anticipate recessions to come. On the very recent period, the probability of crises seems to remain far from its maximum and decreases on a remarkable trend over the recent years.

Effect of the Brexit on office prices in Paris region

The model of section 4 is then applied to Paris Region ('Ile-de-France'). In this variant, the GDP growth is replaced by the number of employees' growth. The reason of this change is twofold. First, this variable is linked to growth, thus enabling to assess one more time the model robustness. Second, it allows to make quantitative prediction about the impact of the Brexit –which is proxied as a positive labor shock - on Ile-de-France office market. This also provides a model where the full scope of data are homogeneous as related to the same geographical area.

The specification retained in this exercise is the same as the one of section 4. On this basis, the model is estimated over the period Q1 2005 - Q2 2018. The impulse response functions thus obtained make it possible to validate the model: a shock on employment, as well as a shock on rents, has a positive effect on prices, while a positive shock of supply or interest rates puts downward pressure on prices.

Given the empirical standard deviation actually observed in the series, it is inferred that an employment shock of 1 percentage point would result in an increase in office prices of 2.3 % over the next five years horizon.

A shock of about 100,000 jobs, representing 2.5% (respectively 3.6%) of all jobs in Paris *Petite Couronne* (respectively Paris and Hauts-de-Seine), would produce a positive shock on office prices of about 6 points (8 percentage points) respectively.

[Chart 19]

A decomposition of the series of prices in trend and cycle is then carried out. The trend and cycle series represent the price fluctuations predicted by the model, as a function of the fundamental variables. Overvaluation is again defined as an observed price level higher than the series predicted by the fundamentals.

[Chart 20]

This measure highlights a very marked overvaluation during the period 2006-2008 followed by a slight underestimate (around 4%) over the period 2009-2015. Over the years 2016-2017 observed prices accelerate and exceed the level that would be predicted by the fundamentals. This overvaluation diminishes in early 2018, and office prices return to equilibrium in Q2 2018.

7. Conclusion

In this paper, we first develop a VECM model which allows to understand the functioning of the office commercial real estate market, in the particular case of France. We find that, consistently with the common wisdom, the office prices depend positively on the GDP and on the rents, and negatively on the interest rates, this latter effect being especially low. In the light of these results, we estimate the overvaluation of the offices prices to be a reliable hypothesis but very weak, as estimated in 2017 Q4 between 0% and 10% of the equilibrium price.

The focus on Paris Region using the number of employee in place of growth yield consistent impulse functions. Also, the predicted overvaluation in Paris shows a pattern consistent with the one computed from GDP growth. Our results also highlight the potential effect of the Brexit on office prices in the Paris region.

It could be interesting to envisage a regime-switching VECM model, although the time span is very short, in order to better take account of the structural changes known by the market over the recent period. In addition, an improvement in the data used could be envisaged, as they are at this point a merger of several heterogeneous sources.

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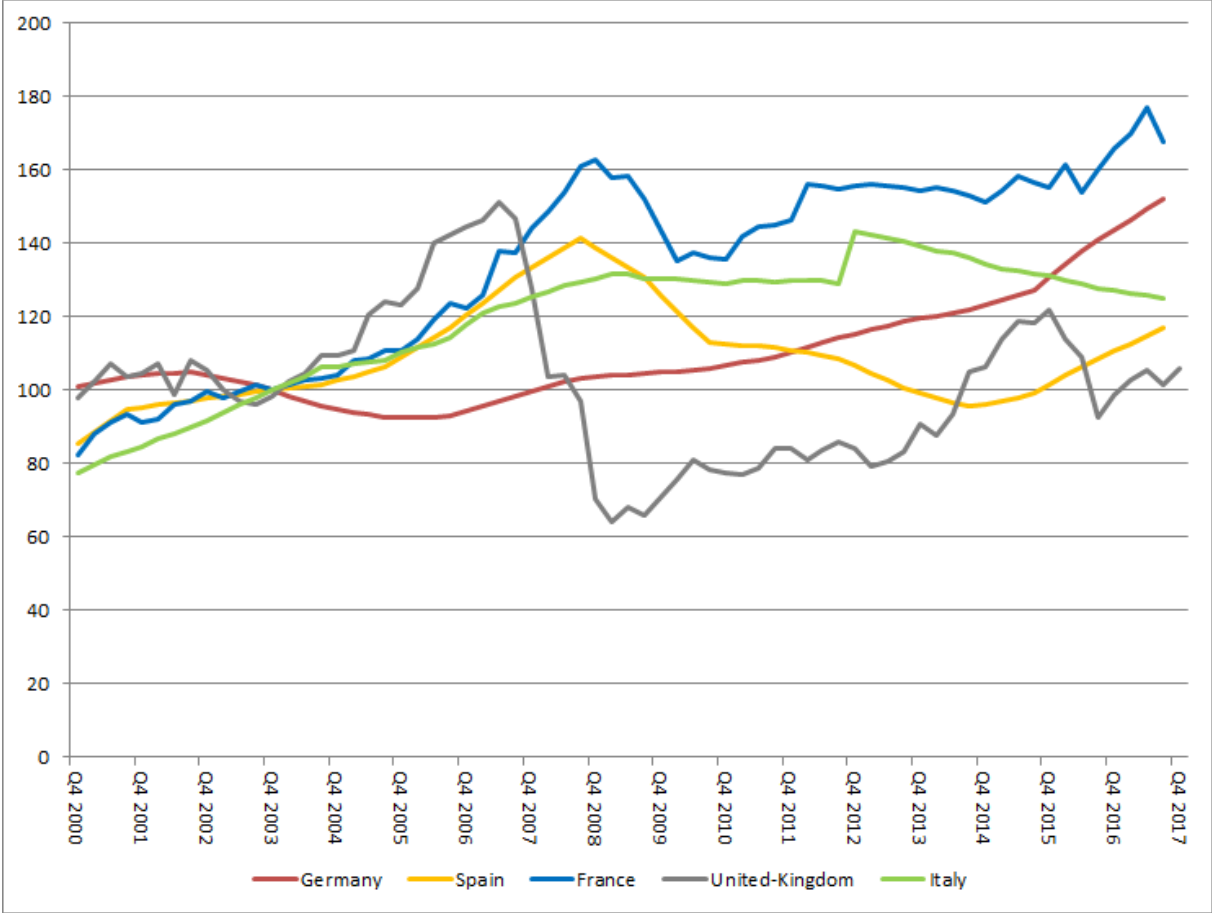
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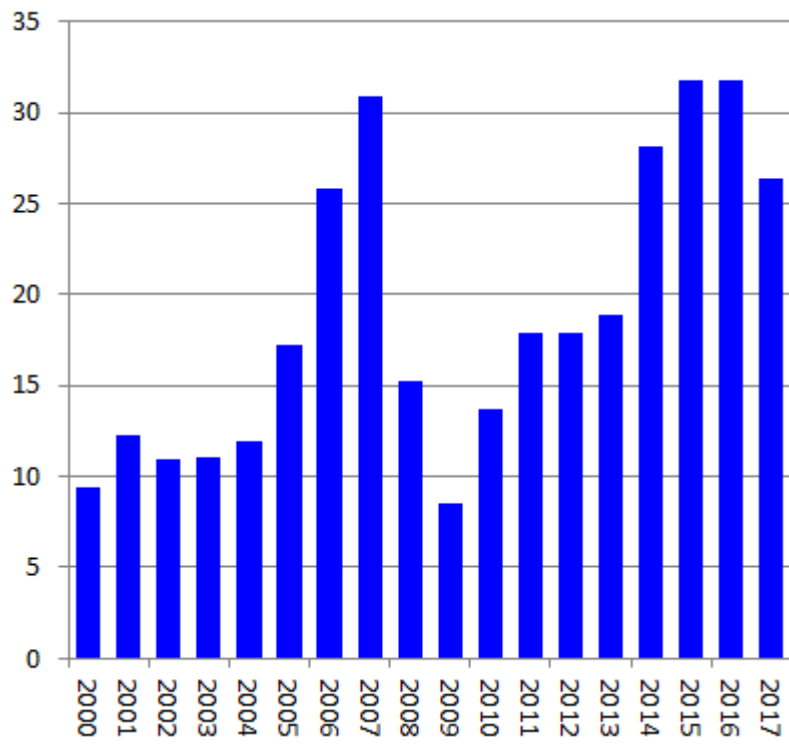
Appendix

Chart 1: commercial real estate prices index for selected European countries
Base 100 2003 Q1



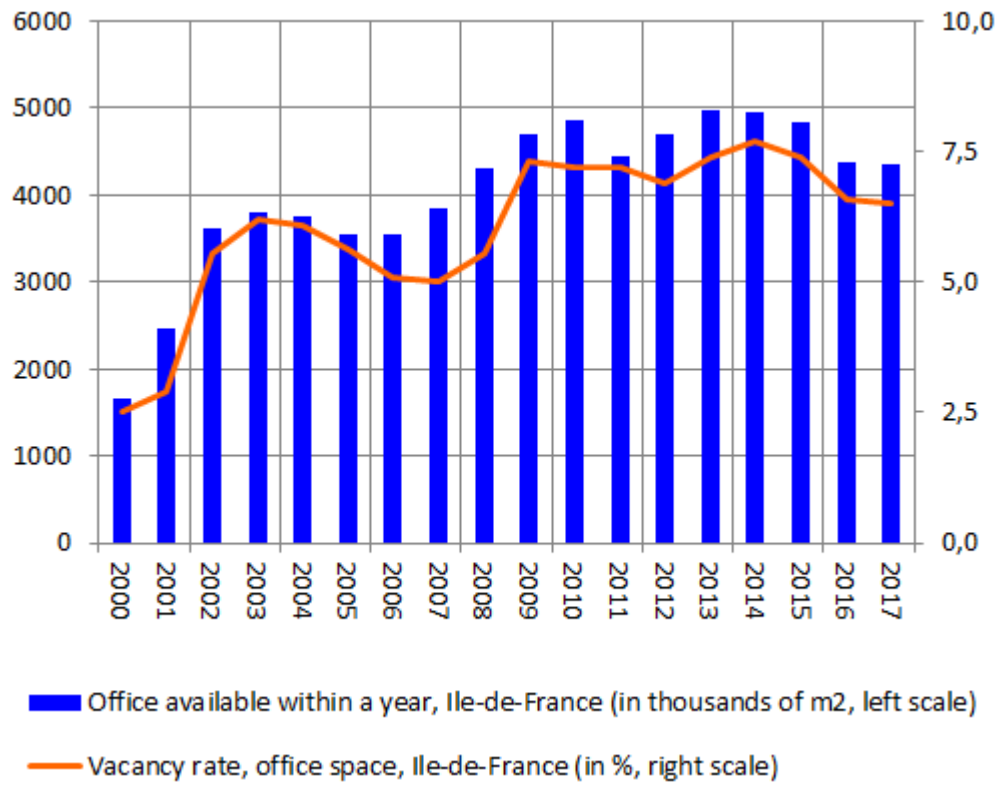
Source : BCE according to IPD (for France, Spain, and UK), Bulwiengesa AG (Germany), Banca d'Italia (Italy)

Chart 2: Amounts invested in corporate real estate in France, billion euros



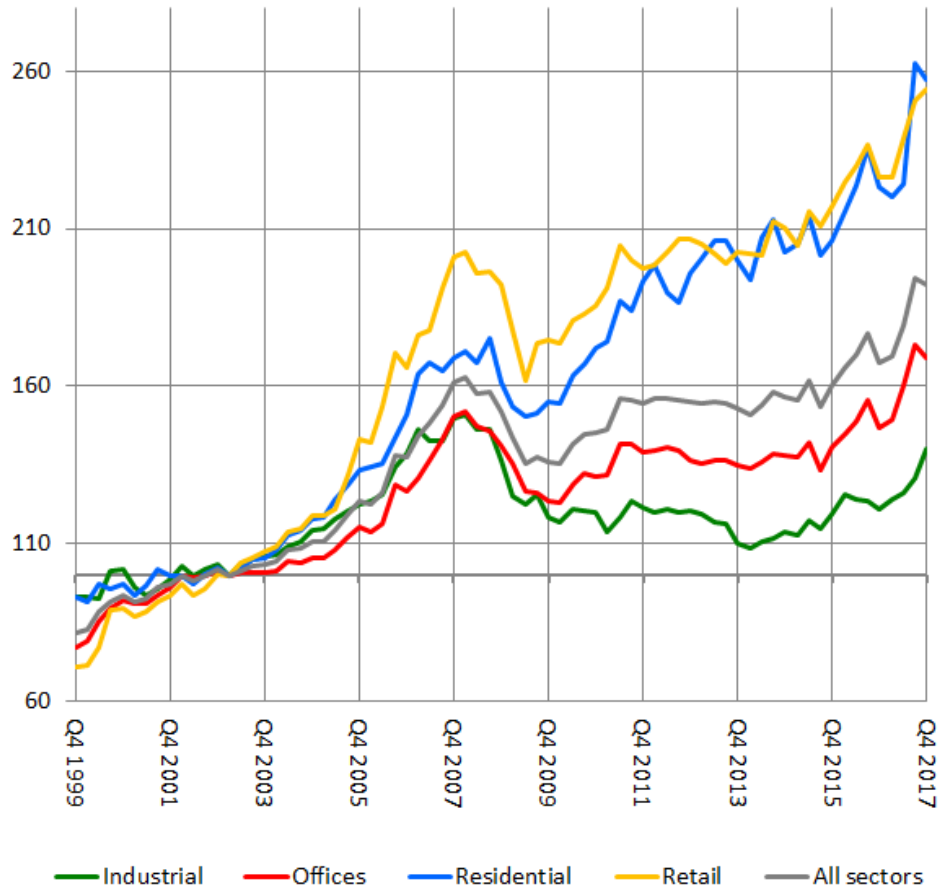
Source : IEIF, BNP Paribas Real Estate

Chart 3: One year offers and vacancy rates for offices in Ile-de-France



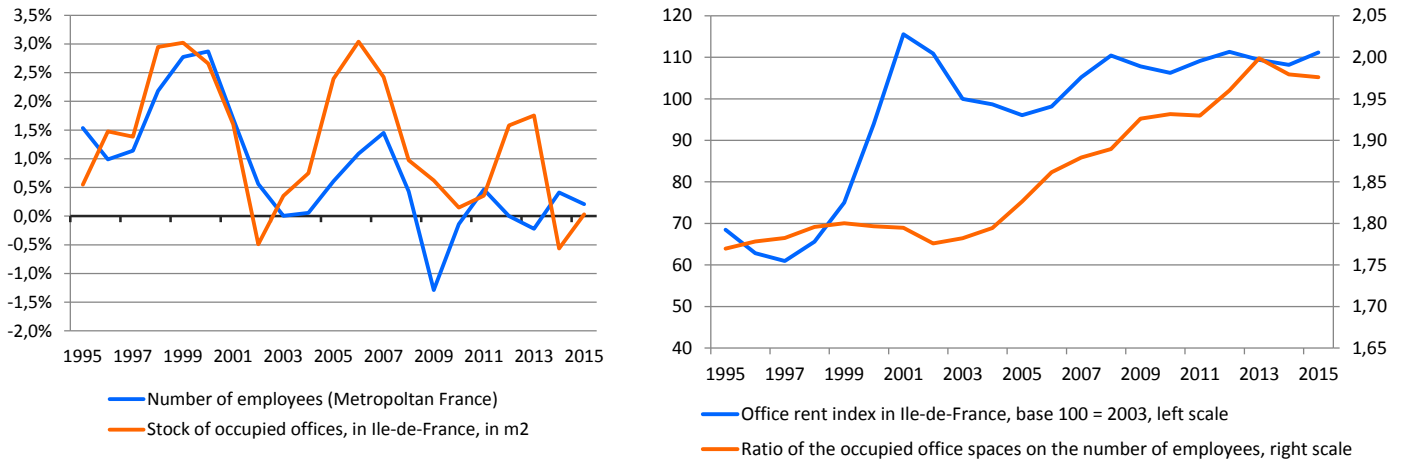
Source: ECB according to IPD, IEIF, Immostat BNP Paribas Real Estate.

Chart 4: Commercial real estate price index by sector of activity for France
(base 100 = Q1 2003)



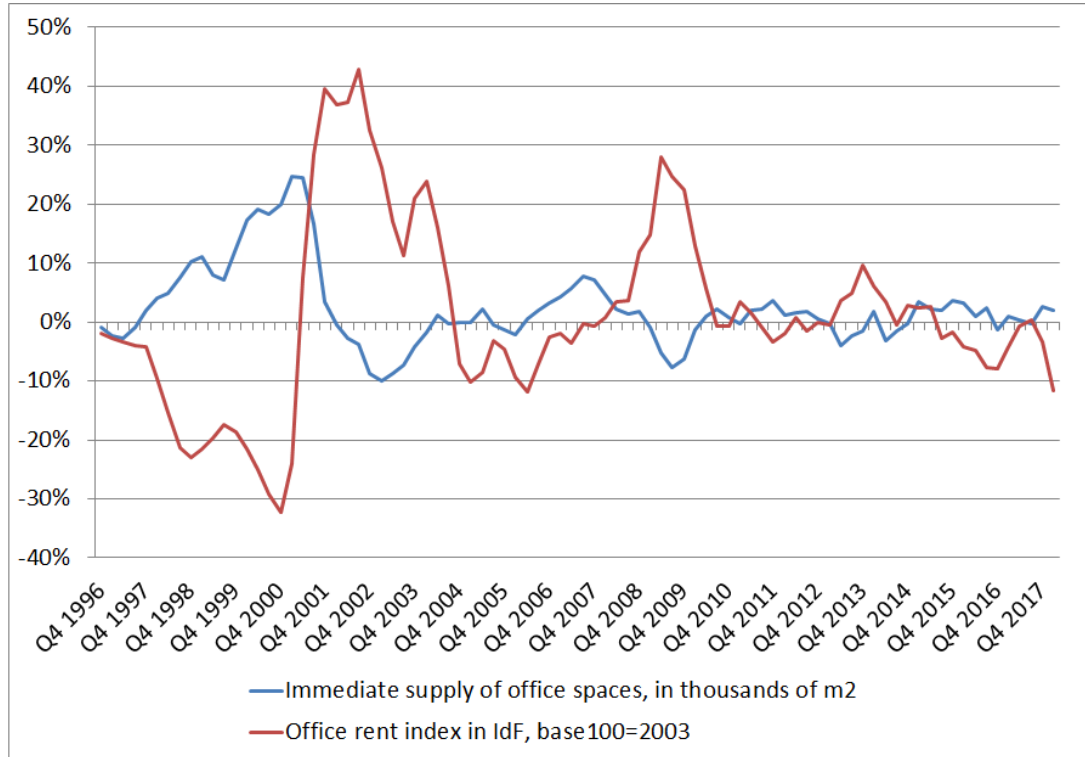
Source: ECB according to IPD

Chart 5: Number of employees, stock of occupied office spaces (IdF) and evolution of the ratio of occupied offices on number of employees and office rent index in Ile-de-France:



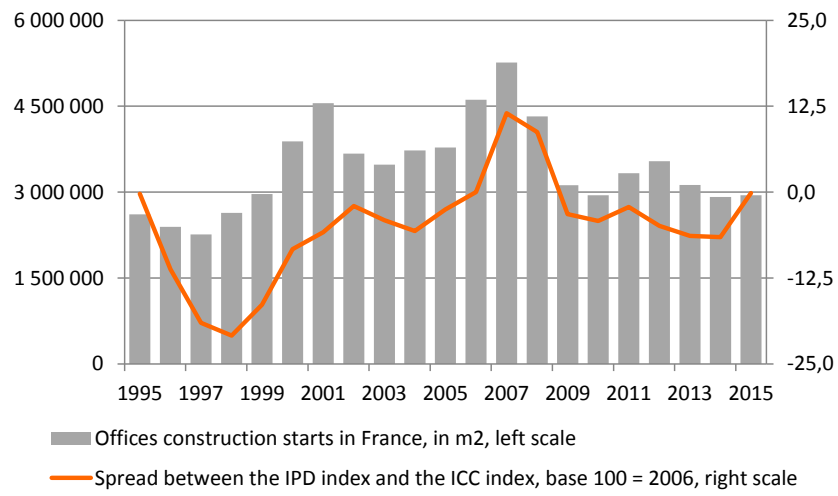
Source: IEIF according to ORIE and CBRE, INSEE, Immostat. The stock of occupied offices has been estimated.

Chart 6: Immediate offer of offices in IdF and office rent index in IdF, annual growth rate in %:



Source: Immostat and IEIF

Chart 7: Offices construction starts in France and spread between the IPD index and the construction cost index



Source: CGEDD, ECB according to IPD and INSEE

Chart 8: Offices prices and rents, and average 6-month Euribor interest rate

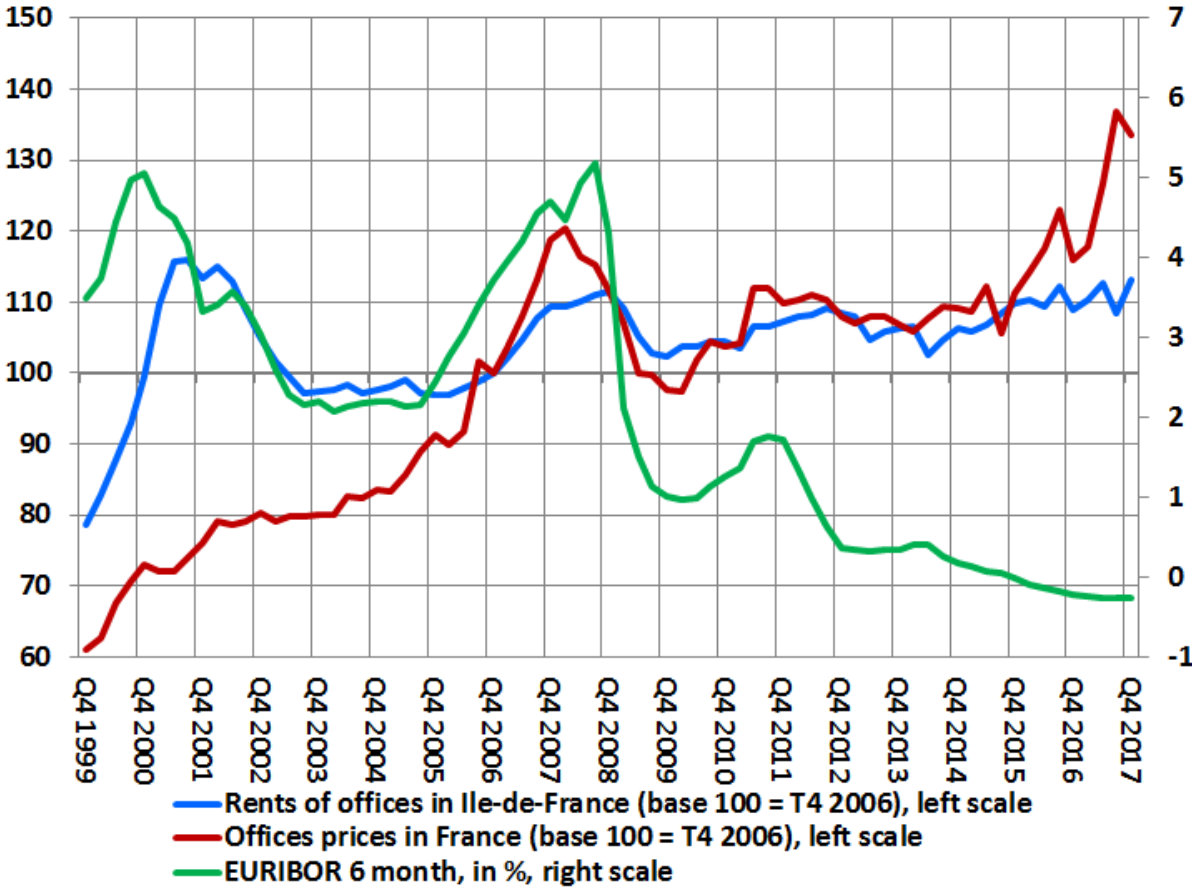
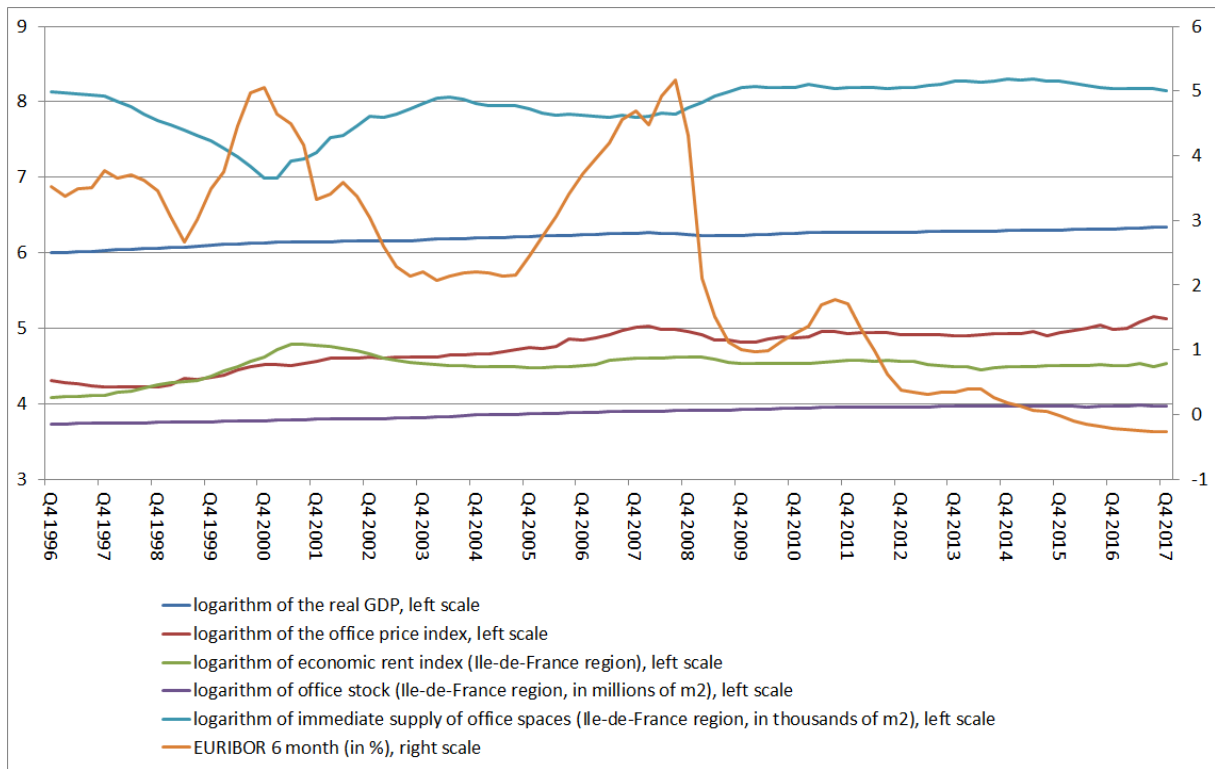
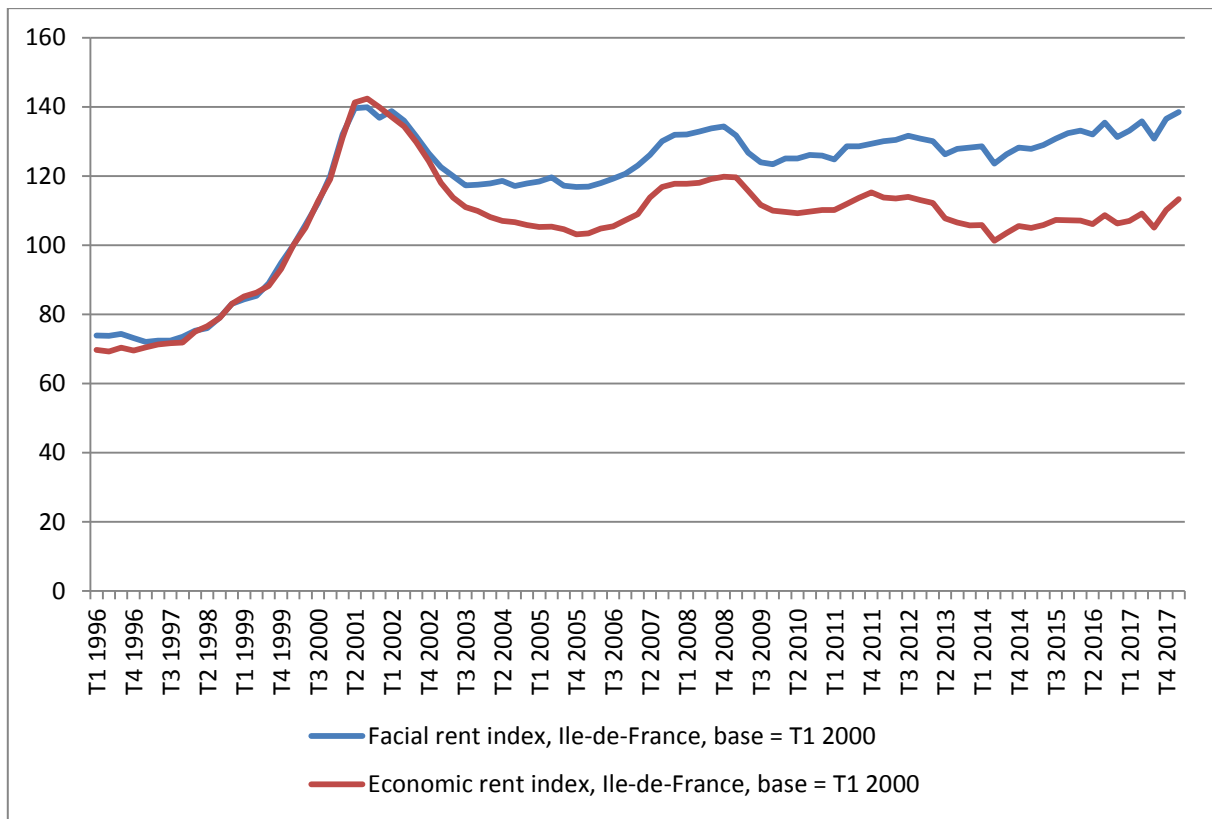


Chart 9: Variables of interest considered in this study



Source: INSEE, Banque de France, IEIF, Immostat, CBRE, BNPP RE, BCE according to IPD

Chart 10: Evolutions of facial and economic rents in Ile-de-France



Source: IEIF from BNP Paribas Real Estate, Immostat (Estimated values)

Chart 11a: impulse response functions

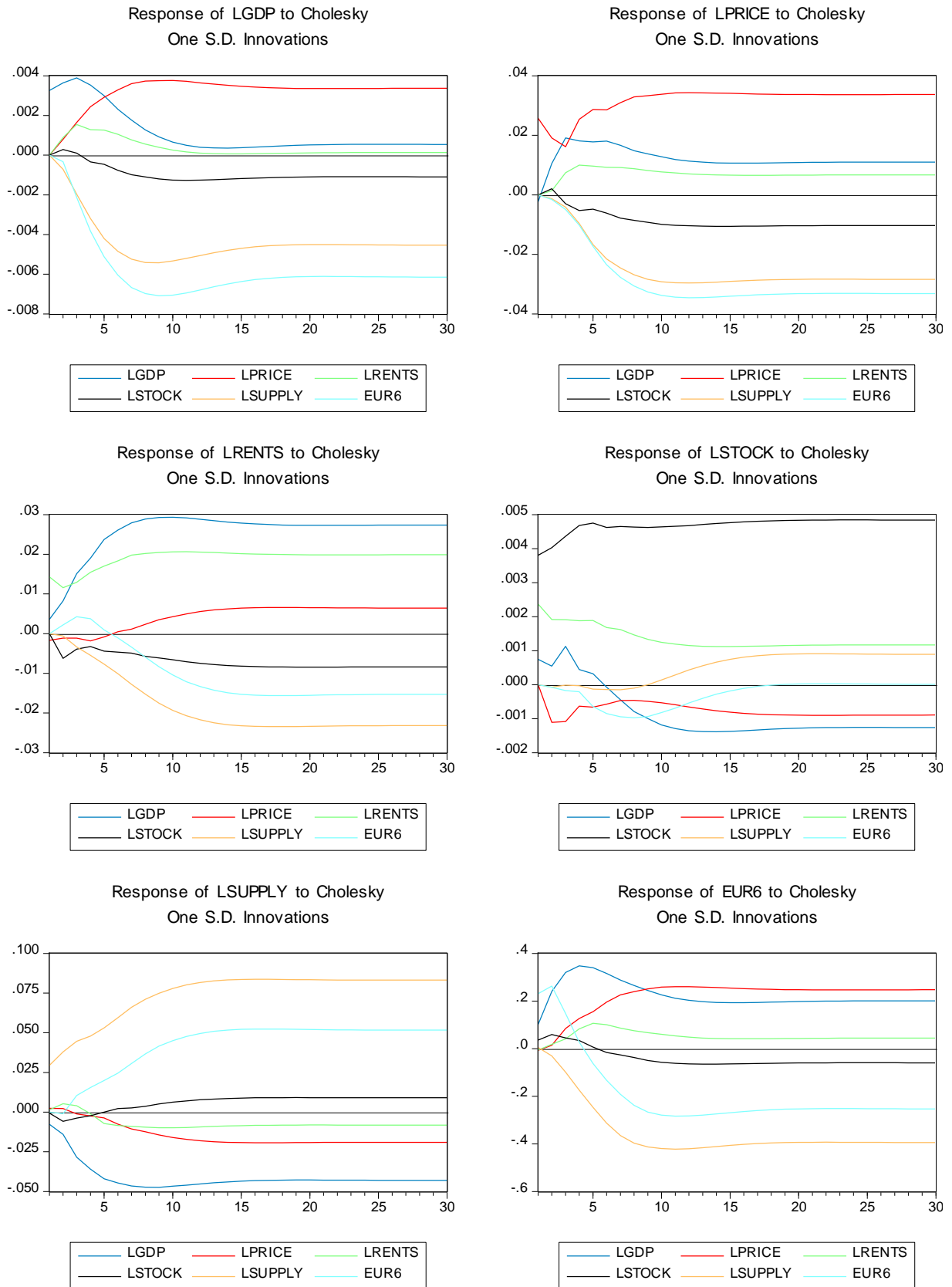
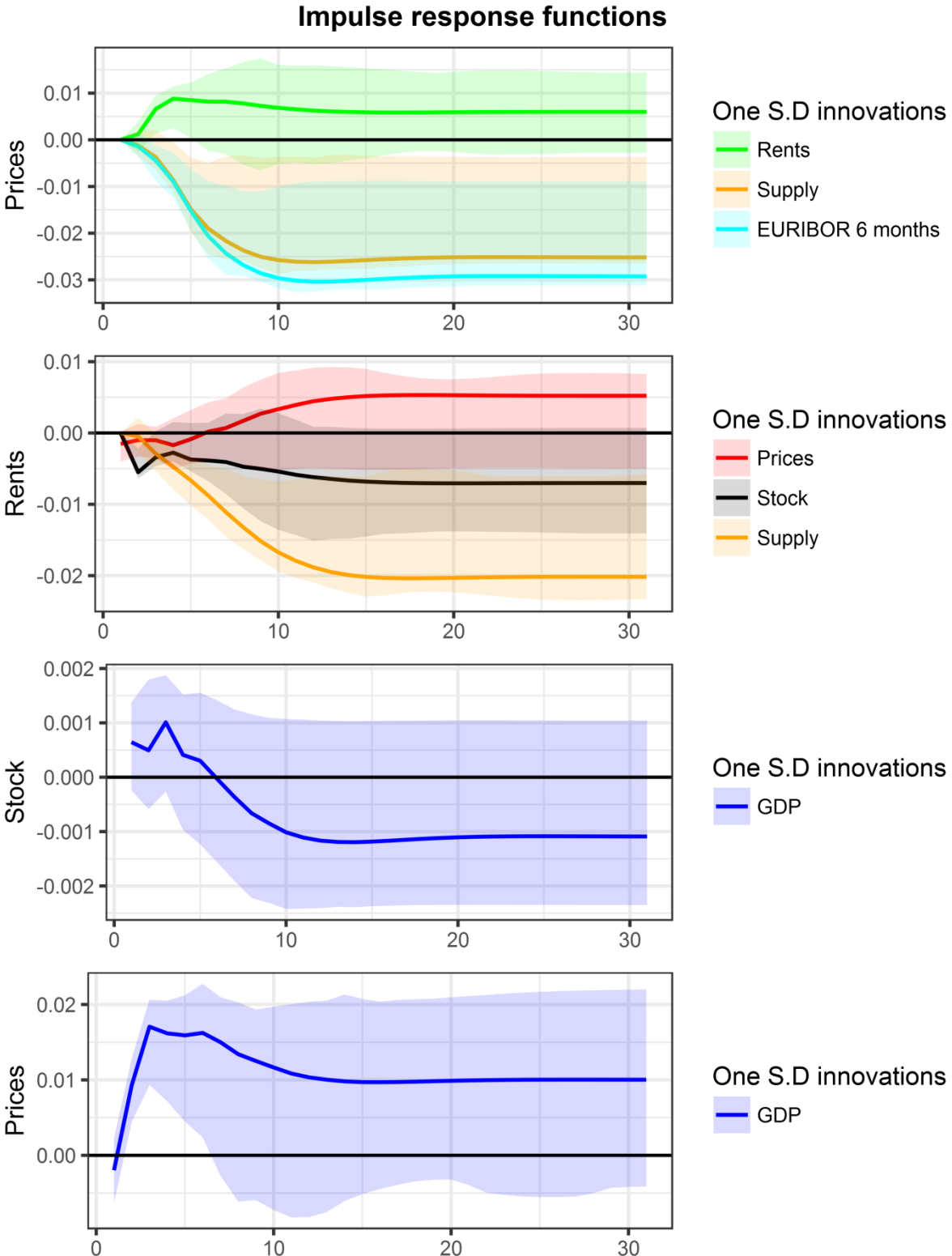


Chart 11b: impulse response functions with confidence intervals (+/- one standard deviation)



Note: All variable except EURIBOR 6 months are log transformed

Chart 12: unit of office stock per unit of real GDP over the period

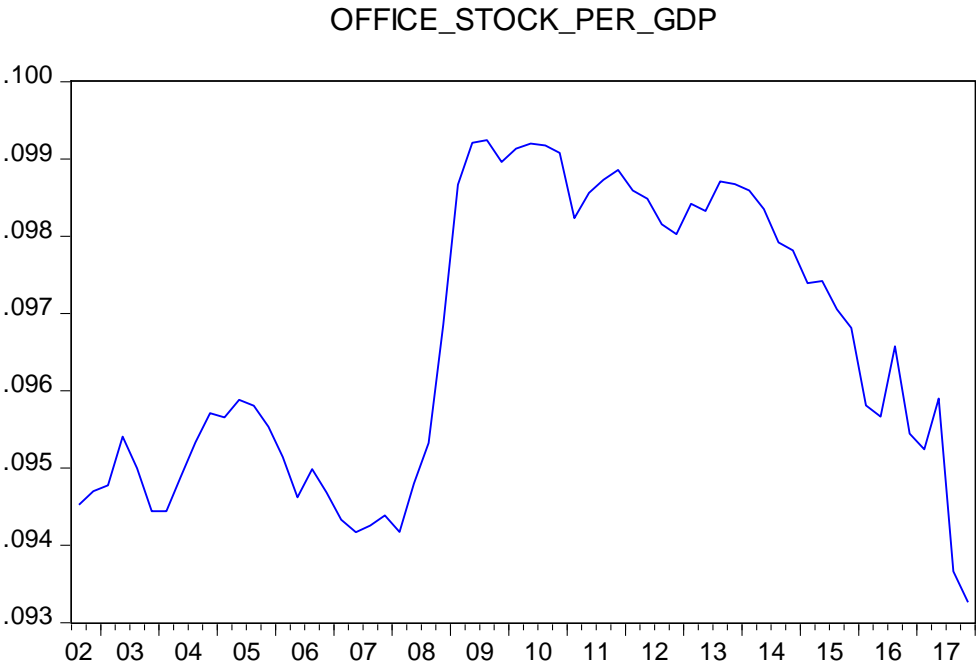


Chart 13: variance decomposition

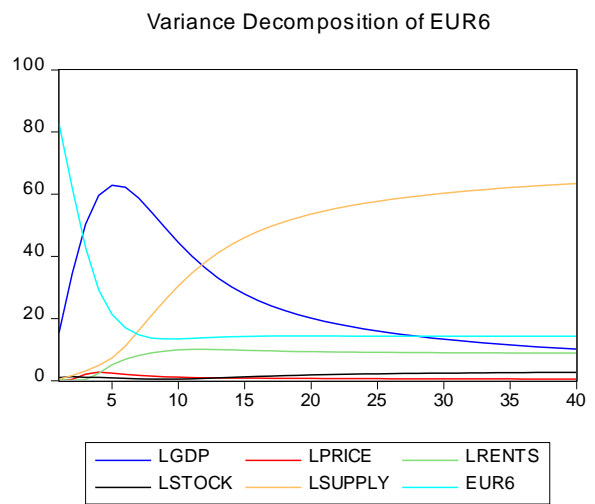
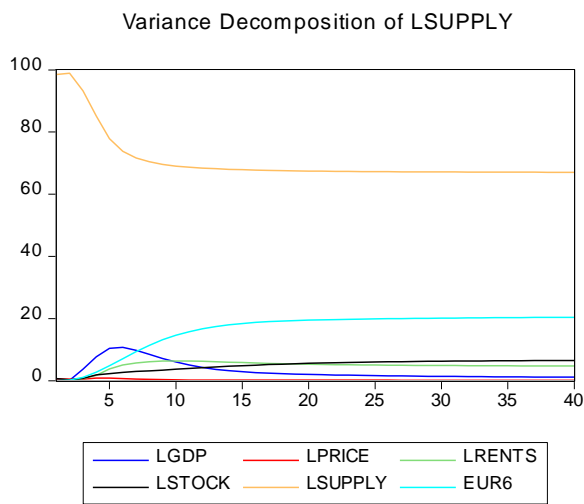
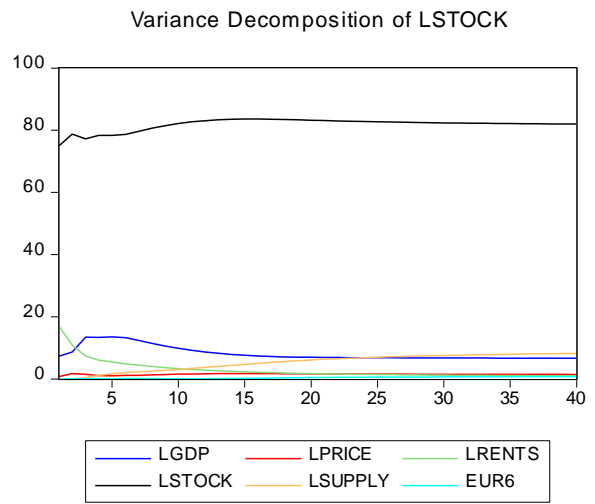
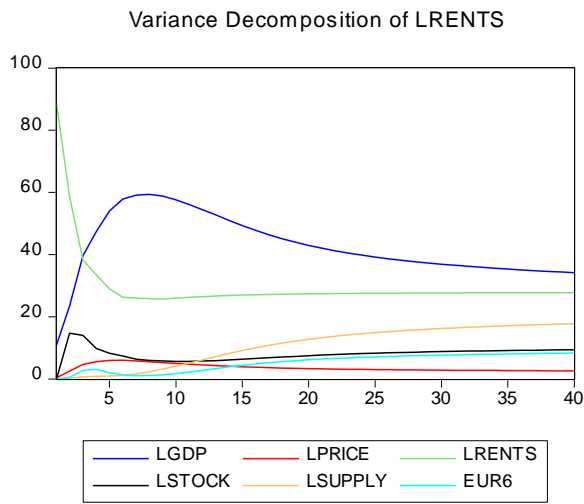
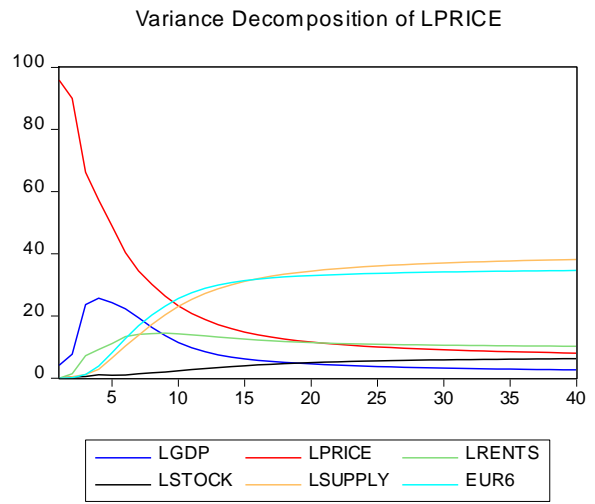
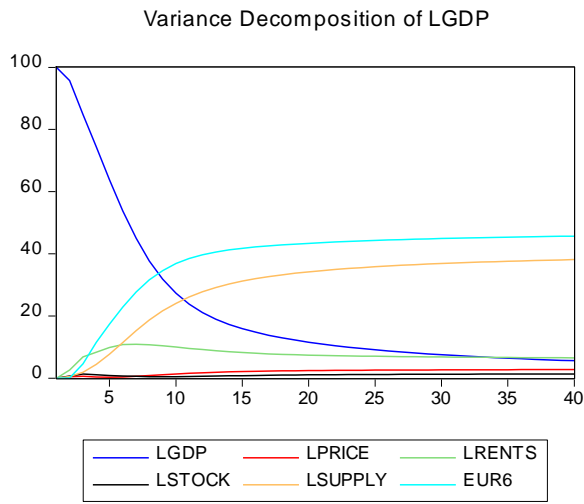


Chart 14: impulse response functions - robustness with facial rents

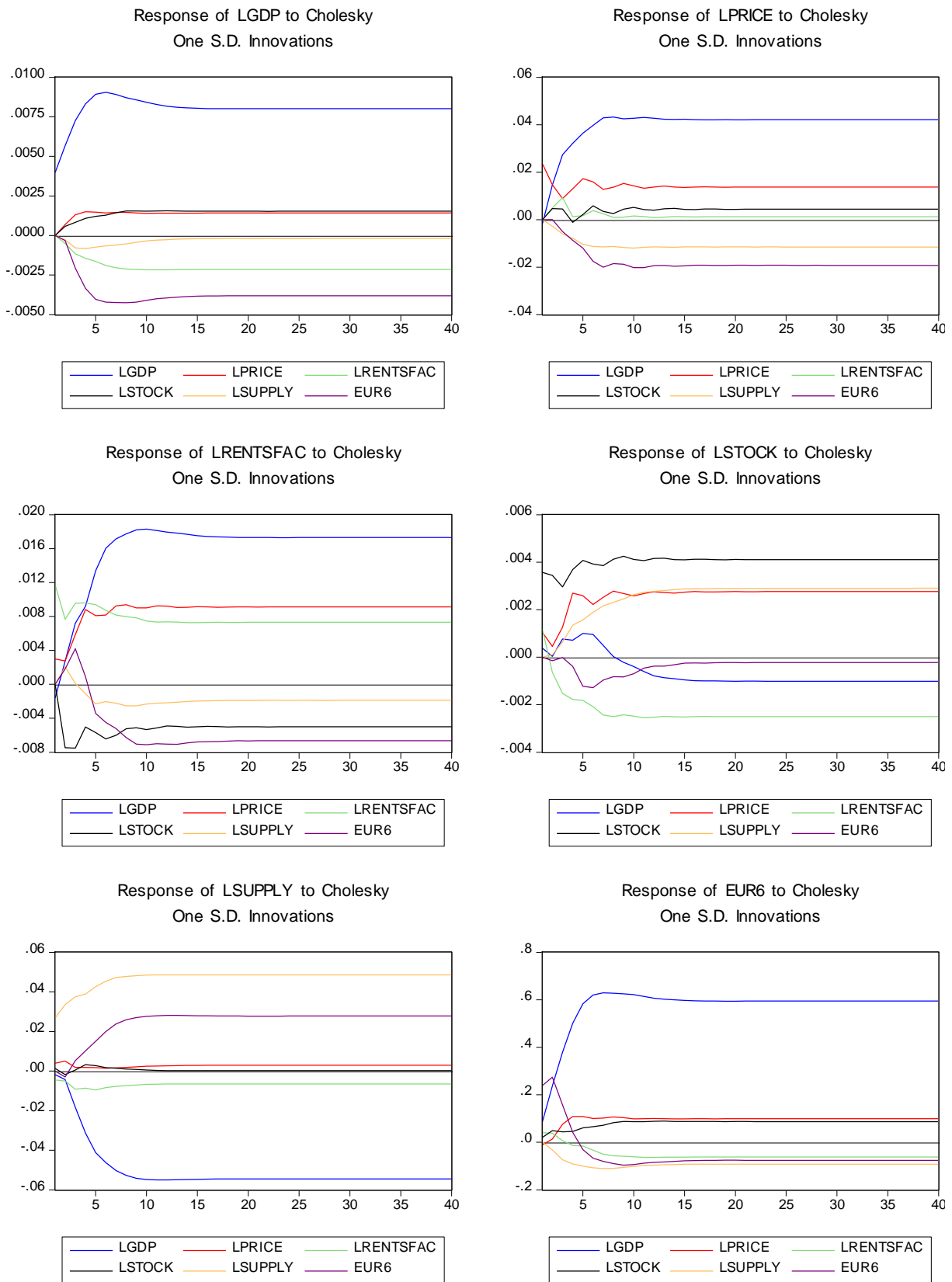


Chart 15: impulse response functions - robustness with crisis dummy

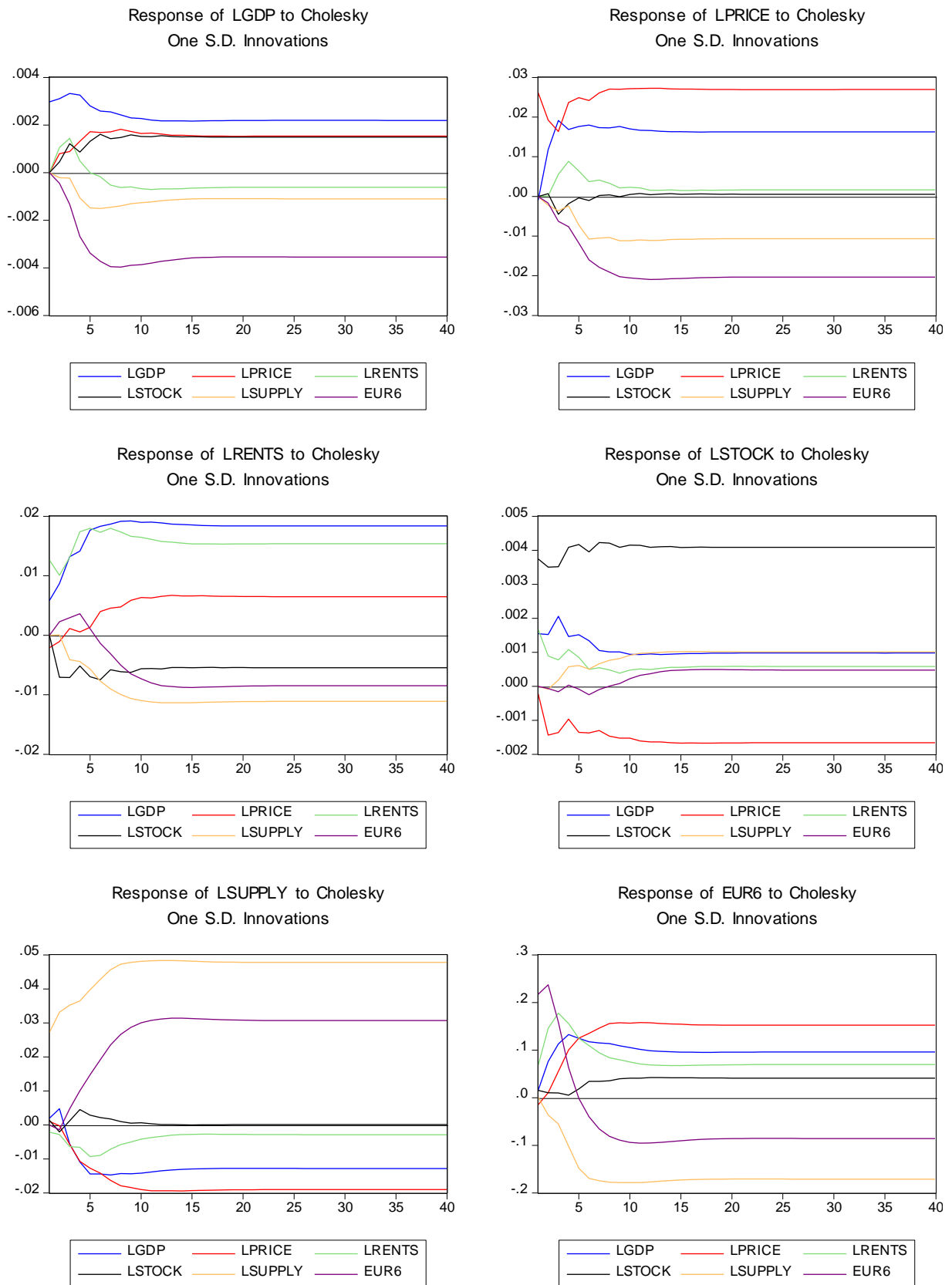


Chart 16: Evolutions of gap between the index logarithm and its trend – main result

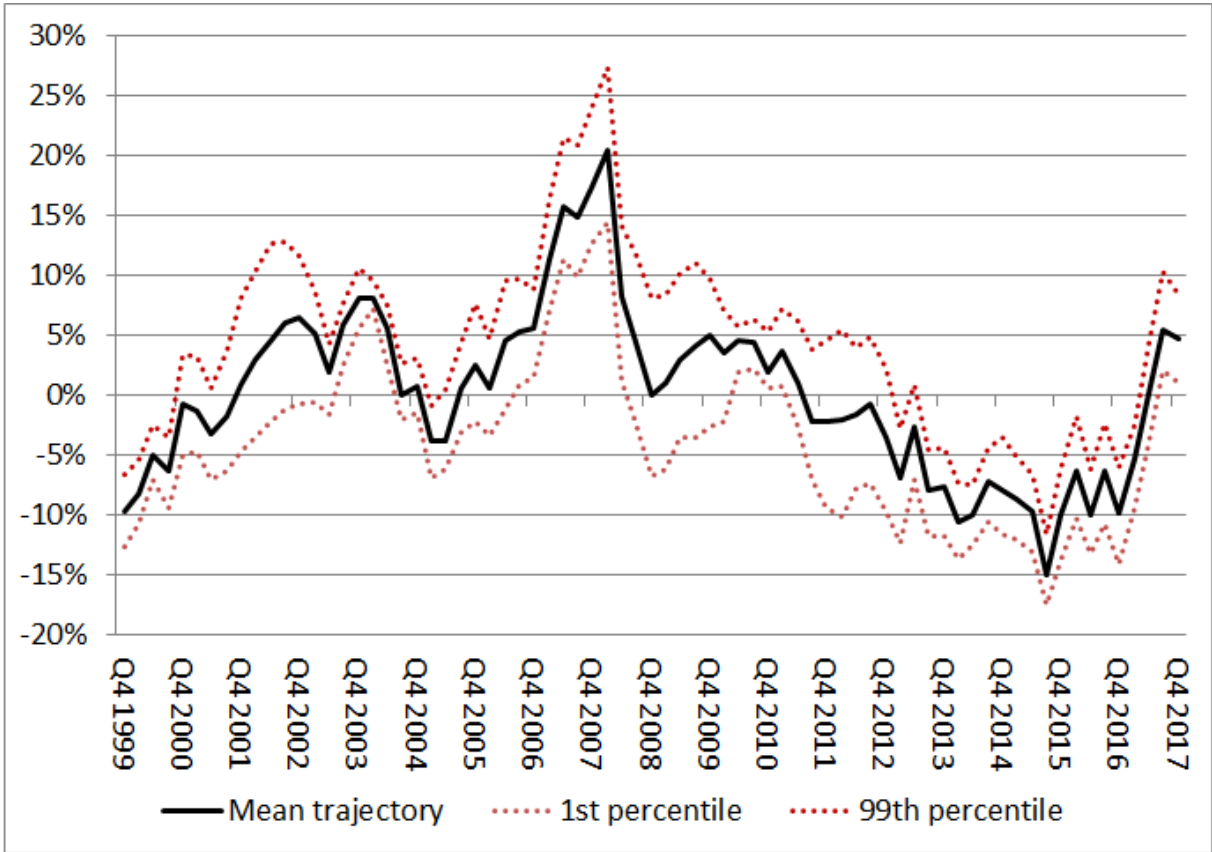


Chart 17: Evolution of gap between the index logarithm and its trend – robustness

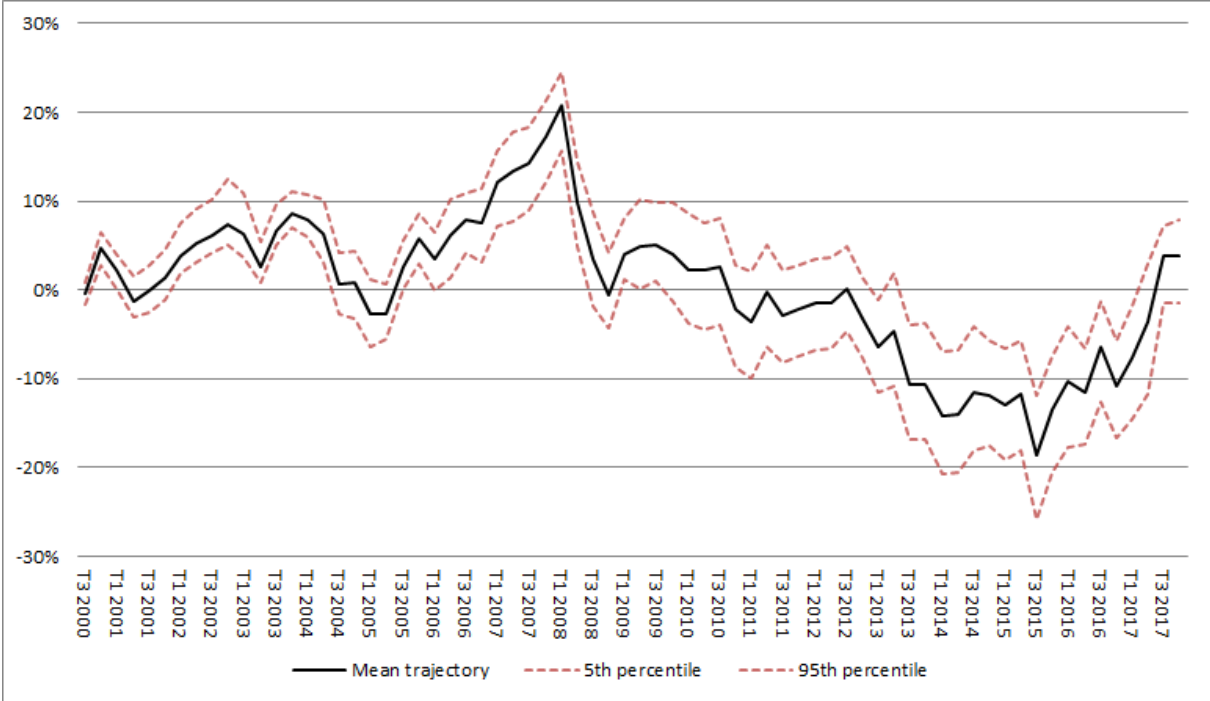


Chart 18: recession index and disequilibrium variables

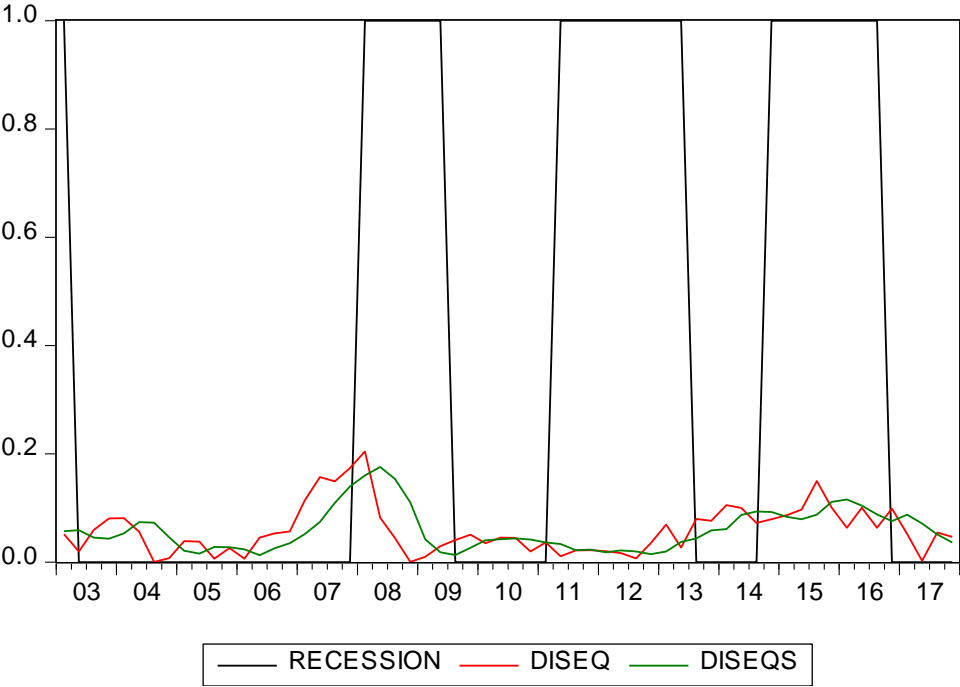


Chart 19: recession index and estimated probability of recession

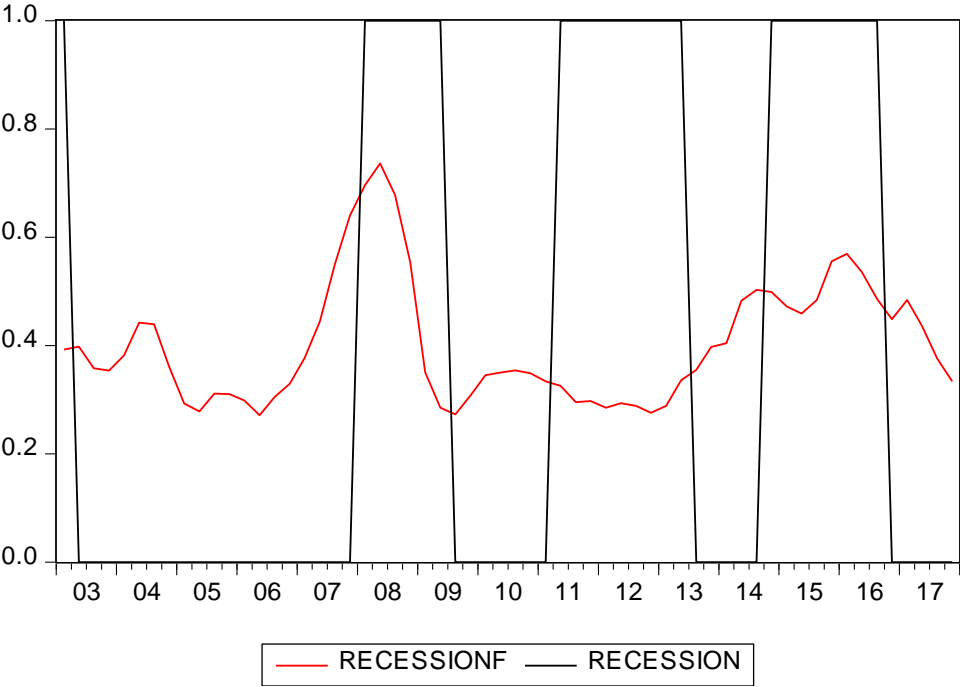


Chart 20: impulse response functions – Paris Region, effect of a one standard deviation shock of each variable on employment

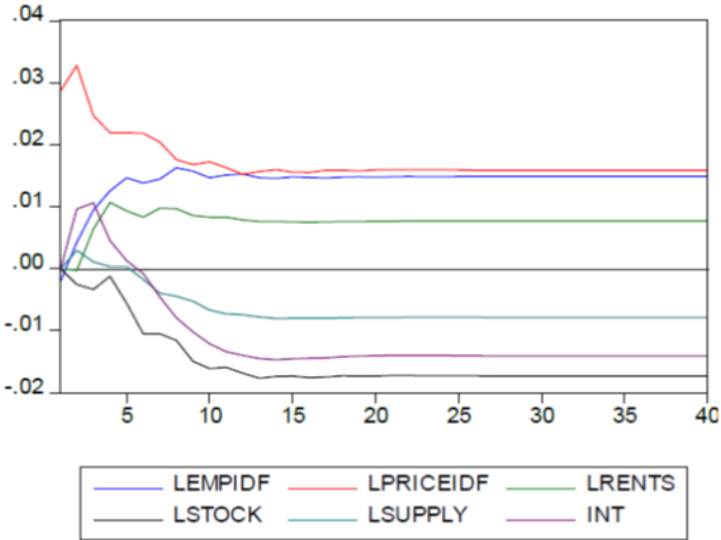


Chart 21: Decomposition of price and Overvaluation for Paris Region (Ile de France)

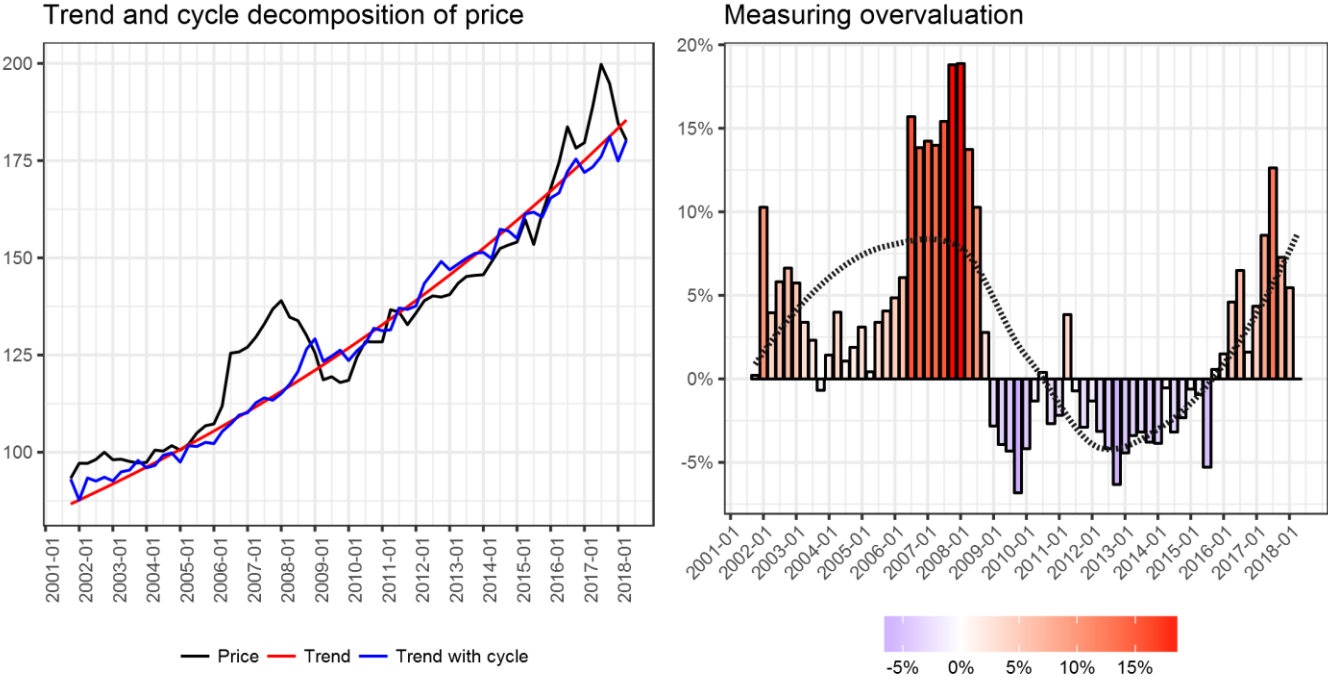


Table 1: correlations between the variables of the model

	LGDP	LPRICE	LRENTS	LSTOCK	LSUPPLY	EUR6
LGDP	1.000000 -----					
LPRICE	0.920725 0.0000	1.000000 -----				
LRENTS	-0.140126 0.2856	0.175562 0.1797	1.000000 -----			
LSTOCK	0.932772 0.0000	0.845777 0.0000	-0.109395 0.4054	1.000000 -----		
LSUPPLY	0.599736 0.0000	0.379482 0.0028	-0.353357 0.0056	0.767965 0.0000	1.000000 -----	
EUR6	-0.530376 0.0000	-0.262867 0.0424	0.495035 0.0001	-0.628579 0.0000	-0.890426 0.0000	1.000000 -----

Coefficient at the top and p-value at the bottom of each cell.
Coefficients in bold are significant at the 5% level.

Table 2: stationarity tests

	LGDP	LPRICE	LRENTS	LSTOCK	LSUPPLY	EUR6
Augmented Dickey-Fuller test						
In level						
Stat	-0.91	-0.87	-3.68	-3.55	-1.39	-1.62
p-value	0.77	0.79	0.01	0.01	0.57	0.46
In first difference						
Stat	-4.02	-6.64	-3.57	-3.39	-5.45	-4.04
p-value	0.00	0.00	0.01	0.01	0.01	0.00
Phillips Perron						
In level						
Stat	-0.86	-0.99	-3.26	-3.88	-1.65	-1.17
p-value	0.79	0.75	0.02	0.01	0.44	0.67
In first difference						
Stat	-3.96	-6.63	-5.36	-7.57	-5.51	-3.88
p-value	0.00	0.00	0.00	0.00	0.00	0.00

Table 3: Akaike Information Criterion and Schwarz Information Criterion

Number of lags	AIC	SIC
1	-29.38	-28.36
2	-29.74	-27.69
3	-29.56	-26.45
4	-29.44	-25.27

Table 4: estimation results for the VECM model

Cointegrating relationship

LGDP(-1)	1.000000
LPRICE(-1)	-0.228522 [-6.40823]
LRENTS(-1)	0.065851 [1.73476]
LSTOCK(-1)	-0.055327 [-0.42900]
LSUPPLY(-1)	0.109351 [4.91248]
EUR6(-1)	0.024022 [9.71070]
C	-6.143404

Coefficients of the long-term relationship with t-stat in brackets.

Short term equations

Error Correction:	D(LGDP)	D(LPRICE)	D(LRENTS)	D(LSTOCK)	D(LSUPPLY)	D(EUR6)
CointEq1	-0.231792 [-4.74900]	0.053349 [0.13788]	0.555492 [2.50208]	-0.009363 [-0.13768]	-0.870648 [-1.89963]	-0.666940 [-0.17515]
D(LGDP(-1))	0.286616 [2.19889]	3.683149 [3.56460]	0.831460 [1.40237]	-0.048098 [-0.26485]	-0.458787 [-0.37483]	34.35011 [3.37784]
D(LGDP(-2))	0.244781 [1.50618]	3.320160 [2.57718]	0.111227 [0.15046]	0.446135 [1.97032]	-4.607253 [-3.01900]	22.35048 [1.76276]
D(LPRICE(-1))	-0.016632 [-0.89988]	-0.243666 [-1.66313]	0.160894 [1.91382]	-0.048139 [-1.86946]	-0.205537 [-1.18428]	0.894092 [0.62006]
D(LPRICE(-2))	-0.004802 [-0.27051]	-0.221591 [-1.57459]	0.005548 [0.06871]	-0.007561 [-0.30568]	-0.362683 [-2.17560]	1.824771 [1.31748]
D(LRENTS(-1))	0.065393 [1.76445]	-0.006062 [-0.02063]	0.067255 [0.39895]	-0.041306 [-0.79994]	0.494704 [1.42149]	1.188230 [0.41094]
D(LRENTS(-2))	0.066974 [1.96473]	0.489203 [1.81038]	-0.165164 [-1.06519]	-0.004296 [-0.09046]	-0.199738 [-0.62399]	0.269356 [0.10128]
D(LSTOCK(-1))	0.072562 [0.62693]	0.601983 [0.65612]	-1.700674 [-3.23034]	0.060449 [0.37486]	-1.324078 [-1.21827]	4.613871 [0.51095]
D(LSTOCK(-2))	0.034943 [0.24762]	-1.434497 [-1.28237]	0.613536 [0.95584]	0.046192 [0.23495]	1.382487 [1.04330]	-3.405348 [-0.30931]
D(LSUPPLY(-1))	0.001420 [0.10415]	-0.050048 [-0.46310]	-0.081551 [-1.31508]	-0.001422 [-0.07484]	0.380146 [2.96944]	-1.162091 [-1.09257]
D(LSUPPLY(-2))	-0.006407 [-0.57032]	-0.013564 [-0.15231]	-0.106590 [-2.08590]	-0.000850 [-0.05431]	0.203436 [1.92846]	-0.729545 [-0.83238]
D(EUR6(-1))	0.004131 [1.87026]	-0.008093 [-0.46224]	-0.003804 [-0.37866]	-0.000114 [-0.03695]	0.016522 [0.79663]	0.155865 [0.90455]
D(EUR6(-2))	-0.002242 [-1.15594]	-0.011359 [-0.73870]	-0.005084 [-0.57620]	-0.000118 [-0.04373]	0.065754 [3.60972]	-0.462520 [-3.05609]
C	0.002074 [2.14698]	-0.004130 [-0.53929]	-0.003266 [-0.74317]	0.001594 [1.18414]	0.028048 [3.09162]	-0.246206 [-3.26638]
R-squared	0.638465	0.503056	0.584390	0.173807	0.544911	0.616806

Coefficients of the short-term relationship with t-stat in brackets.

Table 5: causality tests

...Does not Granger cause...	LGDP	LPRICE	LRENTS	LSTOCK	LSUPPLY	EUR6
LGDP		0.00	0.14	0.47	0.10	0.00
LPRICE	0.07		0.02	0.49	0.02	0.14
LRENTS	0.02	0.02		0.40	0.07	0.13
LSTOCK	0.59	0.24	0.00		0.53	0.17
LSUPPLY	0.22	0.13	0.25	0.46		0.05
EUR6	0.00	0.00	0.03	0.60	0.01	

The table presents the p-value of the Granger causality test

Table 6: estimation results of the probit model

Dependent Variable: RECESSION

Method: ML - Binary Probit (Newton-Raphson / Marquardt steps)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
DISEQS	7.620498	4.355099	1.749787	0.0802
C	-0.705819	0.305068	-2.313642	0.0207
McFadden R-squared	0.039634	Mean dependent var		0.400000