



HAL
open science

Immobilier de bureaux et environnement économique en Europe : essais sur les réactions et interactions de marché

Benoît Lefebvre

► **To cite this version:**

Benoît Lefebvre. Immobilier de bureaux et environnement économique en Europe : essais sur les réactions et interactions de marché. Gestion et management. Université Paris sciences et lettres, 2019. Français. NNT : 2019PSLED009 . tel-02461362

HAL Id: tel-02461362

<https://theses.hal.science/tel-02461362>

Submitted on 30 Jan 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

THÈSE DE DOCTORAT

de l'Université de recherche Paris Sciences et Lettres
PSL Research University

Préparée à l'Université Paris-Dauphine

European office market and economic environment: essays on the
reactions and interactions

École doctorale n°ED 543

DRM FINANCE

Spécialité SCIENCES DE GESTION

Soutenue par **Benoit LEFEBVRE**
le 08 mars 2019

Dirigée par **Alain Coën**
et par **Arnaud Simon**

COMPOSITION DU JURY :

M. Martin Hoesli
Université de Genève
Rapporteur

M. François Des Rosiers
Université Laval
Rapporteur

M. Michel Baroni
ESSEC Business School
Membre du jury

M. Sébastien Bourdin
EM Normandie
Membre du jury

M. Richard Malle
BNP Paribas Real Estate
Membre du jury

M. Alain Coën
Université du Québec à Montréal
Directeur de thèse

M. Arnaud Simon
Université Paris Dauphine
Directeur de thèse

Averstissement / Warnings

Cette thèse a été réalisée dans le cadre d'une Convention Industrielle de Formation par la Recherche (CIFRE) entre l'Université Paris Dauphine et la société BNP Paribas Real Estate. L'Université Paris Dauphine et la société BNP Paribas Real Estate n'entendent donner aucune approbation ou improbation aux opinions émises dans cette thèse.

Ces opinions et résultats doivent être considérés comme propres à leurs auteurs. Ils en assument l'entière responsabilité et ne sauraient engager la responsabilité d'un tiers.

*

* *

This thesis was conducted within an Industrial Training and Research Agreement (CIFRE) between the Paris Dauphine University and BNP Paribas Real Estate.

Paris Dauphine University and BNP Paribas Real Estate will not be responsible for any approval or disapproval opinions expressed in the thesis.

These opinions and results should be considered those of the authors.

Remerciements

Mes premiers remerciements vont tout naturellement à Arnaud Simon et Alain Coën d'avoir accepté d'encadrer ce travail de thèse. Ils m'ont véritablement guidé et soutenu durant ces trois années. J'ai pu mener à bien cette thèse grâce à leurs précieux conseils et leur disponibilité. J'espère avoir été digne de la confiance qu'ils m'ont témoignée et avoir l'occasion, à l'avenir, de continuer à collaborer avec eux.

Je remercie également Richard Malle, Global Head of Research, et Samuel Duah, Head of Economics chez BNP Paribas Real Estate de m'avoir accueilli au sein de leurs départements durant trois ans. Leur expérience et leur connaissance des marchés immobiliers ont nourri des échanges intéressants et m'ont grandement aidé tout au long de mes recherches. Je tiens à remercier tout particulièrement Richard pour sa présence, son soutien et son inspiration au quotidien. La confiance qu'il m'a témoignée depuis mes premiers jours dans l'entreprise et les nombreux projets sur lesquels nous avons pu collaborer ensemble m'ont fait grandir.

Je remercie chaleureusement le Professeur François Des Rosiers et le Professeur Martin Hoesli d'avoir accepté de participer au jury de cette thèse en tant que rapporteur. Mes remerciements vont également au Professeur Michel Baroni, ainsi qu'à Sébastien Bourdin, qui me font l'honneur de participer à ce jury. Leur lecture attentive et leurs remarques serviront à améliorer ce travail de thèse et je leur en suis très reconnaissant.

Mon quotidien de jeune chercheur au sein de BNP Paribas Real Estate n'aurait pas été si plaisant sans la formidable équipe dans laquelle j'ai pu évoluer. La qualité de nos échanges, tant sur le plan professionnel que personnel m'a aidé à réaliser ce travail de thèse et je les en remercie. Les relations d'amitiés que j'ai pu lier au sein de cette entreprise sont aujourd'hui essentielles pour moi.

J'ai une pensée également pour tous mes amis qui m'ont permis de m'évader du quotidien de doctorant. Je remercie tout particulièrement mes amis bisontins, Emilien et Guillaume, pour nos

discussions quasi-quotidiennes et leur soutien dans les moments de doute. Merci également à Antonin, Graziella et Jonathan d'avoir été présents pour moi. David, Julie et Jules, merci pour ces moments de détente et de déconnexion à vos côtés.

Enfin, ce travail n'aurait pas été possible sans l'aide et le soutien infailible de ma famille qui m'a toujours encouragé dans cette démarche. J'ai une pensée particulière pour mon frère Thomas qui a décidé de suivre cette voie quelques années avant moi et qui a toujours été présent pour me guider et me conseiller.

CONTENTS

List of Figures	6
1 Introduction Générale	7
1 General Introduction	19
2 International money supply and real estate risk premium: The case of the London office market.	30
1 Introduction	32
2 Theoretical framework and stylized facts.	37
2.1 Real estate risk premium	37
2.2 The London office market: some stylized facts	39
2.3 Money and real estate prices	43
2.4 A monetary index for international real estate investments	45
3 Model and Data	46
3.1 VAR model	46
3.2 Structural VAR	50
3.3 Data	51
4 Empirical Results	52
4.1 Optimal lag of the monetary index	53
4.2 Results for the whole period: relevance of the monetary index	54
4.3 Results for the sub-periods: the GFC as a potential breakdown	58
4.4 How do real estate markets react differently to money supply and the 3-month Libor rate?	59
4.5 Responses to an unexpected monetary shock	60
5 Conclusion	62
Bibliography	64
Appendix	71

3	New monetary policies: fuelling metropolisation and megalopolisation?	80
1	Introduction	82
2	Monetary policies, European megalopolis and metropolisation	84
2.1	European monetary governance: a federal policy in an imperfectly federal union	84
2.2	European Megalopolis and European centrality	86
2.3	Metropolises and global connectivity	88
3	Measuring the monetary spillover in a heterogeneous European office market	90
3.1	Unconventional monetary policies: fuelling the urban investments?	90
3.2	The heterogeneity of the European office markets	91
3.3	Modelling the fundamentals of the office markets	93
3.4	Elasticities of the European office markets to the monetary policies	97
4	Three wealth-reshaping trends supported by the new monetary policies	98
4.1	European metropolises: global connectivity or market size effect?	98
4.2	The ECB monetary policy: an institutional leverage effect for the German office markets	101
4.3	The revival of the megalopolitan advantage	103
5	Conclusion	107
	Bibliography	110
4	Rental adjustment in European office markets: global or local effect?	116
1	Introduction	118
2	Literature review	119
3	Theoretical framework: economic modelling	123
3.1	Vector autoregression model	123
3.2	Panel data vector autoregression	124
4	Data	125
5	Empirical analysis: Results	127
5.1	Rental value growth: a global effect?	127
5.2	Rental value growth: a predominance of local dynamics?	130
5.3	The natural vacancy rate: A standard approach	135
6	Conclusion	141
	Bibliography	143
5	General Conclusion	147
5	Conclusion Générale	157
	Bibliography	168

LIST OF FIGURES

1.1	Historique des volumes investis en Europe : 2004-2017.	9
1.2	Patrimoine immobilier des investisseurs institutionnels en Europe en 2017.	11
1.3	Rendement global et écart type des actifs immobiliers : 2008-2017.	13
1.1	Historical investment volume in Europe : 2004-2017.	21
1.2	Property portfolio of the institutional investors across Europe in 2017.	23
1.3	Total return and standard deviation in real estate markets : 2008-2017.	24
2.1	Decomposition of the historical total return in Central London: 1981-2015.	38
2.2	Share of foreign investors in the Central London across time: 2004-2015.	42
2.3	Breakpoints of the monetary index according to the Bai-Perron test: 2002-2005.	49
2.4	Impulse response functions following a shock in the monetary supply: 2002-2015.	61
2.5	Monetary aggregates for the eurozone, the US and China: 2004-2015.	71
2.6	Investment volume in Europe across time: 2004-2015	71
2.7	Price of foreign currency in terms of units of domestic currency: 2002-2016.	72
2.8	Price of domestic currency in terms of units of foreign currency: 2002-2016.	72
2.9	Impulse Response Functions following a positive shock to monetary index after QE policies: 2009-2015.	78
2.10	Impulse Response Functions following a shock to the 3-month Libor rate: 2002-2015.	79
3.1	Map of the main office markets in Europe.	94
3.2	Stock value variations between metropoles sub-groups: 2008-2016.	101
3.3	Stock value variations between the German segmentation sub-groups: 2008-2016.	104
3.4	Stock value variations for the megalopolitan sub-groups: 2008-2016.	106
3.5	European investments in the megalopolis and in the periphery: 2009-2016.	107
4.1	Real Prime rent index for the German markets and London: 2002-2017	132
5.1	Prices index for each type of asset: 2001-2017.	154
5.1	Indice des prix pour chaque type d'actif en Europe : 2001-2017.	165

CHAPITRE 1

INTRODUCTION GÉNÉRALE

L'immobilier est un bien financier unique, défini par une forte hétérogénéité, une faible liquidité et un manque de transparence. La particularité de l'immobilier vient principalement de son caractère tangible et non fongible. Un bien immobilier est défini par ses propres caractéristiques (matériaux, étages, surface, adresse, etc.) et ne peut pas être parfaitement répliqué. Chaque actif étant différent les uns des autres, les résultats qui s'appliquent à un actif (ou à un marché) peuvent difficilement être généralisés. La faible liquidité du marché est principalement due à l'aspect réel de l'immobilier direct : la réalisation d'un projet immobilier peut prendre des mois, voire des années (avec la mise à disposition du terrain, la construction de l'immeuble, la vente, etc.). Les importants coûts d'acquisition et de maintenance sont également une contrainte à l'investissement immobilier, réduisant le nombre potentiel d'investisseurs. Le cadre juridique de l'immobilier direct et l'absence d'un marché organisé prolongent encore la durée de réalisation d'une transaction.¹ Devaney et Scofield (2014) ont estimé que le temps moyen pour vendre un bien immobilier commercial à Londres (considéré comme le marché le plus liquide d'Europe) est de 135 jours (i.e quatre à cinq mois). L'immobilier étant un marché de gré à gré, il existe un certain manque de transparence. En effet, dans un marché de gré à gré, tous les détails d'une transaction (tels que les prix, les acheteurs, les vendeurs, etc.) ne sont pas nécessairement disponibles publiquement, ce qui rend l'analyse plus difficile. Certains pays sont considérés comme fortement transparent (principalement les Etats-Unis, les Etats européens et les principaux marchés asiatiques), alors que d'autres marchés sont considérés comme « semi-transparents », voire opaques (les marchés émergents ou des marchés avec des barrières géopolitiques). L'objectif de cette thèse est d'améliorer la connaissance du marché immobilier européen et d'apporter de nouvelles informations pour les investisseurs, ainsi que pour les utilisateurs. Ce travail devrait permettre aux acteurs du marché de l'immobilier de disposer de nouveaux

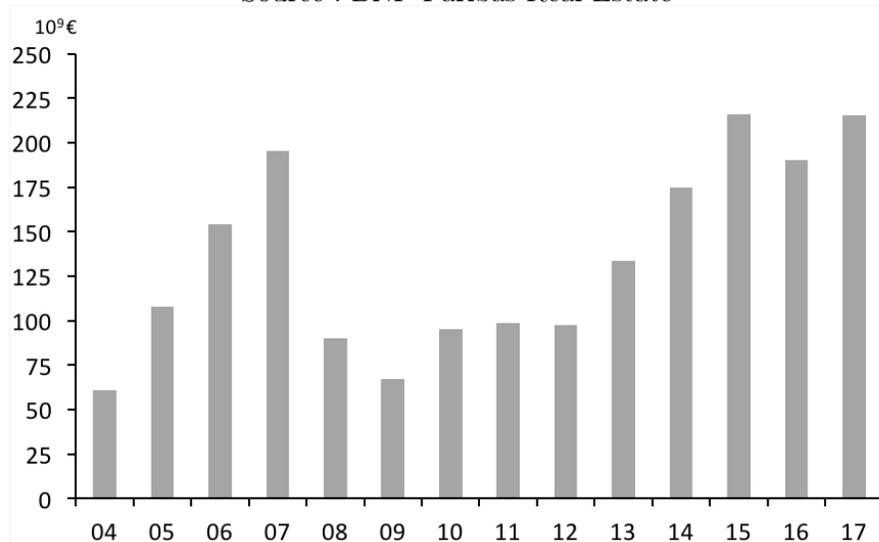
¹L'immobilier direct correspond à l'achat et à la gestion d'un immeuble (ou seulement d'une partie). L'immobilier indirect consiste à acquérir des parts d'un fonds immobilier ou d'une société cotée.

outils pour analyser ce dernier et de mieux le comprendre.

Cette thèse est consacrée à l'immobilier commercial, et plus particulièrement aux marchés des bureaux. Les deux autres classes d'actifs en immobilier commercial sont les commerces et les locaux industriels.² Alors que l'immobilier résidentiel est fortement corrélé aux ménages, l'immobilier commercial doit être vu comme un actif financier. En effet, les locataires en immobilier commercial sont rarement propriétaires et une grande majorité des actifs sont destinés à offrir des revenus (tirés des loyers). En Europe, les volumes investis ont augmenté de 60 milliards à 200 milliards d'euros entre 2004 et 2007 (Figure 1.1). Suite à la crise financière mondiale, les volumes investis ont chuté à 67 milliards d'euros en 2009.

FIGURE 1.1 : Historique des volumes investis en Europe : 2004-2017.

Source : BNP Paribas Real Estate



Depuis, les volumes investis sont en constante augmentation (sauf en 2016) et ont atteint 215 milliards d'euros en 2017, ce qui montre l'intérêt grandissant des investisseurs pour cette classe

²Les locaux industriels comprennent les entrepôts logistiques ainsi que les locaux d'activités.

d'actifs. Cette hausse peut être la conséquence de la bonne performance du secteur, ainsi que de sa faible volatilité comparée à d'autres actifs financiers. L'immobilier est également considéré par les investisseurs comme un actif qui a un pouvoir diversifiant, présentant une corrélation négative avec le marché des actions (Eichholtz, 1996 et Chaudhry, Myer et Webb, 1999 entre autres). De plus, la régulation imposée aux banques et aux assurances (les accords de Bâle et de Solvency) exigent moins de capitaux propres pour réaliser des investissements immobiliers que pour d'autres actifs tels que les actions ou les produits dérivés. Ces éléments renforcent encore la compétitivité du secteur immobilier. En 2017, une enquête menée par l'INREV confirme cette hypothèse puisque les investisseurs institutionnels ont déclaré vouloir augmenter la part allouée à l'immobilier dans leurs portefeuilles.³ Au regard des investissements des institutionnels, l'Europe est la région qui a attiré le plus d'investisseurs en 2017, avec 35% du total des volumes investis (source : MSCI).⁴ Les Etats-Unis sont le deuxième marché juste derrière l'Europe avec 34%. Le Japon continue d'attirer une part importante des volumes investis (10%), le reste du monde ne se partageant que 21%. Il est intéressant de remarquer que les volumes investis en Europe dépassent difficilement ceux des Etats-Unis malgré le nombre important de pays composant la zone. De plus, en analysant la répartition des investissements par pays, nous pouvons voir que la situation est particulièrement contrastée en Europe (Figure 1.2).

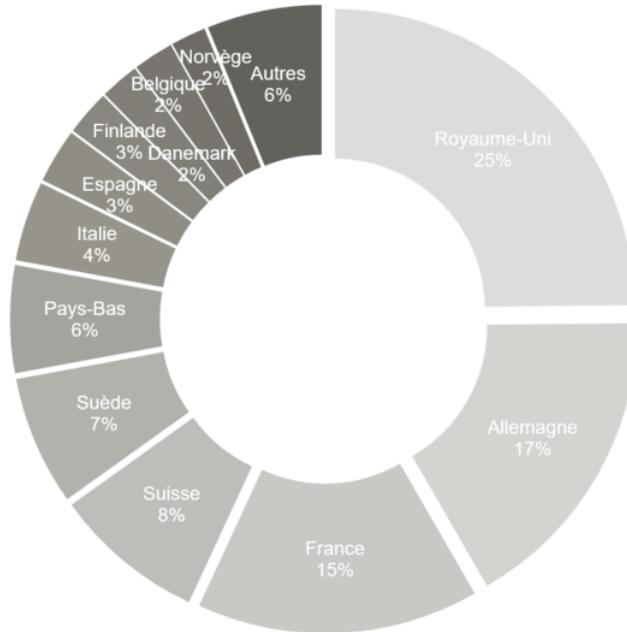
En Europe, le Royaume-Uni est le premier marché en 2017 et représente 25% du total des investissements. La bonne dynamique du marché de Londres et sa dimension internationale (70% d'investissements étrangers) expliquent cette première position. L'Allemagne est le deuxième marché le plus attractif en Europe pour les investisseurs institutionnels. L'Allemagne est le seul pays

³L'INREV (Investors in Non-Listed Real Estate Vehicles) est l'Association Européenne des Investisseurs des Fonds non cotés.

⁴MSCI (Morgan Stanley Capital International) construit et fournit des indices immobiliers couvrant plus de 30 pays et 240 marchés dans le monde. Leur portefeuille est composé d'immeubles détenus par les investisseurs institutionnels dont les banques, les assurances, les fonds de pension, les fonds immobiliers, etc.

FIGURE 1.2 : Patrimoine immobilier des investisseurs institutionnels en Europe en 2017.

Source : MSCI



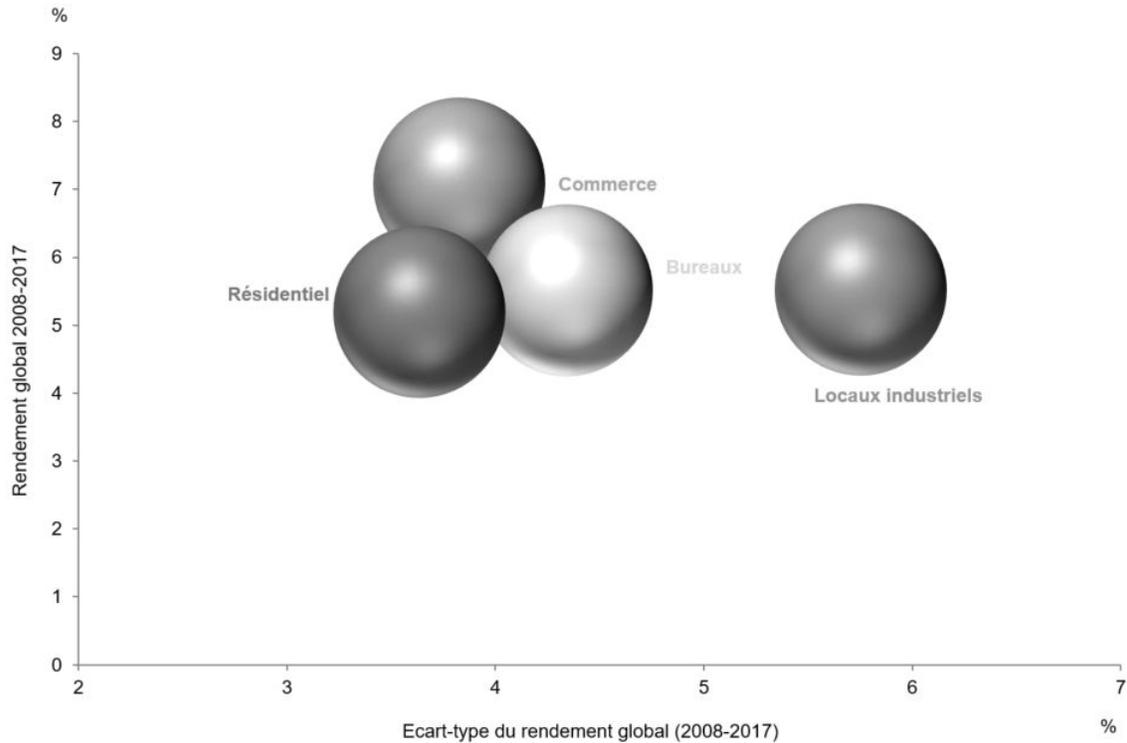
européen composé de plusieurs marchés de grande taille, due à la construction décentralisée du pays (suite à la fragmentation de l'empire germanique et à l'unification tardive du pays au XIX^{ème} siècle). De plus, l'Allemagne étant la première puissance économique en Europe, les investisseurs sont attirés par la stabilité des différents marchés, ainsi que par leur faible volatilité. La France a attiré, quant à elle, 15% des investissements en Europe. Comme pour l'Angleterre, la France est portée par le marché parisien, qui a concentré deux tiers des investissements en 2017. Cependant, la dimension internationale de Paris est à nuancer, puisque les investisseurs étrangers ne représentent que 30% du volume global.

Hormis l'hétérogénéité propre à chaque marché, une distinction doit également être faite entre les

différentes classes d'actifs. Au total, l'immobilier commercial représente presque 80% du volume global investi en 2017 par les investisseurs institutionnels, alors que l'immobilier résidentiel ne représente que 16%. Ce chiffre prouve que l'immobilier commercial doit être étudié comme un actif financier, et non comme un marché de propriétaire occupant. De plus, les rendements locatifs sont souvent plus attractifs pour l'immobilier commercial que pour l'immobilier résidentiel. En effet, la différence entre le rendement brut et le rendement net est souvent plus importante pour le résidentiel, dû à un taux de rotation plus élevé, à la législation ou encore à des coûts de maintenance unitaire plus importants. Les investisseurs sont alors plus attirés par l'immobilier commercial qui apporte des rendements plus élevés, ainsi qu'une meilleure liquidité. Les bureaux sont la classe d'actifs privilégiée par les investisseurs et représentent 39% de leur portefeuille. Le commerce et les locaux industriels représentent, respectivement, 26% et 13% de l'investissement immobilier.

La relation entre le rendement global et la volatilité historique (qui peut être un indicateur du risque) montre des différences importantes entre les différents actifs (Figure 1.3). En effet, pour une performance historique équivalente, la volatilité est moins élevée pour les bureaux que pour les locaux industriels. La volatilité historique des prix des locaux industriels est plus importante que celle des prix des bureaux : par exemple, suite à la crise financière mondiale les prix des bureaux ont diminué seulement pendant 2 ans alors que ceux des locaux industriels ont chuté pendant 7 ans, de 30%. Le secteur du commerce a réalisé de meilleures performances que les autres secteurs ces dernières années mais le niveau limité de produits disponibles pour les investisseurs permet d'expliquer la faible part dans les portefeuilles des investisseurs. En se basant sur les rendements historiques, le risque associé et le nombre de transactions, les bureaux sont la principale classe d'actifs immobiliers. Cependant, la littérature portant sur ce sujet doit encore être approfondie. L'objectif général de cette thèse est de contribuer à la littérature autour du marché des bureaux et d'apporter de

FIGURE 1.3 : Rendement global et écart type des actifs immobiliers : 2008-2017.
Source : MSCI



nouveaux développements sur ce sujet.

Dans cette thèse nous allons principalement nous intéresser à la relation bilatérale entre l'économie réelle et les marchés immobiliers. D'une part, l'immobilier commercial est fortement dépendant de l'environnement économique global. En effet, les fondamentaux du marché (niveau de transaction, taux de vacance, loyers, etc.) sont principalement influencés par des variables telles que le PIB ou le niveau d'emploi. Lorsque l'emploi est en hausse, la demande d'espace de bureaux augmente faisant diminuer le taux de vacance et tirant les loyers vers le haut. Les volumes investis sont également fortement dépendants du contexte économique comme nous avons pu le voir lors de la crise mondiale récente (Figure 1.1). D'autre part, l'économie mondiale est également liée à la santé du marché immobilier. Les exemples de crises économiques déclenchées par l'éclatement d'une bulle du

marché immobilier sont nombreux à travers le monde. Le secteur bancaire, par le biais des prêts hypothécaires, peut être fortement touché par l'évolution du marché immobilier. Si par le passé les crises immobilières avaient principalement un impact national (Japon, 1990 ; France 1991), les effets sont beaucoup plus internationaux de nos jours suite à la financiarisation du marché. Cependant, si le marché de l'investissement peut être considéré comme partiellement intégré et international, la question peut se poser pour le marché utilisateur. Les deux marchés sont en effet différents. Le marché de l'investissement dépend à la fois de facteurs locaux et internationaux (un choc extérieur aura probablement des effets sur le marché local). Le marché utilisateur est quant à lui moins relié à des facteurs externes et dépend plus de variables locales telles que l'emploi ou la santé financière des entreprises. Nous étudierons ces deux marchés séparément pour déterminer les facteurs économiques qui ont pu les impacter lors de ces dernières années. D'un point de vue académique, comme professionnel, il est important d'étudier les deux marchés pour avoir une meilleure compréhension du marché immobilier dans son ensemble.

Avec la crise économique récente, l'impact du nouvel environnement économique mondial sur les marchés immobiliers doit être étudié de manière détaillée. En effet, les plus grandes banques centrales ont mis en place des politiques monétaires expansionnistes suite aux ralentissements importants sur les marchés financiers, aux récessions économiques et à la crise des dettes souveraines. Tout d'abord, les banques centrales ont abaissé leurs taux directeurs à des niveaux proches ou égaux à zéro. L'objectif était d'améliorer la liquidité et le marché interbancaire. L'impact a cependant été limité, dû aux incertitudes élevées. Le faible niveau des taux d'intérêt ne s'est donc pas reflété sur l'investissement privé ou sur les marchés financiers. Les banques centrales ont donc décidé de mettre en place des politiques d'assouplissement monétaire (ou quantitative easing) afin de réduire le risque systémique suite à l'effondrement de Lehman Brothers, à la crise de la dette en Europe et au risque

de déflation. Le quantitative easing est défini comme une politique monétaire expansionniste où la banque centrale achète un montant prédéterminé d'obligations d'Etat ou d'autres actifs financiers pour stimuler l'économie. Ces politiques sont qualifiées de non conventionnelles. Ainsi, de nos jours, il devient plus pertinent d'étudier l'impact de l'abondance de monnaie sur l'économie et sur les marchés immobiliers. Comme les obligations d'Etats et les actions ont été pénalisées respectivement par des rendements de plus en plus faibles et par des contraintes réglementaires, l'afflux de liquidité s'est dirigé vers d'autres classes d'actifs. Les accords de Bâle ou les directives de Solvency ont pour objectif d'assurer la stabilité du système financier en augmentant les capitaux propres nécessaires aux banques et aux assurances lors de l'achat d'actifs financiers. Ces réglementations imposent donc une part de capitaux propres plus faible pour les actifs immobiliers que pour les actions ou les produits dérivés. De plus, comme la demande des obligations d'Etats augmente suite au quantitative easing, les rendements ont été tirés vers le bas.⁵ L'immobilier est donc attractif pour les investisseurs, avec des rendements élevés, une faible volatilité comparé aux actions et aux produits dérivés, et un besoin en capitaux propres moins important.

Cependant, l'augmentation de la masse monétaire ne devrait pas avoir un effet homogène sur tous les marchés. L'hétérogénéité de l'immobilier a pu induire une réallocation implicite des richesses en fonction des pays et certains marchés auraient donc pu bénéficier de cet afflux de capitaux.

Un des principaux objectifs de cette thèse est d'étudier l'impact du nouvel environnement économique sur le marché des bureaux et de permettre une meilleure compréhension des dynamiques de marché depuis que les banques centrales ont mis en place les politiques monétaires non conventionnelles.

⁵Le taux obligataire 10 ans allemand (la référence en Europe) a été en territoire négatif en 2016.

La suite de cette thèse sera organisée comme suit : les deux prochains chapitres vont contribuer à avoir une meilleure compréhension de la relation entre les nouvelles politiques monétaires et le marché de l'investissement immobilier. Plus précisément, nous analyserons dans le chapitre 2 les dynamiques du marché de Londres et ses principaux déterminants entre 2002 et 2015, en donnant une attention particulière à la politique monétaire. Pour cela, nous nous basons sur le modèle théorique ISLM de Mundell-Fleming pour une économie ouverte avec taux de change flexible. Une hausse de la quantité de monnaie en circulation devrait, en théorie, impliquer une augmentation de l'investissement et donc, dans un marché où l'offre est inélastique, une hausse des prix. Afin d'étudier ce phénomène empiriquement, nous allons construire un indice monétaire en pondérant l'offre de monnaie par les volumes investis sur le marché. Tout d'abord, nous estimons un modèle vecteur auto-régressif (VAR) pour étudier les relations statistiques entre les différentes variables. Nous trouvons que le taux de vacance, le FTSE 100, le paramètre autorégressif ainsi que l'indice monétaire sont positifs pour expliquer la prime de risque, alors que l'emploi a un impact négatif. L'effet positif de l'indice monétaire confirme qu'une hausse de la masse monétaire entraîne une augmentation des prix des bureaux, et donc de la prime de risque. Cependant, en segmentant la modélisation par sous-période, la réalité est plus complexe et les résultats deviennent hétérogènes. Enfin, nous estimons un VAR structurel pour estimer les effets d'un changement inattendu de la masse monétaire. L'ampleur de la réponse est plus importante après un choc sur la masse monétaire qu'après un choc sur le taux interbancaire, ce qui confirme que le quantitative easing a eu un impact plus important sur le secteur immobilier qu'une baisse des taux directeurs.

Ensuite, nous étudions l'impact de la masse monétaire sur les principaux marchés immobiliers en Europe. Avoir une meilleure compréhension de l'effet hétérogène des politiques monétaires non conventionnelles sur les marchés immobiliers est important. En effet, entre 2009 et 2016, l'afflux de

capital a constamment augmenté en Europe, exerçant une possible pression à la hausse sur les prix. Dans le même temps, la valeur totale du stock de bureaux en Europe a augmenté de 60%, ce qui interroge sur le rôle des politiques monétaires. Cependant, le soutien de la banque centrale sur les marchés immobiliers a pu être hétérogène en Europe, principalement à cause des différences marquées entre les pays. Tout d'abord, nous étudions l'impact de l'offre de monnaie sur les marchés des bureaux en Europe en utilisant des données de panel pour confirmer l'effet théorique obtenu grâce au modèle IS-LM (chapitre 2). Les résultats suggèrent que le taux de vacance, l'emploi et l'indice monétaire étaient les principaux déterminants des prix des bureaux pendant la période d'étude. Ensuite, nous introduisons plusieurs ségmentations pour tester l'homogénéité de l'effet monétaire sur le marché des bureaux. Au niveau européen, ces résultats sont importants puisque l'hétérogénéité des pays a pu créer des distorsions et des réallocations implicites des investissements et certains marchés ont pu bénéficier davantage de ces nouvelles politiques monétaires. Nous avons trouvé que les métropoles, ainsi que les marchés dans la mégalopole européenne, ont principalement attiré les capitaux. Ce résultat est paradoxal puisque les nouvelles politiques monétaires qui ont été mises en place en Europe pour aider et soutenir les économies périphériques en difficulté ont, au final, favorisé les métropoles et la mégalopole européenne.

Le chapitre 4 est plus en lien avec la recherche en économie immobilière. Comme nous l'avons indiqué précédemment, le marché immobilier peut être divisé en deux sous catégories : le marché de l'investissement et le marché utilisateur. Après avoir étudié le premier, nous allons maintenant nous pencher sur le second. Dans ce chapitre, nous allons étudier la dynamique des valeurs locatives en Europe et leurs principaux déterminants. Tout d'abord, nous allons supposer que les marchés européens ont la même structure en utilisant un modèle de panel vecteur autorégressif. Nous trouvons que les marges des entreprises nationales, l'emploi, le taux de vacance et le paramètre autorégressif

sont les principaux déterminants du loyer Prime. Les différentes relations entre les loyers et les variables explicatives sont celles attendues : toutes les variables ont un effet positif sur les loyers, excepté le taux de vacance. Cependant, étant donné l'hétérogénéité des marchés immobiliers, l'hypothèse d'une structure commune des marchés européens est difficilement soutenable. Pour tester les potentielles différences, nous estimons la même équation pour chacun des marchés. Les résultats montrent que les déterminants sont différents en fonction des marchés et qu'une analyse locale est toujours nécessaire pour avoir une compréhension complète du marché. Enfin, nous revisitons la théorie du taux de vacance naturel et nous fournissons un taux de vacance de référence pour chaque marché. Ces résultats montrent que la plupart des marchés européens ont des taux de vacance inférieurs à leurs taux naturels.

Le cinquième et dernier chapitre tient lieu de conclusion générale sur cette thèse. Nous synthétisons les principaux résultats, ainsi que les contributions scientifiques de nos recherches et ensuite, nous développons quelques perspectives qui peuvent découler de cette thèse ou du contexte actuel.

CHAPTER 1

GENERAL INTRODUCTION

Real estate is a unique financial asset and characterised by an important heterogeneity, a low liquidity and a lack of transparency. The singularity of real estate is mainly related to its tangibility and its non-fungible aspect. A property asset is defined by its characteristics (materials, level, space, address, etc.) and cannot be perfectly replicable. Each asset is different from the other, implying that what applies for an asset (or a market) might not be the same for the others. The illiquidity is driven first by the physical aspect of the sector: it could take months or even years before a new project emerges, such as a building. The high acquisition or maintenance costs also constrain real estate investments by reducing the number of potential buyers. The legal framework of the direct real estate sector and the lack of an organised market extend the time to transaction.¹ Devaney and Scofield (2014) estimated that the time to sale of commercial property in the London market (considered as the most liquid market in Europe) was 135 days (i.e., four to five months). Because the direct real estate market is an over-the-counter (OTC) market, there is an important lack of transparency. In an OTC market, the details of a transaction (such as prices, buyers, sellers, etc.) are not necessarily public, making the analysis and the pricing more difficult. In some countries, the market is highly transparent (predominantly in the United States, Europe and leading Asian markets); in others, it could be qualified as semi-transparent or even opaque (mostly emerging markets or markets with geopolitical barriers). The aim of this thesis is to provide insight into this singular market at the European level and to impart some new information for investors and occupiers. This work should provide new tools to analyse the real estate sector and a better understanding for the market players. This thesis focuses on commercial real estate and, more specifically, on the office market. The two other asset classes are the retail and the industrial sector.² The residential sector is mainly driven

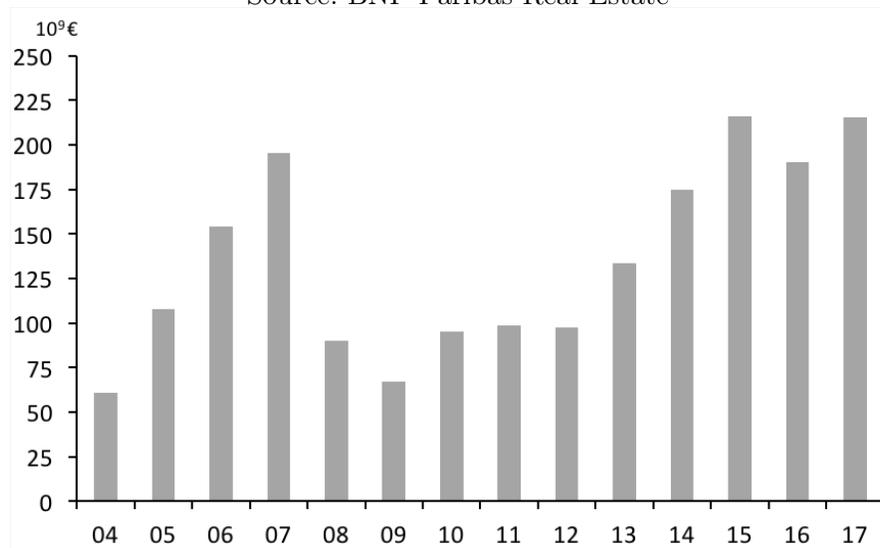
¹Direct real estate investments involve the purchase and the managing of a building (or a part of a building). An indirect investment consists of buying shares of a fund or a publicly or privately held company.

²Both warehouses and light industrial.

by households, but commercial real estate should be seen as a financial asset. Indeed, occupiers are hardly ever the owners of a particular building, and the vast majority of the assets are intended to provide income (stream form rents). In Europe, that investment volume increased from €60 billion to €200 billion between 2004 and 2007 (Figure 1.1). Following the global financial crisis (GFC), investment volume dropped to €67 billion in 2009.

Figure 1.1: Historical investment volume in Europe: 2004-2017.

Source: BNP Paribas Real Estate



Since then, investment volume constantly increased (except in 2016) and reached €215 billion in 2017, showing the growing interest of investors for the real estate sector. This rise can be attributed to the good performance and to the lower volatility of the real estate sector than other financial assets. In addition, real estate is believed to provide portfolio diversification benefits via its low and negative correlation with the stock market (Eichholtz, 1996 and Chaudhry, Myer and Webb, 1999 among others). The regulations imposed on the banking sector and on the insurance companies (the Basel Accords or the Solvency Directive) require less regulatory capital for real estate investment than for stocks or derivatives. These elements contribute to reinforcing the competitiveness of real

estate investments. A 2017 survey published by the INREV association corroborates that point, showing that institutional investors continue to increase the real estate allocations in their portfolios.³

According to the institutional investors' portfolio, the region that attracted the most of the investment in 2017 was Europe, accounting for 35% of the total amount invested (source: MSCI).⁴ The United States was the second market, just behind Europe, with 34%. Japan continues to attract a significant portion of the invested volume (10%). The rest of the world shared only 21%. An important remark is that the European market hardly exceeded the United States, despite the important number of countries in Europe. By analysing the country breakdown, we can see that the situation is much contrasted across Europe (Figure 1.2).

In Europe, the United Kingdom was the first market in 2017 and accounted for 25% of the total investment. This leading position is due to the global city of London and its international dimension (with around 70% of overseas investors). The second most attractive market in Europe for institutional investors is Germany. The situation in Germany is different from the other countries with five big markets, because of historical reasons, such as the fragmentation of the Holy Germanic Empire and the late unification of the country in the 19th century. Moreover, because Germany is the leading economic country in Europe, investors are attracted by the stability and the low volatility. Finally, France draws 15% of the total investment volume in Europe. As for the United Kingdom, France is mostly driven by the Parisian market, which attracted two-thirds of the investments in 2017. However, the international dimension of Paris is less important than that of the London market, with less than 30% of foreign investments. The three main countries accounted for more than

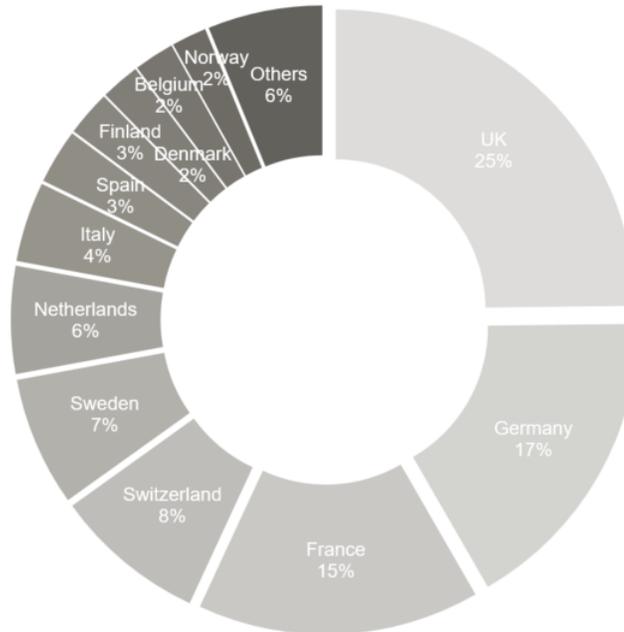
³The INREV is the European Association for Investors in Non-Listed Real Estate Vehicles.

⁴MSCI is a global provider of real estate indexes, covering more than 30 countries and 240 cities worldwide. Its portfolio is composed of buildings owned by institutional investors, including banks, insurance companies, pensions fund, hedge funds and REITs.

half of the total investment.

Figure 1.2: Property portfolio of the institutional investors across Europe in 2017.

Source: MSCI

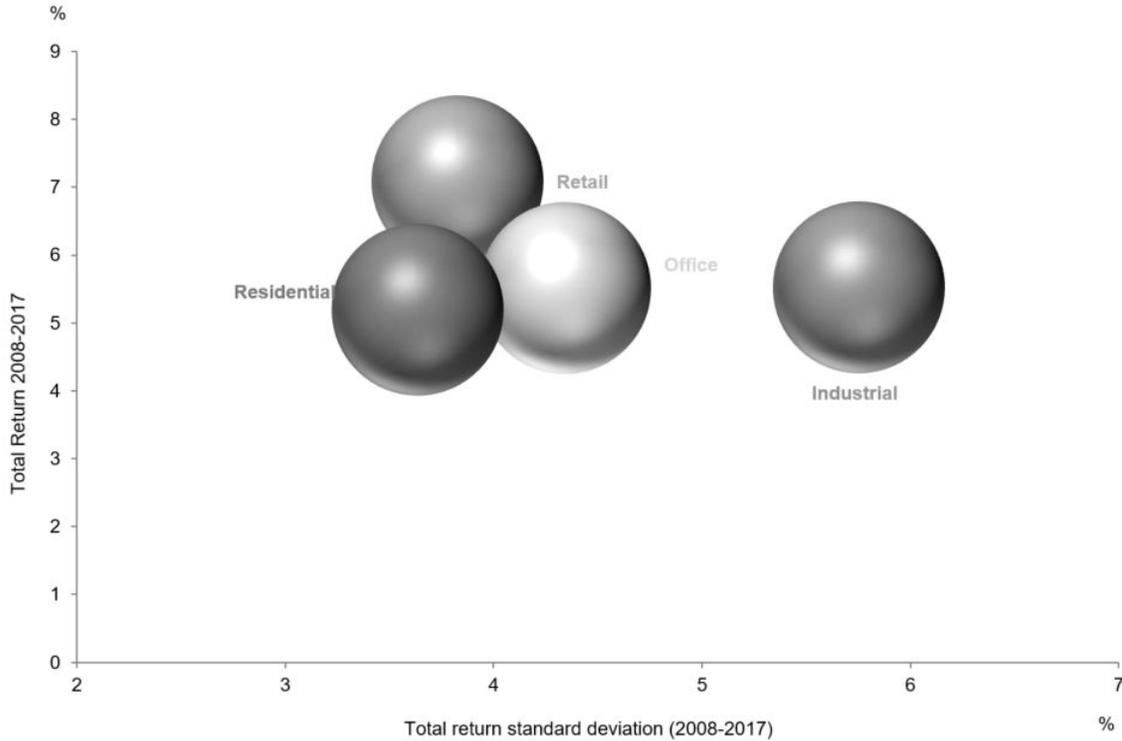


In addition to the important heterogeneity across geographical area, there is a distinction across real estate assets. Altogether, commercial real estate accounted for almost 80% of the total amount invested in 2017 by institutional investors, and the residential market represented only 16%. It confirms that commercial real estate should be seen as an investment asset rather than a homeowner market. Moreover, yields are often more attractive for commercial real estate than for the residential market. Indeed, the difference between the gross and the net yield is greater for residential assets because of important turnover, legislation, higher management fees, and so forth. Investors are thus more attracted by commercial real estate that brings higher income and liquidity. Offices are the main asset for investors and represent 39% of the investors' portfolio. The retail and the industrial

sectors account for 26% and 13%, respectively.

Figure 1.3: Total return and standard deviation in real estate markets: 2008-2017.

Source: MSCI



By studying the relation between the total return and the historical volatility (representing the risk), we can see the main differences of the assets (Figure 1.3). For an equivalent performance, the historical volatility for offices is less important than for the industrial sector. This is mainly explained by the prices' volatility; for example, after the GFC, office prices decreased for only two years, and industrial prices dropped for seven years by 30% overall. Moreover, office prices reached their pre-crisis level in 2013, when industrial prices were still largely below. The retail sector outperformed the other sectors during the past ten years, but the low level of supply explains the small proportion of retail assets in investors' portfolios. According to the historical return, the associated risk and the number of transactions, offices are the main real estate asset. However, the literature

on this topic still needs to be further expanded. The general purpose of this thesis is to contribute to the office market literature and to bring new development on the subject.

Here, we will focus primarily on the economic dimension of the real estate market. The relation between the global economy and real estate is well known and in both ways. On one side, the real estate market is highly dependent on the economic environment. For commercial real estate, the market fundamentals (transaction level, vacancy rates, net absorption, rents, etc.) are mostly driven by economic variables, such as the GDP and employment growth. For example, when employment increases, the demand for office space rises and the vacancy rate should decrease. In addition, investment volumes are highly dependent on economic conditions, as we have seen during the GFC (Figure 1.1). On the other side, the global economy is highly related to the real estate market. Examples of crises triggered or exacerbated by the bursting of housing market bubbles are numerous throughout the world. Moreover, the banking sector is highly dependent on the real estate market conditions, mainly on the home equity loans. Until the end of the 20th century, the bursting of the property bubbles mainly affected the national market (Japan, 1990; France, 1991). Today, following the internationalisation and the financialisation of the real estate market, bubbles have had a global effect. However, if the investment market should be seen as partially integrated and international, the question should be raised for the occupier market. The two markets are significantly different. The investment markets depend on national factor and on the global economy, meaning that an external shock might have an effect on a market. The occupier market is much more independent and related to locally based economic factors, such as the employment growth or the financial health of local companies. This thesis studies these two specifics and distinct markets separately to provide insight into the economic factors that might affect each of the markets. From an academic and from a practitioner's point of view, it is important to study both the occupier and the investment market

to gain a better understanding and a complete picture of the real estate market.

Because the real estate market and economic factors are closely related, the contemporaneous economic environment should be studied carefully. Since the GFC and the major downturns in financial market, followed by a deep economic recession and the European debt crisis, the main central banks have undertaken expansionary monetary policies. First, central banks have lowered their interest rates to zero or to levels close to zero. The aim was to boost the liquidity and the interbank lending market. The effect on the global economy is limited because of the considerable uncertainties. The low interest rate has not resulted in an increase in private investments, and both the financial market and the real economy were still struggling. Thus, the major central banks have decided to establish a quantitative easing program to reduce the systemic risk following the collapse of Lehman Brothers, the European debt crisis and the deflation risk. Quantitative easing (QE), also known as 'large-scale assets purchases' (LSAPs), is defined as *"an expansionary monetary policy whereby a central bank buys predetermined amounts of government bonds or other financial assets in order to stimulate the economy"*⁵ and is qualified as an unconventional monetary policy. Today, it is important to study the effect of the abundance of available money on the real estate market: the increase of the money supply implies a rise in the capital available for investments. As government bonds and stocks are less attractive because of the lower returns and important regulatory constraints, the inflow of liquidity should move towards other investment assets. The Basel Accords and the Solvency Directive regulations aim to ensure the solvency of institutions (both the banking and the insurance sector) and the overall economic stability by increasing the capital requirement when the financial exposure is significant. The regulations imply a greater capital requirement for stocks or derivatives to hedge against financial and operational risks. Moreover, as the demand for governmental bonds increased

⁵"What is quantitative easing?" Bank of England. Retrieved December 14, 2016.

(following the quantitative easing), the yields were driven downward.⁶ Thus, real estate has become more attractive for investors and requires less capital, given its low volatility when compared with stocks and derivatives (25% of equity requirement, compared with 40% to 50% for shares).

However, the rise of the money supply should not have the same effects according to the market. Indeed, the heterogeneity of real estate might have produced implicit wealth reallocation movements across countries and some markets might have benefited more from this inflow of capital.

Thus, the goal of this thesis is to study the effect of the new economic environment on the office market and to allow a better understanding of the market dynamism because the central banks have implemented unconventional monetary policies.

The remainder of this dissertation is divided as follows: The next two chapters contribute to providing a better understanding about the relation between the new monetary policies and the real estate investment market. More precisely, chapter 2 analyses the dynamics of the direct Central London office and its most relevant determinants from 2002 to 2015, giving special attention to the monetary aggregates. We consider an IS/LM Mundell-Fleming framework for an open economy with a flexible exchange rate to describe the link between the available money supply and the London office market dynamics. Theoretically, an increase in the money supply should result in a rise of capital inflow and, given the inelasticity of the supply, an inflation of office prices. To empirically explore this phenomenon, we constructed a monetary index using an appropriate aggregation of the money supply. First, we ran a VAR model to estimate the statistical relation between variables, and we found that the vacancy rate, the FTSE 100, the autoregressive parameter and the new monetary index were significant and had a positive effect on the risk premium, while the employment level

⁶The 10-year German bonds (the reference in Europe) was in negative territory in 2016.

had a negative effect. The positive effect of the monetary index indicates that an increase of the money supply does lead to a rise of office prices. However, by studying the same model for different sub-periods, we showed that reality is complex. Finally, we ran a structural VAR to estimate the effect of unexpected monetary policy changes. The response of the risk premium was more important following a shock in the money supply than a shock in the interbank rate, confirming the greater effect of quantitative easing on the real estate sector.

Next, we studied the effect of money supply on the main real estate market across Europe. It is important to have a better understanding on the way unconventional monetary policies heterogeneously affect real estate. Between 2009 and 2016, the capital inflow strongly and constantly increased in Europe, driving prices up. The total value of the office stock increased by 60% during this period, causing people to question the role of monetary policies on the inflation of these prices. The central bank's support for the real estate market might have different effects across Europe, mainly induced by the willingness to create an economic area with heterogeneous countries. First, we studied the effect of the money supply on European office prices by using panel data analysis to confirm the theoretical effect of the monetary aggregate on the real estate market at a European level, such as in the previous chapter. The results suggest that the vacancy rates, the employment level and the monetary index were the main determinants of office prices during the whole period. Next, we introduced several segmentations to test the homogeneity of the effect of increasing the money supply in the real estate market. At the European level, this result was crucial. The heterogeneity across countries might have generated distortions and implicit reallocation trends: some cities could benefit more from the new ECB policies. We found that the largest cities and the ones in the megalopolis were the most able to attract the liquidities. The paradoxical effects of the new monetary policies, which were made to support peripheral markets but mostly favoured the largest

cities and the megalopolis, raise some challenging economic and political questions.

Chapter 4 is much more part of real estate economic research. As previously indicated, a real estate market can be divided into two sub-markets: the investment and the occupier markets. After studying the first sub-market in the two first chapters, we found it was necessary to have a better understanding of the occupier market and its main drivers. In this section, we study the rental values and their most relevant determinants across Europe at two different geographical levels. First, we considered that European markets have the same structure by using a panel VAR modelling. We found that the margin of national companies, the employment level, the vacancy rate and the autoregressive parameter were the main determinants in the dynamics of the primary rental values. The responses of the rent prices to changes in the variables were consistent with the theoretical expectations: all of the variables had a positive effect on the rents, except for the vacancy rate. However, given the heterogeneity of the real estate markets, the hypothesis of a common structure across European markets would be hardly sustainable. To test the potential specificities, we ran the same equation for each of the markets. The results showed that the drivers were different according to the markets and that a local analysis was required. Finally, we revisited the natural vacancy rate theory and provided empirical benchmarks for each office market. The results showed that most of the European office markets had vacancy rates below the natural rates.

The fifth and last chapter consists of the general conclusion. We synthesise the main results and scientific contributions of our research and then discuss potential research opportunities resulting both from this thesis and from the actual context.

CHAPTER 2

INTERNATIONAL MONEY SUPPLY AND REAL ESTATE RISK PREMIUM: THE CASE OF THE LONDON OFFICE MARKET.

Published: Journal of International Money and Finance, Volume 82, April 2018.

Keywords : Real estate, Office market, Direct risk premium, Monetary policies, Structural VAR

Mots-clés : Immobilier, Marché des bureaux, Prime de risque, Politiques monétaires, VAR structurel

ABSTRACT

The main purpose of this study is to deeply investigate the determinants of the risk premium for the Central London market between Q2-2002 and Q3-2015 using a vector autoregression (VAR) model. We shed new light on the role of central banks in the historical level of the commercial real estate risk premium. Indeed, since the global financial crisis (GFC), central banks have used unconventional monetary policies, increasing the quantity of money available in the economy and creating structural changes. Therefore, we have described the link between monetary policies and real estate using a theoretical IS/LM Mundell-Fleming framework for a small open economy with a flexible exchange rate. To empirically explore this phenomenon, we have constructed a monetary index adapted to the office market. We find that throughout the whole period (2002 to 2015), the vacancy rate, the employment in services, the FTSE 100, the new monetary index and the autoregressive parameter are the main determinants of the historical risk premium. However, this result hides the complex realities of different sub-periods. Finally, we study the structural changes introduced by the monetary policy using a structural VAR model and impulse-response function.

RÉSUMÉ

L'objectif de cet article est d'étudier les déterminants de la prime de risque immobilière pour le marché de Londres entre le T2 2002 et le T3 2015, en utilisant un modèle vecteur autorégressif (VAR). Nous mettons également en perspective le rôle des banques centrales dans la variation de la prime de risque, suite à la mise en place des politiques monétaires non conventionnelles depuis la crise financière de 2007. Théoriquement le lien entre l'offre de monnaie et le marché immobilier peut être analysé grâce à un modèle IS/LM pour une économie ouverte, avec des taux de change flexibles. Pour vérifier ces hypothèses, nous avons construit un indice monétaire adapté au marché des bureaux. Sur toute la période (2002 à 2015), le taux de vacance, l'emploi dans les services, le FTSE 100, l'indice monétaire et le terme autorégressif sont les principaux déterminants de la prime de risque. Cependant, ce résultat global cache une réalité complexe sur les différentes sous-périodes. Nous avons enfin analysé les changements structurels introduits par les politiques monétaires grâce à un modèle VAR structurel et aux fonctions d'impulsion de réponse.

1 Introduction

Our aim in this study is to analyse the dynamics of the direct Central London office market risk premium and its most relevant determinants from 2002 to 2015, giving special attention to the changes in the money supply. We therefore suggest a specific international monetary index as a determinant of the real estate risk premium. Although the Central London office market is one of the most analysed office markets in the real estate economics literature, as reported by Hendershott, Lizieri and MacGregor (2010), our understanding of its mechanism is still fragmented and requires deeper investigation, especially after the global financial crisis (GFC). One of the main drawbacks of the Central London office market is the availability of data and its high volatility. In this study, we are able to use a private database of high quality that provides an exhaustive description of the occupier market and of the investment market in London.

A growing amount of literature has been devoted to the London office market modelling, focusing on the main determinants and potential risk factors. Wheaton, Torto and Evans (1997) highlight the importance of the role played by employment in the cyclicity of the office market. Hendershott, Lizieri and Matysiak (1999) report the relative importance of employment and interest rate fluctuations. Similarly, Hendershott, MacGregor and Tse (2002) confirm the crucial role of employment. Rent dynamics are also a point of interest - for instance, with Hendershott et al. (2010). Lizieri (2009) developed a model in which employment, interest rates and inflation can explain the rent levels in the London City office market. Moreover, some authors (e.g., Wheaton et al. (1997), Farelly and Sanderson (2005), Hendershott et al. (2010) and Lizieri (2009), among others) shed light on the persistence of real estate cycles. The recent article by Lizieri and Pain (2014) should also be mentioned. Analysing the relationship between the production of financial space and systemic risk, they highlighted the crucial role of the London City office market in the diffusion process during

the GFC.

The global determinants of office returns have been largely analysed in the real estate economics literature, as reported by Sivitanidou and Sivitanides (1999), Hendershott et al. (1999), De Wit and Van Dijk (2003) and Hendershott and MacGregor (2005), among others. These articles underline the fact that the supply and demand relationships are related to variables such as construction, absorption, vacancies, rents, employment growth and real interest rates.¹ However, with the recent rise of unconventional monetary policies, it is important to study the impact of the abundance of available money on the real estate market (Appendix A). Indeed, the increase of the money supply implies a rise in the spending power, with a drop in interest rates, creating more capital available for investments.²

Since the seminal study led by Friedman and Schwartz (1963), the impact of monetary policies has been extensively analysed in the economic literature. Following Lucas (1972) or Tobin (1977) (among many others), the deep analysis of the process by which the monetary policies are transmitted into economic changes has been one of the main topics in the economic debates (Ramey 2016). For instance, Bernanke and Kuttner (2005) focused on the stock market's reaction to Federal Reserve policy. They reported that *"the effects of unanticipated monetary policy actions on expected excess returns account for the largest part of the response of stock prices"*. Mishkin (2007) highlighted the important role of the real estate market and especially the housing market in the monetary transmission mechanism. Taylor (2007) indicates that there is a link between the Federal Reserve System's adoption of an accommodative policy between 2002 and 2004 and the housing

¹However, these variables are acknowledged to exhibit endogeneity biases. In this context, there is a need to use a robust econometric method that includes simultaneous equations: the seminal VAR modelling introduced by Sims (1980) is a good candidate.

²Money supply is defined as the total amount of monetary assets and other liquid instruments circulating in a country at a particular time.

bubble in the US. Johnson (2000), Bredin, O'Reilly and Stevenson (2011), as well as Anderson, Boney and Guirguis (2012) (among others), reported that real estate investment trusts (REITs) followed the same pattern as other financial assets regarding monetary policy rate changes. Nevertheless, the GFC in 2008 introduced a breakdown in the monetary policies. 'Quantitative easing' (QE), also known as 'large-scale assets purchases' (LSAPs), is defined as *"an expansionary monetary policy whereby a central bank buys predetermined amounts of government bonds or other financial assets in order to stimulate the economy"* and is qualified as an unconventional monetary policy.³ QE has generated a growing amount of literature focusing on the role of real estate markets in the transmission mechanism of money supply (Joyce et al. (2012), Feroli et al. (2012), Gabriel and Lutz (2014), Chiang et al. (2015), etc.). This monetary policy breakdown, followed by the so-called 'currency war of 2009-2011', gives us the opportunity to shed new light on the real estate risk premium in the London office market, introducing a specific monetary index as a determinant, and to use this market as a case study for the effects of monetary policies. We therefore follow Rozeff (1974), who introduced monetary variables to analyse the impact of money supply on stock prices, and we develop this approach to apply to the real estate office market.

The link between the monetary policy and the London office market dynamic may be described in a simple IS/LM Mundell-Fleming framework for a small open economy with flexible exchange rates.⁴ The Mundell-Fleming framework is an extension of the IS-LM model and is used to study the relationship between an economy's interest rate, nominal exchange rate and national output. The general equilibrium is obtained by combining the simultaneous equilibrium in all the markets: the interest, the assets (goods and services) and the exchange rate. Thus, the total output of an

³"What is quantitative easing?" Bank of England. Retrieved December 14, 2016.

⁴As reminded by S. Fisher in his lecture at the IMF, the Mundell-Fleming framework is still one of the best theoretical frameworks to analyse capital mobility and stabilization under flexible exchange rates.

economy is related to a change on both interest and exchange rates. A change in money supply will create a distortion in the interest rates equation (the local and the global interest rates will not be equal anymore), implying an adjustment of the real exchange rate and of the assets market until local and global interest rates are equal again. A change in the global interest rate will have an impact on the capital flows, the local currency and the net exports with an adjustment of the local interest rate. Finally, the model shows that, in case of a positive change in government expenditure, the flexible exchange rate will offset the effect on the national output, with a capital flight towards foreign economies.

Here, we may consider a relationship between the London office supply (used as the output Y), the exchange rate and the interest rate: an increase of the Bank of England money supply (or an LSAP) shifts the LM curve to the right. This induces a decline of local (domestic) interest rates relative to global (foreign) interest rates. Capital outflow increases, leading to an increase of the real exchange (depreciation of the GBP, *ceteris paribus*). Ultimately, it shifts the IS curve to the right until local interest rates equal global interest rates (assuming horizontal balance of payments). Also acknowledged in the real estate economic literature, we may mention that the short-term office market supply is inelastic: with an increase of money supply, the stock will not be adjusted in the short/medium term, leading to a rise of the office prices (and thus an increase in the real estate risk premium).⁵ Due to the depreciation of the local currency and the relative appreciation of the foreign currency, we should expect a capital inflow from the global economy relative to the local economy and consequently, a change in the identity of investors. Local real estate is cheaper for foreign investors, and we should also observe an arbitrage in asset markets: real estate offers higher

⁵A decrease in the money supply will cause the exact opposite process, *ceteris paribus*. It would be possible to develop a formal model of this mechanism for the office market, with short-term inelastic supply, sticky prices and imperfect capital mobility. Nevertheless, our purpose here is more empirical through the introduction of the monetary index in VAR and SVAR modellings.

returns compared to bonds and shares, *ceteris paribus*.⁶ Here, we suggest a specific and dynamic monetary index to assess this money supply variation.

Our methodological contribution is twofold. First, in order to take into account the international dimension of the London market and its evolutions, we introduce and compute a dynamic specific composite monetary index. Second, in order to analyse the potential determinant candidates of the direct office risk premium dynamic, we suggest the use of structural VAR (SVAR) modelling. The SVAR model highlights the potential contribution of the index during a volatile and crisis period, marked by relevant breaking points in the monetary policy.⁷

At first sight, the monetary index and the interest rates series appear to offer significant explanations of the London premium throughout the period (2002 to 2015), but this hides a very different reality. Indeed, before the GFC, neither the rates nor the index were significant. The main determinant is exogenous and involves the Olympic Games effect. During the GFC and after 2009, our monetary index is strongly significant, contrary to the interest rates. The office market reacts to the monetary policies through an upward adjustment of prices during the QE period. The structural model exhibits the same kind of results when we consider an unexpected monetary shock on the economy. Office prices face a more important adjustment during an unexpected monetary shock than during a shock on interest rates.

The paper proceeds as follows. Section 2 describes our theoretical framework. It explains our methodology and how we extend the previous literature on the subject. Section 3 is devoted to the presentation of the model and of the data. Section 4 presents the empirical results that show the relevance

⁶This mechanism could be described in the theoretical IS/LM framework developed by Blanchard (1981).

⁷The effects of monetary shocks, defined as an unanticipated deviation in a central bank's policy (Campbell et al., 2012; Wright, 2012; and Nakamura and Sternson, 2015), may be relevantly analyzed within a structural vector autoregression (SVAR) framework, as suggested by Barsky and Sims (2011), Francis et al. (2014) and Ben Zeev and Khan (2015).

of our dynamic composite monetary index. Section 5 is the conclusion.

2 Theoretical framework and stylized facts.

2.1 Real estate risk premium

Also acknowledged in the literature, the real estate risk premium is defined as the difference between the property total return and a non-risky asset (usually the national 10-year bond).⁸ The total return is divided into two components: the income return and the capital growth. The first is the net income received by the owner, expressed as a percentage of the invested capital.

$$\text{Income Return} = \frac{N_t}{CV_{t-1}}$$

The capital growth is the percentage of variation between the capital value at the end of the period and the amount originally invested.

$$\text{Capital Growth} = \frac{CV_t}{CV_{t-1}} - 1$$

Thus:

$$\text{Total Return} = \frac{N_t}{CV_{t-1}} + \frac{CV_t}{CV_{t-1}} - 1, \quad (2.1)$$

with N_t the net income received at time t , and CV_t the capital value at time t .

In the professional literature, it may happen that the risk premium is reduced to the yield gap; that is, a simple difference between the income return and the risk-free rate, omitting the capital growth. This simplification is problematic. According to historical values, the average total return⁹ is indeed mainly directed by the capital growth (Figure 2.1), and we can suspect that the

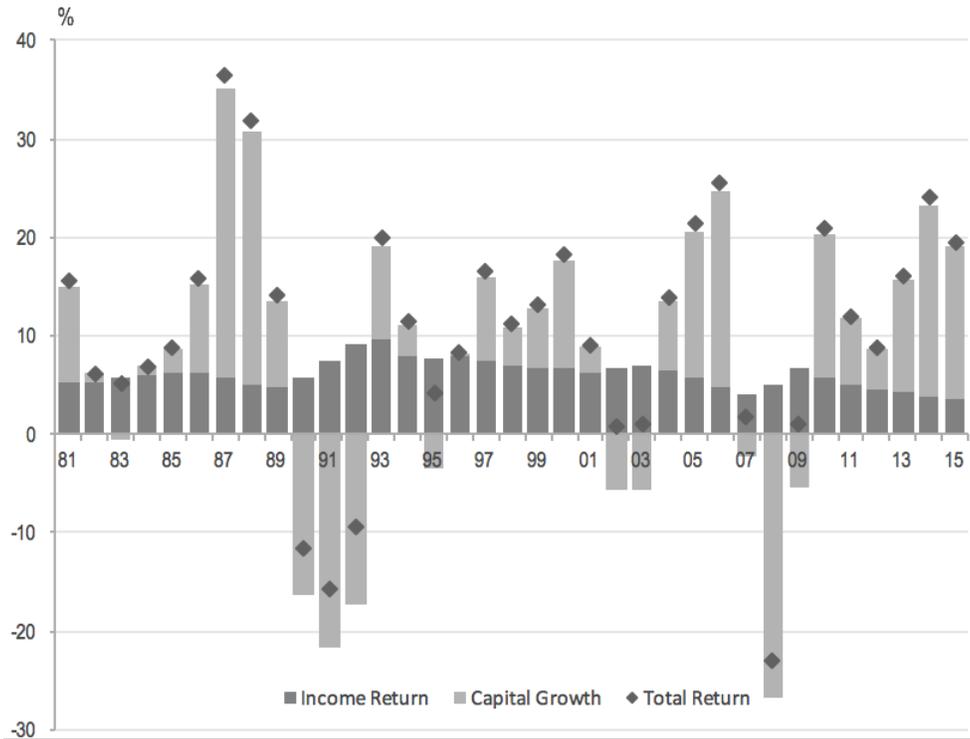
⁸See, for example, Young, Geltner, McIntosh and Poutasse (1995), Geltner and Miller (2007), Brueggeman and Fisher (2015).

⁹In this study we consider the entire market of London, with no distinction between the different segments of

informational content of the yield gap is poor.

Figure 2.1: Decomposition of the historical total return in Central London: 1981-2015.

Source: BNP Paribas Real Estate



Notes: The total return is the sum of income return and capital growth. The income return is the net income received by the owner, expressed as a percentage of the invested capital. Capital growth is the percentage of variation between the capital value at the end of the period and the amount originally invested.

During the first cycle (from 1987 to 1993), the capital value jumped during the first three years.

When the investment volumes dropped due to global uncertainties, prices collapsed, causing a negative total return during those three years. The second real estate cycle ended in 2002 with a crisis

in the occupier market due to the dot-com crash. Following the crisis and the collapse of major commercial real estate investments. These segments are defined as Core, Value Add and Opportunistic strategies. The Core is the least risky investment strategy, with fully leased and secure class A building in major markets. Value Add are investments with medium risk/medium returns and involved mispositioned properties requiring improvement. Opportunistic investments are the riskiest and relate to building that need a high degree of refurbishment in order to realize their potential.

companies, the vacancy rate in London jumped from 4% to 12.3%, and the capital value decreased. After 2004, the market experienced three years of record highs with important investments, strong demand, high prices and high rents. With the subprime crisis, the prime capital value dropped between 2007 and 2009 by 42%.¹⁰ However, as we can see in Figure 2.1, despite the global economic downturn, the capital return was strongly negative just for one year, before quickly recovering. Trying to reduce the effect of the GFC, central banks decided to adopt non-conventional monetary policies. In this context, the London market reached a historical peak in 2016 at 49 272 euros per square meter.

2.2 The London office market: some stylized facts

An office market strongly related to financialization and globalization

Since the early 80's, the office market in London has been growing, and its stock value can be estimated at approximately 270 billion in pounds sterling. According to the Global Financial Centers Index, London was the first financial centre in 2016, before New York and far ahead of its main competitors in Europe (Zürich: 9th rank; Frankfurt: 19th rank). This market is characterized by two main aspects: globalization and finance. Since the nineteenth century, London has been qualified as a global city, with a growing importance in terms of international financial services, especially since the mid-80s and the so-called 'Big bang'. According to Sassen (2006) (reported in Lecomte 2012), a global city is *"a strategic site for the management of the global economy and the production of the most advanced services and financial operations"*, and the London office market satisfies these conditions. As an illustration, and according to TheCityUK, London is the first OTC (Over the

¹⁰The prime capital value is the price per square meter for an office unit of standard size, of the highest quality and specification and in the best location of the market.

Counter) market for derivatives, the first exchange rates market (with a volume of 37% of world transactions in 2016, more than the added volumes of New York and Tokyo). London is also in second place for asset management and in first place for foreign investors. The London Stock Exchange (LSE) reports the highest number of cross-listed firms, and the insurance industry sector is the first in Europe and second in the world. According to Hendershott, Lizieri and MacGregor (2010), financial employment represented 73% of total employment in the City of London in 2006. It is informative to link this percentage with the statistic reported by Lizieri (2009), who observed that more than 85% of real estate space in the City was occupied by financial and professional services in the same year.

A few elements of the London urban policy

Important urban topics must be reported. Thornley (2015) argues that, in a long-term perspective, three stages have to be considered for London. The first one is associated with the dismantling of the Greater London Council in 1986, a structure in charge of the metropolitan government, resulting in planning fragmentation. Then, in the 1990s, growing concerns about the competitive position of London led to a new recentralization. The central government and the private sector became indeed increasingly involved in the promotion and the maintaining of London as a 'world city', the aim of which was to attract international investments. The third stage consisted of organizing a competitive approach to urban regeneration for the funding of projects. On a smaller scale, the Corporation of London (the authority that runs the City) simultaneously launched an institutional reform in the early 2000s to reinvent itself and to market its identity (Kaika, 2010).

The application for the Olympic Games in 2003 and its approval in 2005 must also be mentioned as having a crucial role in this strategy. Vijay (2015) documents, for instance, the rhetoric about

ruins and regeneration developed by planners and officials during the application and its link to the costly developments and the infrastructural changes undertaken thereafter.

These institutional and strategic evolutions helped London to become an emblematic example of a global city (Marchal and Stébé, 2011), as previously mentioned. It went with numerous high rises and architecture projects to rebrand London in the global economy. Appert and Montes (2015) point out that the towers are indeed one of the most striking markers of the contemporaneous metropolization. They also report that more than 50 new towers have already transformed the London skyline since 2000. Following those developments, new territorializations occurred in the old or new business districts from the global companies, and in the central residential districts from the middle and upper classes with the well-known gentrification. This led to Davidson and Lees (2005) arguing that it could be a return in London of the urban model, where centrality is reserved for highly qualified inhabitants. These changes also went with urban planning conflicts, for instance in the northeast of the city (Appert and Drozd, 2010), or about specific buildings, such as the Shard (Appert and Waine, 2011).

Changes of the investors' nationalities

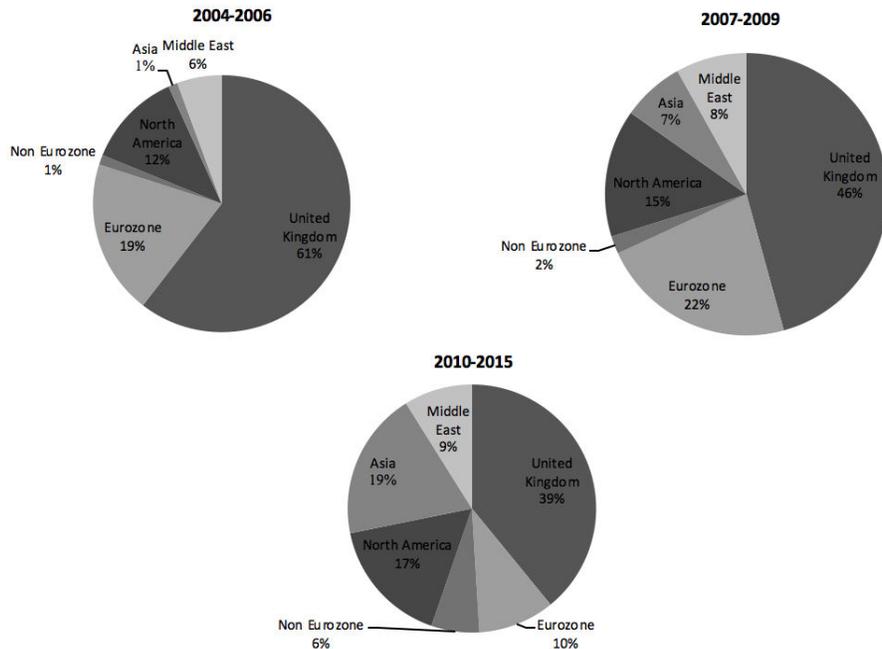
From 2004 to 2006, national investments were the main drivers, making up almost 60% of total investments. After 2007, the percentage of foreign investors strongly increased as a potential consequence of the depreciation of the GBP relative to other currencies (see Appendix B). This induced an outflow of capital from the UK and an increase of exports for London offices. The national withdrawal may also be explained by the variations in the monetary policies of the Bank of England and of the global economy, inducing the emergence of new investors. An increase of money supply and the use of QE in an economic situation with lower interest rates in the UK compared to the

global economy would have caused this phenomenon of capital outflows and inflows (as described in the Mundell-Fleming framework).

Since 2010, national investments represented only 35% of total investments, and the share of the Eurozone investors was just half as large as it had previously been. Indeed, before 2007, Irish investors were the most important foreign investors in the London market.¹¹ Due to the economic downturn, the share of Ireland fell almost to zero, decreasing the total contribution of the Eurozone.

Figure 2.2: Share of foreign investors in the Central London across time: 2004-2015.

Source: BNP Paribas Real Estate



The shares of Middle Eastern and East Asian investors sharply increased after the economic crisis. However, while some countries in Middle East amplified their positions (Qatar and Kuwait),

¹¹Fiscal incentives may explain this point. Before the GFC, Dublin was often seen as a branch of the LSE.

others sharply decreased their investments (Saudi Arabia and United Arab Emirates).¹² For East Asian countries, investments started mostly in 2010, and their share in the total investment volume has continuously grown since then. Nowadays, the share of East Asian investors is around 10%, mostly from China. This can be explained by the boom of the money supply and the strong revaluation of the yuan.¹³

2.3 Money and real estate prices

Introduced by Rozeff (1974), and then developed by Patelis (1997), Thorbecke (1997) and more recently by Bernanke and Kuttner (2005) or Mishkin (2007), a growing literature has focused on the link between money supply and stock prices. If some recent but rare macroeconomics studies have shed light on the impact of money supply (and QE) on the housing and real estate markets (including Iacovello, 2015; Gabriel and Lutz, 2014 or Chiang et al., 2015), they essentially have adopted a US housing and financial perspective (REITs, as securitized real estate, are often used as a proxy for direct real estate). The relationship between money supply and the direct property market requires a specific approach due to the inelasticity of the real estate supply (Geltner et al., 2007), especially for real estate offices. Indeed, the stock cannot be quickly adjusted in case of a demand shock, and only prices are affected.

To briefly analyse the diffusion of a money supply shock in this international context, we suggest the use of a simplified Mundell-Fleming framework where capital mobility and stability under flexible exchange rates could be highlighted.¹⁴ As a short reminder, we have reported in Appendix C the

¹²This withdrawal could be explained by geopolitical evolutions.

¹³As the yuan became stronger in 2009, Chinese investors had a benefit compared to their previous situation with an increase of their spending power.

¹⁴See the seminal work of Fleming (1962) and Mundell (1963). Our purpose is based on the observation of stylized facts and we adopt an empirical approach with VAR and SVAR modelling. A next step, not developed here, would

well-known equations introduced by Mundell (1963) in his fundamental article to illustrate our purpose.

Another point also deserves to be mentioned: the regulations imposed on the banking sector and on the insurance companies (the Basel Accords or the Solvency Directive) require less regulatory capital for real estate investment than for stocks or derivatives. These elements contribute to reinforce the competitiveness of real estate investment. A 2017 survey published by the INREV association corroborates that point, showing that institutional investors continue to increase the real estate allocations in their portfolios.¹⁵

Moreover, as money is continuously injected, the economy should be stimulated and the demand for real estate space in the core market should also increase.¹⁶ This implies that new real estate projects will be launched and that supply will adjust only after a while. Thus, as demand increases, prices would tend to inflate with an inelastic supply (Geltner et al., 2001).

The constant increase in the money supply over the past several years may have had an impact on the real estate market, from both the demand and the supply side of the main markets. However, this effect is not well documented yet. As argued by Feldstein (2011), QE2 led to a rise in the stock market in the United States. Here we report and document that it also led to a price increase in the office market for the UK.

be to consider more formally an IRBC framework.

¹⁵The INREV is the European Association for Investors in Non-Listed Real Estate Vehicles

¹⁶The core market should be more impacted than the secondary market. Indeed, as investments in direct real estate are long (10 years on average), investors prefer to have a good knowledge of the market to decrease the risk.

2.4 A monetary index for international real estate investments

As countries have different definitions of broad money, a simple sum of monetary aggregates would under-represent countries that have narrow definitions of M2.¹⁷ The aim of the monetary index (MI) is to study the effect of the international money supply on the London office market using an appropriate aggregation. Beyer, Doornik and Hendry (2001) developed an aggregation method to reconstruct historical data of the Eurozone for the monetary aggregate M3, GDP and prices over two decades. Since then, this method has been widely used in literature (Giese and Tuxen, 2008 and Belke, Orth and Setzer, 2010) to aggregate data - such as GDP, monetary stocks and interest rates - using national series. Starting from this methodology, we adapted it for international real estate investments. It has three stages:

- Calculating the weights of the investment volume in the London office market according to various nationalities.
- Computing the growth rates of M2 lags of three periods, measured in local currency (here GBP).¹⁸
- Aggregating the growth rate using the weights of the first step.

More formally, we have:

$$MI_t = 100 \prod_{t=1}^T \left[1 + \sum_{t=1}^T \left(\frac{Inv_{n,t}}{\sum_{n=1}^N Inv_{n,t}} \right) \times \left(\frac{M2_{n,t-k} \times e_{t-k}}{M2_{n,t-k-1} \times e_{t-k-1}} - 1 \right) \right], \quad (2.2)$$

where $Inv_{n,t}$ is the invested volume from a country n at time t , $M2_{n,t}$ is the monetary aggregate of the country n , k is a time lag, and e_t is the exchange rate.

We consider that investment volume at period t is defined by the money supply of period t , lagged by several periods, due to real estate illiquidity and the length of the investment process (between 3.5

¹⁷M2 is a money aggregate that measures the money supply. This is generally the sum of currency and coins, demand deposits, money markets and savings deposits.

¹⁸Moreover, to determine the real investment capacity of foreign investors in the London office market, the monetary stock should be expressed in local currency.

and 5 months for the execution, according to Devaney and Scofield (2014), plus the period between the change in monetary policy and the investment decision). This illiquid aspect of commercial real estate has been well documented by, for instance, Geltner et al. (2001).¹⁹

This MI could be used in a money portfolio framework as introduced by Rozeff (1974). The growth rate of the money supply (or variation of money supply) would be seen as a candidate risk factor to explain the variation in the real estate risk premium in the London office market.

In a two-factor asset pricing model framework, with market risk premium (here FTSE index) and the money supply factor (MI) as risk factors, the path to equilibrium could be explained by an adjustment of the money supply factor, *ceteris paribus*. Using the standard linear asset pricing model theoretical framework (including the arbitrage pricing theory), an increase in money supply will induce an undervaluation of real estate with a return to equilibrium by a price increase of the real estate asset. As reported by the Mundell-Fleming framework developed in Appendix C, the MI is designed to capture the consequences of the international financial flows following money supply shocks.

3 Model and Data

3.1 VAR model

To model the risk premium, we will first use a vector autoregression (VAR) model. A VAR is a stochastic process model that allow the study of the linear interdependencies among several time series. A VAR(p) with k endogenous variables is a system of k equations of identical structure with p lags. For each equation, the endogenous variable is regressed on its own lagged value, the lagged

¹⁹Geltner et al. (2001) developed a kinked supply function in which supply is inelastic until rents are equal to the replacement costs.

values of the other variables and an error term. The large set of available variables implies that we need to realize an appropriate selection before estimating the office risk premium. This choice is based on previous literature and also on the multicollinearity issue.

For the sectorial variables, we will retain the vacancy rate and the Prime rental value. The vacancy rate is the ratio between the immediately available supply and the existing stock.²⁰ It is a proxy for market liquidity and for the risk faced by investors (D'Argensio and Laurin, 2009). The Prime rent is the top headline rent for an office unit of standard size but of the highest quality and specifications and in the best location within its market.

For the economic variables, we choose the London workforce jobs in services and the FTSE 100 closing price. The first variable is a key factor for Greater London economic activities, mainly based on financial services. It has already been widely used as a proxy for the space demand in the office market (De Wit and Van Dijk, 2003). Regarding the FTSE 100, it is a proxy for activity in the UK at a larger scale. Moreover, as financial industries are very important in London, this factor should also be correlated to the rents variations. These financial companies are indeed the renters of the offices (Sivitadinou and Sivitadines, 1999).

More formally, the first VAR equation that we will run is:

$$\Delta RP_t = \beta_0 + \beta_1 \Delta RP_{t-1} + \beta_2 \Delta \ln(PR_{t-1}) + \beta_3 \Delta \ln(EM_{t-1}) + \beta_4 \Delta \ln(FTSE_{t-1}) + \beta_5 \Delta \ln(VR_{t-1}) + \epsilon_t, \quad (2.3)$$

where Δ denotes the first difference operator, β_0 is a constant, RP_t refers to the risk premium of the London market at time t , PR_t refers to the Prime rent, EM_t refers to the employment in services,

²⁰We do not consider new future supply that has not been pre-let and/or second-hand supply that will be vacated definitively (notably terminated leases)

FTSE_t refers to the closing price of the FTSE 100 and VR_t refers to the vacancy rate. The logarithm transformation is used to reduce the effect of outliers in the time series.²¹

The risk premium is computed using appraisal-based indices and the 10-year UK government bond. The real estate literature thoroughly documents the fact that appraisers use past market values to estimate current valuations, underestimating price volatility; this is known as the 'tyranny of past values' (Firstenberg, Ross and Zisler, 1988; Quan and Quigley, 1989, 1991 and Drouhin and Simon, 2014). Appraisal techniques also introduce some temporal autocorrelation in the indices. For example, in the case of a market downturn, appraisers do not immediately include the price drop in their estimations. A reasonable method for capturing this smoothing issue is the use of an autoregressive model (Geltner, 1989 and Brown and Matysiak, 1998). Thus, the choice of a VAR model controls for this drawback.

After estimating this initial equation, we will add the monetary index to determine the effect of the monetary policies on the risk premium for different periods. As an alternative measure, we will also test the interbank rate (LIBOR).

$$\Delta RP_t = \beta_0 + \beta_1 \Delta RP_{t-1} + \beta_2 \Delta \ln(PR_{t-1}) + \beta_3 \Delta \ln(EM_{t-1}) + \beta_4 \Delta \ln(FTSE_{t-1}) + \beta_5 \Delta \ln(VR_{t-1}) + \beta_6 \Delta \ln(MI_{t-1}) + \epsilon_t \quad (2.4)$$

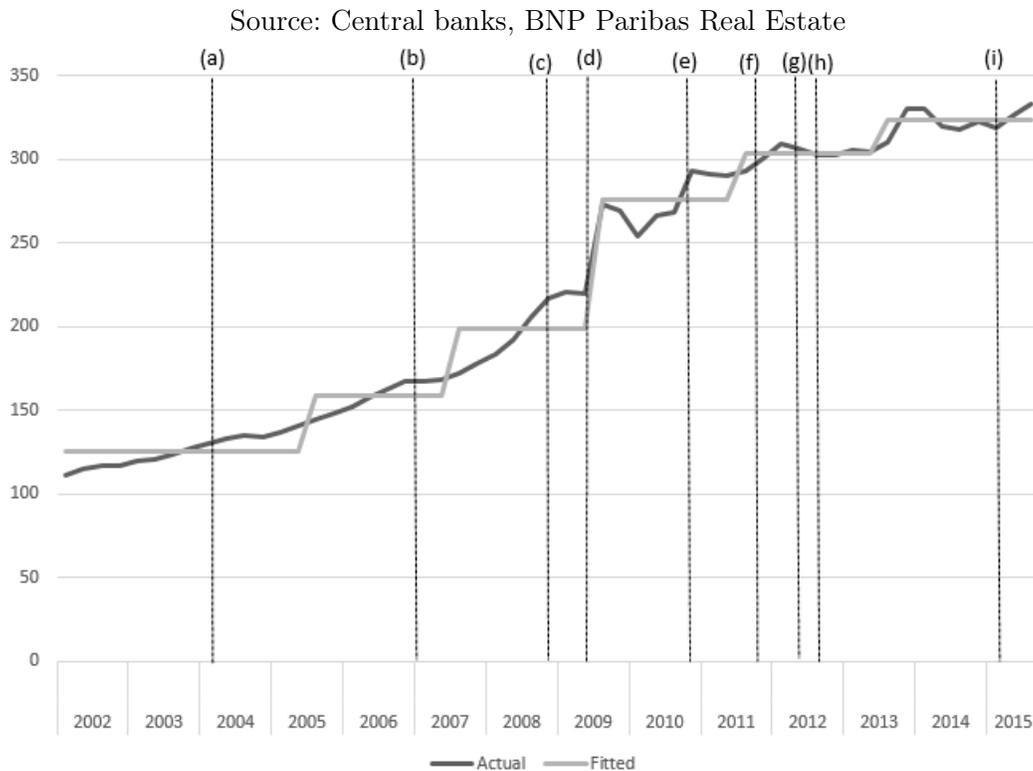
It is interesting to remark that the Bai and Perron test (1998, 2003), when applied to the monetary index, indicates several structural breakpoints.²² The results show five breaks between 2002-Q2 and 2015-Q3 (Figure 2.3). These dates (2005-Q3, 2007-Q3, 2009-Q3, 2011-Q3 and 2013-Q4) can be

²¹The coefficients are directly interpretable as differences of percentage changes

²²We have estimated a simple regression model with only one constant regressor, and we used a multiple breakpoint test (Bai and Perron, 2003).

interpreted in relation to main monetary events. The first one in 2005-Q3 can be put in relation to the tightening of the major central banks' monetary policies. Indeed, the US policy rate was below its theoretical rate from 2002 until the end of 2005 (Taylor, 2007), creating an excess of liquidity in the market. The second is related to the subprime crisis that started in mid-2007, whereas for 2009-Q3, 2011-Q3 and 2013-Q4, these structural breaks could be put in relation to the quantitative easing programs and the launch of three waves of LSAP by the Fed and by the Bank of England since December 2008.

Figure 2.3: Breakpoints of the monetary index according to the Bai-Perron test: 2002-2005.



Notes: (a) Central banks begin to tighten their policy rates; (b) Beginning of the GFC; (c) Fed announces QE1; (d) Bank of England announces QE1; (e) Fed announces QE2; (f) BoE announces QE3; (g) Fed announces QE3; (h) BoE announces QE3; (i) ECB announces QE. Sources: Bank of England and BNP Paribas Real Estate

3.2 Structural VAR

In a similar situation with such structural changes, a structural VAR (SVAR) is more appropriate. It allows for controlling these changes and also for imposing conditions on the coefficients based on economic theory.

A SVAR can be written as:

$$Ay_t = A_1^*y_t + \dots + A_p^*y_{t-p} + B\epsilon_t, \quad (2.5)$$

where y_t is a vector of variables and ϵ_t are unanticipated shocks.

The idea consists of imposing some restrictions on the reduced form model using the A matrix. The restrictions must be consistent with the economic argument (Blanchard and Quah, 1989). We suppose the following relationship among the variables (zeros above the matrix are suppressed):

$$Ay_t = \begin{bmatrix} 1 & & & & & & \\ \beta_{21} & 1 & & & & & \\ \beta_{31} & \beta_{32} & 1 & & & & \\ 0 & 0 & \beta_{43} & 1 & & & \\ 0 & \beta_{52} & 0 & \beta_{54} & 1 & & \\ \beta_{61} & \beta_{62} & \beta_{63} & \beta_{64} & \beta_{65} & 1 & \end{bmatrix} \begin{bmatrix} MI_t \\ FTSE_t \\ EM_t \\ VR_t \\ PR_t \\ RP_t \end{bmatrix} \quad (2.6)$$

We assume that the first two variables are exogenous and are not determined by the sectorial variables of the model. We consider that the closing price of the FTSE 100 can depend on the MI due to the close relationship between the available money and the stock market. Employment can depend on both the monetary index and the UK stock market index, reflecting that levels of employment can depend on financial activity, especially for London. It is straightforward to consider the vacancy rate as dependent on the employment level and that prime rent is supposed to adjust to both the employment level and the FTSE 100. The biggest firms are indeed the ones that are

willing to pay for prime rent. Finally, the risk premium depends contemporaneously on all of the variables in the system.

Once the relationships are estimated, it is possible to generate impulse response functions (IRFs), which describe how the model reacts to a shock, defined as an unanticipated and exogenous deviation of one variable, across time.

After an exogenous shock on the variable MI that occurs at time t , the impulse response function of variable j at time $t + h$ is:

$$\frac{\delta y_{j,t+h}}{\delta \epsilon_{i,t}} = C_{j,h} \quad (2.7)$$

The value $C_{j,h}$ represents the consequences of an unanticipated shock, defined as a unit increase in ϵ_t on each variable j at a given date $(t+h)$.

3.3 Data

The database we use is unique and includes three types of quarterly data for the period from 2002-Q1 to 2015-Q3. The first type of data is provided by BNP Paribas Real Estate and includes real estate variables in the London market. These private data are about the main fundamentals of the London office market and are almost exhaustive. Exclusive information on the nationality of the real estate investors is also available. The second type is related to property performance variables retrieved from Morgan Stanley Capital International (MSCI), which include investment returns for the London office market. The third consists of a set of macroeconomic data provided by the various central banks for the monetary aggregates, the London Stock Exchange for data on the FTSE 100 and the National Office of Statistics for employment in services data.

Table 1. Descriptive statistics of the variables in Central London: 2002-2015.

	Monetary Index	FTSE 100	Employment	Vacancy Rate	Prime Rent	Risk Premium	Libor 3-month
	Index=100 (2001-Q1)		In thousand	%	£	pp	%
Mean	213.25	5507.26	4474.566	7.61	996.36	6.38	2.96
Median	191.76	5549.06	4431.345	7.38	969	9.37	3.8
Maximum	332.54	6920.16	5190.887	11.65	1399	24.44	6.35
Minimum	104.4	3695.69	4129.846	3.43	673	-31.47	0.5
Std Dev	81.84	862.65	307.4019	2.02	197.16	14.16	2.13
Skewness	0.13	-0.31	0.89927	0.15	0.21	-1.09	0.01
Kurtosis	1.36	2.09	2.770292	2.35	1.93	3.64	1.29

Notes: "pp" refers to Percentage Points. The sample is composed of 55 observations

Table 1 presents the main descriptive statistics. The standard deviations are reasonable compared to the average values. The most volatile variables is, as expected, the real estate risk premium which has extreme values and high standard deviations. The risk premium also has a negative skewness and a positive kurtosis, meaning that the series is influenced more by negative shocks and that there is a higher probability of extreme values. Sectorial variables exhibit smaller standard deviations compared to their respective averages.

4 Empirical Results

In this section, we discuss the VAR results for the whole period and for the various sub-periods. Then, we substitute the MI for the LIBOR to determine which series is the most informative for the risk premium - does it respond more to the rates or to the monetary aggregates? In the last subsection, we consider structural models with the SVAR approach.

The study period [2002-Q2; 2015-Q3] is first decomposed in three parts. [2002-Q2; 2006-Q4] corresponds to the pre-GFC period. We will see that it could be qualified as a bubble period for the London office market. The second period, [2007-Q1; 2010-Q1], corresponds to the GFC, while the

third one, [2009-Q1; 2015-Q3], is characterized by non-conventional monetary policies along with massive liquidity injections into the economies.²³ As we can see, the second interval intersects the third one. It is motivated by two reasons; to get enough observations to estimate the model on the various sub-periods, and because it is acceptable to consider that GFC still had effects during the year 2009. In section 4.3, another segmentation into two intervals is analysed. The first interval is [2002-Q2; 2008-Q4], which corresponds to the time period without any QE measures. The second is [2009-Q1; 2015-Q3], with the QE (the Fed launched its program in December 2008).

4.1 Optimal lag of the monetary index

In order to compute the MI (section 2.4), the investment volumes at a given period are multiplied by the money supply parts lagged by several periods because of market illiquidity. The length of the investment process may differ according to the market, the investor's nationality and the market state. London being one of the less illiquid real estate markets, transaction times should be shorter compared to other markets. However, the local nature of the asset implies that transactions realised by non-domestic investors should take more time than those realised by domestic investors. The market state is also important. When it is booming, the time needed to transact is shorter compared to downturn or recovery periods. Consequently, the optimal lag between investment volumes and the monetary supply must be statistically determined.

To select the optimal delay, the model is estimated with various lags. According to the results (Appendix D), two indexes are significant: the index with one lag and the index with three lags. However, the two indexes have opposite signs. According to the Mundell-Fleming theoretical framework (Appendix C), the monetary index should have a positive sign. Theoretically, an increase in

²³The Fed launched its QE program in December 2008, followed by the Bank of England during the first quarter of 2009 and finally the ECB during the first quarter of 2015.

the money supply available in the market should imply an increase in the investment volume and thus in the premium. Moreover, from a real estate point of view, as the market is highly illiquid and as the time to buy an asset is long, we should also consider a time-delay for the effects to be materialized. We retain a lag of three quarters.²⁴ This result is coherent with the average transaction and decision time in the London market.

4.2 Results for the whole period: relevance of the monetary index

For the whole period of 2002-Q2 to 2015-Q3, all of the variables are significant, except for the Prime rent. The autoregressive parameter is highly significant. This momentum is well known in real estate and commonly explained by two factors. As transactions take time (between 1 and 2 quarters for the London office market), real estate markets are quite slow to respond to a shock; hence, their price-discovering function is affected by inertia. The second explanation is related to the variable of interest. The MSCI index is indeed based on appraisal values, and as we saw before, appraisers are subject to past values tyranny, which introduces temporal autocorrelation in appraisers' valuations and thus into the index. The value of the autoregressive parameter is around 0.70, corresponding to the upper bound referenced in the literature. This suggests a great confidence of the appraisers in recent information (Brown and Matysiak, 1998 and Geltner et al., 2007).

The Prime rent is not significant for the whole period. This variable is a way to control for quality effects. An increase in building quality tends to induce an increase in the Prime rent. However, as we can see, the average quality evolutions did not matter during that period.

Employment level had a negative impact. An increase in employment growth implies an increase

²⁴The model using the index lagged by three periods has a greater explanatory power and has the expected signs. The negative impact of the monetary index constructed with one lag could be explained as a delayed effect: central banks may increase the money supply to support the real economy. As the real estate market is highly illiquid, the total return may be negative while the monetary index rises.

of the occupied space. This risk reduction lowers the premium for investors and is also a sign of economic growth. Moreover, in a context of inelastic supply, a rise of the employment growth is followed by an increase of the demand for office space, pushing the rental values and the income return up. However, these effects imply also a decrease of the capital growth and ultimately of the total return. De Wit and Van Dijk (2003) obtained similar results - specifically, a negative relationship between the employment level and real estate returns due to reduced uncertainty.

Table 2. Vector Autoregression results for the whole period and for sub-periods: 2002-2015.

	2002-Q2 to 2015-Q3		2002-Q2 to 2006-Q4		2007-Q1 to 2010-Q1		2002-Q2 to 2008-Q4		2009-Q1 to 2015-Q3					
RP	0.694 [8.68]	0.728 [9.75]	0.680 [8.77]	0.446 [1.37]	0.286 [0.93]	0.598 [3.13]	0.635 [4.09]	0.541 [2.84]	0.655 [4.52]	0.668 [4.62]	0.655 [4.56]	0.691 [6.72]	0.650 [5.80]	
PR	-11.14 [-1.22]	-13.94 [-1.64]	0.886 [0.08]	4.567 [0.39]	4.714 [0.45]	18.85 [0.60]	2.462 [0.09]	54.60 [1.29]	-9.481 [-0.77]	-13.06 [-1.04]	-2.824 [-0.21]	-10.94 [-0.63]	-16.55 [-1.08]	9.128 [0.43]
EM	-106.7 [-2.11]	-97.81 [-2.09]	-63.67 [-1.20]	-23.89 [-0.28]	32.45 [0.35]	-309.3 [-1.58]	-217.7 [-1.33]	-140.0 [-0.59]	-172.1 [-1.61]	-208.7 [-1.87]	-191.5 [-1.71]	-91.58 [-1.31]	-74.67 [-1.21]	-23.63 [-0.29]
FTSE	28.00 [3.80]	26.01 [3.80]	23.41 [3.14]	10.57 [1.56]	9.827 [1.51]	34.22 [1.49]	36.31 [1.96]	24.28 [1.02]	23.21 [2.30]	24.78 [2.45]	24.61 [2.45]	31.98 [2.56]	29.09 [2.62]	21.64 [1.56]
VR	15.30 [2.56]	11.10 [1.96]	13.70 [2.35]	-1.39 [-0.19]	-3.83 [-0.55]	40.10 [2.27]	28.10 [1.84]	40.38 [2.37]	11.53 [1.55]	8.536 [1.08]	11.98 [1.62]	19.48 [1.68]	11.52 [1.08]	11.97 [0.98]
MI		32.96 [3.04]		31.81 [0.92]			43.54 [2.18]			45.44 [1.10]			33.12 [2.64]	
Libor			-7.187 [-2.11]		16.54 [1.44]			-16.31 [-1.22]			-15.15 [-1.17]			-9.730 [-1.55]
C	0.533 [1.17]	-0.148 [-0.31]	0.020 [0.04]	-0.037 [-0.04]	0.526 [0.98]	0.564 [0.41]	-1.070 [-0.80]	-2.026 [-0.81]	0.228 [0.35]	-0.622 [-0.61]	0.387 [0.58]	0.971 [1.27]	0.249 [0.34]	-0.204 [-0.19]
R ²	0.73	0.78	0.76	0.62	0.65	0.88	0.93	0.9	0.69	0.7	0.7	0.75	0.81	0.78
Adj. R ²	0.70	0.75	0.72	0.47	0.51	0.80	0.87	0.81	0.61	0.61	0.62	0.69	0.76	0.71
AIC	5.11	4.96	5.05	4.02	3.97	6.17	5.74	6.11	5.07	5.08	5.08	5.44	5.21	5.4
LR	-131.9	-127	-129.4	-32.3	-31.6	-34.1	-30.3	-32.7	-62.5	-61.7	-61.6	-67.5	-63.4	-65.9

Notes: Table 2 reports regression results based on equation 3 and on equation 4 for the general time period. Variables are in log-difference (except for the risk premium in first-difference). RP refers to the risk premium, PR refers to the "prime" rent, EM refers to the employment level, FTSE refers to the FTSE 100, VR refers to the vacancy rate, MI refers to the monetary index, LIBOR refers to the Libor 3-month and C refers to the constant. The figures in bold are significant at the 5% level. AIC and LR are respectively the Akaike Information Criteria and the Likelihood Ratio. T-statistics are in brackets.

As expected, the FTSE 100 has a positive sign. Indeed, it is possible to consider that when the economy is pursuing a growth path, office prices do the same. This effect would be amplified for London, given the city's specialization in the financial industry.

The results for vacancy rate are as expected (Ho et al., 2015) and are classical. It has a positive effect on the risk premium: when the vacancy rate increases, the risk becomes higher and the premium required by investors also increases. An increase in the vacancy rate suggests a decrease in the income return; competition for space between renters becomes less intense, and the building prices also decrease.

At last, we examine the effect of the MI on the premium. The estimate is significant and positive. Here, it is difficult to consider the risk as being reinforced if the quantity of money available is greater. Consequently, it has to be interpreted as a price effect: if the money supply increases, real estate prices inflate, which has a positive effect on capital growth. This relationship was expected following the simple IS/LM Mundell-Fleming framework: if the money supply increases, the interest rate should go down (following a right shift of the LM curve) and the net export should also rise, with an increase of overseas investments. Offices become more attractive with lower interest rates and the investment volume should rise, such as prices due to the inelasticity of the asset. Moreover, due to a massive purchase of long-term government securities by central banks, the quantitative easing implies downward pressure on government bond yields. Thus, on the one hand, the real estate capital growth increases, and on the other hand, the risk-free rate decreases. The combination of the two phenomena increases the spread; in other words, the premium becomes higher.

This proposed index seems to be suitable for studying the effects of money supply on real estate dynamics. Its significance is strong, and the adjusted R^2 is 5% higher than that of the model without the index. In the next section, we deepen the analysis to better understand the link between money

supply and real estate dynamics as well as how it varies by context.

4.3 Results for the sub-periods: the GFC as a potential breakdown

The estimates for the three sub-periods exhibit strong differences. For the first period, all of the variables are non-significant - even the autoregressive parameter - and the adjusted R^2 is much lower.

At first glance, this result could appear puzzling. But it can be easily explained with an exogenous factor, namely the awarding of the Olympic Games for 2012. As mentioned above, London applied for the Olympics in 2003 and obtained it in 2005. An important urban redevelopment project went with the games. Thus, it is very acceptable to consider that investors' expectations were mainly driven by this factor during the first period and that classical variables were temporarily irrelevant.

The sectorial variables recover their coherency during the GFC: the autoregressive parameter is significant, there is no quality or prime rent effect and the vacancy rate positively impacts the risk premium. Regarding the global variables, neither employment nor the UK financial indexes are significant. Interestingly, when the monetary index is included, the FTSE100 becomes significant with the correct sign, whereas the LIBOR series does not produce such an effect. It is important to note that the monetary index maintains its explanatory power of the premium during the GFC's turmoil. During this period, national investments no longer represent the majority. Foreign investors and their respective monetary supplies start to lead the London office market (Figure 2.2).

The third period is related to QE policies, mainly in the US and UK. The autoregressive parameter is significant, but Prime rent is not. Surprisingly, the vacancy rate, one of the most important risks in a real estate investment, is no longer significant. Employment has no impact, whereas FTSE has a positive effect on the premium. The office market reacts to the monetary policies through the adjustment of the premium, more precisely through an upward price adjustment. During the QE

period, monetary policies produce effects on prices and on some of the fundamentals that drive the market (here, the vacancy rate).

These results are consistent with the economic theory and the IS/LM model. As we previously observed, the international money supply has been constantly rising since the beginning of the 2000s, which explains the inflow of investment on the London office market and the rise of capital values. Before the GFC, Central Banks were tightening their monetary policies (after several years of loose policy), less money was circulating in the economy. The market was driven by domestic investors, and international diversification was less common. The effect of the money supply was less important and did not have a great impact on net export or real estate prices. After the GFC, the story was different. Central banks have adopted unconventional monetary policies and increased the issuing of money. The increase in the money supply has induced a modification of the flows of funds: a net export of London offices. The availability of money is booming, increasing inflation and driving prices up.

4.4 How do real estate markets react differently to money supply and the 3-month Libor rate?

In the last fifteen years, the main tool of monetary policies shifted from short rates to QE around Q1-2009. We estimate the model based on the corresponding sub-periods of [Q2 2002; Q4 2008] and [Q1 2009; Q3 2015]. For this new segmentation, we compare the explaining power of the monetary index and that of the interest rate series.

Both series are significant throughout the whole period. However, if we consider the three sub-periods of the segmentation (cf. section 4.3), the risk-free rate loses its explanatory power at all sub-intervals, whereas the index keeps its significance for several sub-periods. Also, except for the

Olympic Games awarding period of [Q2 2002; Q4 2006], the model with the monetary index is much better and exhibits greater explanatory power. In other words, the unconventional monetary policies seem to more strongly influence investment decisions in real estate than policies driven by rates, and the main influence seems to be price increases. Or, from an urban point of view, QE has played an important role in metropolization dynamics.

To better understand the effects of the shift in policies from conventional to unconventional, we use a new time period ranging from 2002-Q2 to 2008-Q4. The monetary index is not significant before the quantitative easing, but it becomes strongly significant thereafter, whereas the risk-free rate stays insignificant for both. The model using the interbank rate has slightly better explanatory power for the period before unconventional monetary policies. The London market was driven by national investors and by debt: investors were looking for speculative investments with high leveraged returns. Since the crisis, the market has become more driven by equity while investors are looking for long-term income with a buy-and-hold strategy. These results highlight the fact that the London office market has become significantly more sensitive to the monetary supply in recent years.

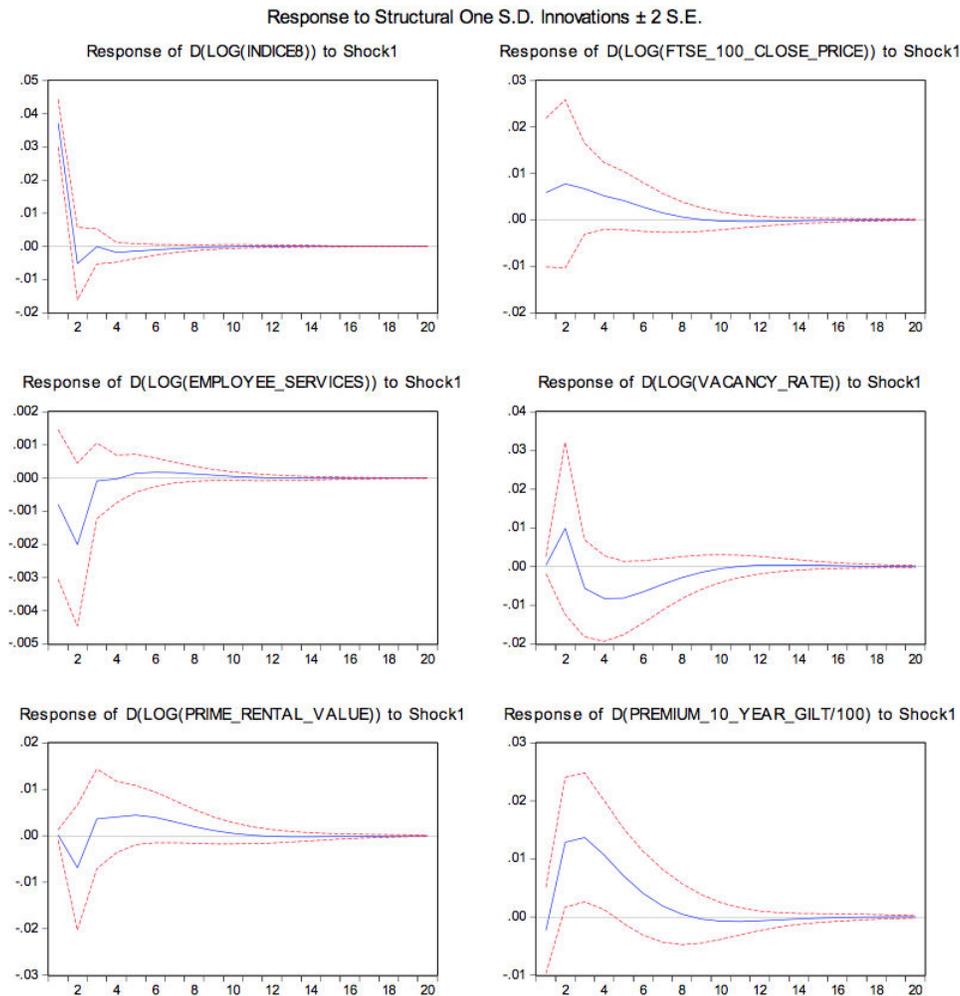
4.5 Responses to an unexpected monetary shock

Figure 2.4 shows the effects of a positive shock of one standard deviation of the monetary index on each variable. We obtain interpretations in terms of percentage changes by dividing the responses of the variables by the standard deviation of the index.

After the shock, the monetary index returns to its equilibrium. A 1% shock on the monetary index generates a peak of 0.2% (0.007/0.03) for the FTSE 100 closing price during the second period. The effect of employment services level is negative and reaches its maximum magnitude during the second period. Regarding sectorial variables, the shock has a positive effect on the vacancy rate but

a negative one on the Prime rental value. For the risk premium, there is first a negative effect; then the risk premium reaches a peak in the third period. With a 1% rise in the monetary index, the risk premium peaks in quarter three at approximately 0.3% (0.013/0.037). As previously mentioned, it is mostly a price effect. Interestingly, the premium is negative during the first period; the price adjustment is not immediate.

Figure 2.4: Impulse response functions following a shock in the monetary supply: 2002-2015.



Notes: The responses are represented by solid lines. The dashed lines show the 95% bootstrapped confidence intervals. The x-axis corresponds to the number of quarter following the shock.

Restricting the model to the quantitative easing sub-period produces different results for the financial variables (Appendix F, Figure 2.9). The effect of an unexpected shock on the monetary index implies a greater increase in the FTSE 100 (0.3%) and in the office risk premium (0.4%), illustrating the reinforced effect of the quantitative easing policy on the office risk premium. Here also, it is mostly a price effect: a monetary shock implies an increase in office prices.

The same model is used to study the effects of a conventional monetary policy based on rates by replacing the monetary index with the 3-month Libor for the full period (Appendix G, Figure 2.10). A shock in the interbank rate implies a negative response of the financial market index due to the tightening of monetary policy. As the interest rate increases, the total investment decreases, discouraging employment. The effect on the vacancy rate arises from the positive (negative) effect on employment along with an increase in occupied space. As expected, the Prime rent has the opposite reaction to the vacancy rate. Finally, a 1% change in the rate leads to a maximum decrease of 0.15% in the office risk premium. The results are stronger when using the monetary index compared to interest rates; unconventional monetary policies have a greater effect on the office market.

5 Conclusion

We used a vector autoregression model to investigate the determinants of the office risk premium for the Central London market and to obtain a better understanding of this elusive concept. The main goal was to determine and to discuss the role of central banks in the historical risk premium and to document the potential effects generated by unconventional monetary policies in recent years. Our empirical approach relies on the Mundell-Fleming model. The international IS/LM framework highlights and explains the net export of London offices following QE and the increase in money supply.

As expected, we find that, for the whole period, the autoregressive parameter, vacancy rate and closing price of the FTSE 100 were significant and had a positive effect on the risk premium, while employment level had a negative impact. Introducing a monetary index based on the nationality of the investors suggests that the global money supply had a significant positive impact on the historical office risk premium. The index allows dealing with the international characteristic of the London office market and with the inertia of the real estate market. Studying the same model for sub-periods helps to create a clearer understanding of the drivers of the historical risk premium. During the Olympic Games awarding period (2002-2006), a disconnection appeared between the London office market and its economic fundamentals. Thereafter, during the quantitative easing period (2009-2015), the office market reacted with upward pressure on prices, implying an increase in the historical premium. Although the fundamentals recovered their role after 2009, however, it is important from an urban perspective to emphasize that the vacancy rate - the main risk for real estate investors - is no longer significant. Finally, a structural VAR was used to study the effect of unexpected monetary policy changes. The results indicate that the response of the risk premium is more important following a shock in the money supply than a shock in the interbank rate. This finding sheds light on the link between monetary policy, commercial real estate and development of global cities, while suggesting avenues for future research.

BIBLIOGRAPHY

- [1] ANDERSON, R., BONEY, V., AND GUIRGUIS, H. The impact of switching regimes and monetary shocks: An empirical analysis of REITs. *Journal of Real Estate Research* 34, 2 (2012), 157–181.
- [2] APPERT, M., AND DROZDZ, M. La géopolitique locale-globale aux marges de la City de Londres: conflits autour des projets de renouvellement urbain de Bishopsgate. *Revue de géographie et de géopolitique*, 137 (2010), 119–134.
- [3] APPERT, M., AND MONTES, C. Skyscrapers and the redrawing of the London skyline: a case of territorialisation through landscape control. *Journal of Urban Research*, Special issue 7 (2015).
- [4] APPERT, M., AND WAINE, O. Skyline policy The Shard and London’s high-rise debate. *Metropolitica* (2011).
- [5] BAI, J., AND PERRON, P. Estimating and testing linear models with multiple structural changes. *Econometrica* 66, 1 (1998), 47–78.
- [6] BAI, J., AND PERRON, P. Computation and analysis of multiple structural change models. *Journal of Applied Econometrics* 18, 1 (2003), 1–22.
- [7] BARSKY, R. B., AND SIMS, E. R. News shocks and business cycles. *Journal of Monetary Economics* 58, 3 (2011), 273–289.

- [8] BELKE, A., ORTH, W., AND SETZER, R. Liquidity and the dynamic pattern of asset price adjustment: A global view. *Journal of Banking & Finance* 34, 8 (2010), 1933–1945.
- [9] BEN ZEEV, N., AND KHAN, H. Investment-Specific News Shocks and US Business Cycles. *Journal of Money, Credit and Banking* 47, 7 (2015), 1443–1464.
- [10] BERNANKE, B. S., AND KUTTNER, K. N. What explains the stock market’s reaction to Federal Reserve policy? *The Journal of finance* 60, 3 (2005), 1221–1257.
- [11] BEYER, A., DOORNIK, J. A., AND HENDRY, D. F. Constructing Historical Euro-zone Data. *The Economic Journal* 111, 469 (2001), 102–121.
- [12] BLANCHARD, O. J. Output, the stock market, and interest rates. *The American Economic Review* 71, 1 (1981), 132–143.
- [13] BLANCHARD, O. J., AND QUAH, D. The Dynamic Effects of Aggregate Demand and Supply Disturbances. *American Economic Review* 79, 4 (September 1989), 655–673.
- [14] BREDIN, D., O’REILLY, G., AND STEVENSON, S. Monetary shocks and REIT returns. *The Journal of Real Estate Finance and Economics* 35, 3 (2007), 315–331.
- [15] BREDIN, D., O’REILLY, G., AND STEVENSON, S. Monetary policy transmission and real estate investment trusts. *International Journal of Finance & Economics* 16, 1 (2011), 92–102.
- [16] BROWN, G. R., AND MATYSIAK, G. A. Valuation smoothing without temporal aggregation. *Journal of Property Research* 15, 2 (1998), 89–103.
- [17] BRUEGGEMAN, W. B., AND FISHER, J. D. *Real estate finance & investments*. McGraw-Hill/Irwin, 2008.
- [18] CAMPBELL, J. R., EVANS, C. L., FISHER, J. D., AND JUSTINIANO, A. Macroeconomic effects of Federal Reserve forward guidance. *Brookings Papers on Economic Activity*, 1 (2012), 1–80.
- [19] CHIANG, Y., SA AADU, J., AND SHILLING, J. Unconventional monetary policy and U.S. housing markets dynamics. *working paper University of Iowa* (2015).
- [20] D’ARGENSIO, J.-J., AND LAURIN, F. The real estate risk premium: A developed/emerging country panel data analysis. *The Journal of Portfolio Management* 35, 5 (2009), 118–132.

- [21] DAVIDSON, M., AND LEES, L. New-build gentrification and London’s riverside renaissance. *Environment and planning A* 37, 7 (2005), 1165–1190.
- [22] DE WIT, I., AND VAN DIJK, R. The global determinants of direct office real estate returns. *The Journal of Real Estate Finance and Economics* 26, 1 (2003), 27–45.
- [23] DEVANEY, S., AND SCOFIELD, D. Time to transact: measurement and drivers. In *Investment Property Forum, September* (2014).
- [24] DROUHIN, P. A., AND SIMON, A. Are property derivatives a leading indicator of the real estate market? *Journal of European Real Estate Research* 7, 2 (2014), 158–180.
- [25] FARRELLY, K., AND SANDERSON, B. Modelling regime shifts in the city of London office rental cycle. *Journal of Property Research* 22 (2005), 325–344.
- [26] FELDSTEIN, M. Quantitative easing and America’s economic rebound. *Project Syndicate* 24 (2011).
- [27] FEROLI, M., HARRIS, E. S., SUFI, A., AND WEST, K. D. Housing, monetary policy, and the recovery. *Chicago Booth Research Paper*, 12-16 (2012).
- [28] FIRSTENBERG, P. M., ROSS, S. A., AND ZISLER, R. C. Real estate: the whole story. *The Journal of Portfolio Management* 14, 3 (1988), 22–34.
- [29] FRANCIS, N., OWYANG, M., ROUSH, J., AND DICECIO, R. A flexible finite-horizon alternative to long-run restrictions with an application to technology shocks. *Review of Economics and Statistics* 96, 4 (2014), 638–647.
- [30] FRIEDMAN, M., AND SCHWARTZ, A. *A monetary history of the United States*. Princeton University Press, 1963.
- [31] GABRIEL, S., AND LUTZ, C. The impact of unconventional monetary policy on real estate markets. *Federal Reserve Bank of San Francisco*, august 2014 (2014).
- [32] GELTNER, D. Estimating real estate’s systematic risk from aggregate level appraisal-based returns. *Real Estate Economics* 17, 4 (1989), 463–481.

- [33] GELTNER, D., MILLER, N. G., CLAYTON, J., AND EICHHOLTZ, P. *Commercial real estate analysis and investments*, vol. 1. South-western Cincinnati, OH, 2001.
- [34] GIESE, J. V., AND TUXEN, C. K. Global Liquidity, Asset Prices and Monetary Policy: Evidence from Cointegrated VAR Models. *Nuffield College, University of Oxford, and Department of Economics, Copenhagen University* (2007).
- [35] HENDERSHOTT, P. H., LIZIERI, C. M., AND MACGREGOR, B. D. Asymmetric adjustment in the city of London office market. *The Journal of Real Estate Finance and Economics* 41, 1 (2010), 80–101.
- [36] HENDERSHOTT, P. H., LIZIERI, C. M., AND MATYSIAK, G. A. The workings of the London office market. *Real Estate Economics* 27, 2 (1999), 365–387.
- [37] HENDERSHOTT, P. H., AND MACGREGOR, B. D. Investor rationality: evidence from UK property capitalization rates. *Real Estate Economics* 33, 2 (2005), 299–322.
- [38] HENDERSHOTT, P. H., MACGREGOR, B. D., AND TSE, R. Y. Estimation of the rental adjustment process. *Real Estate Economics* 30, 2 (2002), 165–183.
- [39] HO, D. K. H., ADDAE-DAPAAH, K., AND GLASCOCK, J. L. International Direct Real Estate Risk Premiums in a Multi-Factor Estimation Model. *The Journal of Real Estate Finance and Economics* 51, 1 (2015), 52–85.
- [40] IACOVIELLO, M. Financial business cycles. *Review of Economic Dynamics* 18, 1 (2015), 140–163.
- [41] JOHNSON, R. R. Monetary policy and real estate returns. *Journal of Economics and Finance* 24, 3 (2000), 283–293.
- [42] JOYCE, M., MILES, D., SCOTT, A., AND VAYANOS, D. Quantitative easing and unconventional monetary policy—an introduction. *The Economic Journal* 122, 564 (2012).
- [43] KAIKA, M. Architecture and crisis: re-inventing the icon, re-imag (in) ing London and re-branding the City. *Transactions of the Institute of British Geographers* 35, 4 (2010), 453–474.
- [44] LECOMTE, P. *Produits dérivés et actifs immobiliers: étude de faisabilité des méthodes de couverture factorielle*. PhD thesis, Paris 10, 2012.

- [45] LIZIERI, C. *Towers of capital: office markets & international financial services*. Wiley-Blackwell, 2009.
- [46] LIZIERI, C., AND PAIN, K. International office investment in global cities: the production of financial space and systemic risk. *Regional Studies* 48, 3 (2014), 439–455.
- [47] LUCAS, R. E. Expectations and the Neutrality of Money. *Journal of economic theory* 4, 2 (1972), 103–124.
- [48] MARCHAL, H., AND STÉBÉ, J.-M. *Les grandes questions sur la ville et l'urbain*. Presses universitaires de France, 2011.
- [49] MISHKIN, F. S. Housing and the monetary transmission mechanism. Tech. rep., National Bureau of Economic Research, 2007.
- [50] MUNDELL, R. A. Capital mobility and stabilization policy under fixed and flexible exchange rates. *Canadian Journal of Economics and Political Science* 29, 4 (1963), 475–485.
- [51] NAKAMURA, E., AND STEINSSON, J. High frequency identification of monetary non-neutrality: The information effect. Tech. rep., National Bureau of Economic Research, 2013.
- [52] PATELIS, A. D. Stock return predictability and the role of monetary policy. *the Journal of Finance* 52, 5 (1997), 1951–1972.
- [53] QUAN, D. C., AND QUIGLEY, J. M. Inferring an investment return series for real estate from observations on sales. *Real Estate Economics* 17, 2 (1989), 218–230.
- [54] QUAN, D. C., AND QUIGLEY, J. M. Price formation and the appraisal function in real estate markets. *The Journal of Real Estate Finance and Economics* 4, 2 (1991), 127–146.
- [55] RAMEY, V. A. Macroeconomic shocks and their propagation. *Handbook of Macroeconomics* 2 (2016), 71–162.
- [56] ROZEFF, M. S. Money and stock prices: Market efficiency and the lag in effect of monetary policy. *Journal of financial Economics* 1, 3 (1974), 245–302.
- [57] SASSEN, S. *The Global City: New York, London, Tokyo*. Princeton University Press, 2001.

- [58] SIMS, C. A. Macroeconomics and reality. *Econometrica* 48, 1 (1980), 1–48.
- [59] SIVITANIDOU, R., AND SIVITANIDES, P. Office capitalization rates: Real estate and capital market influences. *The Journal of Real Estate Finance and Economics* 18, 3 (1999), 297–322.
- [60] TAYLOR, J. B. Housing and monetary policy. Tech. rep., National Bureau of Economic Research, 2007.
- [61] THORBECKE, W. On stock market returns and monetary policy. *The Journal of Finance* 52, 2 (1997), 635–654.
- [62] TOBIN, J. How dead is Keynes? *Economic Inquiry* 15, 4 (1977), 459–468.
- [63] WHEATON, W. C., TORTO, R. G., AND EVANS, P. The cyclic behavior of the Greater London office market. *The Journal of Real Estate Finance and Economics* 15, 1 (1997), 77–92.
- [64] WRIGHT, J. H. What does monetary policy do to long-term interest rates at the zero lower bound? *The Economic Journal* 122, 564 (2012), 447–466.
- [65] YOUNG, M. S., GELTNER, D. M., MCINTOSH, W., AND POUTASSE, D. M. Defining commercial property income and appreciation returns for comparability to stock market-based measures. *Real Estate Finance* 12 (1995), 19–31.

APPENDIX

A. Monetary aggregates and Investment volumes

Figure 2.5: Monetary aggregates for the eurozone, the US and China: 2004-2015.
Source: Local Central banks

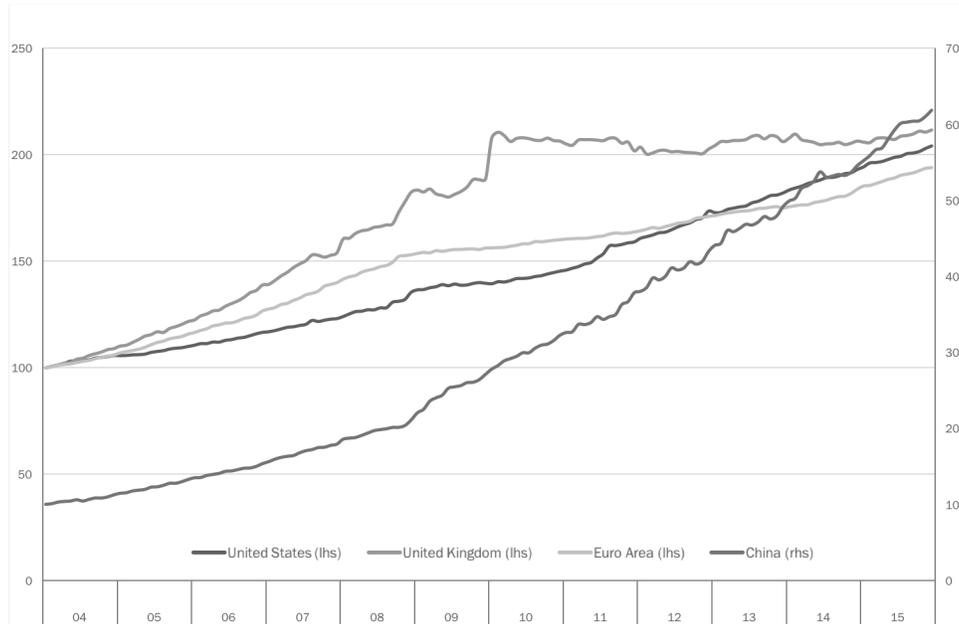
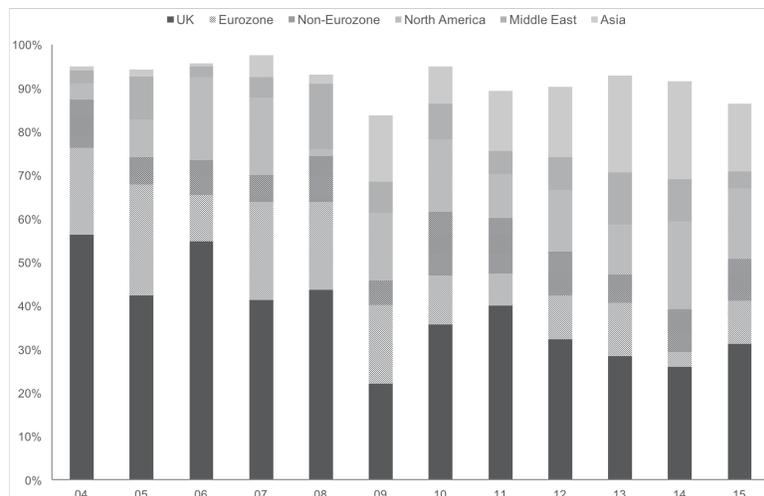


Figure 2.6: Investment volume in Europe across time: 2004-2015
Source: BNP Paribas Real Estate



Notes: For the sake of clarity, investment volume were grouped by the main areas. Detailed results per country are available upon request.

B. Exchange rate between the main currency and the GBP: 2002-2016.

Figure 2.7: Price of foreign currency in terms of units of domestic currency: 2002-2016.
Source: Local Central banks

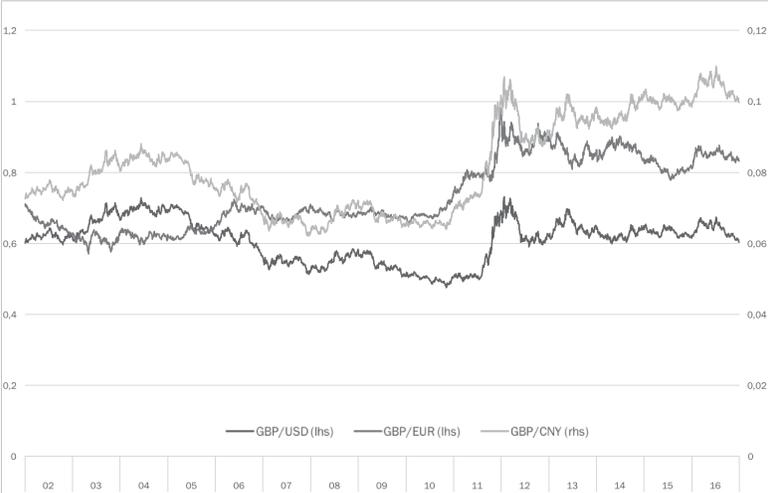


Figure 2.8: Price of domestic currency in terms of units of foreign currency: 2002-2016.
Source: Local Central banks



C. A short reminder: The Mundell-Fleming framework for the London Office Market

To describe the simplest case of our theoretical framework and illustrate the diffusion process of the variation in money supply, we assume a pure open economy with flexible exchange rates.²⁵

In the IS/LM Mundell-Fleming framework, the equilibrium is given by three well-known equations:

$$Y = A(Y, i, G, T) + XN(e): (\text{IS})$$

$$M = L(Y, i): (\text{LM})$$

$$i = i^*: (\text{BP (Balance of Payments)})$$

With Y representing the domestic GDP including real estate, for our purposes we can consider the specific GDP related to real estate as $Y(\text{RE})$; G represents government spending, an exogenous variable; M , nominal money supply; i , nominal interest rate; L , liquidity preference (real money demand); T , taxes; XN , net exports; and e , nominal exchange rate (the price of domestic currency in terms of units of the foreign currency). * defines foreign variables.

If we consider the absorption, we have:

$$A(Y, i, G, T) = C + I + G - T$$

With C , the consumption and I , the physical investment.

We may add that the balance of payments (BoP) may be considered the balance surplus and defined as follows:

$$\text{BoP} = \text{CA} + \text{KA}$$

Where CA is the current account surplus and KA is the capital account surplus. We also have:

²⁵As mentioned earlier, a next step, not developed here, would be to consider more formally an IRBC framework with specific stylized facts. We leave this theoretical point for future research.

$$KA = z(i - i^*) + k$$

With, i^* , the foreign interest rate; k , the exogenous component of financial capital flows; and z , the interest-sensitive component of capital flows. The derivative of the function is the degree of capital mobility (the effects of differences between domestic and foreign interest rates upon capital flows KA).

The IS curve could also be described as follows (Taxes are not the focus here):

$$Y = C + I + G - NX(e)$$

Under flexible exchange rates, as it is well known, the exchange rate is the third endogenous variable, while BoP is set equal to zero.

The dynamic of the variation in the money supply for the Mundell-Fleming model is given by:

$$\begin{aligned} dY &= A_Y dY + A_i di + A_G dG + XN_e de \\ dM &= L_Y dY + L_i di \\ di &= di^* \end{aligned}$$

In an open economy with flexible exchange rates (a pure open economy with no transaction cost or institutional barrier), we have $di = di^* = 0$ (the world interest rate is exogenous).

Therefore, in the simplest case when government spending (exogenous variable) is constant, the impact of an increase of the money supply is expressed by:

$$\begin{aligned} dY &= \frac{1}{1 - A_Y} (XN_e de) \\ dM &= L_Y dY \Rightarrow dY = \frac{dM}{L_Y} > 0 \\ de &= \frac{dM}{L_Y} \left(\frac{1 - A_Y}{XN_e} \right) < 0 \end{aligned}$$

Literarily, we may simply sum up the diffusion process of a money supply as follows. An increase

in the money supply in the UK (1) induces a decrease of domestic interest rate (2) and an increase of investment (3), followed by an increase of GDP (4) (with an increase of domestic employment), a decrease of exchange rate and thus an increase of net exports (including the London offices), *ceteris paribus*. Because the short-term real estate supply is inelastic, the path to short-term equilibrium implies an increase of prices. Moreover, the real estate total return is defined as the sum of income return and capital growth. The price increase induces an increase of capital growth, and the income return stays stable over the short term. In this case, real estate assets are very attractive compared to bonds (fixed incomes exhibiting an interest decrease), and to a certain extent to stocks (the asset arbitrage in this mechanism is not our main purpose in this study, and it could be further developed).²⁶

This money supply dynamic, which is valid for the UK, could be easily extended to foreign countries (the US, the eurozone, China, etc.) to illustrate the economic consequences of the so-called currency war after the GFC. We can report a depreciation of GBP vs USD, vs EUR and especially vs CNY during this period (2010-2015). The London office market, as a component of GDP, has been exported after the GFC. These capital flows (foreign investment flows in UK real estate) have led to a decline in UK investors relative to foreign (global) investors, *ceteris paribus*.

To capture this phenomenon and its impact on the real estate risk premium, we suggest the composite monetary index defined in section 2.4.

²⁶For theoretical development see Blanchard (1981) in a domestic IS/LM framework.

D. Stationarity of the variables.

Table 3. Stationarity tests for the variables.

Variable (level)	ADF t-Statistic	PP t-Statistic	Prob. ADF	Prob. PP
Risk Premium	-4.297551***	-2.291927	0.0011	0.1780
Prime Rent	-1.488341	-1.102262	0.5323	0.7093
Employment level	-1.189591	-1.471519	0.6733	0.5409
FTSE 100	-1.955773	-1.711095	0.3052	0.4204
Vacancy Rate	-2.427356	-2.442641	0.1390	0.1349
LIBOR 3 Month	-1.443086	-1.289566	0.5549	0.6287
Monetary Index	-0.299007	-0.270200	0.9182	0.9225
Variable (1st difference)	ADF t-Statistic	PP t-Statistic	Prob. ADF	Prob. PP
Risk Premium	-3.711170***	-3.078110***	0.0064	0.0339
Prime Rent	-3.919561***	-3.905711***	0.0035	0.0036
Employment level	-6.451485***	-6.388660***	0.0000	0.0000
FTSE 100	-5.284743***	-5.278236***	0.0000	0.0000
Vacancy Rate	-4.277398***	-4.301653***	0.0012	0.0011
LIBOR 3 Month	-3.955824***	-3.937701***	0.0031	0.0033
Monetary Index	-7.180174***	-7.192899***	0.0000	0.0000

Notes: T-statistics are in brackets. *, **, *** indicates significant at 10%, 5% and 1% respectively. ADF and PP are respectively the Augmented Dickey Fuller and the Phillips-Perron unit root tests.

E. Optimal lag length for the monetary index

Table 4. Vector autoregression results for each index.

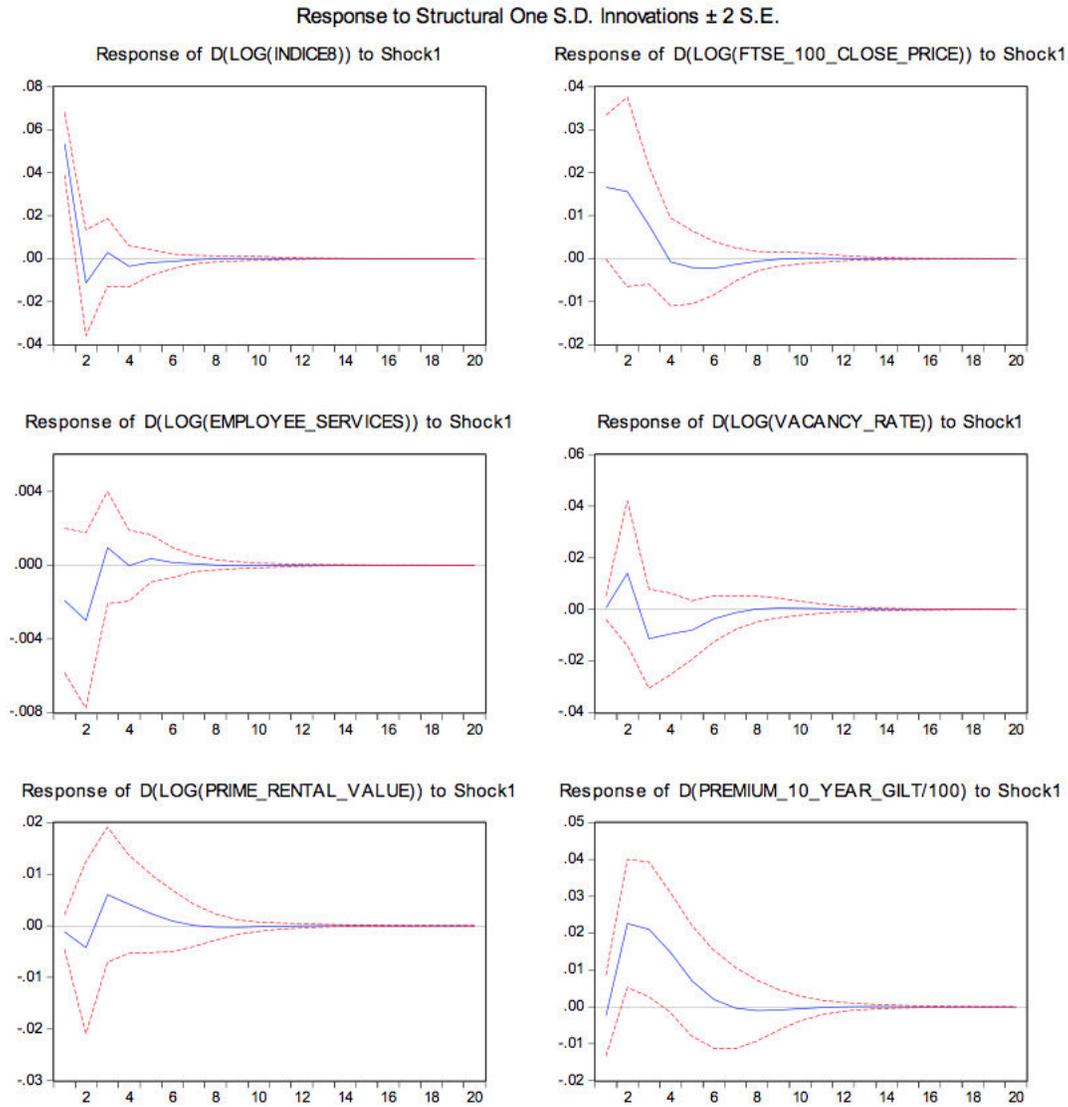
	No Lag	1 Lag	2 Lags	3 Lags	4 Lags
RP	0.69 [8.57]	0.66 [8.59]	0.68 [8.58]	0.73 [9.75]	0.7 [8.80]
PR	-11.16 [-1.21]	-19.86 [-2.10]	-12.20 [-1.34]	-13.94 [-1.64]	-9.55 [-1.04]
EM	-108.65 [-2.13]	-135.12 [-2.71]	-104.35 [-2.08]	-97.81 [-2.09]	-82.71 [-1.55]
FTSE	29.05 [3.77]	28.21 [4.01]	28.78 [3.91]	26.01 [3.80]	26.71 [3.62]
VR	15.49 [2.57]	12.23 [2.29]	16.44 [2.74]	11.10 [1.96]	14.62 [2.46]
MI	8.39 [0.51]	-27.67 [-2.38]	-21.12 [-1.12]	32.96 [3.04]	21.60 [1.30]
C	0.37 [0.69]	1.35 [2.45]	0.99 [1.72]	-0.15 [-0.31]	-0.015 [-0.02]
R ²	0.73	0.76	0.74	0.77	0.74
Adj-R ²	0.70	0.73	0.71	0.75	0.71
AIC	5.14	5.03	5.11	4.96	5.10
LR	-131.8	-128.8	-131,0	-127.04	-130,9

Notes: Appendix E reports regression results based on equation 4 for the whole period with different time-lags for the monetary index. Variables are in log-difference (except for the risk premium in first-difference). RP refers to the risk premium, PR refers to the "prime" rent, EM refers to the employment level, FTSE refers to the FTSE 100, VR refers to the vacancy rate, MI refers to the monetary index, LIBOR refers to the Libor 3-month and C refers to the constant. The figures in bold are significant at the 5% level. AIC and LR are respectively the Akaike Information Criteria and the Likelihood Ratio.

T-statistics are in brackets.

F. Impulse Response Functions following a positive one standard deviation shock to the monetary index after QE programs: 2009-2015.

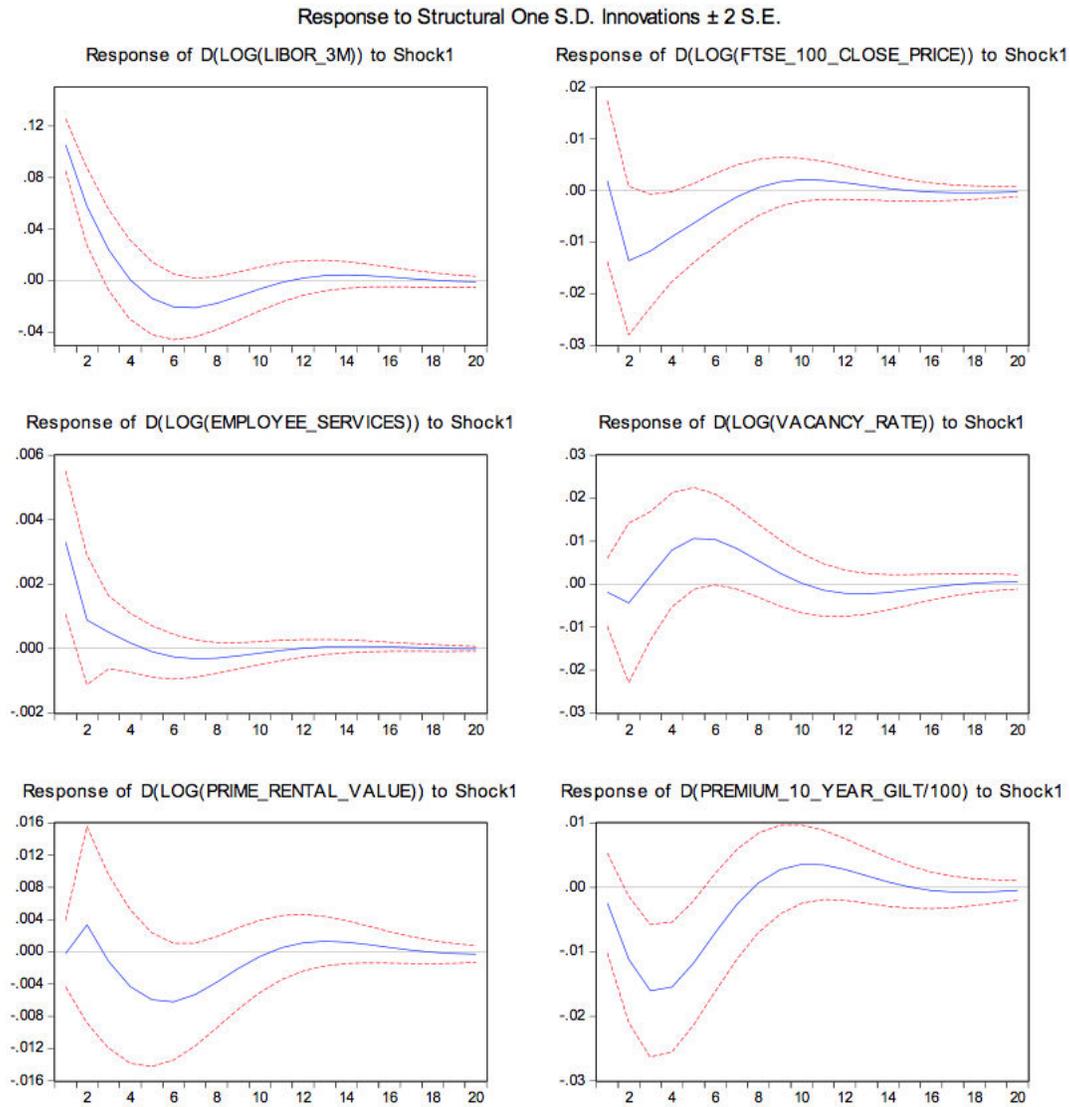
Figure 2.9: Impulse Response Functions following a positive shock to monetary index after QE policies: 2009-2015.



Notes: The responses are represented by solid lines. The dashed lines show the 95% bootstrapped confidence intervals. The x-axis corresponds to the number of quarter following the shock

G. Impulse Response Functions following a positive one standard deviation shock to the 3-month Libor rate: 2002-2015

Figure 2.10: Impulse Response Functions following a shock to the 3-month Libor rate: 2002-2015.



Notes: The responses are represented by solid lines. The dashed lines show the 95% bootstrapped confidence intervals. The x-axis corresponds to the number of quarter following the shock

CHAPTER 3

NEW MONETARY POLICIES: FUELLING METROPOLISATION AND MEGALOPOLISATION?

THE CASE OF THE WESTERN EUROPEAN OFFICE MARKETS.

Keywords : Office market, Urban economy, Monetary policies, Metropoles, European megalopolis

Mots-clés : Marché des bureaux, Économie urbaine, Politiques monétaires, Métropoles, Mégalopole européenne.

ABSTRACT

How do the money supplies generated by the central banks' new monetary policies influence the urban reshaping at work in Western Europe? The purpose of this paper is to identify the driving lines along which these liquidities are distributed and invested across metropolises: global connectivity, premium for the largest cities, effects on the German markets due to their leadership in Europe or revival of the megalopolitan advantage. After use of a panel approach, with specific monetary indexes for each city, results report that the quantitative easing policies affect the urban investments differently and influence the reshaping of wealth.

RÉSUMÉ

L'objectif de cet article est d'étudier les caractéristiques urbaines qui ont été déterminantes pour attirer l'afflux de capitaux sur les marchés financiers suite à la mise en place des politiques non conventionnelles par les banques centrales. Nous allons donc considérer plusieurs facteurs comme la connectivité des villes, leur taille, ou encore leur place au sein de la mégapole européenne. Suite à l'utilisation d'un modèle en panel avec un indice monétaire spécifique pour chaque marché, les résultats montrent que les politiques monétaires récentes ont affecté les marchés immobiliers européens de manière différente et inégale.

1 Introduction

Since the Global Financial Crisis (GFC), central banks have drastically increased their money supply, directly impacting financial markets and economic cycles. If the effects of quantitative easing for classic financial assets are well-documented in the literature, few studies focused on its impact on the urban investments and its role in the recent evolutions of the metropolises. It is however possible to suspect that this role is probably important. In a context where government bonds and stocks are today less attractive due to lower returns and important regulatory constraints, this inflow of liquidity should tend to move towards alternative investment assets. Between 2009 and 2016, the European monetary aggregate (M2) increased from 8,000 to 11,000 billion euros, whereas in the same time the total value of the main Western office markets rose from 780 to 1,230 billion euros. Understanding if and how the new monetary policies fuelled and influenced urban development is thus an important requirement.

The global monetary effect on real estate prices can be analysed using a simple Mundell Fleming framework for a small open economy with a flexible exchange rate. Prices should rise with monetary supply. The relationship between office prices and fundamental economic variables is estimated through a panel modelling from 2009 to 2016 for the sixteen main office markets in Western Europe. Attention is given to the changes in the money supply by constructing monetary indices specific to each metropole and taking into account the investors' nationalities (obtained from a private broker database). However, as significant heterogeneity exists across European countries in their economies and financial markets, the increase in money supply may generate distortions and implicit reallocation trends; some cities could indeed benefit heterogeneously from the new European Central Bank (ECB) policy.

To determine the degree of homogeneity of the monetary influence on contemporaneous European wealth reshaping, several segmentations are introduced. We study three major concerns in Europe that could raise some challenging economic and political questions. First, we will see whether the highly globalized metropolises benefit from this new paradigm. We highlight their ability to capture the international quantitative easing liquidities worldwide. Then we will shed some light on the attractiveness of the German economy across the Euro area. Indeed, as Germany is the leading economic country in Europe and has a strong influence on European institutions, the German real estate market could have benefitted more from the new monetary policies. Finally, another issue is the importance of the long-standing European megalopolis from London to Milan, the continent's strongest attraction pole. In recent years, the ECB demonstrated its ability to evolve and played a major role in preserving the Eurozone financial system's integrity. However, some metropolises' possibly reinforced ability to attract monetary injections more easily would raise an important policy issue within the Eurozone. If the unconventional monetary policies were essentially made to support peripheral markets, what would be the implications if the main beneficiaries, through the evolution of their urban wealth, were the European megalopolis markets?

Section 2 presents the ECB mandates' roles and evolutions in the last few years, the notion of the European megalopolis and elements of the metropolisation process. Section 3 develops theoretical, empirical and practical arguments on the relationship between office prices and urban investments and the monetary supply. Section 4 discusses the results of the segmentations mentioned above.

2 Monetary policies, European megalopolis and metropolisation

2.1 European monetary governance: a federal policy in an imperfectly federal union

Historically, the statutes of the European Central Bank, attached as a protocol to the Maastricht Treaty (1992), ensued from the Deutsch Central Bank statutes (1957). Two points are of particular importance. First, the German legislation defended by the Federal Constitutional Court of Karlsruhe established the Bundesbank's independence from political influence, and it was seen as a crucial point that this enshrined political independence was directly transferred to the ECB. Second, as the Bundesbank did with the mark, the ECB's initial mission is to maintain price stability in the Eurozone and to preserve the single currency's purchasing power. This stability mandate is supported by the rules of the Stability and Growth Pact (SGP 1997). Although fiscal policy, taxes and spending remain in the jurisdiction of national governments, the SGP was (and is still) a guaranty that no member (Italy and Greece, especially) would evade the ECB's anti-inflation policy by cutting taxes and spending.

The ECB policy's efficiency has been widely studied in the literature. Since the early nineties, the rule of Taylor (1993) has been the instrument used to guide and evaluate the Central Bank's decisions. Defined by a single equation, this rule recommends raising the federal funds rate if inflation increases above a target of 2 percent. Faust et al. (2001), using this guidance, argued that the ECB put too much weight on the output gap relative to inflation and seemed to respond much more to changes in the business cycles, compared to what the former Bundesbank would have done. Fourçans and Vranceanu (2004) also found that the ECB reacted strongly to variations in the inflation rate during the Duisenberg presidency (1999-2003) but less to output variations. Sauer and Sturm (2007),

assuming rational expectations and using a forward-looking specification (as suggested by Clarida et al. 1998), demonstrated that the ECB had followed a stabilizing rule from 1999 to 2006.

Sauer and Sturm (2007) also pointed out a large degree of partial adjustment in the interest short rate. Following Rudebusch (2002), they indicated that the ECB responds much more slowly to changes in the economic environment, compared to what a central bank in a federal state should do. This slow adjustment is required to mitigate the economic risks faced by heterogeneous European economies. Sturm and Wollmerhäuser (2008), using the asymmetries in inflation and cyclical output developments, underlined notable differences in the single monetary policy's adequacy across Eurozone countries. They showed that before the GFC developments, small member countries received more than proportional weight in the ECB's monetary policy decisions. Combined with the low adjustment argument, it highlights the common policy led by the ECB.

After the GFC, the SGP was improved to enhance fiscal and macroeconomic surveillance (regulation of the «six-pack», 2011) and budgetary coordination (regulation of the «two-pack», 2013). As reported by Micossi (2015), the ECB's role has simultaneously evolved, especially after the launch of the quantitative easing policies in the UK and the US. This institution now has three mandates: an inflation control mandate, an employment mandate, and a mitigation of systemic risk mandate but with limited instruments. The ECB stands as the only policy player in the Eurozone able to respond in times of crisis and stress.

However, recent events have shed intense light on serious drawbacks. A monetary union with persisting divergences in prices and productivity and without sufficient consistency in its fiscal and economic policies may generate an unstable economic environment. More precisely, it may increase the intra-European capital reallocation movements, generating a new steady state. For ten years, the stock and bond markets may have seemed less attractive, but at the same time, the metropolisation

process is powerful. It raises the issue of determining whether this new potential capital rebalancing would not be realized through the channel of the real estate investments.

2.2 European Megalopolis and European centrality

In such a context, which cities would benefit the most from the reallocation? The central ones? Those belonging to the European megalopolis? This section presents these two notions.

A megalopolis is a spatial model of settlement and planning that refers to a densely urbanized region on a national or continental scale, comprising several big cities, metropolises and/or global cities (Lang and Dhavale, 2005). The notion was initially used to describe the region located in the northeastern coast of the USA, from Boston to Washington (Gottmann, 1961; Vicino et al., 2007). Two other megalopolises were also identified: the Japanese one, first extending from Tokyo to Fukuoka (Isomura, 1969; Hanes, 1993) and then from Sendai to Kumamoto, and the European one, extending from London to North Italy (Brunet, 1989). Originally, because of its anti-urban scientific context of production, the notion was part of strong criticism of the developed countries' quick urbanization, especially the USA's (Baigent, 2004). Today, its sense is more technical: It designates an urban ensemble functionally integrated on various scales by a dense and diverse infrastructure network, which makes the megalopolis spatially broader than just a conurbation. Urbanization is discontinuous within large rural and sub-urban areas (Gottmann, 1961).

The European megalopolis is the most populated and ancient one. It stems from the accumulation and networking dynamics of European cities, territories, and societies on an extensive historical scale¹ (Pirenne 2014, 1914; Braudel, 1982; Arrighi, 1994; Taylor and Derudder, 2015). Its great

¹Its "southern pole" (Braudel, 1982: 96) was formed during the 10th century across northern Italy thanks to the spread of Venice's dynamism: It formed the "first European world-economy" (Braudel, 1982). At that time, the "weaker northern pole" of the actual megalopolis was created by the development of Flanders based on the Baltic sea-Black sea commercial exchanges. Between these poles, merchant colonies were gradually established in cities (Pirenne, 2014: 121). It led to a commercial revolution in Western Europe (Spufford, 2002) and the establishment of

dimension is the result of a permanent renewal and enhancement of its material, immaterial and human resources due to its spatial extent, its demographic magnitude and density, the diversity of its components and the quality of its regional integration (Cattan and Saint-Julien, 1998). It is the exceptional expression of strong forces of regional integration and important accumulation of capital, knowledge and population in a very long period.

Although the notion of a megalopolis rests on the observation of regional cohesion, it generates strong debates in Europe because of its proximity to the concept of centrality. This second notion refers to another spatial pattern and different theoretical equipment: the centre-periphery models. A centre is an area that ensures central functions related to various domains of power such as political, economic or religious functions (Cattan and Saint-Julien, 1998). In Europe, centres are traditionally relevant on national scales. The nature of European centrality is therefore usually seen as polycentric. It corresponds to the coalition of national centres and the connection of national urban systems (Cattan, 1996, 2007; Dematteis, 1996).

For the European Union, the notions of megalopolis and centrality overlap without being equivalent. The question about the status of London and Paris is particularly enlightening for this theoretical difference and helps interrogate the European megalopolis's geographical limits. Indeed, considering the spatial discontinuity between London, Paris and the rest of the megalopolis, some scholars exclude the two cities (Brunet, 1989; Cattan and Saint-Julien, 1998). On the other hand, because London and Paris are the two most powerful global cities on the continent (Sassen, 2001; Taylor et al., 2006), nobody contests the fact they belong to the European polycentric system and play

the proto-megalopolis. Medieval Europe became a "region of cities" (Pirenne, 2014: 103) built on intense commercial exchanges from North to South, and economic intermediary sub-regions based on fairs appeared as the Champagne Fairs (Braudel, 1982: 111). During the 14th century, the economy of fairs collapsed because of the rise of direct maritime exchanges between the two poles and because of the opening up of the eastern Alpine passes: the proto-megalopolis evolved from a "region of cities" with episodic interactions to a European city network (Taylor et al. 2006: 3-4).

the role of true centres of the continental urban system. Recently, the case of Berlin has emerged according to the same characteristic: an emerging centre outside of the megalopolis (Cochrane and Jonas, 2001; Berroir et al., 2009).

2.3 Metropolises and global connectivity

If the hypothesis of a capital flight to a megalopolis or toward European centres has to be considered, the hypothesis of a flight to metropolises also requires attention. As the contemporaneous rise of metropolises is closely related to globalisation, such consideration would entail extending the consequences of monetary supplies in the model.

A metropole is defined as a city that concentrates command functions of the global economy and intermediation jobs enabling the connection of local and global scales (Lang et al., 2005; Senecal and Bherer, 2009; Veltz, 1996). Because of the European construction, the situation in Europe is different from that in North America or Pacific Asia (Berg et al., 2007; Ghorra-Gobin, 2015). Three logics are combined here: structuration of the national urban networks (Pumain and Saint-Julien, 1996; Berg et al., 2007), integration of European cities and territories (Baeten, 2001) and globalization of urban networks and economies (Beaverstock et al., 2000; Derudder et al., 2012). Those three processes lead to different kinds of metropolises: strongly globalized metropolises such as Paris and London; European-size metropolises such as Edinburgh (Scotland) and Stuttgart (Germany), which benefited from national and European planning efforts; and national-size metropolises.

If globalization of urban economies can be observed in the three cases, its effects and consequences should differ depending on the intensity of connection to the global economy. Rankings realized by the GaWC² (Globalization and World Cities Research Network) can help classify cities on that basis.

²Taylor et al. (2006), Taylor and Derudder (2016). This ranking includes variables such as connectivity, connection to globalization, share of international investments and number of hosted global headquarters.

Taylor et al. (2013) ranked European metropolises in three levels based on their global connectivity: London and Paris are at the top of the European urban hierarchy; Milan, Madrid and Brussels are classified at the second rank; and twenty cities at the third rank, divided in three sub-groups (Table 1).

Table 1. Ranking of European metropolises based on their global network connectivity.

Source: GaWC (Taylor et al. 2013).

Global network connectivity rank	Cities
Alpha	London, Paris
Beta	Milan, Madrid, Brussels
Gamma 1	Warsaw, Zurich, Amsterdam Dublin, Rome
Gamma 2	Lisbon, Francfort, Stockholm, Prague, Vienna, Budapest, Athens
Gamma 3	Barcelona, Bucharest, Oslo, Berlin, Helsinki, Geneva, Copenhagen, Hamburg

According to the literature, the over-productivity of metropolises³ compared to "ordinary" cities and territories would have several causes. The greater concentration of talents; upper-functions; and upper-jobs in metropolises, especially intermediation jobs, would create and accumulate more wealth in the long run (Fujita and Hill, 2006). Positive economic externalities would also be higher in metropolises (Krugman (1991) for the US; Fujita and Hill, 2006, for Japan; Davezie, 2008, for France). It would also include metropolitan externalities that are not just economical or spatial ones, for instance urban governance, coordination structures, efficiency of collaboration, and dynamics of collective learning (Halbert, 2015). In this article, a fourth factor is tested: Are metropolises the most likely to benefit from the new international monetary policies?

³For instance, Paris contained 19% of the national population but generated 29% of the GDP in 2008 (INSEE). Tokyo contained 12% of the national population but generated 18% of the GDP in 2013 (TMG, 2013).

3 Measuring the monetary spillover in a heterogeneous European office market

3.1 Unconventional monetary policies: fuelling the urban investments?

Since late 2008 and the fall of interest rates to almost zero, central banks have shifted their policies and introduced new monetary measures. Analysing the effects on asset prices of these massive money injections is today more relevant than analysing the rate variations. Although the money supply's impact on stock prices has been well-documented in the literature across time (Rozen, 1974; Patelis, 1997; Bernanke and Kuttner, 2005; Feldstein, 2011, among others), fewer studies focused on the impact on real estate prices. The few recent articles dealing with it consider the US housing market (Iacovello, 2015; Chiang et al., 2015) and more rarely, office markets (Coën et al., 2018, for London). This lack of studies has to be pointed out.

The effect of money supply in an international context can be modelled using a simplified Mundell-Fleming framework for a small open economy with flexible exchange rates. By considering an increase of money supply, the LM (liquidity preference-money supply) curve shifts to the right, inducing a decline of domestic interest rates relative to foreign interest rates. Capital outflow increases, leading to an increase of the real exchange rate, shift the IS (investment-saving) curve to the right until domestic interest rates equal foreign rates (assuming horizon balance of payments). However, the relationship between money supply and the property market is specific given the inelasticity of the real estate supply (Geltner et al., 2001). When a money injection stimulates the economy and consequently also the demand for spaces, new development projects are launched. But this supply response is limited for time and space reasons: constructions take time, and space is limited in metropolises. In this context, the adjustment is consequently mainly realised through a significant price increase. Prices and volume simultaneously increase, leading to a spatial wealth concentration

as observed in the metropolisation process.

Other relevant elements deserve to be mentioned. During the last decade, as the short and long interest rates reached very low levels, bonds became less attractive. Moreover, a quantitative easing policy affected the reselling of bonds to central banks. These two elements combined generated outflows from the bond market. The matter was then to reinvest these liquidities in the stock market or in the real estate market. Here, the regulations of the banking and insurance sectors (Basel 3, Solvency 2) played a role. Less regulatory capital is indeed required for real estate investments compared to stocks or derivatives. In other words, the regulatory context helped to reinforce the competitiveness of real estate investments and to redirect the bond outflows toward urban investments. A 2017 survey published by the INREV corroborated this arbitrage.⁴ It is also interesting that these available liquidities met at the right time for the metropolises to continue their adaptation to globalization.

3.2 The heterogeneity of the European office markets

Sixteen European office markets are considered in this article.⁵ They represent 219 M.sqm, of which the value jumped from 782 to 1229 billion euros between 2009 and 2016 (Table 2). Whether it be in terms of size, evolution of their stock value or percentage of international investments, heterogeneity is strong within this set.

Central London is one of the biggest markets. During the last thirty years, institutional and strategic evolutions helped this city become an emblematic example of a global city (Marchal and Stébé, 2011; Sassen, 2001) with its display of planning reform (Pilmott and Rao, 2002), branding strategy as a world city and organization of a competitive approach for the funding of urban regeneration

⁴See the Investment Intentions Survey, published by the European Association for Investors in Non-Listed Real Estate Vehicules.

⁵The selection was based on the availability and the consistency of the data.

projects (Kaika, 2010, Wright 2006). The Olympic Games of 2012 also played a crucial role (Appert, 2012; Davis and Thornley, 2010; Watt, 2013). Now it is the most attractive European metropole for international investments.

Central Paris is the biggest market in Europe in terms of stock. The actual urban development related to the metropolitan greater Paris, the Olympic Games of 2024 and Brexit should increase future international investments in offices (Gilli, 2014). The second French market, Lyon, is smaller, but it greatly benefits today from the metropolisation process, given its historically advantageous position as a hub between Paris, the north of Italy, the Mediterranean and Germany.

Table 2. Size, stock value variations and percentage of international investments in the office markets.

Source: BNP Paribas Real Estate.

	Stock (K. sqm)	Stock Value (€billion)		Intl. invest.		Stock (K. sqm)	Stock Value (€billion)		Intl. invest.
		2008	2016				2008	2016	
Amsterdam	7 236	19.2	18.3	57.9%	Central London	20 016	135	324	65.3%
Barcelona	5 658	15.2	15.6	53.3%	Lyon	6 290	10.6	18.8	30.9%
Berlin	19 299	39.6	82.7	42.3%	Madrid	14 940	44.4	43.5	47.2%
Brussels	13 320	30.3	36.5	48.6%	Milan	12 065	43.8	47.9	40.4%
Düsseldorf	9 308	23.5	32.6	30.5%	Munich	20 550	56.2	87.8	30.5%
Francfort	15 635	42.8	57	42.8%	Central Paris	35 253	175.2	302.4	43.8%
Hamburg	13 866	36.8	53.6	27.9%	Roma	9 720	43.8	38.3	38.7%
Lisbon	4 638	11.1	10.2	49.2%	Vienna	11 100	54.3	59.6	41.9%
					Total	218 902	781.8	1228.8	43.2%

In comparison, the five German markets are much more similar in size due to historical reasons (fragmentation of the Holy Germanic Empire, late unification of the country in the 19th century). Their degrees of internationalization depend on recent elements: European construction, reunification and globalization. These determinants generate a multispeed Germany: Munich, the capital of the powerful state of Bavaria, which has a low internationalization rate; the financial and more internationalized city of Frankfurt; the booming market of Berlin, with its stock value doubling in a few years; and so on. The former imperial capital of Vienna is also comparable to these real estate

markets (Beaverstock, 2011).

In Italy, the biggest office market is Milan, a part of the megalopolis, with a significant sector of services (the main office renters). Rome, Milan and Napoli are of equal size due to the Italian fragmentation before national unification in the 19th century. However, on an economic, historical and political basis, and in contrast to Germany, the contrast is important between these regions: the north of Italy ruled the unification, and although the second office market is the administrative capital of Rome, Milan remains the economic capital (Calafati, 2009).

Between Madrid and Barcelona, the situation is different. Although the regions have equivalent GDPs, the office market in Madrid is three times greater and more developed. It hosts the headquarters of the main Spanish companies, and given their common language, Latin-American companies are also present (Colombo, 2016). Barcelona benefits from significant harbour activity, a good city brand and the 1992 Olympic Games, but its office sector is much smaller.

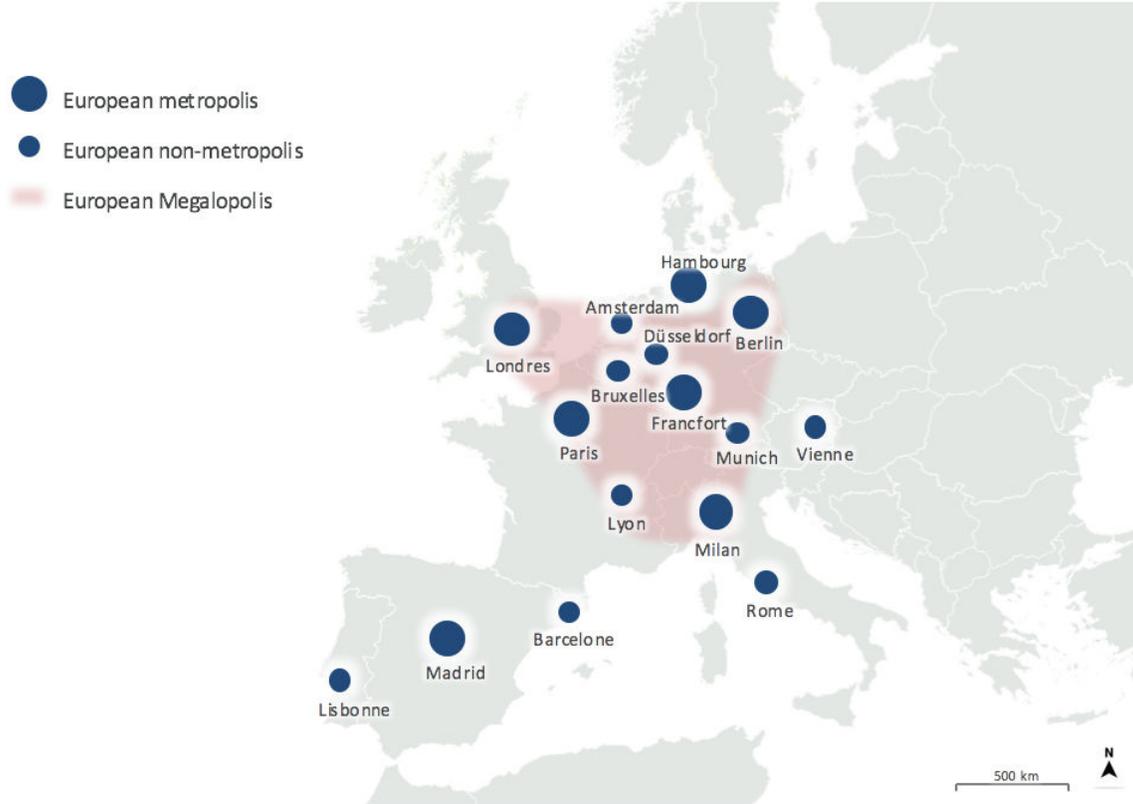
The small markets of Amsterdam and Lisbon share some common points with Barcelona: present or past harbour activities, historical roles in great discoveries and colonial empires. They also play a significant role in European construction but cannot be considered important metropolises or political centres. As for Brussels, this city is rather unique because of the presence of the EU headquarters and the concurrent threat to the young Belgium state's national cohesion (Huyseune and Jans, 2008).

3.3 Modelling the fundamentals of the office markets

To determine how the prices' evolutions in these 16 markets are influenced by the new monetary policies, we collected eight years of annual panel data.⁶ The price index (Price) for each market

⁶In this approach, the explanatory variables are supposed to have the same impact on the endogenous variable, and the heterogeneity between the markets is captured by the constants (the pooling test is rejected).

Figure 3.1: Map of the main office markets in Europe.



is calculated using the MSCI capital growth indexes.⁷ The control variables are chosen according to the real estate literature. The vacancy rate (VR) is the ratio of the immediate supply to the existing stock. It is a proxy for the market's liquidity and the risk faced by investors (D'Argensio and Laurin, 2009). The Prime rent (PR) is the level of the top headline rent for an office building of standard size and the highest quality and specification in the best location. It controls for the quality variations of the building stock. The real estate literature has also well-established that the output measure (GDP) was related to office demand (Mouzakis and Richards, 2007). However, it could overestimate it when firms increase their productivity instead of their space. Following De Wit and

⁷MSCI is a global provider of real estate indexes, covering more than 30 countries and 240 cities worldwide

Van Dijk (2003), we prefer using office-based employment (Emp) as a proxy for the demand⁸. Last, the national stock market index (Stock) is used to approximate economic health and investment opportunities in the stock market (Sivitadinou and Sivitadines, 1999). Usually, the firms that belong to the national stock index are also among the most important office renters in the country.

Table 3. Variables description (2009-2016)

Variable	Description	Source
Vacancy rate (VR)	Percentage of vacant space	BNPPRE
Prime rental value (PR)	Rent level of the prime building	
National Employment (Emp)	National employment in all sectors, expressed in thousands of employees	National Bureau of Statistic
Stock index (Stock)	Main national stock index	Euronext
Monetary index (MI)	Constructed using the M2, the investors' nationalities and the exchange rates	Central Banks, BNPPRE, ECB Change
Price index (Price)	Constructed using office capital growth	MSCI

The monetary index (**MI**) is calculated for each market using an aggregation method⁹. This technique was first developed by Beyer et al. (2001) to reconstruct historical data of money aggregates, GDP and consumption prices for the Eurozone over two decades. Since then, this method has been widely used in the literature (Giese and Tuxen 2008, Belke et al. 2010) to aggregate national data series, such as GDP, monetary stocks and interest rates. Following Coën et al. (2018), who adapted it for international real estate investments, the various monetary growth rates were aggregated according to the investors' nationalities.

More precisely, for a given market, the growth rates of M2¹⁰ (expressed in local currency) of each

⁸Brounen and Jennen (2009) find a marginal difference between output and employment in their study on the European office market.

⁹As countries have various definitions of broad money, a simple sum of monetary aggregates would under-represent countries with narrow definitions of M2.

¹⁰M2 is a money aggregate that measures the money supply. It is generally defined as the sum of currency and coins, demand deposits, money markets and savings deposits.

country investing in market i are weighted by the investment volume realized by country n in this local market:

$$MI_{i,t} = 100 \prod_{t=1}^T \left[1 + \sum_{t=1}^T \left(\frac{Inv_{n,t}}{\sum_{n=1}^N Inv_{n,t}} \right) \times \left(\frac{M2_{n,t-k} \times e_{t-k}}{M2_{n,t-k-4} \times e_{t-k-4}} - 1 \right) \right], \quad (3.1)$$

where $Inv_{n,t}$ is the invested volume from a country, n , at time t ; $M2_n$ is the monetary aggregate from a country (or an area) n ; k is a time lag; and e_t is the exchange rate. This index reflects the international money supply, but it is limited to the countries who effectively invested in this specific market. It is computed on a quarterly basis but employed in the model annually. The M2 are lagged by two quarters due to real estate illiquidity and the length of the investment process¹¹.

The model is written in first difference logarithm to ensure the series's stationarity:

$$\begin{aligned} \Delta \ln(\text{Price index}_{i,t}) = & \alpha_i + \beta_1 \Delta \ln(\text{VR}_{i,t}) + \beta_2 \Delta \ln(\text{PR}_{i,t}) + \beta_3 \Delta \ln(\text{Emp}_{i,t}) + \\ & \beta_4 \Delta \ln(\text{Stock}_{i,t}) + \beta_5 \Delta \ln(MI_{i,t}) + \epsilon_{i,t}, \end{aligned} \quad (3.2)$$

where $i = 1, \dots, 16$ is the market index, t is the time index and $\epsilon_{i,t}$ is the error term. α_i takes into account the heterogeneity across the market. Spatial autocorrelation has been tested and rejected. As for testing the impact of the single European M2 on office markets, it consists only of replacing $MI_{i,t}$ with the European M2 series index.

¹¹Between 3.5 and 5 months for the execution (Devaney and Scofield (2014)), plus the period between the change in monetary policy and the investment decision.

3.4 Elasticities of the European office markets to the monetary policies

Table 4 presents the estimations for the whole set of markets with the international monetary index and with the Eurozone-M2 series.

Table 4. Panel equation results for the entire sample.

Variables	Estimate	Estimate
Vacancy rate	-0.10 (***)	-0.09 (***)
Prime rent	0.04	0.05
Employment	1.39 (***)	1.32 (***)
Stock index	-0.03	-0.04 (**)
MI	0.13 (*)	
EURO		0.53 (***)
Adj. R ²	0.48	0.59

*Notes: Variables are in log-difference. *, **, *** indicates significance at 10%, 5% and 1%, respectively. The sample is composed of 128 observations.*

The variables are globally significant, except for the prime rent, and their signs are as expected. An increase in the vacancy rate has a negative price impact: if the occupancy rate becomes lower, the value of the building decreases due to a fall in demand and a higher investment risk. A rise in the employment level has a positive impact on the capital values because of a stronger demand. The stock index has a small or non-significant negative effect. It may be interpreted as an arbitrage behaviour: When the stock market decreases, investors tend to look for other asset classes.

The coefficients of the monetary series are positive and significant: an increase of the money supply growth has a positive impact on the office market. The massive money injection of the quantitative easing during the last years impacted the European building stock value. The level of significance and the coefficient are moderate for the international monetary supply with an elasticity of 0.13. For the European aggregate, the result is clearer and stronger with a substantial elasticity of 0.53. This result could be expected due to real estate's regional nature and its illiquidity. However, the

main insights stand in the structural heterogeneity.

4 Three wealth-reshaping trends supported by the new monetary policies

4.1 European metropolises: global connectivity or market size effect?

Here we want to determine whether the more advanced cities in the metropolisation process are also the most likely to benefit from the new international money flow. We organized the cities in sub-groups according to the GaWC, ranking them from the most metropolised to the least metropolised, and applied the model for the various groups.¹² Surprisingly, the results were the opposite of what we expected (Table 5). The most globally interconnected cities were not influenced by the international quantitative easing (insignificant coefficient), but the elasticity for the less connected was 0.25 and significant. The result also contradicts the European aggregate, which would lead us to believe that the less connected countries would benefit the most.

The GaWC index focuses on the network's connectivity effect by measuring the intensity of the relationship between the various cities. Our main monetary variables are exogenous to that structure. They first depend on the central banks' policies. The diffusion of the money supply is indeed not realized through the inter-city connectivity network. It is also interesting to notice the number of German markets in the last group.

More than the interconnectivity degree, the international investors' investment rules are relevant to understanding how a global money supply shock diffuses into offices prices across metropolises.

¹²The sub-groups were not disjointed, allowing us to determine a gradient for the monetary effect with the global effect in the middle. The first group is composed of the cities ranked alpha or beta in the GaWC, the fifth group is made of the gamma 3 cities and the unclassified ones, and the third group corresponds to the whole set. The second group is the whole set minus the less metropolised, and the fourth is the whole set minus the most metropolised. The series of sets corresponds to the sequence: A ; $A \cup B$; $A \cup B \cup C = \text{whole set}$; $B \cup C$; C .

The market depth and market liquidity are two crucial points for these actors. On that basis, several groups are defined, combining the market size as a proxy for the market depth and liquidity and the percentage of international investors. When we applied the model to these sub-groups, the results were coherent. The international and European monetary elasticities of the largest markets were almost twice that of the whole set (0.21 and 1.04). These markets exhibited a greater ability to capture the quantitative easing liquidities: a premium is given, driving prices up. As illustrated in Figure 3.2, the value of the offices' total stock in these metropolises increased more than in the last group (+20%). These results also indicate that the over-productivity of metropolises can be explained in addition to the factors mentioned above (cf. 2.c.) by their ability to capture the monetary policies' effects through the channel of the investor decisions.

Table 5. Panel equation results differencing metropolises and the other cities.

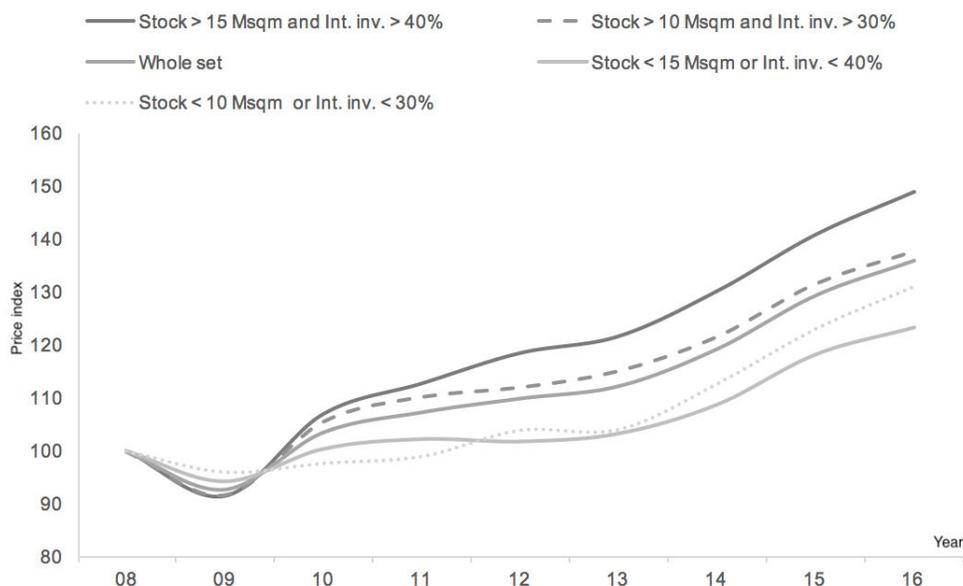
Metropolises sub-groups based on GaWC					
	Paris, Brussels, London, Madrid, Milan	Paris, Brussels London, Madrid, Milan, Amsterdam, Roma, Francfort, Lisbon, Vienna	Whole set	Amsterdam, Roma - Francfort, Lisbon, Vienna, Barcelona, Berlin, Hamburg, Munich Düsseldorf, Lyon,	Barcelona, Berlin, Hamburg, Düsseldorf, Lyon, Munich
Monetary Index	0.12	0.09	0.13 (*)	0.22 (**)	0.26 (**)
Euro index	0.51 (*)	0.46 (*)	0.53 (***)	0.68 (***)	0.92 (***)
Nb Observation	40	80	128	88	48
Metropolises sub-groups based on market stock and international investment					
	Stock > 15 M sqm and int. inv > 40%	Stock > 10 M sqm and int. inv > 30%		Stock < 15 M sqm or int. inv < 40%	Stock < 10M sqm or int. inv < 30%
	Berlin, Francfort, London, Madrid ¹³ Paris	Berlin, Francfort, London, Madrid, Paris, Brussels, Milan, Munich, Vienna	Whole Set	Brussels, Milan Munich, Barcelona, Amsterdam, Vienna Dusseldorf, Hamburg Lisbon, Lyon, Roma	Amsterdam, Lyon, Barcelona, Roma Dusseldorf, Hamburg, Lisbon
Monetary Index	0.21 (***)	0.17 (**)	0.13 (*)	0.17	0.17
Euro index	1.04 (***)	0.66 (***)	0.53 (***)	0.39	0.45
Nb Observation	40	72	128	88	56

Notes: Variables are in log-difference. *, **, *** indicates significant at 10%, 5% and 1% respectively

¹³Including also Madrid (14,948 Msqm)

Figure 3.2: Stock value variations between metropolises sub-groups: 2008-2016.

Source: MSCI, BNP Paribas Real Estate.



4.2 The ECB monetary policy: an institutional leverage effect for the German office markets

The puzzling results for the last GaWC group, including four German cities, and the historical filiation between the ECB and the Bundesbank, invited us to determine whether the German markets react differently (cf. Table 6). At first sight, they seemed able to capture the international liquidities (0.28 and significant), but when Berlin was removed, this feature disappeared. Regarding the ECB liquidities, the elasticity is strong, compared to the large market (cf. Table 5), and superior to 1. When the European monetary aggregate increased by 1%, the value of the real estate stock in these cities increased by more than 1%. The issue of an institutional leverage effect could be raised. As for the non-German markets, the effect is globally non-significant despite the presence of the big markets of Paris, London and Madrid in the subsets.

Table 6. Panel equation results differencing German market and the other cities.

	German markets vs the rest of Europe				
	Berlin, Dusseldorf, Frankfort, Hamburg, Munich	Berlin, Dusseldorf, Frankfort, Hamburg, Munich, Brussels, Amsterdam, Vienna	Whole set	Amsterdam, Brussels, Vienna, Barcelona, Lisbon, London, Lyon Madrid, Milan, Paris Roma	Barcelona, Lisbon London, Lyon Madrid, Milan Paris, Roma
Monetary index	0.28 (**)	0.16	0.13 (*)	0.07	0.07
Euro index	1.12 (***)	0.58 (***)	0.53 (***)	0.24	0.38
Nb Observation	40	64	128	88	64

Notes: Variables are in log-difference. *, **, *** indicate significance at 10%, 5% and 1%, respectively

If we consider that the main channel for liquidities to go from the ECB up to specific markets is through investors' decisions, the practical plausibility of investing in Germany during that period has to be analysed. The reorientation of the capital previously invested in bonds toward real estate assets necessitated the comparison of opportunities between the various cities. For obvious reasons, the Southern markets were not attractive during that period. The small or medium markets of Brussels, Amsterdam, Vienna and Lyon, although more stable, were lacking sufficient depth to easily absorb these investments. As for the more mature markets of London and Paris, they were already very expansive compared to the German markets (at least twice as high). Aside from these relative elements, Germany's quick recovery after the GFC also reassured real estate investors, who were generally strongly risk-averse, and helped attract the money supply. On the demand side, the urban need to increase the spatial concentration of the services sector in the main metropolises¹⁴ probably also played a role in this flight of the monetary liquidities to Germany.

The indirect fuelling of the German markets by the ECB is of the first order. Compared to the other markets, the valuation spread reached 25% by the end of 2016 (Figure 3.3). The vacancy rate and the employment level, usually fundamental drivers of the office markets, are no more significant in the panel model, which indicates a certain degree of disconnection between the traditional economic drivers and the situation of the German markets in that period.

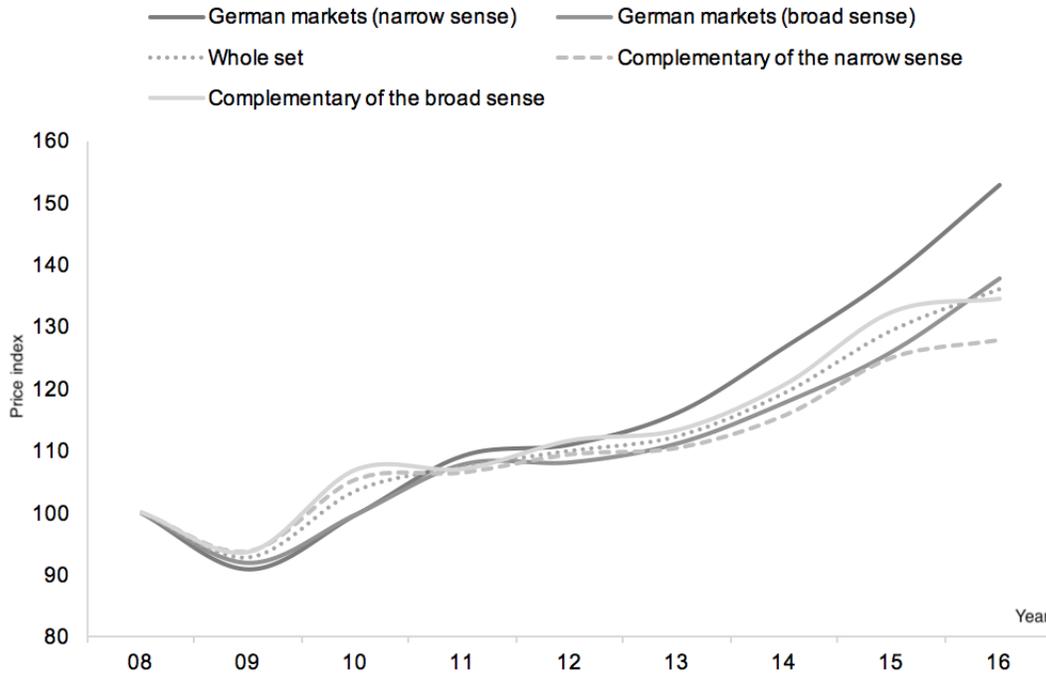
4.3 The revival of the megalopolitan advantage

Does the new federal monetary policy of the ECB tend to reinforce the historical European megalopolis? To distinguish the megalopolis from the European urban centres, we first adopt a restrained delimitation. We exclude London, Paris, and Lyon in the West and Berlin in the East. It is limited

¹⁴We can note the German population's negative demographic trend and the unavoidable ongoing spatial wealth reshaping (Bartholomae et al. 2017).

Figure 3.3: Stock value variations between the German segmentation sub-groups: 2008-2016.

Source: MSCI, BNP Paribas Real Estate.



to a territorial band stretching from the enlarged Rhineland system in the North to Northern Italy in the South, its historical shape inherited from the Braudelian analysis of Europe at the medieval stage. For a second time, we extended the megalopolis to its broad sense, including these four cities. It follows a notion of peripherals in a broad and a narrow sense.

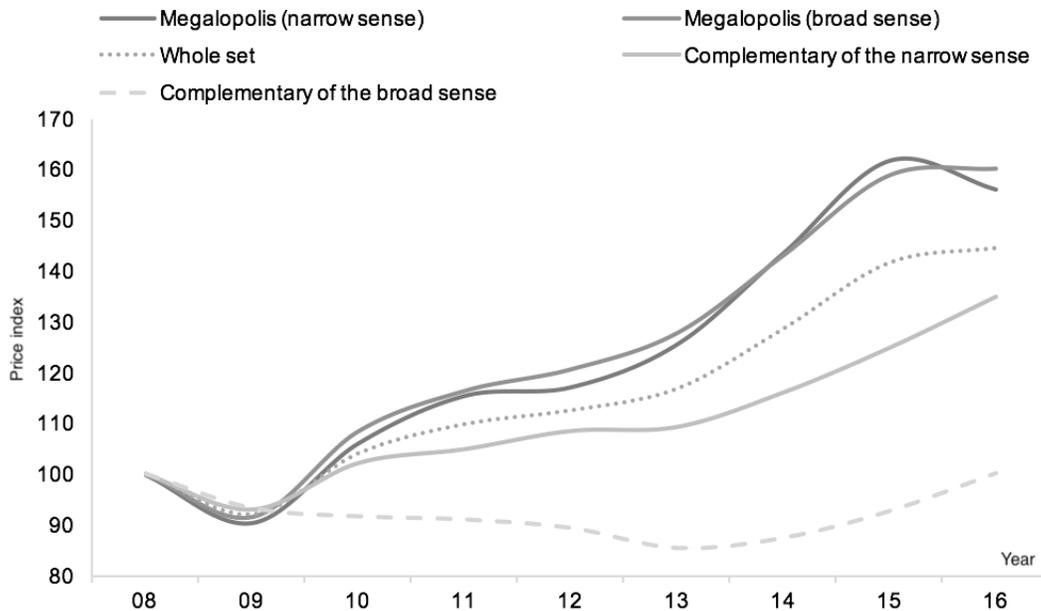
Table 7. Panel equation results differencing markets in the megalopolis and peripheral markets.

European megalopolis vs peripheral market					
	Amsterdam, Brussels, Dusseldorf, Frankfort, Munich, Milan	Amsterdam, Brussels, Dusseldorf, Frankfort, Munich Milan, London Paris, Berlin, Lyon	Whole set	London, Paris, Lyon, Berlin, Hamburg, Barcelona, Lisbon, Madrid, Roma Vienna	Hamburg, Barcelona, Lisbon Madrid, Roma Vienna
	Narrow sense	Broad sense		Complementary of the narrow sense	Complementary of the broad sense
Monetary index	0.17	0.19	0.13 (*)	0.10	0.18
Euro index	0.63 (**)	0.55 (**)	0.53 (***)	0.45 (*)	0.52
Nb Observation	48	80	128	80	48

*Notes: Variables are in log-difference. *, **, *** indicate significance at 10%, 5% and 1%, respectively*

The elasticities are presented in Table 7. The effect of the international monetary supply on the narrow megalopolis is non-significant (the significance for the broad sense is mainly due to the inclusion of three large markets of Paris, Berlin and London). On the contrary, the European aggregate is clearly significant. The megalopolis tends to better capture the ECB liquidities whereas the peripheral markets do not benefit from the new monetary policies. When we turn to the evolution of the office stock, the difference is striking. If the spread for the metropolises and the German markets is around 25%, the spread between the megalopolitan markets and the peripheral ones reaches 50% (Figure 3.4).

Figure 3.4: Stock value variations for the megalopolitan sub-groups: 2008-2016.
Source: MSCI, BNP Paribas Real Estate

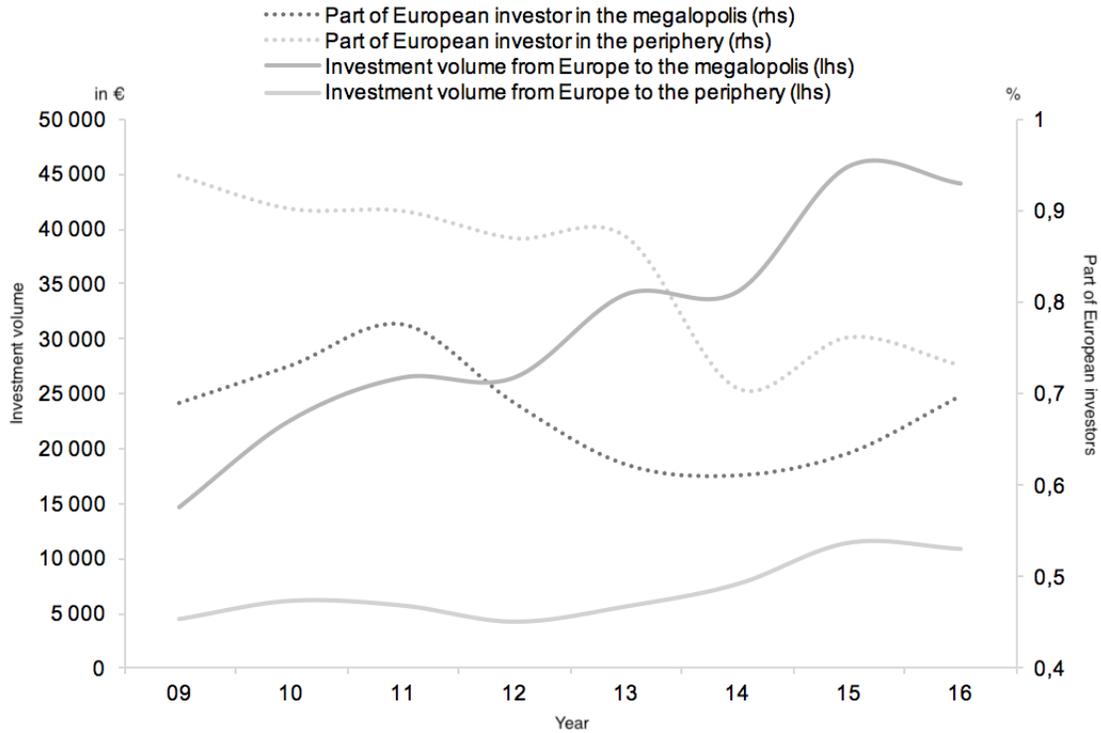


This ongoing gap creation also occurs in the investment shares (Figure 3.5). The European investments percentage decreased in the peripheral markets but remained constant for those in the megalopolis. Although the European amounts invested in the megalopolis were multiplied by

three during that period (in absolute terms), for the peripheral, it just doubled. Although the new European monetary policies have been introduced essentially to support Southern European peripheral markets, the main beneficiaries are the megalopolitan markets. These results directly question the quality of intra-European solidarity under the new monetary regime.

Figure 3.5: European investments in the megalopolis and in the periphery: 2009-2016.

Source: BNP Paribas Real Estate



5 Conclusion

The purpose of this paper was to study the effect of the new European and global monetary policies on sixteen important and contrasting office markets in Western Europe. Based on theoretical, empirical and practical arguments, we have shed light on a positive relationship between money supplies

and office prices. The findings show that global metropole connectivity is not the channel by which the liquidities circulate, and the large markets are more able to attract these liquidities. It has also been established that the German markets greatly benefit from the Eurozone money supply but not from the international liquidities, except for Berlin. Also, some important economic fundamentals are surprisingly insignificant in terms of their price dynamics. Regarding the European megalopolis, results indicate its very long-term ability to capture capital is also effective throughout these new monetary policies.

The office prices' elasticity for the European aggregate is four times higher than for the international aggregates. This stylized fact highlights the role of European sovereignty. The optimal federal monetary policy of the ECB in a not completely federal union tends to produce implicit wealth reallocation movements across states. Studying the link between money supply and office prices was a relevant occasion to observe these implicit lines along which the driving forces are acting, favouring or even leveraging some metropolises and forgetting others. According to the retained criteria, the building stock valuation spread between sub-groups of cities ranges between 20% and 50%.

Several limits have to be mentioned. Due to data availability issues, the studied office markets are those in Western Europe. However, the European monetary effects on the Central and Eastern markets deserve exploration. Similarly, the monetary effects on office values in the medium and small cities could be studied. Last, the heterogeneous price responses across Europe to the new monetary policies for housing and other real estate assets require analysis.

The "ECB conservatism", a supposed Bundesbank legacy for which the European institution is often blamed, is a hardly defensible opinion today after the strong evolution of the ECB mandates. However, the paradoxical effects of the new monetary policies, essentially made to support peripheral markets but mostly favouring the metropolises, the German cities and the megalopolis, raise

some challenging economic and political questions. Should Europe consider derogative measures for the SGP to compensate for these unwanted effects? Would new European planning investments be necessary to rebalance these divergences?

BIBLIOGRAPHY

- [1] APPERT, M. Les JO 2012 à Londres: un grand événement alibi du renouvellement urbain à l'est de la capitale. *Géoconfluences* (2012).
- [2] ARRIGHI, G. *The long twentieth century: Money, power, and the origins of our times*. Verso, 1994.
- [3] BAETEN, G. The Europeanization of Brussels and the Urbanization of 'Europe' Hybridizing the City. Empowerment and Disempowerment in the EU District. *European Urban and Regional Studies* 8, 2 (2001), 117–130.
- [4] BAIGENT, E. Patrick Geddes, Lewis Mumford and Jean Gottmann: divisions over 'megapol is'. *Progress in Human Geography* 28, 6 (2004), 687–700.
- [5] BARTHOLOMAE, F., WOON NAM, C., AND SCHOENBERG, A. Urban shrinkage and resurgence in Germany. *Urban Studies* 54, 12 (2017), 2701–2718.
- [6] BEAVERSTOCK, J. V. German cities in the world city network. *Raumforschung und Raumordnung* 69, 3 (2011), 213–217.
- [7] BEAVERSTOCK, J. V., SMITH, R. G., TAYLOR, P. J., WALKER, D., AND LORIMER, H. Globalization and world cities: some measurement methodologies. *Applied geography* 20, 1 (2000), 43–63.

- [8] BELKE, A., ORTH, W., AND SETZER, R. Liquidity and the dynamic pattern of asset price adjustment: A global view. *Journal of Banking & Finance* 34, 8 (2010), 1933–1945.
- [9] BERNANKE, B. S., AND KUTTNER, K. N. What explains the stock market’s reaction to Federal Reserve policy? *The Journal of finance* 60, 3 (2005), 1221–1257.
- [10] BERROIR, S., CATTAN, N., DECROLY, J.-M., FLEURY, A., AND GUÉROIS, M. Les mobilités internationales en Europe. Berlin, Bruxelles, Londres et Paris dans les nouveaux réseaux territoriaux. *Géocarrefour* 84, 3 (2009), 151–161.
- [11] BEYER, A., DOORNIK, J. A., AND HENDRY, D. F. Constructing Historical Euro-zone Data. *The Economic Journal* 111, 469 (2001), 102–121.
- [12] BRAUDEL, F. *Civilization and capitalism, 15th-18th century, vol. III: The perspective of the world*. Univ of California Press, 1982.
- [13] BROUNEN, D., AND JENNEN, M. Local office rent dynamics. *The Journal of Real Estate Finance and Economics* 39, 4 (2009), 385–402.
- [14] BRUNET, R. *Les villes " européennes ": rapport pour la DATAR, Délégation à l’Aménagement du Territoire et à l’Action Régionale*. La Documentation Française, 1989.
- [15] CALAFATI, A. G. *Economie in cerca di città: la questione urbana in Italia*. Donzelli Editore, 2009.
- [16] CATTAN, N. Comparative Studies of sets of European Cities: an overview. *Urban Networks in Europe* (1996), 237–250.
- [17] CATTAN, N. *Cities and networks in Europe: a critical approach of polycentrism*. John Libbey Eurotext, 2007.
- [18] CATTAN, N., AND SAINT-JULIEN, T. Modèles d’intégration spatiale et réseau des villes en Europe occidentale. *L’Espace géographique* (1998), 1–10.
- [19] CHIANG, Y., SA AADU, J., AND SHILLING, J. Unconventional monetary policy and U.S. housing markets dynamics. *working paper University of Iowa* (2015).

- [20] CLARIDA, R., GALI, J., AND GERTLER, M. Monetary policy rules in practice: Some international evidence. *European Economic Review* 42, 6 (1998), 1033–1067.
- [21] COCHRANE, A., AND JONAS, A. Reimagining Berlin: world city, national capital or ordinary place? *European urban and regional studies* 6, 2 (1999), 145–164.
- [22] COËN, A., LEFEBVRE, B., AND SIMON, A. International money supply and real estate risk premium: The case of the London office market. *Journal of International Money and Finance* 82 (2018), 120–140.
- [23] COLOMBO, R. Processes of Globalization in Madrid: Indicators and Analysers for a Contemporary Metropolis. *Urbanities* 6, 1 (2016), 90–105.
- [24] D’ARGENSIO, J.-J., AND LAURIN, F. The real estate risk premium: A developed/emerging country panel data analysis. *The Journal of Portfolio Management* 35, 5 (2009), 118–132.
- [25] DAVEZIES, L. La République et ses territoires. La circulation invisible des richesses. *Lectures, Les livres* (2008).
- [26] DAVIS, J., AND THORNLEY, A. Urban regeneration for the London 2012 Olympics: Issues of land acquisition and legacy. *City, Culture and Society* 1, 2 (2010), 89–98.
- [27] DE WIT, I., AND VAN DIJK, R. The global determinants of direct office real estate returns. *The Journal of Real Estate Finance and Economics* 26, 1 (2003), 27–45.
- [28] DEMATTEIS, G. Towards a unified metropolitan urban system in Europe: Core centrality versus network distributed centrality. *Urban networks in Europe* (1996), 19–28.
- [29] DERUDDER, B., HOYLER, M., TAYLOR, P. J., AND WITLOX, F. *International handbook of globalization and world cities*. Edward Elgar Publishing, 2012.
- [30] DEVANEY, S., AND SCOFIELD, D. Time to transact: measurement and drivers. In *Investment Property Forum, September* (2014).
- [31] FELDSTEIN, M. Quantitative easing and America’s economic rebound. *Project Syndicate* (2011).

- [32] FOURÇANS, A., AND VRANCEANU, R. The ECB interest rate rule under the Duisenberg presidency. *European Journal of Political Economy* 20, 3 (2004), 579–595.
- [33] FUJITA, K., AND HILL, R. C. Place Stratification in Tokyo and New York. *Durban, South Africa* (2006).
- [34] GELTNER, D., MILLER, N. G., CLAYTON, J., AND EICHHOLTZ, P. *Commercial real estate analysis and investments*, vol. 1. South-western Cincinnati, OH, 2001.
- [35] GHORRA-GOBIN, C. *La métropolisation en question*. Presses Universitaires de France, 2015.
- [36] GIESE, J. V., AND TUXEN, C. K. Global Liquidity, Asset Prices and Monetary Policy: Evidence from Cointegrated VAR Models. *Nuffield College, University of Oxford, and Department of Economics, Copenhagen University* (2007).
- [37] GILLI, F. *Grand Paris: l'émergence d'une métropole*. Presses de Sciences Po, 2014.
- [38] GOTTMANN, J. *Megalopolis: the urbanized northeastern seaboard of the United States*. Twentieth Century Fund Study. M.I.T. Press, 1961.
- [39] HALBERT, L. *L'avantage métropolitain*. Presses universitaires de France, 2015.
- [40] HANES, J. E. From megalopolis to megaroporisu. *Journal of urban history* 19, 2 (1993), 56–94.
- [41] HUYSSSEUNE, M., AND JANS, T. Brussels as the Capital of a Europe of the Regions? *Brussels Studies*, 16 (2008).
- [42] ISOMURA, E. Nihon no megaroporisu-sono jitai to miraizo (Megalopolis in Japan-its reality and future). *Nihon Keizai Shimbunsha* (1969).
- [43] JON FAUST AND JOHN H. ROGERS AND JONATHAN H. WRIGHT. An empirical comparison of Bundesbank and ECB monetary policy rules. International Finance Discussion Papers 705, Board of Governors of the Federal Reserve System (U.S.), 2001.
- [44] KAIKA, M. Architecture and crisis: re-inventing the icon, re-imag (in) ing London and re-branding the City. *Transactions of the Institute of British Geographers* 35, 4 (2010), 453–474.
- [45] KRUGMAN, P. Increasing returns and economic geography. *Journal of political economy* 99, 3 (1991), 483–499.

- [46] LANG, R. E., BLAKELY, E. J., AND GOUGH, M. Z. Keys to the new metropolis: America's big, fast-growing suburban counties. *Journal of the American Planning Association* 71, 4 (2005), 381–391.
- [47] LANG, R. E., AND DHAVALÉ, D. Beyond megalopolis: Exploring America's new "megapolitan" geography. Tech. rep., Metropolitan Institute Census Report Series, 2005.
- [48] MARCHAL, H., AND STÉBÉ, J.-M. *Les grandes questions sur la ville et l'urbain*. Presses universitaires de France, 2011.
- [49] MICOSSI, S. The monetary policy of the European Central Bank (2002-2015). Tech. Rep. 109, CEPS Special Report, 2015.
- [50] MOUZAKIS, F., AND RICHARDS, D. Panel data modelling of prime office rents: a study of 12 major European markets. *Journal of Property Research* 24, 1 (2007), 31–53.
- [51] PATELIS, A. D. Stock return predictability and the role of monetary policy. *The Journal of Finance* 52, 5 (1997), 1951–1972.
- [52] PIMLOTT, B., AND RAO, N. *Governing London*. OUP Oxford, 2002.
- [53] PIRENNE, H. The stages in the social history of capitalism. *The American Historical Review* 19, 3 (1914), 494–515.
- [54] PIRENNE, H. *Medieval cities: Their origins and the revival of trade*. Princeton University Press, 2014.
- [55] PUMAIN, D., AND SAINT-JULIEN, T. Urban networks in Europe. *John Libbey Eurotext INED* (1996).
- [56] RUDEBUSCH, G. D. Term structure evidence on interest rate smoothing and monetary policy inertia. *Journal of monetary economics* 49, 6 (2002), 1161–1187.
- [57] SASSEN, S. *The global city: New York, London, Tokyo*. Princeton University Press, 2001.
- [58] SAUER, S., AND STURM, J.-E. Using Taylor rules to understand European Central Bank monetary policy. *German Economic Review* 8, 3 (2007), 375–398.

- [59] SÉNÉCAL, G., AND BHERER, L. *La métropolisation et ses territoires*, vol. 11. PUQ, 2009.
- [60] SIVITANIDOU, R., AND SIVITANIDES, P. Office capitalization rates: Real estate and capital market influences. *The Journal of Real Estate Finance and Economics* 18, 3 (1999), 297–322.
- [61] SPUFFORD, P. *Power and profit: the merchant in medieval Europe*. Thames & Hudson London:, 2002.
- [62] STURM, J.-E., AND WOLLMERSHÄUSER, T. The stress of having a single monetary policy in Europe. CESifo Working Paper Series 2251, CESifo Group Munich, 2008.
- [63] TAYLOR, J. B. Discretion versus policy rules in practice. In *Carnegie-Rochester conference series on public policy* (1993), vol. 39, Elsevier, pp. 195–214.
- [64] TAYLOR, P., DERUDDER, B., SAEY, P., AND WITLOX, F. *Cities in Globalization: Practices, policies and theories*. Routledge, 2006.
- [65] TAYLOR, P. J., AND DERUDDER, B. *World city network: a global urban analysis*. Routledge, 2016.
- [66] TAYLOR, P. J., HOYLER, M., AND SÁNCHEZ-MORAL, S. European Cities in Globalization: a comparative analysis based on the Location Strategies of Advanced Producer Services. In *Service Industries and Regions*. Springer, 2013, pp. 285–304.
- [67] VAN DEN BERG, L., BRAUN, E., VAN DER MEER, J., ET AL. *National policy responses to urban challenges in Europe*. Ashgate Publishing, 2007.
- [68] VELTZ, P. Mondialisation, villes et territoires. *L'économie d'archipel* (1996).
- [69] VICINO, T. J., HANLON, B., AND SHORT, J. R. Megalopolis 50 years on: The transformation of a city region. *International Journal of Urban and Regional Research* 31, 2 (2007), 344–367.
- [70] WATT, P. ‘It’s not for us’ Regeneration, the 2012 Olympics and the gentrification of East London. *City* 17, 1 (2013), 99–118.
- [71] WRIGHT, H. *London High. A Guide to the Past, Present and Future of London’s Skyscrapers*. Frances Lincoln, 2006.

CHAPTER 4

RENTAL ADJUSTMENT IN EUROPEAN OFFICE MARKETS: GLOBAL OR LOCAL EFFECT?

Keywords : Office market, Rental dynamics, Panel VAR, Natural vacancy rate, European integration.

Mots-clés : Marché des bureaux, Dynamiques des loyers, Panel VAR, Taux de vacance naturel, Intégration européenne.

ABSTRACT

The purpose of this study is to deeply investigate the rental dynamics of the European office market during a long period (2002-2017). This paper analyses the global and local dynamics of the 26 largest European office markets. First we estimate a dynamic panel vector autoregressive (PVAR) modelling. Then, we estimate the same equation for each market individually. Our modelling at two levels highlights a significant heterogeneity across European office markets. Finally, we revisit the natural vacancy rate theory. We show that European office markets currently exhibit vacancy rates below their natural rates suggesting relevant opportunities for real estate portfolio investors.

RÉSUMÉ

Cette étude s'intéresse à la dynamique des loyers sur les principaux marchés de bureaux en Europe pour une longue période (2002-2017). Ce papier analyse les dynamiques globales et locales des 26 plus gros marchés en Europe. Tout d'abord, nous estimons un vecteur autoregressif en panel (PVAR), puis un vecteur autoregressif (VAR) pour chaque marché individuellement. Notre modélisation à deux niveaux met en avant une importante hétérogénéité sur les marchés des bureaux en Europe. Enfin, nous revisitons la théorie du taux de vacance naturel. Nous montrons que la plupart des marchés européens ont actuellement des taux de vacance inférieurs à leurs taux de vacance naturels, suggérant des opportunités d'investissement significatives pour les investisseurs immobiliers.

1 Introduction

This paper proposes a global analysis of rental dynamics in a large sample of European commercial office markets between 2002 and 2017. This period begins with the adoption of the Euro, and it also encompasses the unprecedented Global Financial Crisis (GFC) and the European sovereign debt crisis. Since the seminal work by Blank and Winnick (1953), important literature has been devoted to the relationship between rent and vacancy rates in real estate markets. Here, we revisit the vacancy rate theory with dynamic panel vector autoregressive (PVAR) modelling for the main 26 European office markets. Nowadays, Europe is the first region for institutional investors, just before the United States. These two geographical areas account, respectively, for 35% and 34% of the institutional investors' portfolio in 2017. While we may assume that rental formation in the US might have the same structure across the markets (with some differences on urbanism or construction regulations), the situation for European real estate markets should be more contrasted. Therefore, we suggest the use of a panel VAR to treat the European market as a global combination. Our first objective is to examine if the same assumption of integration could be made for Europe. Several empirical articles analysed the dynamics of vacancy and rent dynamics. They use residential (Eubank and Sirmans, 1979; Rosen and Smith, 1983) or commercial real estate market data (Shilling et al., 1987; Wheaton and Torto, 1988; Hendershott, 1996; Hendershott et al., 2002, 2010, 2013; Englund et al., 2008; Brounen and Jennen, 2009; Ibanez and Pennington-Cross, 2013 and more recently Chau and Wong, 2016). However, to our knowledge, no previous study used a robust dynamic panel VAR econometric method to examine a large sample of European office markets during a long period with unprecedented economic events. We follow the panel VAR approach developed by Love and Zicchino (2006) and Canova et al. (2007). The rent dynamics are studied at two levels: pan-European and a local segmentation. Our results report a partial segmentation of the European office markets.

Our modelling highlights a significant heterogeneity. To deepen the analysis, we also revisit the natural vacancy rate theory and provide empirical benchmarks for each office market. We establish that European office markets currently have vacancy rates below their natural levels, suggesting different opportunities for real estate portfolio investors.

This article is organized as follows: Section 2 is devoted to a synthetic literature review. Section 3 introduces our conceptual and theoretical framework with the dynamic PVAR. Section 4 presents the data for the office markets. Section 5 provides empirical results and robustness checks at European and local levels, with a specific focus on the natural vacancy rate. Section 6 summarizes the main results of the paper.

2 Literature review

The academic research on commercial office markets has often been constrained by the lack of data. In particular, the European data on the direct real estate market are in general private and mostly cover short periods. Even so, we have seen significant developments in the analysis of office market rental dynamics in the last three decades. Two major theoretical frameworks have been developed over time to estimate the main drivers of commercial office rent.

The first is based on the natural vacancy rate theory, introduced by Blank and Winnick (1953). The natural vacancy rate is defined as the vacancy rate for which the market rent is at the equilibrium. If the actual vacancy rate is greater than the natural one, rents should experience a downward pressure to equilibrate the market. This rental decrease would imply a greater demand and a reduction of the available space. The opposite reasoning is also possible with a shortage of supply and an upward adjustment of the rental values. We have:

$$f(R_t) = g(V_t - V^*),$$

where R_t and V_t are the rental value and the vacancy rate at time t . V^* is the natural vacancy rate. The variables f and g are two adjustment functions.

The main studies with this type of modelling focus on the US market due to data availability (both the available variables and the length of the time series). Rosen (1984) was one of the first to implement this theory in a multiple equation model to estimate residential rents across the San Francisco area between 1961 and 1983. The supply side was estimated using the lagged vacancy rate, the construction costs, taxes and interest rates. The demand side was a function of the rents and the employment level. Wheaton (1987) also used this model on the US office market for the period of 1960-1986 at the national scale.

In Europe, rental studies have often been published on the London market due to the availability of the vacancy rate. Wheaton et al. (1997) modelled the rental adjustment process in London from 1970 to 1995. More recently, Malle (2010) used a multiple-equations model to study the Parisian office market. The first equation explained the occupied stock using the office-based employment and the rent. The second equation explained the new office supply by rental values, occupied space, the cost of construction index and interest rates. An error-correction model was used to estimate the relationship between the rental level and the vacancy rate.

The second approach consists of estimating rental dynamics using a unique equation with a sample of variables representing the supply and the demand sides. Such a single-equation model mainly tries to estimate the statistical relationship between commercial office rent and economic

activity. It can be written as:

$$f(R_t) = h_1(\tilde{S}) + h_2(\tilde{D}) + h_3(R_{t-1}),$$

where R_t , \tilde{S} and \tilde{D} are, respectively, the rental value, the supply and the demand variables. The functions f , h_1 , h_2 and h_3 are adjustment functions. As the rental values are highly dependent on their past values, the lagged rent is also incorporated.

Several studies chose this kind of approach due to its simplicity and the low real estate data requirement. Hekman (1985) was one of the first to use this approach; he expressed the rent as a function of the vacancy rate, the GDP, the employment level and the unemployment rate for 14 markets across the US. McGough and Tsolacos (1994) used VAR modelling to estimate the relationship between rent, company profits, business surveys and the construction level.

Some studies focused on the European office market. D'Arcy et al. (1997) estimated the rental dynamics of 22 European cities using a time-series cross-sectional methodology. They found that GDP changes and the interest rate have a significant impact on European rental values. D'Arcy et al. (1999) examined the short-run adjustment process of Dublin office rent for the period from 1970 to 1997. Changes in GDP and office stock were the main factors that influenced the rental dynamic. Mouzakis and Richards (2007) used a panel data technic to explain rental growth across 12 office markets in Europe. Their model provided new insight into the intradependencies of the markets. It also made possible the comparison of adjustment speeds along the long-run equilibrium across the European market. They reported that London, Amsterdam, Dublin and Madrid seemed to respond more quickly to a change in the explanatory variables (the local level GVA for market services, the total office floorspace and the Prime real office rents). Brounen and Jennen (2009) also developed

rent-adjustment models for 10 European office markets from 1990 to 2006 using a two-stage error correction model. They found that the local variables do not perform better than national ones. From that perspective, Hekman (1985) argued that national variables perform poorly as soon as they do not move in tandem with local variables.

However, as the role of public and private services is increasingly important in the global economy across Europe, there is a need to better understand office market dynamics. The need for office space should rise as Europe is moving towards a service economy. Indeed, the majority of previously mentioned studies either focused on a single market or used an econometric approach that does not fit with actual modelling technics (Tsolacos et al., 1998). The lack of rental dynamics studies at a pan-European level is important in real estate literature.

The issue of integration between the various European countries and the current econometric technics brought us to consider using panel vector autoregression (PVAR).¹ In this case, European office markets are supposed to have the same structure and be impacted by the same economic variables. The long-term dynamics of the real estate market may be the same for various European markets. Panel VAR allows researchers to study interdependencies across markets in an unrestricted model while controlling local heterogeneity with a cross-sectional dimension. Love and Zicchino (2006) were one of the first to use the panel VAR. They estimated a firm-level panel for 36 countries to study the dynamics of firms' financial conditions and investment levels. They supposed that the structure was the same for all countries, allowing for unobserved individual heterogeneity. Since then, panel VAR has been used to address issues of interest mainly for policymakers or macroe-

¹European integration is the process of economic, political, social and cultural integration of states. It involves the transfer of national sovereignty to a supranational organization (the European Union or the Council of Europe).

conomists. For example, Canova et al. (2007) used a panel VAR to study the similarities among G7 economic cycles. Panel VAR is also interesting for capturing the transmission of shocks across countries (Canova et al. 2012, Ciccarelli et al., 2012 and Caivano, 2006). Finally, panel VAR is also used to estimate the average effect among a group of heterogeneous individuals (firms, countries, etc.) following a shock or a change in policy (Canova and Pappa, 2005, 2007).

By combining these two approaches in the present research, we provide a general overview of the commercial office rent dynamics at a pan-European level. First, we consider that European markets follow the same economic structure and we examine their interdependencies. However, the heterogeneity of the real estate market also requires that we consider a more traditional method (an equation controlling for the demand and supply side) for each market to estimate and compare the local dynamics.

3 Theoretical framework: economic modelling

3.1 Vector autoregression model

Vector autoregression models are well established in macroeconomic studies and allow the lagged analysis of statistical relationships between a set of endogenous variables. VAR models are an alternative to classical simultaneous equations. They are useful for describing the dynamic of economic and financial time series. They also have great forecasting power and often outperform univariate models and multiequation models.

A VAR(p) with k endogenous variables is a system of k equations of identical structure with p lags. Formally, a VAR model is defined by:

$$Y_t = \mu + A_1 Y_t + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + \epsilon_t, \quad (4.1)$$

where Y_t is a k -dimensional vector of endogenous variables, μ is a deterministic vector and ϵ_t is the error term. Before estimating a VAR model, the stationarity of the variables needs to be checked.

However, a simple VAR modelling does not take into account the interdependences that may exist across real estate sectors and across European countries. A complementary approach consists in considering a panel VAR.

3.2 Panel data vector autoregression

Before estimating a single VAR model for each of the 26 markets, we first estimate a panel VAR model (PVAR). This modelling allows us to treat economies, regions or markets as a global combination and not in isolation.

PVAR modelling combines traditional vector autoregressive approaches and considers all the variables as endogenous with a panel data approach. This choice assumes that existing individual heterogeneity in the data sample is captured using a fixed effect. Indeed, by using a vector autoregressive model on panel data, we hypothesize that the structure is the same for each cross-sectional unit.

More formally, we consider a panel VAR with k endogenous variables of order p with a panel-specific fixed effect:

$$Y_{it} = \sum_{p=1}^n A_p Y_{it-p} + X_{it}B + u_{it} + \epsilon_t, \quad (4.2)$$

where Y_{it} is a vector of k endogenous variables for each cross-sectional unit i , A_p is a vector of coefficient, X_{it} are exogenous variables, u_{it} are the fixed effect and ϵ_t is the error term.²

The Levin, Lin Chu (LLC) and the Im, Pesaran, Shin (IPS) tests are used to ensure the stationarity of the variables using first differences of the log-transformed variables.

4 Data

Our market data comes from the Property Market Analysis (PMA) database, which contains quarterly real estate information for most of the biggest European markets. For our study, we retain 26 markets between 2002 and 2017.

Table 1 presents the list of markets and their real estate fundamentals. The number of markets varies widely across countries, with UK and Germany more represented than others. Due to the high heterogeneity of the assets and of the markets even within the same country, such a prevalence will not bias our estimation by overweighting the coefficients. Each market differs in terms of maturity, but also in terms of volatility. For example, due to German history, Berlin can be seen as a less mature market than Frankfurt. Indeed, Berlin has had major real estate development since 2009 with international investments and an important number of transactions, while Frankfurt had its major development in the early 2000s with the implantation of the Eurozone institutions. Then we could easily compare Central London and Manchester to understand how the volatility can differentiate the markets. Central London is a more volatile market because the market is more reactive to the international context and thus to contemporaneous shocks.

For the market variables, we retain the level of the Prime rental value (PR) and the vacancy rate (VR). The Prime rent is the top headline rent for an office unit of standard size but of the highest

²Because of the Nickell bias, we estimate our equation using the Generalized Method of Moment rather than a classic OLS.

quality and specifications and in the best location within its market. To remove the scale effect (due to the wide range of rental values across European market) and the inflation component, we construct a deflated rent index. The vacancy rate is also used. It is the ratio between the immediately available supply and the existing stock. It is a proxy for market liquidity and for the risk faced by investors (D'Argensio and Laurin, 2009).

Table 1. Stock and investment volume of the European real estate markets in 2017

Source: BNP Paribas Real Estate.

Market	Stock (in thousands of sqm)	Invested volume (in billions of €)		Stock (in thousands of sqm)	Invested volume (in billions of €)
Amsterdam	7.203	3.354	Frankfurt	15.519	5.611
Barcelona	5.635	.851	Glasgow	1.660	.293
Berlin	19.395	5.072	Hamburg	13.934	1.626
Birmingham	1.487	.677	Helsinki	8.752	4.120
Brussels	13.335	1.487	Lisbon	4.667	.728
Budapest	3.415	1.284	Madrid	14.942	1.501
Central London	20.703	16.768	Manchester	1.811	.875
Central Paris	35.253	15.621	Munich	20.743	2.612
Cologne	7.905	.799	Prague	3.342	1.018
Copenhagen	5.876		Stockholm	12.425	1.406
Dublin	3.950	.807	Vienna	11.200	2.800
Dusseldorf	9.358	2.258	Warsaw	5.395	.415
Edinburgh	2.063	.401			

For the economic variables, we used the companies' margin (CM), the country openness index (OI) and the level of employment (Emp). The companies' margin is the ratio between the gross operating surplus and the value added.³ It refers to the remaining percentage of value added after wages and taxes and reflects the investment capacity of the companies. Following the international business

³In national accounts, the gross value added is defined as the gross output less the cost of intermediate goods and services. The gross operating surplus (or GOS) is the value added minus the compensation of employees, taxes and subsidies on production and imports. (Eurostat).

literature (Krugman, 1980), the openness index has been developed to measure the impact of trade on a domestic economy. It is computed by dividing the sum of a country’s imports and exports by its GDP. This index can be related to the companies’ exposure to external events. Indeed, if the index is low, this means that a country is less dependent on other countries. Finally, we use the total employment level. As we study the office market for the biggest European cities and the largest service-based economies, we may assume that the total employment level is a good proxy for office demand. This variable is expected to have a positive impact on rent since employment growth increases the demand and reduces the available space. Unfortunately, this data is available in most European countries at the national level. It is thus a simplification to consider that national employment may have an impact on the local market. Eurostat estimates the NUTS3 employment level every year.⁴ It seems acceptable to suppose that the national quarterly variation of the employment level is the same as the regional one because the markets we chose are the biggest cities of each country.⁵

5 Empirical analysis: Results

5.1 Rental value growth: a global effect?

For the whole period (2002 Q1 to 2017 Q4) and considering all the markets, the rent index lagged by one period, the margin of the companies, the employment growth and the vacancy rate are

⁴NUTS refers to the Nomenclature of Territorial Units for Statistics and is a standard geocode for referencing the subdivisions of countries across Europe. For the NUTS3, the population of the administrative units should be between 150,000 and 800,000 inhabitants.

⁵The methodology we apply is the following: Let’s consider emp_t and emp_{t-4} the employment level for a specific NUTS, on two consecutive years, with ν_t as the national variation of the employment level between the quarter $i - 1$ and i . We want to estimate such as:

$$\text{emp}_t = \text{emp}_{t-4} \prod_{i=t-3}^t \left(1 + \frac{\nu_t + x}{100} \right)$$

significant in explaining the rent dynamic. The autoregressive parameter is highly significant. This means that the actual market Prime rent is partially determined by the rent of the previous period. The margin of the companies is also positive and highly significant. This result is expected as the size of a company (and its need for offices) is related to its margin; when the health of the company is better, its demand for office space should increase and positively impact rent. The coefficient for the employment growth is also positive and significant. This result is well known in the literature (Rosen, 1984 or Wheaton et al., 1997 among others): a growth in employment implies a rise in office demand and less available space followed by a rise in rent. Finally, the vacancy rate has a negative effect on rental values. Indeed, rent is supposed to move in an opposite direction compared to the vacancy rate; when vacancy increases, the available supply rises and rent is supposed to decrease to equilibrate the market.

Table 2. Panel VAR results for the entire sample: 2002-2017.

	$\Delta\ln(RI_t)$	$\Delta\ln(CM_t)$	$\Delta\ln(OI_t)$	$\Delta(\text{EMP}_t)$	$\Delta\ln(\text{VR}_t)$
$\Delta\ln(RI_{t-1})$	0.8891 (***)	-0.0038	-0.0667 (***)	0.0040	0.0578
$\Delta\ln(CM_{t-1})$	0.2079 (***)	0.4381	0.0437	0.0550 (***)	-0.7161 (**)
$\Delta\ln(OI_{t-1})$	0.0226	0.0048	0.9295 (***)	0.0206 (***)	-0.2038 (**)
$\Delta(\text{EMP}_{t-1})$	0.1920 (*)	0.1932 (*)	0.0722	-0.0763 (*)	-0.3019
$\Delta\ln(\text{VR}_{t-1})$	-0.0362 (***)	-0.0018	-0.0045	-0.0051	0.9388 (***)

Notes: Table reports the results based on equation 4. Variables are in log differences, except for the employment growth (as we have negative values). The number of observations is 1664. All the eigenvalues lie inside the unit circle. PVAR satisfies stability condition.

We now consider a common segmentation differentiating the biggest countries (UK, Germany and France) from the others.

First, we run the same model for markets in UK, Germany and France taken as a whole. The real Prime rental value index lagged by one period is still positive and highly significant. This time, an important difference from the previous estimation has to be noticed: the openness index is now significant and positive, meaning that when a market becomes more dependent on international

trades, its rent should increase. This result can be explained by the maturity and the international dimension of the market. Trade and the openness to other economies are important because we are looking at the biggest markets. Indeed, with London, Paris, Frankfurt, Munich and Berlin in the sample, the international dimension is easily understandable. The vacancy rate is still highly significant with a negative sign.

Table 3. Panel VAR results for the biggest markets: 2002-2017.

	$\Delta\ln(RI_t)$	$\Delta\ln(CM_t)$	$\Delta\ln(OI_t)$	$\Delta(\text{EMP}_t)$	$\Delta\ln(\text{VR}_t)$
$\Delta\ln(RI_{t-1})$	0.8506 (***)	0.0306 (*)	-0.1010 (***)	-0.0012	0.2649
$\Delta\ln(CM_{t-1})$	0.1326 (***)	0.7847 (***)	0.0668	0.257 (**)	-0.2522
$\Delta\ln(OI_{t-1})$	0.0395 (*)	-0.0077	0.8928 (***)	0.0174 (***)	-0.3145 (***)
$\Delta(\text{EMP}_{t-1})$	0.056	0.0862 (*)	0.1885 (***)	-0.0706	-0.0723
$\Delta\ln(\text{VR}_{t-1})$	-0.0346 (***)	0.0183 (***)	-0.0138	-0.0022 (*)	0.0124 (***)

Notes: Table reports the results based on equation 4. Variables are in log differences except for the employment growth (as we have negative values). The number of observations is 832. All the eigenvalues lie inside the unit circle. PVAR satisfies stability condition.

The second group is composed of smaller markets (with Benelux, Central and Eastern Europe and southern countries). Here, the lag of the real Prime rent index is still positive and significant. This shows that the autoregressive component stays important in the rental value formation everywhere. The margin of companies and the employment growth are significant and have a positive relationship with rent, as expected. The vacancy rate also stays significant with a negative sign.

Table 4. Panel VAR results for the smallest markets: 2002-2017.

	$\Delta\ln(RI_t)$	$\Delta\ln(CM_t)$	$\Delta\ln(OI_t)$	$\Delta(\text{EMP}_t)$	$\Delta\ln(\text{VR}_t)$
$\Delta\ln(RI_{t-1})$	0.9095 (***)	0.0003	-0.0411 (*)	0.0045	0.0772
$\Delta\ln(CM_{t-1})$	0.1518 (***)	0.3063	0.0418	0.0580 (***)	-0.7550 (*)
$\Delta\ln(OI_{t-1})$	0.0126	0.0346	0.9430 (***)	0.0189 (*)	-0.0730
$\Delta(\text{EMP}_{t-1})$	0.3449 (**)	0.1930 (*)	-0.0073	-0.0794	-0.5514 (*)
$\Delta\ln(\text{VR}_{t-1})$	-0.0314 (**)	-0.0009	0.0064	-0.0061 (*)	0.9652 (***)

Notes: Table reports the results based on equation 4. Variables are in log differences, except for the employment growth (as we have negative values). The number of observations is 832. All the eigenvalues lie inside the unit circle. PVAR satisfies stability condition.

Summing up, the rents of the first group are explained by the autoregressive coefficient, the openness index and the vacancy rate. In the second group, they are related to the margin of companies, the employment growth and the vacancy rate. This difference may be well explained by the international dimension of the first group; as the markets are more driven by international companies, the national margin of companies and the employment level should have a lower impact. In the small and average markets, these variables keep a significant explanatory power.

One limitation has to be mentioned: the panel VAR model supposes that the office markets have the same economic structure and depend on the same variables. However, by taking two samples, we saw some heterogeneity across the results, meaning that European real estate markets should not be only considered as a unique market with an identical structure. The importance of local factors (the previous rent, the employment growth and the vacancy rate) in explaining the contemporaneous rent raises the issue of the predominance of local dynamics.

5.2 Rental value growth: a predominance of local dynamics?

In this section, we run the same equation as previously but for each market separately. The objective is to deepen our understanding of how the macroeconomic variables that influence rent at the European level have or do not have an impact at the market (micro) level.

Results are presented in table 6. First, we can note that the model is not relevant for four markets: Brussels, Edinburgh, Helsinki and Lisbon (none of the variables are significant). This may be explained by the low volatility of the Prime rental value for these markets. Margin of companies is nonsignificant for all markets except Barcelona. For this market, the coefficient is negative, implying that when the profitability of the company rises, the Prime rent should decrease. This result is

counterintuitive as companies should be more willing to pay a higher rent when their margins are increasing. However, an increase of the margin is not necessarily implied by a rise of the net income and could be induced by decreasing costs. As real estate expenditures are among the higher costs for companies, they could rationalize their costs by asking for lower rent. Globally, this nonsignificant margin also shows that the level of rent seems to depend more on property market conditions than financial capacities of companies.

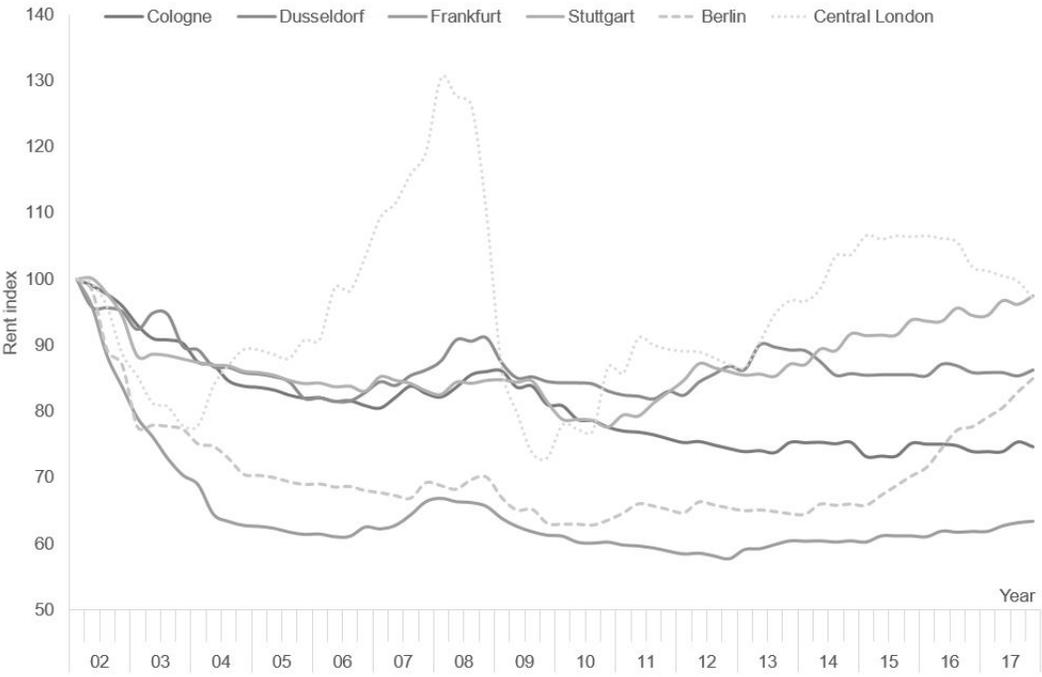
The employment is significant and positive for only four markets (Barcelona, Budapest, central Paris and Stockholm). The Parisian market is more elastic as rental values in Paris are more sensitive to employment growth. Two factors could explain this counterintuitive result. Firstly, the contractual rigidity of leases prevents fast adjustment of the occupied space. As medium and large companies are used to signing long term leases, they often have to keep the same space even if their needs change over time. Secondly, office stock is not constant in large markets beyond tight areas such as central business districts (CBDs). Office developments usually follow the economic cycle and can limit the theoretical positive impact of employment on rents, *ceteris paribus*. For instance, in case of stronger job creation, property developers and investors can anticipate more need for office space and then build more buildings than usual. Finally, if supply adjusts to new economic conditions, the impact of employment on vacancy will be less than expected.

The most frequently significant variable is the vacancy rate: for 14 markets, the vacancy rate is significant and has a negative effect on the rental values (which is the expected sign).⁶ Elasticities differ across the market. Berlin has the highest coefficient and Copenhagen the lowest. Barcelona has medium elasticity with a coefficient of 0.158, and markets with a greater coefficient are the most sensitive to a variation in the vacancy rate. The results from the sensitivity analysis are expected:

⁶To assist in the understanding, we consider the absolute values.

the markets with the smallest coefficient are the most stable and the least cyclical. All the German markets are in this group (except Berlin), and their rents are among the most stable across Europe (Figure 1). Berlin is an exception due to its history: there has been a catch-up since 2015 with a huge increase in its rental values (+33% between Q4 2014 and Q4 2017) following a boom on the demand side and a drop in the vacancy rate (from 6.3% to 3.1% over the same period) notably due to a restriction of new building projects.

Figure 4.1: Real Prime rent index for the German markets and London: 2002-2017
 Source: Property Market Analytics.



Notes: 2002Q1=100

The other markets with a low elasticity between their rental value and their vacancy rate are Warsaw and Copenhagen. For Warsaw, a constant increase of stock over the last years drastically increased the vacancy rate (from 2.2% in 2008 to 15% in 2015) and pushed down rental values. However, as we study the Prime rental values (and not the average rental value), we have to keep in

mind that the variable is less sensitive to an increase in the stock, especially if the new constructions are of good quality and more sought after by companies compared to older buildings.

The Prime rental value is also considered very stable in Copenhagen with almost no variations since 2010. In that market, the Prime rental value and the vacancy rate have followed opposite directions from 2002 to 2010, whereas during the last years the vacancy rate tends to decrease.

The most sensitive markets are located in the UK (Central London and Manchester), in Spain (Madrid), in Ireland (Dublin) and in the Netherlands (Amsterdam). These countries have experienced volatile economic cycles over the two last decades. London, with its international position, is considered the most cyclical market in Europe and the most dependent on external factors. Thus, it is not surprising to observe a strong relation between the rental values and the vacancy rate. We can even suppose that this relation is slightly underestimated as the vacancy rate we used is for the entire market and not for the Prime submarket (the West End in London).

Spanish real estate experienced a dramatic dip following the Global Financial Crisis and has been highly cyclical since then. Thus, the relationship between the vacant space and rent is expectedly strong. The vacancy rate sharply increased from 2007 to 2014 (from 4.8% to 12.5% in Madrid and from 5.3% to 17% in Barcelona), pulling down rental values. The rental values are closely linked to the vacancy rate, like the entire market dynamic (with new completions, incentives, etc.).

The Dublin office market is also very sensitive to a change in vacancy rate. This result was also expected, mainly because of the market's size (less than 4 million square meters). As the market is small, rental values are more reactive to a change in the vacancy rate, reflecting either a change in demand for office space or some new building construction. The reasoning can be similar for Manchester.

Table 5. Vector autoregression results for the 26 markets.

	Intercept	$\Delta\ln(RI_{t-1})$	$\Delta\ln(CM_{t-1})$	$\Delta\ln(OI_{t-1})$	$\Delta(\text{EMP}_{t-1})$	$\Delta\ln(\text{VR}_{t-1})$
Amsterdam	-0.0008	-0.0502	-0.1734	-0.1049	0.366	-0.263 (***)
Barcelona	-0.0031	0.2229	-0.5517 (*)	-0.0042	0.3366	-0.1589 (***)
Berlin	-0.0063 (*)	-0.0102	0.2475	-0.0513	0.046	-0.4555 (***)
Birmingham	-0.0014	0.3297 (**)	-0.3447	0.0323	0.2116	-0.0864
Brussels	-0.0065 (***)	-0.0857	-0.0535	0.1624	-0.5327	-0.051
Budapest	-0.0079 (***)	0.242	0.0132	-0.1246	0.4125 (*)	-0.0503
Central London	0.0056	0.4003 (***)	0.0901	0.0432	-1.4488	-0.2273 (**)
Central Paris	-0.0078	0.1226	-0.1652	0.4102	2.5406 (*)	-0.0163
Cologne	-0.004 (*)	-0.0135	0.0477	-0.1022	0.0984	-0.0777 (*)
Copenhagen	-0.0043 (*)	-0.0537	0.0102	0.0221	0.0519	-0.0679 (***)
Dublin	-0.007	0.253 (*)	0.0872	0.3493	1.0174 (*)	-0.2873 (**)
Dusseldorf	-0.002	0.0837	-0.1092	0.2131	-0.0095	-0.0846 (*)
Edinburgh	-0.0042	0.162	0.0982	0.0405	0.0542	-0.0535
Francfort	-0.002	0.4058 (***)	0.0357	-0.0763	0.3026 (*)	-0.1152 (***)
Glasgow	0.0008	-0.0025	-0.1018	-0.2431 (*)	-0.0995	-0.0965
Hamburg	-0.0006	0.1107	0.112	-0.0151	0.114	-0.1215 (***)
Helsinki	-0.0047 (**)	-0.0814	0.0988	0.0218	0.1319	-0.0389
Lisbon	-0.0067 (*)	0.1171	-0.0943	-0.0112	0.3221	-0.0235
Madrid	-0.0018	0.2518 (*)	-0.3559	0.1894	0.2441	-0.2499 (***)
Manchester	0.001	-0.0857	0.0382	0.0726	0.0587	-0.1788 (**)
Munich	-0.0009	0.2743 (*)	-0.1315	0.0273	0.1587	-0.044
Prague	-0.0024	0.3106 (*)	-0.1	0.0369	0.4753	-0.0077
Stockholm	-0.002	0.2537	-0.0311	-0.0538	1.6072 (*)	-0.1088
Stuttgart	0.0004	0.067	0.0966	-0.1105	0.0117	-0.0897 (***)
Warsaw	-0.0034	0.428 (***)	0.09	-0.0059	0.1029	-0.0734 (*)
Vienna	-0.0025	0.2975 (*)	-0.0274	0.1066	0.1654	-0.0282

Notes: Table reports the results based on equation 5. Variables are in log differences.

The strong coefficient in Amsterdam could be explained by several factors. First, the reduced size of the market makes rental values more sensitive to a change in the vacancy rate. Moreover, as the vacancy rate was high the government implemented new regulations in 2011 and obliged owners of empty spaces to work with the municipality. To avoid introducing additional space, speculative developments have also been restricted.⁷ All the regulations exerted a downward pressure on the

⁷Speculative developments are a process in which a real estate project is undertaken without commitment from any users.

vacancy rate. Office rent increased, followed by a decrease in the available space and a global rise in office quality with the refurbishments.

For the other markets, we do not observe a significant coefficient for the vacancy rate. This lack of relationship could be explained by the dependent variable. For example, in Paris the Prime rental value is located in the CBD (a particular submarket in the whole area with its own dynamics and a quasi-constant office stock over time at 6.5 million square meters⁸), but the vacancy rate stands for Central Paris (36 million square meters in 2017). We may have a perimeter effect for some markets.

The second most important variable in the model is the autoregressive parameter. Its sign is positive, as expected, meaning that rents will likely follow the same dynamics as the previous period. As real estate is an illiquid asset, the inertia is strong and the effects of a particular shock may take months (or even quarters) to be felt. The weakness of the rental adjustment shows that the market players are not able to react immediately to changing market conditions. The office market inertia has been outlined by McCartney (2012) and is generated by several factors such as transaction costs, search costs or the persistence of the lease.

The importance of the local factor to explain the rental dynamics leads to a complete analysis with the natural vacancy rate theory.

5.3 The natural vacancy rate: A standard approach

The natural vacancy rate can be estimated using a simple linear equation. By definition, the natural vacancy rate is the vacancy rate for which the market rent is at an equilibrium. The percentage of rent variation is first regressed on the vacancy rate:

⁸Source: Regional Real Estate Observatory in Greater Paris (ORIE).

$$\frac{R_t}{R_{t-1}} - 1 = \beta_0 + \beta_1 VR_t, \quad (4.3)$$

where R_t and VR_t are, respectively, the rent and the vacancy rate at period t . The estimated coefficients are β_0 and β_1 . The natural vacancy rate corresponds to a zero variation of the rent:

$$V^* = -\frac{\beta_0}{\beta_1}$$

All the results are reported in table 7.

Regarding the modelling, the R-squared statistics are low. This is mainly due to the simplicity of the modelling (with only one variable). However, the results seem rather coherent.

The first important result is that, contrary to possible assertions, the natural vacancy rate is quite heterogeneous across the markets and also across subperiods. The natural vacancy rate depends mainly on the characteristic of the market and of the occupiers. The computed natural vacancy rate for the entire period has a wide range (from 3.7% to 16.1%) and the median is at 9.95%. The markets with the lowest natural rates are mostly the ones with a limited stock and with a low level of new supply. On the contrary, the markets with the highest natural vacancy rates are the most dynamic in terms of construction and new developments.

The evolution of the natural vacancy rate across time is interesting and highly informative. The structure of office markets, such as the equilibrium, changed after the GFC. The markets that suffered the most (especially the southern and eastern markets) have experienced an increase in their natural vacancy rate. Indeed, the equilibrium of the rental values is now at a higher rate due to the economic shock on markets and the sharp increase in the vacancy rate during subsequent years. For

example, the vacancy rate sharply increased after the GFC in Dublin, and the natural vacancy rate also changed (from 15% to 21%), implying a drop in rental values (from €646 per square meter in 2008 to €296 in 2012 for the Prime rent). On the contrary, the more dynamic markets (in terms of investment and transaction volume) or those less impacted by the crisis (with the German market at the top, or the spillover markets such as Lyon) saw a decrease in their natural vacancy rate.

The theoretical comparison between the actual and the natural vacancy rate is also informative for the future dynamics of the market. By assuming few or no change in the supply condition in the near future, the markets with a vacancy rate currently greater than the natural one (Milan, Rome or Warsaw for example) should experience a decrease in rent in the future to equilibrate the market. On the other hand, markets with a vacancy rate below the natural one (Paris, London or Hamburg) should record an increase in rent due to the limited quantity of available space on the market.

Overall, the European markets have current vacancy rates below their natural rates, meaning that rental values are on a positive trend and that this situation should continue to equilibrate the market.⁹ After the global financial crisis, we observed in most European markets some regulations to restrict real estate supply, driving down the available space. Even if we still have a multispeed European office markets, the majority of them followed the same trend since the last couple of years. In the biggest markets (Paris and London), we also saw a repositioning of the companies in the core markets, such as the CBDs, with a fall in the available space and a rise in the rental values, although the situation is different for the other submarkets. In the Parisian market, La Defense and the Western Crescent had a high vacancy rate during the years after the GFC. Currently, due to high prices (and rent), companies started to move again towards the submarkets outside Paris,

⁹In hindsight, this happened in Western Europe in 2018.

driving rent up. The same reasoning is valid for London.

For some markets, such as Amsterdam and Berlin, the drop in vacancy rates is mainly due to the supply side. Regulations in these two markets make speculative construction difficult, helping to constrain supply and simultaneously the available space. Moreover, when land is available, property developers can be encouraged to build more profitable assets than offices, such as residential spaces. Rental values have been drastically increasing. For instance, between 2010 and 2017 Prime rents rose in Amsterdam and Berlin by +30% and +50%, respectively.

Only a few markets still have a high vacancy rate, with mixed effects on rental values. For these markets, this high rate is mainly the effect of an unbalanced supply. Despite good economic conditions, the vacancy rate in Warsaw and Stockholm is still high due to the persistent level of office completion: Warsaw has the highest percentage of building starts in Europe (7.7% at the end of 2017). For the Italian markets, the high vacancy rate is mainly due to the lack of a quality supply. Indeed, as companies relocate to modern and energy-efficient buildings, there is an important volume of second-hand grade B and C spaces that has been released into the market.¹⁰ For all these markets, the Prime rental value is increasing (as the competition for high quality building is important) while the average rental values are still suffering from the GFC.

¹⁰The poorer quality of stock has been estimated to account for 80% of the available space (source: PMA).

Table 6. Natural vacancy rate analysis for the European commercial office market.

Market	All period	Before 2008	After 2010	Vacancy in 2017Q4	Market	All period	Before 2008	After 2010	Vacancy in 2017Q4
Vienna	4.7 (2.03)	5.9 * (13.37)	7.8 (2.61)	5.3	Rome	6.1 (1.66)	7.8 (20.24)	14.1 * (9.24)	13.5
Brussels	8.9 * (6.01)	9.4 ** (19.33)	7.6 (2.98)	8.2	Luxembourg	6.7 (0.6)	4.6 * (0.48)	6.3 * (33.34)	4.8
Prague	11.6 ** (7.88)	10.2 (7.03)	12.7 ** (19.55)	7.2	Amsterdam	15.1 (1.05)	25.7 (3.92)	16.8 *** (34.4)	9.1
Copenhagen	5.0 * (4.38)	5.9 ** (22.3)	7.5 (2.22)	7.6	Rotterdam		13.7 *** (0.02)	20.2 (1.94)	14.9
Helsinki	13.0 ** (7.86)	9.4 ** (18.42)		13.2	Oslo	8.5 (4.16)	9.6 *** (51.41)	7.7 (9.33)	6.6
Lyon	6.6 (0.71)	7.0 * (2.34)	6.6 (0.21)	7.0	Warsaw	9.3 *** (11.25)	13.0 *** (57.04)	9.1 ** (16.34)	12.3
Paris CBD	3.7 (0.48)	4.8 * (14.03)	6.0 (0.76)	3.1	Lisbon	16.1 ** (10.1)	14.6 * (12.39)	23.3 (0.14)	12.1
Central Paris	11.0 (0.12)	6.1 (8.67)	8.5 * (8.92)	6.7	Barcelona			13.9 * (11.15)	9.5
Paris	11.7 (0.47)	6.2 (9.11)	8.5 (1.75)	7.6	Madrid		6.8 * (15.07)	11.3 (0.62)	9.9
Paris WBD	12.1 (0.83)	7.1 (1.82)	10.3 (0.02)	11.6	Stockholm	12.5 *** (18.83)	11.6 (5.28)	12.2 *** (20.24)	8.5

Market	All period	Before 2008	After 2010	Vacancy in 2017Q4	Market	All period	Before 2008	After 2010	Vacancy in 2017Q4
Berlin	7.5 *** (18.65)	10.5 ** (27.32)	8.3 *** (34.21)	3.1	Birmingham	9.5 (2.65)	7.4 ** (17.93)	13.6 (8.27)	11.0
Cologne		13.9 * (17.78)	7.8 (7.76)	5.5	Edinburgh	6.5 (0.95)	13.9 (3.52)	10.8 (2.23)	7.4
Dusseldorf	13.5 (0.4)	14.5 (2.48)		7.4	Glasgow	10.8 (1.85)	9.7 ** (17.4)	14.0 (2.75)	14.6
Frankfurt		20.0 *** (54.03)	14.6 ** (19.01)	9.1	Central London	9.1 ** (9.2)	11.5 ** (19.71)	5.1 (1.55)	8.3
Hamburg	13.0 *** (0.27)	10.5 (50.14)	9.0 * (8.32)	5.4	London City	10.4 *** (12.18)	13.2 ** (26.68)		8.7
Munich	5.7 (2.43)	11.6 (4.77)	12.3 (3.76)	2.8	London Docklands	8.0 ** (8.14)	9.6 *** (35.78)	10.2 (3.0)	12.4
Stuttgart	5.9 (3.94)	8.7 (9.32)	9.2 (1.94)	2.6	London WE and Midtown	7.1 *** (12.84)	8.9 ** (24.95)	3.4 (0.73)	6.5
Budapest		5.2 * (15.59)	15.1 ** (19.32)	7.6	M25 West	13.1 (1.19)	6.9 (0.16)	17.1 (0.98)	12.7
Dublin	16.1 *** (16.27)	15.0 *** (32.56)	21.4 ** (15.34)	7.3	Manchester	13.9 (0.48)	10.1 (7.53)	10.0 (0.12)	11
Milan	9.0 (0.12)	10.3 (6.63)	15.6 (0.65)	14.5					

Notes: The R^2 of the regressions are in brackets.

6 Conclusion

In this paper, we provide new insights on the rental value dynamics of commercial office markets at a pan-European level. It is central for tenants, investors or even local governments to better understand the real estate drivers. The main feature of this study was to estimate a model based on two separate geographical levels: a pan-European level and market modelling. This kind of two-stage modelling is interesting for overseas investors to understand the dynamics of rental values across Europe and their main macroeconomic drivers. At a European level, we find that the margin of companies, the employment level, the vacancy rate and the autoregressive parameter are significant to explain the Prime rental values. The responses of rent to changes in the variables are in line with theoretical expectations; all the variables have a positive effect on the rents except for the vacancy rate. However, by using a segmented approach, it is possible to see that these results could be heterogeneous across the markets (even at a macroeconomic level).

Then, we estimated the same VAR equation for all the markets. We found once more that the results were quite different according the markets. However, the results show that even if markets are more transparent and dependent on economic activity the standard approach remains valid: the main driver for rental values is the vacancy rate. Generally, rental values for the German markets are less volatile and respond less to a change in the vacancy rate. The more responsive markets are London, as expected, as well as Amsterdam, Berlin and Madrid.

Finally, we estimated the natural vacancy rate for each market to have a clearer view of the past and of the current dynamic across the European market. Again, the results showed an important heterogeneity across the markets. As the vacancy rates are currently below the natural vacancy rate for the majority of the markets, rental values may continue to increase in cases where we will not experience any shock in supply or demand over the near future.

The relevance of the different modelling for forecasting is not the main purpose of this study, even if it is an important topic for real estate market practitioners. Providing insights for global real estate forecasting should be considered an extension of the research. Especially due to the need for gathering homogeneous variables across numerous European markets, we have seen some limits in our findings between the Prime market and the whole market. Some future investigation could be useful to better understand the link between Prime and non-Prime assets within a same area. Moreover, portfolio diversification across European commercial real estate markets could also benefit from such research with a wide geographical area.

BIBLIOGRAPHY

- [1] BLANK, D. M., AND WINNICK, L. The structure of the housing market. *The Quarterly Journal of Economics* 67, 2 (1953), 181–208.
- [2] BROUNEN, D., AND JENNEN, M. Local office rent dynamics. *The Journal of Real Estate Finance and Economics* 39, 4 (2009), 385–402.
- [3] CAIVANO, M. The transmission of monetary and technology shocks between the US and the euro area. *manuscript, Bank of Italy* (2006).
- [4] CANOVA, F., CICCARELLI, M., AND ORTEGA, E. Similarities and convergence in G-7 cycles. *Journal of Monetary economics* 54, 3 (2007), 850–878.
- [5] CANOVA, F., CICCARELLI, M., AND ORTEGA, E. Do institutional changes affect business cycles? Evidence from Europe. *Journal of Economic Dynamics and Control* 36, 10 (2012), 1520–1533.
- [6] CANOVA, F., AND PAPPÀ, E. Does it cost to be virtuous? The macroeconomic effects of fiscal constraints. Tech. rep., National Bureau of Economic Research, 2005.
- [7] CANOVA, F., AND PAPPÀ, E. Price differentials in monetary unions: The role of fiscal shocks. *The Economic Journal* 117, 520 (2007), 713–737.
- [8] CHAU, K., AND WONG, S. K. Information asymmetry and the rent and vacancy rate dynamics in the office market. *The Journal of Real Estate Finance and Economics* 53, 2 (2016), 162–183.

- [9] CICCARELLI, M., ORTEGA, E., AND VALDERRAMA, M. Heterogeneity and cross-country spillovers in macroeconomic-financial linkages. *European Central Bank Working Paper Series 1498* (2012).
- [10] D'ARCY, E., MCGOUGH, T., AND TSOLACOS, S. National economic trends, market size and city growth effects on European office rents. *Journal of Property Research 14*, 4 (1997), 297–308.
- [11] D'ARCY, E., MCGOUGH, T., AND TSOLACOS, S. An econometric analysis and forecasts of the office rental cycle in the Dublin area. *Journal of Property Research 16*, 4 (1999), 309–321.
- [12] D'ARGENSIO, J.-J., AND LAURIN, F. The real estate risk premium: A developed/emerging country panel data analysis. *Journal of Portfolio Management 35*, 5 (2009), 118–132.
- [13] ENGLUND, P., GUNNELIN, Å., HENDERSHOTT, P. H., AND SÖDERBERG, B. Adjustment in Property Space Markets: Taking Long-Term Leases and Transaction Costs Seriously. *Real Estate Economics 36*, 1 (2008), 81–109.
- [14] EUBANK JR, A. A., AND SIRMANS, C. The price adjustment mechanism for rental housing in the United States. *The Quarterly Journal of Economics 93*, 1 (1979), 163–168.
- [15] HEKMAN, J. S. Rental price adjustment and investment in the office market. *Real Estate Economics 13*, 1 (1985), 32–47.
- [16] HENDERSHOTT, P. H. Rental adjustment and valuation in overbuilt markets: Evidence from the Sydney office market. *Journal of Urban Economics 39*, 1 (1996), 51–67.
- [17] HENDERSHOTT, P. H., JENNEN, M., AND MACGREGOR, B. D. Modeling space market dynamics: An illustration using panel data for US retail. *The Journal of Real Estate Finance and Economics 47*, 4 (2013), 659–687.
- [18] HENDERSHOTT, P. H., LIZIERI, C. M., AND MACGREGOR, B. D. Asymmetric adjustment in the city of London office market. *The Journal of Real Estate Finance and Economics 41*, 1 (2010), 80–101.
- [19] HENDERSHOTT, P. H., MACGREGOR, B. D., AND TSE, R. Y. Estimation of the rental adjustment process. *Real Estate Economics 30*, 2 (2002), 165–183.

- [20] IBANEZ, M. R., AND PENNINGTON-CROSS, A. Commercial property rent dynamics in US metropolitan areas: an examination of office, industrial, flex and retail space. *The Journal of Real Estate Finance and Economics* 46, 2 (2013), 232–259.
- [21] KRUGMAN, P. Scale economies, product differentiation, and the pattern of trade. *The American Economic Review* 70, 5 (1980), 950–959.
- [22] KRUGMAN, P. R. Increasing returns, monopolistic competition, and international trade. *Journal of international Economics* 9, 4 (1979), 469–479.
- [23] LOVE, I., AND ZICCHINO, L. Financial development and dynamic investment behavior: Evidence from panel VAR. *The Quarterly Review of Economics and Finance* 46, 2 (2006), 190–210.
- [24] MALLE, R. Un modèle à équations simultanées du cycle des bureaux en région parisienne. *Economie & prévision*, 3 (2010), 93–108.
- [25] MCCARTNEY, J. Short and long-run rent adjustment in the Dublin office market. *Journal of Property Research* 29, 3 (2012), 201–226.
- [26] MCGOUGH, T., AND TSOLACOS, S. Forecasting office rental values using vector autoregressive models. In *The Proceedings of the Cutting Edge Property Research Conference* (1994), pp. 303–20.
- [27] MOUZAKIS, F., AND RICHARDS, D. Panel data modelling of prime office rents: a study of 12 major European markets. *Journal of Property Research* 24, 1 (2007), 31–53.
- [28] ROSEN, K. T. Toward a model of the office building sector. *Real Estate Economics* 12, 3 (1984), 261–269.
- [29] ROSEN, K. T., AND SMITH, L. B. The price-adjustment process for rental housing and the natural vacancy rate. *The American Economic Review* 73, 4 (1983), 779–786.
- [30] SHILLING, J. D., SIRMANS, C., AND CORGEL, J. B. Price adjustment process for rental office space. *Journal of Urban Economics* 22, 1 (1987), 90–100.
- [31] TSOLACOS, S., KEOGH, G., AND MCGOUGH, T. Modelling use, investment, and development in the British office market. *Environment and Planning A* 30, 8 (1998), 1409–1427.

- [32] WHEATON, W. C. The cyclic behavior of the national office market. *Real Estate Economics* 15, 4 (1987), 281–299.
- [33] WHEATON, W. C., AND TORTO, R. G. Vacancy rates and the future of office rents. *Real Estate Economics* 16, 4 (1988), 430–436.
- [34] WHEATON, W. C., TORTO, R. G., AND EVANS, P. The cyclic behavior of the Greater London office market. *The Journal of Real Estate Finance and Economics* 15, 1 (1997), 77–92.

CHAPTER 5

GENERAL CONCLUSION

This thesis contributes to the general understanding of the relation between the real estate market and the economy. In this section, we synthesise the main results and highlight the scientific contributions of our work. We distinguish each of the three articles. First, we provide a summary of our study on the main determinants of the London office risk premium across time, in which we place emphasis on money changes. Second, we remind the reader of the effect of the unconventional monetary policies on the European real estate market and, more generally, on the urban reshaping. Third, we synthesise the contributions of our findings with the relation between European rental values and vacancy rate. Finally, we propose future research on the basis of our work.

In the first paper, we focused on the modelling of the Central London office's market risk premium and its main determinant across time. The risk premium is defined as the difference between the total return (sum of the income return and of the capital growth) and a risk-free asset. Unfortunately, despite its importance for investors, the real estate risk premium is still an elusive concept in the real estate literature, mainly because of the lack of data. In regard to the new economic environment, because of the rise of the unconventional monetary policies, we paid special attention to the effect of an increased money supply on the real estate market. The effect of an increase of the money supply on the real estate market can be described in a simple IS/LM Mundell-Fleming framework for a small open economy with a flexible exchange rate. An increase in the money supply implies that domestic interest rates should decline relative to foreign interest rates and that the capital outflow should increase. Consequently, the investment should rise until local interest rates equal global interest rates. Because the real estate supply is highly inelastic in the short term, the demand will increase without an adjustment in the supply side, leading to an increase in the prices. On the other side, because of the depreciation of the local currency, we should expect a

capital inflow from foreign countries, implying a change in the identity of the investors. Next, we constructed a specific monetary index for the real estate market by weighing, for each country, the changes in money supply by its share of investment volume.¹ We then estimated a vector autoregression (VAR) model to estimate the main determinants of the risk premium and a structural vector auto-regression model to analyse the effect of an unexpected money supply shock on the variable of interest. We found that the vacancy rate, the FTSE 100, the autoregressive parameter and the monetary index were significant and had a positive effect that could explain the historical risk premium, whereas the employment level had a negative effect. The positive sign of the monetary index suggests that increases in the money supply lead to increases in office prices. Studying the same model for sub-periods helped to provide clearer insight into the drivers of the historical risk premium. The monetary index was significant not only for the entire period but also for the period after 2009, when unconventional monetary policies were launched. Before QE policies, the monetary index was non-significant, meaning that money supply did not affect the risk premium before the GFC. The significance of the fundamental variables also changed across the different sub-periods. By replacing the monetary index with the short-term interest rate, we saw that the interbank rate was never significant enough to explain the risk premium. Finally, a structural VAR was used to study the effect of an unexpected monetary shock. The results confirmed the previous results that showed a positive effect of increasing the money supply on the real estate risk premium. Moreover, the response was more important following a shock in the money supply rather than a shock in the interbank rate. However, if the results of the theoretical IS/LM Mundell-Fleming framework were confirmed at the market level, we could expect some heterogeneity at a wider level.

¹For the countries belonging to the euro area, we have considered the entire area.

In the second chapter, we studied the dynamics of office prices across Europe after the introduction of unconventional monetary policies. Because the total value of the office stock in Europe increased by about 60% since 2009, we may assume that the increasing money supply has been one of the main drivers of office prices. The effect of the QE policies should not be homogenous across Europe and might have generated urban wealth reshaping as investments being driven by investors' preferences. We constructed a monetary index for each market, on the basis of the methodology developed in the first chapter. Next, we estimated the main determinants of office prices across 16 European markets by using panel data. As expected, the monetary index had a positive effect on real estate prices at the European level. To determine the degree of homogeneity and the driving lines along which the liquidities were distributed and invested across the market, we introduced several segmentations. We have highlighted that the larger markets are more able to attract the liquidities. When we focused only on the Eurozone money supply, we found that the German markets greatly benefited from the available liquidities, mainly because of the quick recovery of the country after the GFC and a catch-up effect. Finally, we used the notion of European megalopolis to distinguish central and peripheral markets. Prices of the European megalopolis were highly supported by the increase in the money supply, while the peripheral market recovered only in 2016. These results raise questions on the relevance of quantitative easing programmes: though the policies were introduced to support peripheral markets, the main beneficiaries were therefore the largest and the strongest markets at the centre of Europe. A monetary union with persisting divergences in prices and productivity and without sufficient consistency in its fiscal and economic policies may generate an unstable economic environment. More precisely, a monetary policy in a not completely federal union tends to produce implicit wealth reallocation movements across states.

In addition, investors need to have a better understanding of the European real estate market via innovative studies on both the investment and the occupier markets. Indeed, the investment market is highly dependent on the occupier side because rent are the main source of income for investors. Thus, it is important to have insight on the rental formation and its main drivers. The real estate literature is mainly focused on the United States, because of the historical importance of the market and the availability of the data. However, Europe is now the first market in terms of investment volume (with 35% of the worldwide investments); just behind is the United States (34%). With the growing importance of the European market, overseas investors are becoming interested in the global structure of the rental formation and in the integration or the independence of the real estate markets across Europe.

In the last chapter of the thesis, we estimated the dynamics of the rental values at a pan-European level and at a local level. As a first step, we assumed that real estate markets were globally integrated and that the dynamics were the same across Europe. We estimated the rental adjustment using a panel vector autoregression (PVAR) model that used the margin of the companies, the country's openness index, the level of employment and the vacancy rate. The panel data enabled us to consider some unobserved individual heterogeneity across the markets. We found that the margin of the companies, the employment growth and the rent lagged by one period, which was significant and positive. In addition, the vacancy rate was significant but had a negative effect on the rental value. This result is well acknowledged in real estate literature. Indeed, the two variables are negatively correlated: a decrease in the vacancy rate should imply an upward adjustment of the rental values following the decline of the available supply. By focusing only on the largest market (i.e., France, Germany and the United Kingdom), we found that local employment was not more

significant, whereas the openness index is now significant. This finding shows not only that the largest markets have an international orientation (with a greater importance of foreign variables) when compared with the smallest markets but also that some heterogeneity exists across the market. The strong significance of the local variables (vacancy rate, employment, margin of companies and the rental value) shows that real estate markets may still be driven by local dynamics. As a second step, we estimated the same equation for all the markets while assuming that the structures and the dynamics were different. We found an important heterogeneity, because the variables do not have the same effect across the markets. The most significant variable was the vacancy rate, with a wide range in its effect. A quick comparison of the sensitivity of the vacancy rate with the rental value enabled us to draw interesting conclusions about the European market. As expected, the German markets were the more stable, whereas the markets in the United Kingdom, Spain and Ireland were the most sensitive to a change in their vacancy rates. Finally, we followed the vacancy rate theory to conduct a more detailed analysis of the correlation between rental values and the occupied space. The natural vacancy rate was defined as the vacancy rate for which the market rent was at the equilibrium. A comparison between the actual and the natural vacancy rate provided us an indication of the dynamics of each market. Currently, European markets have a vacancy rate below their natural vacancy rate, suggesting that rental values should continue to grow during the next quarters.

The aim of this thesis was to gain insight into the European real estate market in this new international environment. We focused our study on the relation between the global economy and real estate, paying special attention in the first two chapters to the influence of new monetary policies on the office markets. In the last chapter, we focused on rental values, which are one of the main variables in real estate, because of their effect on the decisions of users, investors and developers.

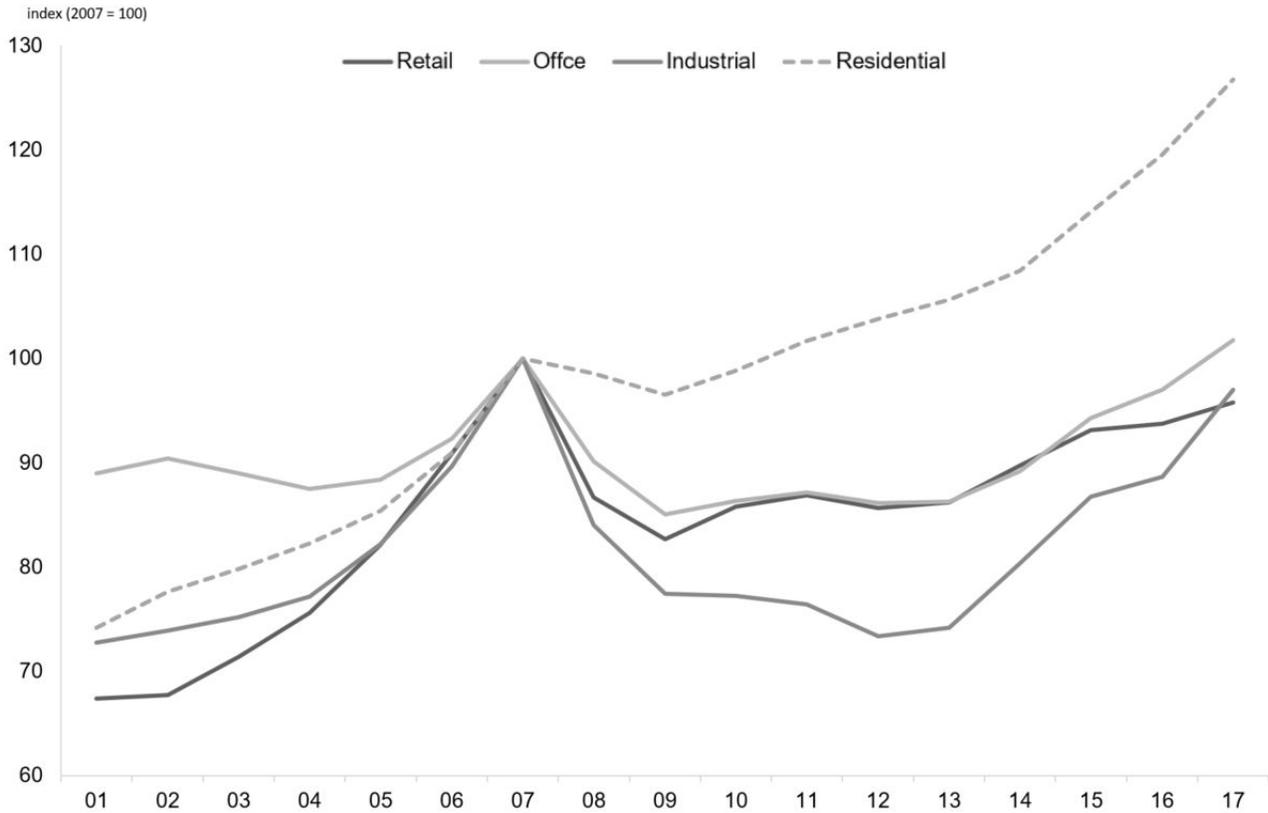
For all of the real estate actors, the cost-benefit analysis was affected primarily by the rental values. Thus, we hope we have contributed to improving the understanding of this particular asset, which is becoming increasingly attractive for investors. Even though Europe is the largest market in terms of investment volume, there is still a lack of literature and knowledge on the structure of this market. The topics we covered in this thesis are a basis for further investigation. The first two papers are focused on the effect of quantitative easing on the European office market, on both the risk premium and the prices. Since then, the main central banks have announced that the normalisation of their monetary policies has begun. It might be interesting to study how the real estate market would react to a gradual reduction of the money supply. Several responses could be considered. We previously found that increasing the money supply should support real estate prices; similarly, we may expect an opposite effect following a decrease in the money supply. However, central banks begin the normalisation process only when the economic conditions are positive and stable. Thus, the positive effects of the monetary policies could be substituted by the economic cycle, so prices should continue to increase, driven by the economic growth. The two opposite effects should then be studied in more detail.

The effect of quantitative easing policies should be studied for other asset classes, such as retail, industrial or residential classes. By merely regarding the prices for each asset class, we see that the residential market in the main metropolis recovered quickly after the GFC and that commercial real estate upturn was slow (Figure 5.1).

Thus, it would be interesting to study the effect of unconventional monetary policies for each type of asset. The residential market is driven more by demographic factors and therefore interest rates, implying that quantitative easing may have a marginal effect on prices. Commercial real estate prices are more dependent on institutional investors and thus should be influenced more by the

Figure 5.1: Prices index for each type of asset: 2001-2017.

Source: MSCI.



unconventional monetary policies. It would thus be interesting to study the heterogeneity across the assets of the effect following an increase in the money supply. In addition to the difference induced by the heterogeneity of the market, interesting results could be derived from analyses of all types of assets. However, as in most cases in real estate research, we face a substantial lack of data.

Moreover, in regard to future research on real estate, we should consider the current changes in the market and the new uses of space. A contemporary example that could potentially affect the real estate market is the coworking phenomena. Coworking is a new approach of consuming office spaces and is challenging the traditional layout of the labour market. Because the labour market is more individualised with freelance, nomad and self-employed workers, they tend to shift away from the

common working models. Coworking has shown a strong performance since 2010, with a double digit growth per year. In 2017, the number of coworking spaces in the world was 13,800; by 2020, that number should reach 26,000. However, the question of a coworking economic bubble could be raised because we do not have data on the sustainability of the model. According to Deskmag's co-working survey (2017), 41% of the coworking spaces are profitable.² The increasing number of coworking spaces and their significance in office layouts might have artificially boosted the drop in the vacancy rate in the main market. In Europe, the number of coworking spaces has increased considerably. For example, in 2017, the volume of deals (in square metres) for coworking spaces increased by 379% in Germany, by 160% in London and by 96% in Paris. In the future, the sustainability of the business model may affect the real estate market in terms of space release. If the model is not sustainable, European markets will face large space releases of second-hand offices not adapted to the usual models, implying a considerable increase in vacant spaces. The role of coworking and its effect on the real estate market should then be of particular interest for the literature in the next few years.

In regard to the "relative" opacity of the market, researchers need to have access to large amounts of high-quality data. The latest buildings can now communicate and interact with their environments, as well as record and emit a continuous flow of information from both the building and the users. The obtained data can be various; for example, data can come directly from the building and provide information on such things as the occupancy of meeting rooms, or external data on such things as temperature and wind can be obtained. This massive flow of data offers promising developments for real estate research and can provide direct support to professionals. Property management should be more affected than other sectors, with a better control of the

²<https://zevillage.net/wp-content/uploads/2017/01/2017-global-coworking-survey-Deskmag.pdf>

workspace environment (lights, air conditioning, etc.) and a better prevention of dysfunction. The data collected from the buildings or from the external environment can enable professionals to have complete views of particular buildings and to improve the targeting of potential buyers or users. A property forecast could then be realised for a particular building via real time data on rents, occupancy, typology of companies, economic conditions, and so forth. Investors can also consider smart buildings with some improvements of their strategies by optimising their operational costs or by measuring the attractiveness of their assets. This type of research is still in its early stages because of the recent emergence of smart buildings and the need to be more developed.

These thoughts on future research are just an overview of the subjects that will be of particular interest to researchers and practitioners during the next few years. The recent economic crisis triggered by the sub-prime lending showed that detailed information on the market is needed to avoid the overheating of the property market. The growing interest of households, companies, investors and politicians for the real estate sector implies that research will continue to be at the heart of future developments.

CHAPITRE 5

CONCLUSION GÉNÉRALE

Cette thèse contribue à la compréhension globale de la relation entre les marchés immobiliers et l'économie. Dans cette dernière section, nous synthétisons les principaux résultats et nous mettons en avant les contributions scientifiques. Nous pouvons distinguer chacun des trois articles. Tout d'abord, nous résumons notre étude sur les principaux déterminants de la prime de risque historique sur le marché londonien avec une attention particulière pour les effets d'un changement de l'offre de monnaie. Ensuite, nous rappelons les effets des politiques non conventionnelles sur le marché des bureaux en Europe et plus généralement sur les réorganisations urbaines. Puis nous allons synthétiser les principales contributions de notre étude sur la relation entre la dynamique des loyers et le taux de vacance. Enfin, nous proposons plusieurs perspectives de recherche qui peuvent découler de cette thèse ou du contexte actuel.

Dans le premier article, nous avons étudié la prime de risque relative au marché des bureaux et ses principaux déterminants dans le temps. La prime de risque correspond à la différence entre le rendement global (somme entre le rendement locatif et le rendement en capital) et un taux sans risque. Cependant, malgré son importance pour les investisseurs, ce concept reste flou dans la littérature immobilière, principalement à cause du manque de données. En prenant en compte le nouvel environnement économique, avec la mise en place de politiques monétaires non conventionnelles par les banques centrales, nous portons une attention particulière à l'impact de l'offre de monnaie sur le marché immobilier. Les effets d'une telle augmentation peuvent être décrits, théoriquement, en utilisant le modèle IS-LM de Mundell-Fleming pour une économie ouverte avec des taux de changes variables. Une hausse de l'offre de monnaie entraîne une baisse des taux d'intérêts domestiques relativement aux taux d'intérêts étrangers et l'afflux de capitaux devrait augmenter. En conséquence, l'investissement devrait croître jusqu'à ce que les taux d'intérêts locaux soient égaux au

taux d'intérêts étrangers. Comme l'immobilier est un actif inélastique, une pression de la demande sans ajustement de l'offre devrait mener à une hausse des prix. De plus, suite à la dépréciation de la monnaie locale, les capitaux devraient également affluer de l'étranger. Pour vérifier ces résultats théoriques, nous avons construit un indice monétaire spécifique au marché immobilier en pondérant, pour chaque pays, la variation d'offre de monnaie par la part des volumes investis. Nous avons ensuite estimé un vecteur autorégressif (VAR) afin de déterminer les principaux déterminants de la prime de risque, puis un modèle autorégressif structurel pour analyser les effets d'un choc inattendu de l'offre de monnaie sur la variable d'intérêt. Nous avons trouvé que le taux de vacance, le FTSE 100, le paramètre autorégressif et l'indice monétaire étaient significatifs et positifs pour expliquer la prime de risque, alors que l'emploi était significativement négatif. Le signe positif de l'indice monétaire suggère qu'une augmentation de l'offre de monnaie a un effet haussier sur le prix des bureaux. Pour avoir une compréhension détaillée de ce résultat, nous avons étudié le même modèle pour plusieurs sous-périodes. L'indice monétaire est donc significatif pour toute la période de l'étude, mais également pour la sous-période après 2009, lorsque les politiques monétaires non conventionnelles ont commencé à être mise en place. Pour la sous-période précédente, avant la mise en place de ces politiques d'assouplissement quantitatif, l'indice monétaire n'était pas significatif, ce qui signifie que l'offre de monnaie n'a eu aucun impact sur la prime de risque avant la crise économique mondiale. Le caractère significatif des variables fondamentales change également à travers les différentes sous-périodes. En remplaçant l'indice monétaire par le taux d'intérêt de court terme, nous avons estimé que le taux interbancaire n'était jamais significatif pour expliquer la prime de risque. Enfin, les résultats du VAR structurel nous ont confirmé les résultats obtenus précédemment, avec un effet positif de l'offre de monnaie sur les prix immobiliers. De plus, la réponse de la prime de risque est plus importante suite à un choc sur l'offre de monnaie que suite à un choc sur le

taux interbancaire. Cependant, si ces résultats confirment ceux du modèle théorique, nous pouvons attendre une certaine hétérogénéité à une échelle plus large.

Dans le second chapitre, nous avons étudié les dynamiques des prix des bureaux en Europe depuis la mise en place des politiques monétaires non conventionnelles par les banques centrales. Comme nous avons pu le voir, la valeur totale du parc de bureaux a augmenté d'environ 60% depuis 2009 et nous pouvons supposer que l'afflux de monnaie sur les marchés financiers a pu être un des principaux facteurs explicatifs. Cependant, les effets des politiques monétaires peuvent être hétérogènes à travers l'Europe et ont donc pu générer une redistribution des richesses. Nous avons donc construit un indice monétaire pour chaque marché, basé sur la même méthodologie que celle du premier chapitre. Puis, nous avons estimé les principaux déterminants des prix des bureaux pour 16 des principaux marchés immobiliers européens en utilisant un modèle de panel. Comme nous le prévoyons, l'indice monétaire a un effet positif sur les prix des bureaux au niveau européen. Pour déterminer le degré d'homogénéité de ce résultat ainsi que les canaux par lesquels l'afflux de liquidité est distribué et investi dans chaque marché, nous avons introduit plusieurs segmentations. Tout d'abord, nous avons mis en avant une plus grande capacité pour les métropoles d'attirer les capitaux. En se basant uniquement sur l'offre de monnaie de la zone euro, nous avons trouvé que les marchés allemands ont grandement bénéficié de l'augmentation des liquidités disponibles, notamment grâce à la puissance économique du pays et à sa plus grande capacité à absorber les chocs. De plus, les prix des marchés allemands étant beaucoup plus faibles que ceux de Londres et de Paris en 2009, les investisseurs ont bénéficié d'opportunités et ces marchés ont connu un effet de rattrapage. Enfin, nous avons utilisé la notion de mégapole européenne pour distinguer les marchés centraux des marchés périphériques. Les prix au sein de la mégapole européenne ont ainsi bénéficié de la

politique monétaire alors que les marchés de la périphérie ont retrouvé leur niveau d'avant crise uniquement en 2016. Ces résultats peuvent soulever certaines questions sur la pertinence des politiques monétaires non conventionnelles. En effet, alors que ces politiques ont été mises en place pour aider les marchés en périphérie, les principaux bénéficiaires sont les plus grands marchés, au centre de l'Europe. Une union monétaire avec des divergences importantes en termes de prix et de productivité, et sans politique fiscale et économique a pu générer un environnement économique instable et certaines disparités dans les résultats de politiques globales. Plus précisément, une politique monétaire dans une union qui n'est pas complètement homogène tend à produire des réallocations de richesse à travers les Etats.

Les investisseurs ont besoin d'avoir une meilleure compréhension des marchés européens avec de nouveaux résultats sur le marché de l'investisseur et également sur le marché utilisateur. En effet, le marché de l'investissement est fortement dépendant du marché utilisateur puisque les loyers sont la principale source de revenus des investisseurs. Il est donc important d'avoir des éléments de compréhension sur la formation des loyers et sur ses principaux facteurs explicatifs. La littérature immobilière se concentre principalement sur les Etats-Unis suite à l'importance historique du marché, ainsi qu'à la disponibilité des données. Cependant, l'Europe est maintenant le premier marché immobilier en termes de volumes investis (avec 35% du total mondial), juste devant les Etats-Unis (34%). Avec une importance grandissante du marché européen, les investisseurs étrangers sont également intéressés par la structure globale de la formation des loyers, ainsi que par l'intégration, ou l'indépendance des marchés immobiliers.

Dans le dernier chapitre de cette thèse, nous avons estimé la dynamique des valeurs locative à

la fois à un niveau pan-européen et à un niveau local. Dans un premier temps, nous avons fait l'hypothèse que les marchés européens sont globalement intégrés et que les dynamiques sont identiques en Europe. Nous avons donc estimé l'ajustement des loyers en utilisant un vecteur autorégressif en panel. Les loyers sont influencés par le taux de marge des entreprises, par le degré d'ouverture des pays, l'emploi et le taux de vacance. Les données de panel nous permettent d'introduire une hétérogénéité individuelle, tout en considérant une structure commune. Nous avons trouvé que le taux de marge des entreprises, l'emploi et les loyers retardés sont significatifs et positifs. Le taux de vacance est également significatif, avec un signe négatif. Ce résultat est connu dans la littérature immobilière. En effet, ces deux variables sont négativement corrélées : une baisse du taux de vacance exerce une pression haussière sur les loyers puisque l'offre disponible diminue. En se basant uniquement sur les marchés les plus importants (i.e. France, Allemagne et Royaume-Uni), nous avons vu que l'emploi local n'est plus significatif, alors que l'indice d'ouverture est un facteur significatif expliquant la formation des loyers. Ce résultat montre que les plus gros marchés ont une orientation plus internationale que les plus petits et qu'il existe encore une certaine hétérogénéité entre les marchés. Le caractère fortement significatif des variables locales (taux de vacance, emploi, marges des entreprises et loyers retardés) montre que les marchés immobiliers peuvent être toujours impactés par des dynamiques locales. Dans une deuxième étape, nous avons estimé la même équation pour tous les marchés en faisant l'hypothèse que les structures et les dynamiques sont différentes. Nous avons trouvé une hétérogénéité importante entre les marchés puisque les variables n'ont jamais le même impact, ni même la même significativité en fonction des marchés. La variable la plus significative reste le taux de vacance, avec une forte dispersion dans son impact. Une rapide comparaison de la sensibilité du taux de vacance sur les valeurs locatives nous a permis de tirer des conclusions intéressantes sur les marchés européens. Comme nous l'anticipions, les marchés allemands sont les

plus stables alors que les marchés au Royaume-Uni, en Espagne et en Irlande sont les plus sensibles à un changement de leur taux de vacance. Enfin, nous avons repris la théorie du taux de vacance naturel pour avoir une analyse plus détaillée de la corrélation entre les valeurs locatives et l'espace occupé. Le taux de vacance naturel est défini comme le taux de vacance auquel le loyer de marché est à l'équilibre. Une comparaison entre le taux de vacance actuel et le taux de vacance naturel nous permet d'avoir des indications sur les dynamiques de court terme de chaque marché. Les marchés européens ayant actuellement des taux de vacance inférieurs à leurs taux de vacance naturels, nous pouvons supposer que les valeurs locatives devraient continuer à croître dans un futur proche.

L'objectif de cette thèse était d'apporter de nouvelles informations sur les marchés immobiliers européens en lien avec le nouvel environnement économique mondial. Nous nous sommes concentrés sur la relation entre l'immobilier commercial et l'économie mondiale en portant une attention particulière à l'influence des politiques monétaires non conventionnelles sur le marché des bureaux. Dans le dernier chapitre, nous avons étudié les valeurs locatives, une des principales variables en immobilier grâce à leur influence auprès des utilisateurs, des investisseurs et des promoteurs. En effet, pour tous les acteurs du marché, l'analyse coût-bénéfice est principalement influencée par la dynamique des loyers. Ainsi, nous espérons avoir contribué à l'amélioration de la compréhension de ce marché particulier, qui devient de plus en plus attractif pour les investisseurs. Malgré le fait que l'Europe soit devenue le plus gros marché immobilier en termes de volume investi, ce dernier reste encore assez peu étudié dans la littérature.

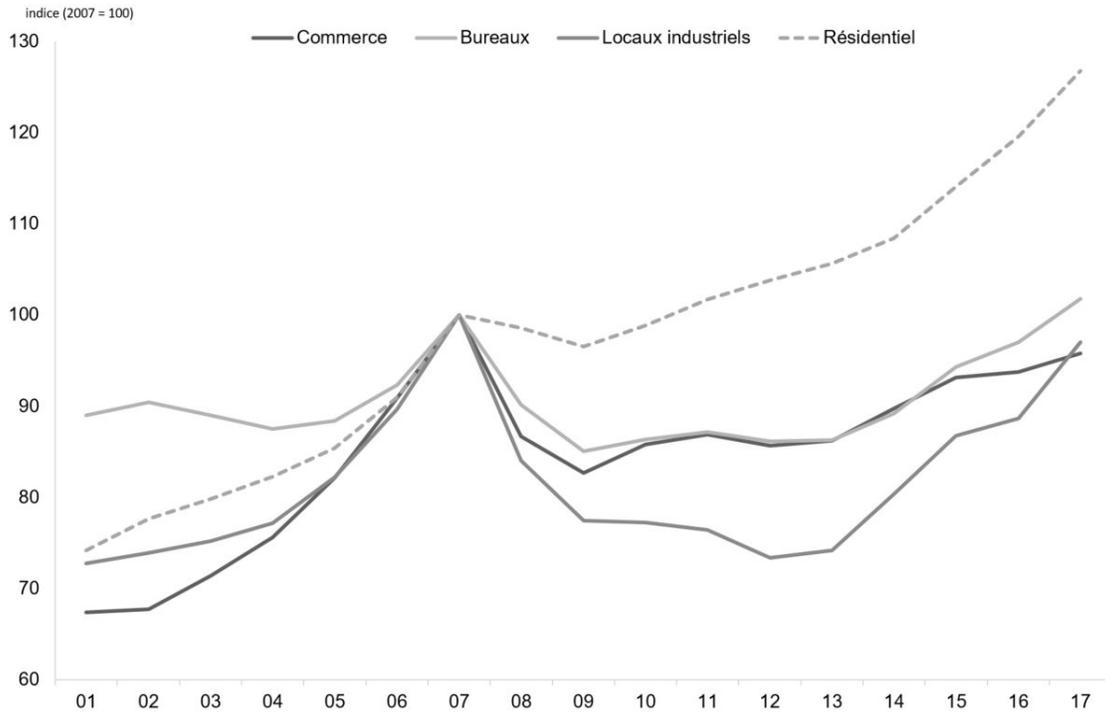
Les sujets que nous avons couverts dans cette thèse peuvent nécessiter de plus amples investigations. En effet, les deux premiers articles se concentrent sur l'impact de l'assouplissement monétaire

sur les marchés de bureaux en Europe, à la fois sur la prime de risque et sur les prix. Depuis lors, les principales banques centrales ont annoncé le début de la normalisation de leurs politiques monétaires. Il peut donc être intéressant d'étudier comment les marchés immobiliers vont répondre à cette réduction graduelle de la liquidité disponible sur les marchés financiers. Plusieurs réponses pourraient en effet être considérées. Nous avons démontré que l'augmentation de l'offre de monnaie a soutenu les prix immobiliers et donc, par opposition, nous pouvons supposer un effet inverse lors d'une réduction de la masse monétaire. D'un autre côté, les banques centrales ont commencé la normalisation de leurs politiques lorsque l'environnement économique a retrouvé une tendance stable et positive. Ainsi, le cycle économique positif pourrait se substituer aux politiques monétaires et les prix pourraient continuer à croître, de nouveau portés par la croissance. Les deux effets opposés devraient ainsi être étudiés en détails.

Les effets des politiques monétaires non conventionnelles pourraient également être analysés pour les différentes classes d'actifs telles que le commerce, les locaux industriels et le résidentiel. Uniquement en étudiant les dynamiques de prix de chaque classe d'actifs, nous pouvons voir que les marchés résidentiels dans les grandes métropoles européennes sont rapidement repartis sur une dynamique positive après la crise économique mondiale, alors que le retournement de l'immobilier commercial a été plus long (Figure 5.1).

Il pourrait donc être pertinent d'étudier les effets des politiques non conventionnelles sur chaque type d'actif immobilier. Le marché résidentiel étant plus impacté par des facteurs démographiques et donc par les taux d'intérêts, nous pouvons supposer un effet marginal de l'assouplissement quantitatif. L'immobilier commercial, plus dépendant des investisseurs institutionnels, devrait être plus impacté par les politiques monétaires non conventionnelles. Il pourrait donc être intéressant d'étudier l'hétérogénéité d'une augmentation de l'offre de monnaie entre les différentes classes d'actifs. En plus

FIGURE 5.1 : Indice des prix pour chaque type d'actif en Europe : 2001-2017.
Source : MSCI



des différences induites par l'hétérogénéité de chaque marché ou pays, nous pourrions trouver certains résultats intéressants en analysant chaque type d'actif. Cependant, comme dans la plupart des cas en recherche immobilière, nous faisons pour le moment face à un manque de données disponibles.

De plus, lorsque nous considérons des pistes de recherche future, nous devons également nous pencher sur les changements actuels du marché et sur les nouveaux usages de l'espace. Un exemple actuel qui pourrait, à terme, avoir un impact sur les marchés est le coworking. Le coworking est une nouvelle manière de consommer les espaces de bureaux et devient concurrentiel par rapport à l'approche traditionnelle. De nos jours, le marché du travail devient de plus en plus individualisé avec des travailleurs en freelance, nomades et autoentrepreneurs, et les travailleurs tendent à s'éloi-

gner de la manière traditionnelle de consommer les espaces de travail. Le coworking a connu un fort développement depuis 2010 avec une croissance à deux chiffres. D'ici 2020, il devrait y avoir environ 26 000 espaces de coworking dans le monde (contre 13 800 en 2017). Cependant, la question d'une bulle du coworking peut se poser puisqu'aucune donnée sur la viabilité du modèle n'est disponible. Selon l'enquête menée par Deskmag's Coworking (2017), uniquement 41% des espaces de coworking sont profitables.¹ De plus, la part grandissante du coworking dans le niveau de transaction global de surfaces de bureaux peut avoir artificiellement tiré le taux de vacance vers le bas dans la plupart des marchés. En Europe, le nombre de transaction des espaces de coworking a constamment augmenté depuis 2010. Par exemple, en 2017, le volume de transaction (en mètre carré) pour des espaces de coworking a augmenté de 379% en Allemagne, 160% à Londres et de 96% à Paris. La rentabilité du modèle peut, dans le futur, avoir un impact sur les marchés immobiliers en termes de libération d'espace. En effet, si le modèle n'est pas aussi profitable qu'espéré, les marchés européens pourraient faire face à une forte libération d'espaces de travail de seconde-main, non adaptés aux modèles traditionnels, ce qui entraînerait une augmentation significative du taux de vacance. Le rôle et l'impact du coworking sur les marchés immobiliers peuvent alors être particulièrement intéressants pour la littérature ces prochaines années.

De par la relative opacité du marché, il existe encore un besoin pour les chercheurs d'avoir accès à des données nombreuses, et également de bonne qualité. Les derniers immeubles sont maintenant capables de communiquer et d'interagir avec leur environnement, enregistrant et émettant un flux continu d'informations sur l'immeuble ainsi que sur les occupants. Ces données peuvent être variées avec des données venant directement de l'immeuble (telles que le taux d'occupation des salles

¹<https://zevillage.net/wp-content/uploads/2017/01/2017-global-coworking-survey-Deskmag.pdf>

de réunion ou des bureaux) et externes (température, vents, etc.). Cette masse de données offre des perspectives de développement prometteuses pour la recherche immobilière et peut également fournir un support direct aux professionnels. Les services de gestion immobilière (property management) devraient être plus impactés que les autres secteurs, grâce à un meilleur contrôle de l'environnement de travail (lumières, climatisation, etc.), et un meilleur contrôle des dysfonctionnements. Les données collectées sur les immeubles ou l'environnement externe peuvent également permettre aux professionnels d'avoir une vision complète sur l'immeuble et d'améliorer le ciblage des potentiels acheteurs ou utilisateurs, en fonction de leurs attentes. Les prévisions sur les biens immobiliers pourraient également être améliorées et réalisées au niveau individuel, avec des données en temps réel sur les loyers, l'occupation, la typologie des entreprises ou l'environnement économiques. Les investisseurs peuvent également être intéressés par les immeubles intelligents avec une amélioration de leur stratégies en optimisant leurs coûts opérationnels ou en mesurant l'attrait de leur immeuble. Ce type de recherche en est toujours au stade préliminaire avec l'émergence récente des immeubles intelligents et devrait être plus développé par la suite.

Ces idées sur de potentielles recherches sont uniquement un aperçu des sujets qui pourraient être d'intérêt général pour les chercheurs, ainsi que pour les professionnels pendant les prochaines années. La crise économique récente, déclenchée par les crédits hypothécaires « subprime », nous a montré que notre compréhension de l'immobilier doit encore être améliorée. L'intérêt grandissant du secteur immobilier auprès des ménages, des entreprises, des investisseurs et même des politiques confirme que la recherche devrait continuer à être au coeur des futurs développements.

BIBLIOGRAPHY

- [1] ANDERSON, R., BONEY, V., AND GUIRGUIS, H. The impact of switching regimes and monetary shocks: An empirical analysis of REITs. *Journal of Real Estate Research* 34, 2 (2012), 157–181.
- [2] APPERT, M. Les JO 2012 à Londres: un grand événement alibi du renouvellement urbain à l'est de la capitale. *Géoconfluences* (2012).
- [3] APPERT, M., AND DROZDZ, M. La géopolitique locale-globale aux marges de la City de Londres: conflits autour des projets de renouvellement urbain de Bishopsgate. *Revue de géographie et de géopolitique*, 137 (2010), 119–134.
- [4] APPERT, M., AND MONTES, C. Skyscrapers and the redrawing of the London skyline: a case of territorialisation through landscape control. *Journal of Urban Research*, Special issue 7 (2015).
- [5] APPERT, M., AND WAINE, O. Skyline policy The Shard and London's high-rise debate. *Metropolitica* (2011).
- [6] ARRIGHI, G. *The long twentieth century: Money, power, and the origins of our times*. Verso, 1994.

- [7] BAETEN, G. The Europeanization of Brussels and the Urbanization of ‘Europe’ Hybridizing the City. Empowerment and Disempowerment in the EU District. *European Urban and Regional Studies* 8, 2 (2001), 117–130.
- [8] BAI, J., AND PERRON, P. Estimating and testing linear models with multiple structural changes. *Econometrica* 66, 1 (1998), 47–78.
- [9] BAI, J., AND PERRON, P. Computation and analysis of multiple structural change models. *Journal of Applied Econometrics* 18, 1 (2003), 1–22.
- [10] BAIGENT, E. Patrick Geddes, Lewis Mumford and Jean Gottmann: divisions over ‘megapolis’. *Progress in Human Geography* 28, 6 (2004), 687–700.
- [11] BARSKY, R. B., AND SIMS, E. R. News shocks and business cycles. *Journal of Monetary Economics* 58, 3 (2011), 273–289.
- [12] BARTHOLOMAE, F., WOON NAM, C., AND SCHOENBERG, A. Urban shrinkage and resurgence in Germany. *Urban Studies* 54, 12 (2017), 2701–2718.
- [13] BEAVERSTOCK, J. V. German cities in the world city network. *Raumforschung und Raumordnung* 69, 3 (2011), 213–217.
- [14] BEAVERSTOCK, J. V., SMITH, R. G., TAYLOR, P. J., WALKER, D., AND LORIMER, H. Globalization and world cities: some measurement methodologies. *Applied geography* 20, 1 (2000), 43–63.
- [15] BELKE, A., ORTH, W., AND SETZER, R. Liquidity and the dynamic pattern of asset price adjustment: A global view. *Journal of Banking & Finance* 34, 8 (2010), 1933–1945.
- [16] BEN ZEEV, N., AND KHAN, H. Investment-Specific News Shocks and US Business Cycles. *Journal of Money, Credit and Banking* 47, 7 (2015), 1443–1464.
- [17] BERNANKE, B. S., AND KUTTNER, K. N. What explains the stock market’s reaction to Federal Reserve policy? *The Journal of finance* 60, 3 (2005), 1221–1257.
- [18] BERROIR, S., CATTAN, N., DECROLY, J.-M., FLEURY, A., AND GUÉROIS, M. Les mobilités internationales en Europe. Berlin, Bruxelles, Londres et Paris dans les nouveaux réseaux territoriaux. *Géocarrefour* 84, 3 (2009), 151–161.

- [19] BEYER, A., DOORNIK, J. A., AND HENDRY, D. F. Constructing Historical Euro-zone Data. *The Economic Journal* 111, 469 (2001), 102–121.
- [20] BLANCHARD, O. J. Output, the stock market, and interest rates. *The American Economic Review* 71, 1 (1981), 132–143.
- [21] BLANCHARD, O. J., AND QUAH, D. The Dynamic Effects of Aggregate Demand and Supply Disturbances. *American Economic Review* 79, 4 (September 1989), 655–673.
- [22] BLANK, D. M., AND WINNICK, L. The structure of the housing market. *The Quarterly Journal of Economics* 67, 2 (1953), 181–208.
- [23] BRAUDEL, F. *Civilization and capitalism, 15th-18th century, vol. III: The perspective of the world*. Univ of California Press, 1982.
- [24] BREDIN, D., O'REILLY, G., AND STEVENSON, S. Monetary shocks and REIT returns. *The Journal of Real Estate Finance and Economics* 35, 3 (2007), 315–331.
- [25] BREDIN, D., O'REILLY, G., AND STEVENSON, S. Monetary policy transmission and real estate investment trusts. *International Journal of Finance & Economics* 16, 1 (2011), 92–102.
- [26] BROUNEN, D., AND JENNEN, M. Local office rent dynamics. *The Journal of Real Estate Finance and Economics* 39, 4 (2009), 385–402.
- [27] BROWN, G. R., AND MATYSIAK, G. A. Valuation smoothing without temporal aggregation. *Journal of Property Research* 15, 2 (1998), 89–103.
- [28] BRUEGGEMAN, W. B., AND FISHER, J. D. *Real estate finance & investments*. McGraw-Hill/Irwin, 2008.
- [29] BRUNET, R. *Les villes "européennes": rapport pour la DATAR, Délégation à l'Aménagement du Territoire et à l'Action Régionale*. La Documentation Française, 1989.
- [30] CAIVANO, M. The transmission of monetary and technology shocks between the US and the euro area. *manuscript, Bank of Italy* (2006).
- [31] CALAFATI, A. G. *Economie in cerca di città: la questione urbana in Italia*. Donzelli Editore, 2009.

- [32] CAMPBELL, J. R., EVANS, C. L., FISHER, J. D., AND JUSTINIANO, A. Macroeconomic effects of Federal Reserve forward guidance. *Brookings Papers on Economic Activity*, 1 (2012), 1–80.
- [33] CANOVA, F., CICCARELLI, M., AND ORTEGA, E. Similarities and convergence in G-7 cycles. *Journal of Monetary economics* 54, 3 (2007), 850–878.
- [34] CANOVA, F., CICCARELLI, M., AND ORTEGA, E. Do institutional changes affect business cycles? Evidence from Europe. *Journal of Economic Dynamics and Control* 36, 10 (2012), 1520–1533.
- [35] CANOVA, F., AND PAPPA, E. Does it cost to be virtuous? The macroeconomic effects of fiscal constraints. Tech. rep., National Bureau of Economic Research, 2005.
- [36] CANOVA, F., AND PAPPA, E. Price differentials in monetary unions: The role of fiscal shocks. *The Economic Journal* 117, 520 (2007), 713–737.
- [37] CATTAN, N. Comparative Studies of sets of European Cities: an overview. *Urban Networks in Europe* (1996), 237–250.
- [38] CATTAN, N. *Cities and networks in Europe: a critical approach of polycentrism*. John Libbey Eurotext, 2007.
- [39] CATTAN, N., AND SAINT-JULIEN, T. Modèles d’intégration spatiale et réseau des villes en Europe occidentale. *L’Espace géographique* (1998), 1–10.
- [40] CHAU, K., AND WONG, S. K. Information asymmetry and the rent and vacancy rate dynamics in the office market. *The Journal of Real Estate Finance and Economics* 53, 2 (2016), 162–183.
- [41] CHIANG, Y., SA AADU, J., AND SHILLING, J. Unconventional monetary policy and U.S. housing markets dynamics. *working paper University of Iowa* (2015).
- [42] CICCARELLI, M., ORTEGA, E., AND VALDERRAMA, M. Heterogeneity and cross-country spillovers in macroeconomic-financial linkages. *European Central Bank Working Paper Series* 1498 (2012).

- [43] CLARIDA, R., GALI, J., AND GERTLER, M. Monetary policy rules in practice: Some international evidence. *European Economic Review* 42, 6 (1998), 1033–1067.
- [44] COCHRANE, A., AND JONAS, A. Reimagining Berlin: world city, national capital or ordinary place? *European urban and regional studies* 6, 2 (1999), 145–164.
- [45] COËN, A., LEFEBVRE, B., AND SIMON, A. International money supply and real estate risk premium: The case of the London office market. *Journal of International Money and Finance* 82 (2018), 120–140.
- [46] COLOMBO, R. Processes of Globalization in Madrid: Indicators and Analysers for a Contemporary Metropolis. *Urbanities* 6, 1 (2016), 90–105.
- [47] D’ARCY, E., MCGOUGH, T., AND TSOLACOS, S. National economic trends, market size and city growth effects on European office rents. *Journal of Property Research* 14, 4 (1997), 297–308.
- [48] D’ARCY, E., MCGOUGH, T., AND TSOLACOS, S. An econometric analysis and forecasts of the office rental cycle in the Dublin area. *Journal of Property Research* 16, 4 (1999), 309–321.
- [49] D’ARGENSIO, J.-J., AND LAURIN, F. The real estate risk premium: A developed/emerging country panel data analysis. *Journal of Portfolio Management* 35, 5 (2009), 118–132.
- [50] DAVEZIES, L. La République et ses territoires. La circulation invisible des richesses. *Lectures, Les livres* (2008).
- [51] DAVIDSON, M., AND LEES, L. New-build gentrification and London’s riverside renaissance. *Environment and planning A* 37, 7 (2005), 1165–1190.
- [52] DAVIS, J., AND THORNLEY, A. Urban regeneration for the London 2012 Olympics: Issues of land acquisition and legacy. *City, Culture and Society* 1, 2 (2010), 89–98.
- [53] DE WIT, I., AND VAN DIJK, R. The global determinants of direct office real estate returns. *The Journal of Real Estate Finance and Economics* 26, 1 (2003), 27–45.
- [54] DEMATTEIS, G. Towards a unified metropolitan urban system in Europe: Core centrality versus network distributed centrality. *Urban networks in Europe* (1996), 19–28.

- [55] DERUDDER, B., HOYLER, M., TAYLOR, P. J., AND WITLOX, F. *International handbook of globalization and world cities*. Edward Elgar Publishing, 2012.
- [56] DEVANEY, S., AND SCOFIELD, D. Time to transact: measurement and drivers. In *Investment Property Forum, September* (2014).
- [57] DROUHIN, P. A., AND SIMON, A. Are property derivatives a leading indicator of the real estate market? *Journal of European Real Estate Research* 7, 2 (2014), 158–180.
- [58] ENGLUND, P., GUNNELIN, Å., HENDERSHOTT, P. H., AND SÖDERBERG, B. Adjustment in Property Space Markets: Taking Long-Term Leases and Transaction Costs Seriously. *Real Estate Economics* 36, 1 (2008), 81–109.
- [59] EUBANK JR, A. A., AND SIRMANS, C. The price adjustment mechanism for rental housing in the United States. *The Quarterly Journal of Economics* 93, 1 (1979), 163–168.
- [60] FARRELLY, K., AND SANDERSON, B. Modelling regime shifts in the city of London office rental cycle. *Journal of Property Research* 22 (2005), 325–344.
- [61] FELDSTEIN, M. Quantitative easing and America’s economic rebound. *Project Syndicate* (2011).
- [62] FEROLI, M., HARRIS, E. S., SUFI, A., AND WEST, K. D. Housing, monetary policy, and the recovery. *Chicago Booth Research Paper*, 12-16 (2012).
- [63] FIRSTENBERG, P. M., ROSS, S. A., AND ZISLER, R. C. Real estate: the whole story. *The Journal of Portfolio Management* 14, 3 (1988), 22–34.
- [64] FOURÇANS, A., AND VRANCEANU, R. The ECB interest rate rule under the Duisenberg presidency. *European Journal of Political Economy* 20, 3 (2004), 579–595.
- [65] FRANCIS, N., OWYANG, M., ROUSH, J., AND DICECIO, R. A flexible finite-horizon alternative to long-run restrictions with an application to technology shocks. *Review of Economics and Statistics* 96, 4 (2014), 638–647.
- [66] FRIEDMAN, M., AND SCHWARTZ, A. *A monetary history of the United States*. Princeton University Press, 1963.

- [67] FUJITA, K., AND HILL, R. C. Place Stratification in Tokyo and New York. *Durban, South Africa* (2006).
- [68] GABRIEL, S., AND LUTZ, C. The impact of unconventional monetary policy on real estate markets. *Federal Reserve Bank of San Francisco*, august 2014 (2014).
- [69] GELTNER, D. Estimating real estate's systematic risk from aggregate level appraisal-based returns. *Real Estate Economics* 17, 4 (1989), 463–481.
- [70] GELTNER, D., MILLER, N. G., CLAYTON, J., AND EICHHOLTZ, P. *Commercial real estate analysis and investments*, vol. 1. South-western Cincinnati, OH, 2001.
- [71] GHORRA-GOBIN, C. *La métropolisation en question*. Presses Universitaires de France, 2015.
- [72] GIESE, J. V., AND TUXEN, C. K. Global Liquidity, Asset Prices and Monetary Policy: Evidence from Cointegrated VAR Models. *Nuffield College, University of Oxford, and Department of Economics, Copenhagen University* (2007).
- [73] GILLI, F. *Grand Paris: l'émergence d'une métropole*. Presses de Sciences Po, 2014.
- [74] GOTTMANN, J. *Megalopolis: the urbanized northeastern seaboard of the United States*. Twentieth Century Fund Study. M.I.T. Press, 1961.
- [75] HALBERT, L. *L'avantage métropolitain*. Presses universitaires de France, 2015.
- [76] HANES, J. E. From megalopolis to megaropolis. *Journal of urban history* 19, 2 (1993), 56–94.
- [77] HEKMAN, J. S. Rental price adjustment and investment in the office market. *Real Estate Economics* 13, 1 (1985), 32–47.
- [78] HENDERSHOTT, P. H. Rental adjustment and valuation in overbuilt markets: Evidence from the Sydney office market. *Journal of Urban Economics* 39, 1 (1996), 51–67.
- [79] HENDERSHOTT, P. H., JENNEN, M., AND MACGREGOR, B. D. Modeling space market dynamics: An illustration using panel data for US retail. *The Journal of Real Estate Finance and Economics* 47, 4 (2013), 659–687.

- [80] HENDERSHOTT, P. H., LIZIERI, C. M., AND MACGREGOR, B. D. Asymmetric adjustment in the city of London office market. *The Journal of Real Estate Finance and Economics* 41, 1 (2010), 80–101.
- [81] HENDERSHOTT, P. H., LIZIERI, C. M., AND MATYSIAK, G. A. The workings of the London office market. *Real Estate Economics* 27, 2 (1999), 365–387.
- [82] HENDERSHOTT, P. H., AND MACGREGOR, B. D. Investor rationality: evidence from UK property capitalization rates. *Real Estate Economics* 33, 2 (2005), 299–322.
- [83] HENDERSHOTT, P. H., MACGREGOR, B. D., AND TSE, R. Y. Estimation of the rental adjustment process. *Real Estate Economics* 30, 2 (2002), 165–183.
- [84] HO, D. K. H., ADDAE-DAPAAH, K., AND GLASCOCK, J. L. International Direct Real Estate Risk Premiums in a Multi-Factor Estimation Model. *The Journal of Real Estate Finance and Economics* 51, 1 (2015), 52–85.
- [85] HUYSSSEUNE, M., AND JANS, T. Brussels as the Capital of a Europe of the Regions? *Brussels Studies*, 16 (2008).
- [86] IACOVIELLO, M. Financial business cycles. *Review of Economic Dynamics* 18, 1 (2015), 140–163.
- [87] IBANEZ, M. R., AND PENNINGTON-CROSS, A. Commercial property rent dynamics in US metropolitan areas: an examination of office, industrial, flex and retail space. *The Journal of Real Estate Finance and Economics* 46, 2 (2013), 232–259.
- [88] ISOMURA, E. Nihon no megaroporisu-sono jitai to miraizo (Megalopolis in Japan-its reality and future). *Nihon Keizai Shimbunsha* (1969).
- [89] JOHNSON, R. R. Monetary policy and real estate returns. *Journal of Economics and Finance* 24, 3 (2000), 283–293.
- [90] JON FAUST AND JOHN H. ROGERS AND JONATHAN H. WRIGHT. An empirical comparison of Bundesbank and ECB monetary policy rules. International Finance Discussion Papers 705, Board of Governors of the Federal Reserve System (U.S.), 2001.

- [91] JOYCE, M., MILES, D., SCOTT, A., AND VAYANOS, D. Quantitative easing and unconventional monetary policy—an introduction. *The Economic Journal* 122, 564 (2012).
- [92] KAIKA, M. Architecture and crisis: re-inventing the icon, re-imag (in) ing London and re-branding the City. *Transactions of the Institute of British Geographers* 35, 4 (2010), 453–474.
- [93] KRUGMAN, P. Scale economies, product differentiation, and the pattern of trade. *The American Economic Review* 70, 5 (1980), 950–959.
- [94] KRUGMAN, P. Increasing returns and economic geography. *Journal of political economy* 99, 3 (1991), 483–499.
- [95] KRUGMAN, P. R. Increasing returns, monopolistic competition, and international trade. *Journal of international Economics* 9, 4 (1979), 469–479.
- [96] LANG, R. E., BLAKELY, E. J., AND GOUGH, M. Z. Keys to the new metropolis: America’s big, fast-growing suburban counties. *Journal of the American Planning Association* 71, 4 (2005), 381–391.
- [97] LANG, R. E., AND DHAVALA, D. Beyond megalopolis: Exploring America’s new “megapolitan” geography. Tech. rep., Metropolitan Institute Census Report Series, 2005.
- [98] LECOMTE, P. *Produits dérivés et actifs immobiliers: étude de faisabilité des méthodes de couverture factorielle*. PhD thesis, Paris 10, 2012.
- [99] LIZIERI, C. *Towers of capital: office markets & international financial services*. Wiley-Blackwell, 2009.
- [100] LIZIERI, C., AND PAIN, K. International office investment in global cities: the production of financial space and systemic risk. *Regional Studies* 48, 3 (2014), 439–455.
- [101] LOVE, I., AND ZICCHINO, L. Financial development and dynamic investment behavior: Evidence from panel VAR. *The Quarterly Review of Economics and Finance* 46, 2 (2006), 190–210.
- [102] LUCAS, R. E. Expectations and the Neutrality of Money. *Journal of economic theory* 4, 2 (1972), 103–124.

- [103] MALLE, R. Un modèle à équations simultanées du cycle des bureaux en région parisienne. *Economie & prévision*, 3 (2010), 93–108.
- [104] MARCHAL, H., AND STÉBÉ, J.-M. *Les grandes questions sur la ville et l'urbain*. Presses universitaires de France, 2011.
- [105] MCCARTNEY, J. Short and long-run rent adjustment in the Dublin office market. *Journal of Property Research* 29, 3 (2012), 201–226.
- [106] MCGOUGH, T., AND TSOLACOS, S. Forecasting office rental values using vector autoregressive models. In *The Proceedings of the Cutting Edge Property Research Conference* (1994), pp. 303–20.
- [107] MICOSSI, S. The monetary policy of the European Central Bank (2002-2015). Tech. Rep. 109, CEPS Special Report, 2015.
- [108] MISHKIN, F. S. Housing and the monetary transmission mechanism. Tech. rep., National Bureau of Economic Research, 2007.
- [109] MOUZAKIS, F., AND RICHARDS, D. Panel data modelling of prime office rents: a study of 12 major European markets. *Journal of Property Research* 24, 1 (2007), 31–53.
- [110] MUNDELL, R. A. Capital mobility and stabilization policy under fixed and flexible exchange rates. *Canadian Journal of Economics and Political Science* 29, 4 (1963), 475–485.
- [111] NAKAMURA, E., AND STEINSSON, J. High frequency identification of monetary non-neutrality: The information effect. Tech. rep., National Bureau of Economic Research, 2013.
- [112] PATELIS, A. D. Stock return predictability and the role of monetary policy. *The Journal of Finance* 52, 5 (1997), 1951–1972.
- [113] PIMLOTT, B., AND RAO, N. *Governing London*. OUP Oxford, 2002.
- [114] PIRENNE, H. The stages in the social history of capitalism. *The American Historical Review* 19, 3 (1914), 494–515.
- [115] PIRENNE, H. *Medieval cities: Their origins and the revival of trade*. Princeton University Press, 2014.

- [116] PUMAIN, D., AND SAINT-JULIEN, T. Urban networks in Europe. *John Libbey Eurotext INED* (1996).
- [117] QUAN, D. C., AND QUIGLEY, J. M. Inferring an investment return series for real estate from observations on sales. *Real Estate Economics* 17, 2 (1989), 218–230.
- [118] QUAN, D. C., AND QUIGLEY, J. M. Price formation and the appraisal function in real estate markets. *The Journal of Real Estate Finance and Economics* 4, 2 (1991), 127–146.
- [119] RAMEY, V. A. Macroeconomic shocks and their propagation. *Handbook of Macroeconomics* 2 (2016), 71–162.
- [120] ROSEN, K. T. Toward a model of the office building sector. *Real Estate Economics* 12, 3 (1984), 261–269.
- [121] ROSEN, K. T., AND SMITH, L. B. The price-adjustment process for rental housing and the natural vacancy rate. *The American Economic Review* 73, 4 (1983), 779–786.
- [122] ROZEFF, M. S. Money and stock prices: Market efficiency and the lag in effect of monetary policy. *Journal of financial Economics* 1, 3 (1974), 245–302.
- [123] RUDEBUSCH, G. D. Term structure evidence on interest rate smoothing and monetary policy inertia. *Journal of monetary economics* 49, 6 (2002), 1161–1187.
- [124] SASSEN, S. *The global city: New York, London, Tokyo*. Princeton University Press, 2001.
- [125] SASSEN, S. *The Global City: New York, London, Tokyo*. Princeton University Press, 2001.
- [126] SAUER, S., AND STURM, J.-E. Using Taylor rules to understand European Central Bank monetary policy. *German Economic Review* 8, 3 (2007), 375–398.
- [127] SÉNÉCAL, G., AND BHERER, L. *La métropolisation et ses territoires*, vol. 11. PUQ, 2009.
- [128] SHILLING, J. D., SIRMANS, C., AND CORGEL, J. B. Price adjustment process for rental office space. *Journal of Urban Economics* 22, 1 (1987), 90–100.
- [129] SIMS, C. A. Macroeconomics and reality. *Econometrica* 48, 1 (1980), 1–48.

- [130] SIVITANIDOU, R., AND SIVITANIDES, P. Office capitalization rates: Real estate and capital market influences. *The Journal of Real Estate Finance and Economics* 18, 3 (1999), 297–322.
- [131] SPUFFORD, P. *Power and profit: the merchant in medieval Europe*. Thames & Hudson London:, 2002.
- [132] STURM, J.-E., AND WOLLMERSHÄUSER, T. The stress of having a single monetary policy in Europe. CESifo Working Paper Series 2251, CESifo Group Munich, 2008.
- [133] TAYLOR, J. B. Discretion versus policy rules in practice. In *Carnegie-Rochester conference series on public policy* (1993), vol. 39, Elsevier, pp. 195–214.
- [134] TAYLOR, J. B. Housing and monetary policy. Tech. rep., National Bureau of Economic Research, 2007.
- [135] TAYLOR, P., DERUDDER, B., SAEY, P., AND WITLOX, F. *Cities in Globalization: Practices, policies and theories*. Routledge, 2006.
- [136] TAYLOR, P. J., AND DERUDDER, B. *World city network: a global urban analysis*. Routledge, 2016.
- [137] TAYLOR, P. J., HOYLER, M., AND SÁNCHEZ-MORAL, S. European Cities in Globalization: a comparative analysis based on the Location Strategies of Advanced Producer Services. In *Service Industries and Regions*. Springer, 2013, pp. 285–304.
- [138] THORBECKE, W. On stock market returns and monetary policy. *The Journal of Finance* 52, 2 (1997), 635–654.
- [139] TOBIN, J. How dead is Keynes? *Economic Inquiry* 15, 4 (1977), 459–468.
- [140] TSOLACOS, S., KEOGH, G., AND MCGOUGH, T. Modelling use, investment, and development in the British office market. *Environment and Planning A* 30, 8 (1998), 1409–1427.
- [141] VAN DEN BERG, L., BRAUN, E., VAN DER MEER, J., ET AL. *National policy responses to urban challenges in Europe*. Ashgate Publishing, 2007.
- [142] VELTZ, P. Mondialisation, villes et territoires. *L'économie d'archipel* (1996).

- [143] VICINO, T. J., HANLON, B., AND SHORT, J. R. Megalopolis 50 years on: The transformation of a city region. *International Journal of Urban and Regional Research* 31, 2 (2007), 344–367.
- [144] WATT, P. ‘It’s not for us’ Regeneration, the 2012 Olympics and the gentrification of East London. *City* 17, 1 (2013), 99–118.
- [145] WHEATON, W. C. The cyclic behavior of the national office market. *Real Estate Economics* 15, 4 (1987), 281–299.
- [146] WHEATON, W. C., AND TORTO, R. G. Vacancy rates and the future of office rents. *Real Estate Economics* 16, 4 (1988), 430–436.
- [147] WHEATON, W. C., TORTO, R. G., AND EVANS, P. The cyclic behavior of the Greater London office market. *The Journal of Real Estate Finance and Economics* 15, 1 (1997), 77–92.
- [148] WRIGHT, H. *London High. A Guide to the Past, Present and Future of London’s Skyscrapers*. Frances Lincoln, 2006.
- [149] WRIGHT, J. H. What does monetary policy do to long-term interest rates at the zero lower bound? *The Economic Journal* 122, 564 (2012), 447–466.
- [150] YOUNG, M. S., GELTNER, D. M., MCINTOSH, W., AND POUTASSE, D. M. Defining commercial property income and appreciation returns for comparability to stock market-based measures. *Real Estate Finance* 12 (1995), 19–31.

Résumé

Cette thèse porte sur les marchés de bureaux en Europe au travers de différentes perspectives. Dans une première partie, nous étudions les effets des politiques monétaires non conventionnelles sur le marché des bureaux. Tout d'abord, nous analysons les effets de l'offre de monnaie sur la dynamique du marché des bureaux londoniens puis sur les principaux marchés européens. Nous trouvons que l'offre de monnaie a un effet positif sur les prix des bureaux suite à une augmentation de la demande. Ces résultats sont attendus théoriquement suite au développement d'un modèle théorique IS-LM de Mundell-Fleming. Cependant, cet effet est fortement hétérogène en Europe avec une plus grande capacité pour les principaux marchés à capturer l'afflux des capitaux. Enfin, nous analysons les dynamiques des valeurs locatives en Europe en utilisant une modélisation à deux niveaux : à un niveau pan-européen et à un niveau local. Nos résultats montrent que même si l'Europe tend à être considérée comme une union fédérale, les marchés immobiliers possèdent toujours une hétérogénéité importante qui doit être étudiée par les investisseurs.

Mots Clés

Marché des bureaux, Politiques monétaires, Prime de risque, Prix des bureaux, Dynamiques des loyers

Abstract

This thesis studies the European office market through different perspectives. In the first part, we study the effects of the unconventional monetary policies on the office market. First, we analyse the effect of the money supply on the dynamics of the London office market and then, on the main office markets across Europe. We find that the money supply has a positive effect on the office prices through an increase of the demand. This result confirms our theoretical expectations based on a IS-LM Mundell-Fleming framework. We find also an important heterogeneity across the European markets, with the biggest ones that have more benefited from QE policies and the others that were not able to attract the available liquidities. Finally, we analyse the dynamics of the rental values across the main office markets in Europe using a two-stage modelling: at a Pan-European level and at a local level. Our results highlight that, even if Europe could be considered as a federal union, real estate markets still have important heterogeneities that need to be studied by investors.

Keywords

Office market, Monetary policies, Risk premium, Office prices, Rental dynamics