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L'immobilier commercial en Europe face aux risques : Quels enjeux pour l'investissement ?

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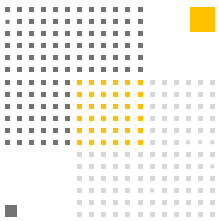
The Commercial Real Estate in Europe facing Risks: What are the stakes for investment?



Naoufal Nassili



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Declaration

I hereby declare that the work presented in this thesis has not been submitted for any other degree or professional qualification, and that it is the result of my own independent work.

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Abstract

The purpose of this thesis is to investigate the ways in which the potential for future total returns on investments in commercial real estate may be impacted by the presence of uncertainty. Not only we examine the "Global Financial Crisis," but also the "European Debt Crisis," and the "Quantitative Easing Era," since our study period spans the years 2004 to 2018. We hope to add a stone contribution to the existing body of research by providing novel perspectives on the topic of investing in commercial real estate during times of economic crisis and accommodating monetary policies. This thesis will devote one chapter to each of the following types of real estate investment exposure: direct real estate exposure, indirect listed real estate exposure, and indirect non-listed real estate investment exposure. The purpose of this research is to determine the different kinds of shocks that are inherent to the various investment exposure frameworks. In this first chapter, we are going to investigate the interdependence of volatility connectedness as a proxy for exploring the effects of shocks on European REITs. To accomplish this, we will employ a variety of methods. Finding the optimal configuration for unlisted public funds is the primary focus of the second chapter, with the intention of strengthening the resilience of these funds. In this third and final chapter, we will discuss how sudden shifts in monetary policy can have far-reaching effects on the industrial/logistics market. These shifts can range from small to large scale effects and the persistency over short- medium- and long-run.



Avertissements / 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. Les points de vue et opinions exprimés dans ce document sont ceux de l'auteur et ne reflètent pas nécessairement la position de l'Université Paris Dauphine et de BNP Paribas Real Estate.

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These views and findings should be regarded as those of the author solely.

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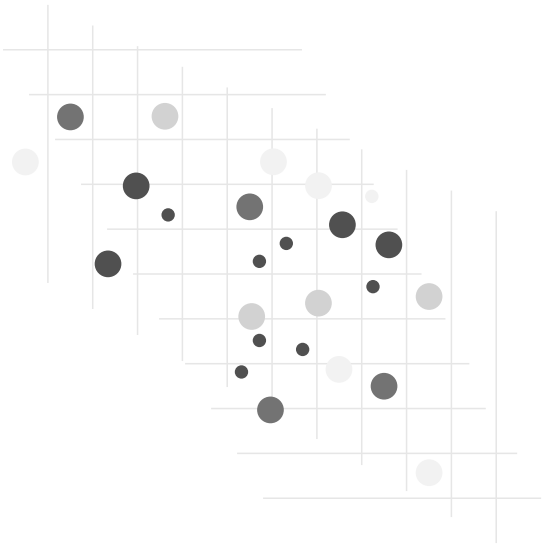

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Résumé en français

La motivation initiale de notre travail de thèse était de contribuer à l'état de l'art en ajoutant une nouvelle dimension à la littérature sur la gestion de portefeuille immobilier commercial. De ce fait, la raison principale de notre recherche est de produire un document de thèse pour combler le manque de travaux scientifiques dans le secteur de l'immobilier, en particulier en Europe, et sans oublier que l'immobilier commercial en général est le carburant de l'économie, puisqu'il s'agit de l'espace physique où toutes les entreprises créent leur chiffre d'affaires. Liée à la financiarisation de cette classe d'actifs, la question de la diversification des risques a émergé et revient donc à une échelle mondiale plus large, mais toujours avec des conséquences locales inhérentes aux actifs eux-mêmes. La thèse analyse de manière holistique comment les concepts de risque et de rendement changent avec le temps et les régimes monétaires, les inversions ou les marchés baissiers (cycles) et les expositions (directes et indirectes) à l'immobilier commercial. La motivation pour créer ce travail est soulignée. Cet ouvrage de thèse peut également être considéré comme un guide pour les praticiens afin de mieux appréhender l'immobilier commercial et ses risques spécifiques. La revue de la littérature sert de représentation internationale de l'état actuel de la recherche dans ce domaine.

Cette section rappelle tous les résultats antérieurs pour souligner la contribution de nos travaux à la littérature scientifique de l'immobilier commercial. Initialement, il est important de rappeler que notre période d'étude a été prolongée de 2004 à 2018. Cette période a été marquée par la fin d'un cycle qui a duré d'août 1989 à janvier 2007, avec un nouveau cycle débutant en 2007. La politique monétaire accommodante s'est poursuivie en réponse à la crise financière mondiale. Notre objectif principal avant de commencer la thèse était d'enrichir le matériel de recherche en présentant de nouvelles percées pour l'investissement immobilier commercial à une nouvelle ère de liquidité abondante. En fait, la forme du risque et du rendement peut changer à mesure que nous analysons différents types d'expositions et de typologies d'actifs. Au début il s'est avéré que ce n'était pas si simple, mais avec le temps, nous avons adapté l'approche de recherche à chaque chapitre afin de répondre au mieux à la question de recherche. Cette problématique a conduit à une approche méthodologique qui s'est vu adaptée à chaque chapitre et donc à chaque exposition de l'immobilier d'entreprise. Le deuxième chapitre étudie les foncières « REITs » cotées, le troisième étudie les SCPI

publiques non cotée et enfin nous nous intéressons à une exposition directe avec l'immobilier logistique. Nos modèles sont basés sur l'hypothèse que les relations risque-rendement de l'immobilier ne sont ni limitées dans le temps ni définies géographiquement. Nous nous sommes alors posé la question si cette relation risque-rendement peut être ajustée ou réévaluée pour chaque chapitre afin de mieux l'appréhender et l'analyser. Les frontières stratégiques, telles que les différences géographiques ou sectorielles, soulèvent inévitablement des questions sur notre capacité à atténuer certains types de risques. Les caractéristiques inhérentes à chaque actif sont importantes, tout comme la couche supplémentaire de risque systémique et systématique qui augmente le risque inhérent. L'objectif de la gestion des risques dans l'investissement immobilier est d'évaluer la composante de risque systémique sous-jacente tout en minimisant autant que possible la composante de risque non systématique, il s'agit d'un sujet important pour les universitaires et les praticiens. L'exposition évaluée, les circonstances, le moment et le lieu de l'investissement jouent tous un rôle dans la détermination de l'importance relative de ces risques.

Etat de l'art

Tout au long de la thèse, la priorité était de maintenir un ordre logique de l'information avec un fil conducteur. Au fur et à mesure que les chapitres progressent, nous redéfinissons les rendements et les risques que nous considérons à chaque niveau. Chaque chapitre fait l'objet d'une courte introduction qui couvre le sujet de la recherche et l'importance de la méthodologie utilisée. Nous avons suivi un processus minutieux pour sélectionner la littérature pertinente pour chaque chapitre. Essentiellement, nous avons défini la portée, identifié les sources pertinentes et collecté des données en lisant, organisant, notant et suivant les citations. Ci-dessous, nous avons répertorié l'état de l'art (modélisation économétrique) utilisé pour la méthodologie. Pour le chapitre 2, les deux articles de Diebold, Yılmaz (2012, 2014) établissent la méthodologie générale de décomposition statique de la volatilité, l'article de Barunik et Krehlik (2018) nous aide à reproduire l'analyse dynamique à court, moyen et long terme. Pour le chapitre 3, nous avons utilisé les travaux de Fuerst et Matysiak (2009), Delfim et Hoesli (2016) comme référence pour l'analyse de la finance privée. Puis, pour le quatrième chapitre, les articles de Pesaran et al. (2004), Pesaran et al. (2007) ont établi la méthodologie GVAR que nous avons utilisée pour analyser l'immobilier logistique dans un contexte de liquidité abondante.

Le Premier chapitre est introductif mettant en avant l'actif étudié à savoir l'immobilier d'entreprise ou commercial qui est issu de la famille des actifs réels. Ensuite, nous présentons les différentes manières de s'exposer à cet actif directement, ou indirectement : via des foncières cotées ou en achetant des parts dans des fonds publiques ou privés. Nous formulons aussi dans ce même chapitre notre question de recherche et comment nous l'adaptons aux spécificités de chaque chapitre.

Chapitre 2 : Structure de connectivité des foncières paneuropéennes

Nous nous intéressons à démêler et décomposer la connectivité des « REITs » ; notre principale question de recherche est la suivante : quelle structure de connectivité de la volatilité est spécifique aux foncières paneuropéennes ? Pour répondre à cette question, nous différencierons la connectivité de la volatilité provenant du bruit du marché, de la propriété sous-jacente et des interventions des politiques monétaires. Nous sommes intéressés à démêler et à décomposer la connectivité des « REITs ». Comme objectifs secondaires, nous examinerons les impacts à long, moyen et court terme. Le fait de disposer de plusieurs sous-périodes d'étude nous aide à interpréter la variation de ces moteurs en fonction des conditions de marché. Nos résultats au niveau de la connectivité statique sont en accord avec ceux de littérature évaluant la connectivité des actions pendant une période de stress, c'est-à-dire la convergence de la connectivité entre les REITS. De surcroît, la performance des sous-secteurs de l'immobilier commercial et les caractéristiques géographiques contribuent à expliquer les co-mouvements des REITS.

La modélisation économétrique est réalisée à travers une décomposition généralisée de la variance et un cadre de dynamique temps-fréquence. Les foncières paneuropéennes des « REITs » présentent des schémas de volatilité complexes car elles font l'objet de l'interaction de deux marchés : l'immobilier et le marché des actions. À partir d'un échantillon de 42 foncières paneuropéennes sur une période de 15 ans allant de 2004 à fin 2018 et en utilisant un échantillonnage intra-journalier. Nous calculons une mesure du risque basée sur la décomposition de la variance de la mesure de la volatilité et les erreurs de prévision. Une façon de regarder cette mesure est que plus nous sommes éloignés de la vraie valeur, plus nous sommes exposés au risque.

Cette métrique est utilisée dans un cadre de connectivité des foncières européennes, et elle est décrite plus en détail dans ce chapitre.

Les résultats de cet article intéresseront les praticiens, les gestionnaires de « REITS », les investisseurs et les régulateurs. La volatilité de ces véhicules d'investissement est multidimensionnelle et comporte différentes couches, nous sommes disposés à décomposer ces couches au fur et à mesure que nous décomposons la volatilité. Par ailleurs, nous souhaitons avoir des réponses sur différentes périodes, différents secteurs de ces foncières paneuropéennes et essayons de créer un lien entre l'immobilier direct et les véhicules des foncières cotées. En outre, nous comparerons nos résultats à ceux de la littérature financière pour identifier les points de divergence et les similitudes avec d'autres actifs financiers autres que les « REITs ».

Étant donné que les foncières sont cotées en bourse et versent des dividendes, le moyen le plus efficace de mesurer leur performance est l'évolution des prix. Bien que nous examinions la volatilité, il était important d'utiliser une mesure de la volatilité qui prend en compte quatre niveaux de rendement des prix à partir de l'ouverture, du haut, du bas et de la clôture de la journée (ajusté pour les distributions et les dividendes). Cette volatilité de l'écart prix-rendement est aussi efficace que la volatilité basée sur des données intra journalières à haute fréquence et est robuste à certaines formes de bruits de microstructure. La volatilité des marchés financiers peut être considérée comme une source de revenus sous contraintes de risques de volatilité.

L'ensemble de l'échantillon de connectivité statique (de 2004 à fin 2018) démontre que les « REITs » britanniques ont transmis et reçu la majorité de la connectivité de la volatilité. En raison de l'essor du commerce électronique, le marché de détail a connu une incertitude accrue ; en conséquence, ce secteur a transmis une quantité substantielle de la volatilité aux autres secteurs (positivement ou négativement). Par exemple, le secteur industriel a bénéficié des chocs de connectivité du secteur du commerce de détail. Avant la crise, la connexion était bipartite ou tripartite, le marché de détail français connaissant une interconnexion en volume plus élevée que son homologue néerlandais. En raison de leurs mauvaises performances au cours de cette période, les REITS italiennes ont été isolées de l'infrastructure du réseau. Tout au long de la crise (mi-2007 à mi-2009),

nous avons identifié des résultats similaires à ceux publiés dans la littérature boursière : En ces temps difficiles, la convergence de la connectivité est fermement confirmée. Le secteur du commerce de détail (35,45 %) avait la connectivité la plus volatile, suivi du secteur des bureaux (29,31 %). Après la GFC (mi-2009 à fin 2014), les « REITs » français et britanniques étaient à l'épicentre de la connectivité de la volatilité en raison de leur potentiel de rebond beaucoup plus rapide. En termes de connectivité totale à l'échelle du système, la période d'assouplissement quantitatif (de 2015 à fin 2018) a surperformé les périodes précédentes. Au cours de cette période, la taille des REITS a été un facteur important de transfert de connexion, car les grandes REITS ont davantage bénéficié de l'injection de liquidités en raison de leur capacité à les absorber. Au niveau du système dynamique, la source des chocs (par exemple, la politique monétaire ou les marchés financiers) n'explique pas tant la persistance que la façon dont les marchés perçoivent les chocs à des intervalles de haute fréquence. L'ampleur d'un choc est davantage décrite par la façon dont les REITS l'interprètent dans le trading à haute fréquence. En effet, les « REITS » communiquent entre elles et avec leurs actionnaires via la connectivité de la volatilité en tant que canal d'incertitude. Comme les informations concernant le choc sont fortement intégrées dans le marché des « REITS », le choc sera implicitement caractérisé comme étant à court, moyen ou long terme après le traitement de cette communication.

Les conclusions de ce chapitre sont cohérentes avec la littérature sur la connectivité financière ; Fait intéressant, nous avons également trouvé des résultats spécifiques aux « REITS ». Ce chapitre étudie un sous-ensemble de 42 REITS qui ont été cotées tout au long de la période de recherche ; nous ne pouvons pas considérer un biais de survie car ces REITS sont les plus grandes en taille et sont bien équilibrées en termes d'allocation (bureau, logistique, commerce et diversifiée) pour mieux refléter le marché. Cependant, ces résultats ne s'appliquent qu'à notre échantillon de « REITS » et tout au long de la période de notre étude (2004-2018). Bien que ces résultats ne soient pas fiables pour les années à venir, ils peuvent sans aucun doute être utilisés pour améliorer le suivi de l'incertitude future.

Chapitre 3 : La diversification sectorielle/géographique est-elle un bon choix ? Cas d'étude pratique des fonds immobiliers français (SCPI)

A première vue, le sujet d'étude général de ce chapitre semble simpliste : la nature du patrimoine détenu par les SCPI françaises a-t-elle une influence sur leur performance ? Il y a une montagne de matériel sur les économies américaines ou asiatiques, mais aucun sur les statistiques françaises. Les SCPI en tant que véhicules d'investissement étant propres à la France et ayant une structure fondamentalement distincte des SCPI, l'exemple américain n'est pas directement transposable à la France. Cette étude est la première à aborder ce sujet d'une simplicité trompeuse, crucial pour les sociétés de gestion de patrimoine (SGP) dont les objectifs premiers sont de collecter l'épargne publique, d'acheter des actifs immobiliers et autres, et de générer un cash-flow déterminé dans un marché compétitif. En particulier, nous prenons en compte le type de propriété (logements, commerces, bureaux, etc.) et la localisation dans le calcul de nos indices Herfindahl, qui fournissent une métrique unique pour mesurer la concentration (Paris, Région parisienne, Province, Etranger).

L'utilisation d'un estimateur à effet fixe nous aide à saisir les caractéristiques uniques qui identifient chaque SCPI. En réalité, lorsque nous avons simplement exécuté le modèle OLS, nous avons découvert que la relation entre le rendement SCPI qui est représenté avec la performance par action et les indices de concentration n'est pas simple. Par conséquent, ces modèles nous aident à démêler ces effets. Le modèle unidirectionnel exclut les effets temporels, tandis que le modèle bidirectionnel inclut à la fois les effets individuels et temporels. Nous allons étudier la diversification au-delà des diversifications géographiques et typologiques. De plus, il n'y a pas eu de recherche antérieure sur la performance du marché français des SCPI conditionnées à la diversification. De plus, grâce à l'accès à une large base de données française, notre recherche sera la première à aborder ces questions en incorporant et tenant compte des considérations spatiales, de l'impact sur la gouvernance et des considérations directes du marché immobilier.

Le marché des fonds publics non cotés est à mi-chemin entre les sociétés immobilières cotées et non cotées : les porteurs de parts reçoivent un revenu basé sur les parts qu'ils possèdent, et le prix

de ces parts est en constante évolution, ce qui entraîne une croissance de la valeur. A cet effet, le taux de distribution de la valeur marchande qui intègre les deux composantes est le meilleur candidat. Du côté des risques, nous nous intéresserons à la concentration plutôt qu'à la diversification comme stratégie de risque pour les gestionnaires de SCPI. La question n'est pas de savoir s'il faut se concentrer ou se diversifier, mais plutôt quelle est la combinaison optimale de l'emplacement et du type de propriété pour se prémunir contre la faible performance du taux de distribution de la valeur marchande. La diversification des types de biens a eu un impact significatif et positif sur la performance des SCPI. La diversification géographique, en revanche, réduit le taux de distribution de la valeur marchande. Nous avons documenté que la meilleure stratégie pour les fonds français non cotés est d'être à la fois diversifiés dans les types de biens et spécialisés dans un marché (localisation), ce qui se traduit par une augmentation de 62 points de base des rendements moyens. La diversification est une notion fondamentale pour ces organisations de gestion immobilière, et souvent les praticiens l'adoptent pour augmenter les chances d'un objectif de rendement prospectif. La principale conclusion qui peut être tirée est que le sujet de la diversification SCPI n'est ni unidimensionnel ni d'une réponse simple. En effet, la diversification n'est pas toujours comme prévu. Les résultats suggèrent que la diversité des types de propriété a eu une influence significative et favorable sur la performance SCPI. La diversification géographique, en revanche, a l'effet inverse, c'est-à-dire qu'elle a une influence négative sur le taux de distribution de la valeur marchande. Par conséquent, cibler une géographie spécifique est une stratégie efficace pour les SCPI. Par rapport à la littérature, nous avons documenté des résultats à la fois comparables et contradictoires. La diversification des actifs semble être largement acceptée. La diversité géographique, d'autre part, est extrêmement dépendante d'un éventail de circonstances, y compris le type d'exposition (directe ou indirecte), que le fonds immobilier soit coté ou non, qu'il s'agisse d'un fonds privé ou public, et bien d'autres considérations.

En France, aucune étude antérieure n'a investigué ce sujet de recherche pour les SCPI. De ce fait, il est difficile de l'examiner et de la comparer aux études antérieures sur les fonds immobiliers. Cependant, ce n'est que le point de départ d'un débat et d'une enquête supplémentaires. Ces résultats devraient idéalement être reproduits dans une étude qui considère les années précédentes de récession et comment nos résultats pourraient changer. Par ailleurs, il est urgent de régler les problèmes de liquidité des SCPI. Nos résultats s'ajoutent à un nombre croissant de recherches suggérant que les avantages de la diversification peuvent différer selon les actifs étudiés.

De ce fait, nous émettons quelques réserves sur nos résultats car ils s'appliquent principalement à une période importante (1998-2018) et aux 44 SCPI de l'échantillon. Bien sûr, si l'on a accès à une base de données plus étendue que la nôtre, il existe d'autres approches pour aborder notre question d'étude : « Panel Spatial VAR », modèles de panels dynamiques, méthodes généralisées des moments. Malgré les limites de notre ensemble de données, les modèles bidirectionnels à effet fixe ont donné des résultats intéressants et pratiques. En effet, nous sommes les premiers à utiliser la modélisation en panel pour examiner les bénéfices de diversification des fonds d'investissement non cotés (SCPI) français. Nous avons pu identifier les profils d'intérêt et aller au-delà des diversifications unidimensionnelles grâce au rééchantillonnage « Bootstrap ». Par ailleurs, la nécessité globale d'explorer la question de la liquidité des SCPI peut conduire à un autre élargissement potentiel de notre recherche, qui est un sujet particulièrement pertinent, soulignant comment, pour ces métiers de la gestion immobilière, la diversification est fondamentalement une idée essentielle et la seule voie pour maximiser les perspectives d'un objectif de rendement prospectif.

Chapitre 4 : Répercussions des chocs directs sur l'immobilier logistique de la politique monétaire : dans quelle mesure les rendements évoluent-ils ?

La BCE a abaissé son taux directeur en territoire négatif, a eu recours à des opérations de refinancement ciblées pour stimuler l'expansion du crédit et a adapté son programme d'achat d'actifs (APP) aux circonstances particulières de la zone euro. D'autre part, l'immobilier commercial en général et le secteur de la logistique en particulier ont connu une compression continue des rendements et ont bénéficié de volumes d'investissement croissants. L'intérêt des investisseurs pour les investissements immobiliers logistiques a fortement augmenté ces dernières années grâce à la mondialisation, au commerce électronique et aux progrès de la chaîne d'approvisionnement logistique. Ces dernières années, il y a eu un regain d'intérêt pour les actifs logistiques en tant qu'opportunité d'investissement sur le marché immobilier. L'objectif principal de cet article est d'examiner les effets des politiques monétaires non conventionnelles, parfois appelées assouplissement quantitatif, sur le marché de l'immobilier logistique. La performance de l'immobilier logistique/industriel résultant des interactions de marché entre l'offre et la demande est au centre de nos recherches. Par conséquent, le caractère cyclique de ces deux sous-marchés doit être souligné. Est-il possible que l'injection de liquidités de la nouvelle politique monétaire ait amélioré la performance du secteur de l'immobilier industriel/logistique, entraînant une réduction de la prime de risque ? La contribution et les conclusions de cet article devraient être d'une grande importance pour les décideurs politiques, les praticiens de l'immobilier industriel, les promoteurs, les occupants et les investisseurs. À l'aide du modèle GVAR, cette recherche examine la transmission et les retombées de la politique monétaire sur le marché de l'immobilier logistique. Notre approche statistique nous permet d'évaluer l'ampleur du problème en question et de fournir une solution générale avant de nous concentrer sur un choc particulier. Selon la structure VARX*, des sous-systèmes tels que le marché du travail, les taux d'intérêt et la valeur ajoutée brute des entreprises d'entreposage peuvent être affectés par des effets globaux sur des facteurs locaux sous-jacents. Pour aller plus loin, un VAR global peut être dérivé en combinant les modèles VARX*. Les relations théoriques à long terme sur-identifiantes peuvent être analysées comme des limites vectorielles de cointégration à l'aide de la VARX*. Notre définition du modèle GVAR considère comment le marché financier mondial affecte la fabrication et la logistique. La réponse impulsionnelle définit l'impact

temporel d'un choc sur le système dynamique et ses variables globales telles que l'injection de liquidités de la politique monétaire.

L'injection de liquidités via la nouvelle politique monétaire a-t-elle contribué à une nouvelle compression des rendements sur l'immobilier commercial ? Comment évaluer les mécanismes de transmission et juger de leur efficacité ? Quels sont les canaux candidats suivant la littérature ? L'injection de liquidités s'est-elle transmise de manière hétérogène à court et à long terme et entre les pays ? Nous souhaitons apporter des réponses précises sur les mécanismes de propagation de l'injection de liquidité de la banque centrale vers les revenus locatifs de l'immobilier logistique. La contribution de cet article devrait intéresser les décideurs politiques, les professionnels de l'immobilier et les investisseurs.

Un modèle GVAR est mobilisé pour déterminer les rôles des facteurs mondiaux et évaluer les effets d'entraînement des facteurs spécifiques au pays sur la dynamique des rendements totaux industriels. Les modèles vectoriels de correction d'erreurs spécifiques à chaque pays sont estimés dans le modèle GVAR, dans lequel les variables pondérées spécifiques à chaque pays sont reliées grâce à une matrice de lien en plus des facteurs faiblement exogènes globaux, tels que le « shadow rate » ou des réserves excédentaires.

Le premier angle de notre étude est d'étudier le choc systémique, c'est-à-dire celui qui se produit dans la politique monétaire. Les changements récents associés aux politiques monétaires non conventionnelles, communément appelés assouplissement quantitatif, ont eu un effet profond sur le marché de l'immobilier logistique. Nous examinerons les chocs de demande qui se produisent sur le marché des occupants du secteur de l'immobilier logistique. Ces chocs de demande se produisent lorsqu'il y a un changement rapide et significatif dans les modèles de dépenses privées, sous la forme de dépenses de consommation. Un ralentissement d'un grand marché d'exportation d'une économie donnée peut avoir un impact négatif sur l'investissement des entreprises, en particulier dans les industries d'exportation. Une baisse des prix des actions ou de l'immobilier peut provoquer un choc de demande négatif lorsque les ménages réagissent à une perte de richesse en réduisant fortement leurs dépenses de consommation. L'alimentation et l'énergie, dont la demande est

inélastique par rapport aux prix, peuvent potentiellement générer un choc de demande en réduisant le revenu réel des consommateurs. Le taux de rendement total est la meilleure mesure de rendement appropriée pour notre question de recherche puisqu'il tient compte à la fois du marché de la demande des occupants et du marché de l'offre. Les politiques monétaires comme l'injection de liquidités ne sont pas considérées comme un risque. Cependant, nous discutons de leur efficacité à atteindre des marchés logistiques sous-développés. Les investissements dans les entrepôts logistiques créent à leur tour : des emplois directs et indirects, l'amélioration de la chaîne d'approvisionnement pour le client, le développement des industries dans certaines régions, la fourniture de marchandises... L'investissement immobilier logistique présente certaines caractéristiques uniques.

En raison de la faible demande d'espace de stockage, le "rendement du capital" (appréciation/dépréciation de la propriété) des entrepôts peut être inférieur à celui des autres types d'investissements immobiliers. L'obsolescence s'installe après un, deux ou trois cycles de revente. Cependant, cette notion n'est applicable qu'après un certain temps car les entrepôts sont peu coûteux à démolir et à reconstruire. Le rendement (loyer/prix) est supérieur à celui des autres classes d'actifs. De nombreux investisseurs modernes sont attirés par ce secteur car ils estiment que les rendements locatifs des autres marchés immobiliers font défaut.

Les « shadow rate » et les réserves excédentaires ont été étudiés en premier par un choc global. Après avoir simuler le Shadow Rate, les fonctions d'impulsions ont une réponse plutôt lisse. La relance de la politique monétaire par le biais de hausses des taux d'intérêt a un effet plus constant que les chocs de quantité de monnaie (réserves excédentaires). L'Irlande a enregistré une augmentation de 1,2 % de son rendement total, suivie de la Belgique et de l'Espagne (0,40 %). Le Portugal a le moins réagit face au choc simulé. Les réponses à 4 trimestres de certains pays sont négatives. À court terme, le rendement total néerlandais augmente. Une baisse à moyen terme des rendements n'implique aucune réponse impulsionnelle. A long terme, la convergence se stabilise et la réponse impulsionnelle s'estompe. Après avoir choqué les réserves excédentaires, tous les pays réagissent positivement (sauf les Pays-Bas). Rotterdam, le port maritime d'Europe le plus achalandé, peut expliquer pourquoi les Pays-Bas ont obtenu des résultats différents. Le marché néerlandais de l'immobilier industriel/logistique est saturé, ce qui entraîne une perte de 0,10 % du rendement total.

L'Irlande, l'Italie, le Portugal et lEspagne (+0,8%), puis la Belgique, la Finlande et la France (+0,4%). L'augmentation de l'Allemagne (+0,10%) est la même que celle des Pays-Bas. Tous les pays chutent près de 0 après 1 an, mais les Pays-Bas progressent. Cette convergence vers 0 indique des niveaux pré-choc. Tous les marchés se développent 1 à 2 ans avant de se stabiliser. Le stimulus de l'argent se termine dans 2 à 3 ans. L'Espagne, le Portugal et l'Italie ont eu des réponses similaires à la France, la Belgique et l'Allemagne.

Compte tenu de sa modeste exposition à l'immobilier logistique, la faible réaction du Portugal aux injections de liquidités n'est pas surprenante. La taille du marché portugais de la logistique correspond à son rôle historique. La Pologne, les pays baltes et l'Espagne sont également concernés. La croissance interne est plus susceptible de stimuler la croissance du secteur de la logistique que les variables externes. Les marchés établis sont plus stables pendant les récessions. La plupart des investissements directs étrangers vont en France, aux Pays-Bas et en Allemagne, et ces pôles établis ne se développent plus, laissant peu de place à de nouveaux concurrents. Les investisseurs en immobilier logistique doivent anticiper les évolutions de l'offre et de la demande. Les changements démographiques et technologiques peuvent affecter le marché.

Le résultat de l'Irlande est inattendu. Les explications possibles incluent les valeurs relatives de l'euro et de la livre, et le rôle de l'Irlande en tant que point d'ancrage pour le Royaume-Uni (en dehors de la zone euro). Les deux premiers facteurs, situés au cœur de l'Irlande, témoignent des rendements élevés disponibles pour les investisseurs dans cet espace. Il s'agit de ventes et de logistique, pas de fabrication. L'amélioration des infrastructures aidera les deux industries. L'augmentation de l'espace de stockage pourrait aider la fabrication si les terrains pour la croissance industrielle sont rares. L'augmentation des dépenses d'infrastructure devrait stimuler l'emploi dans les industries connexes.

Applications potentielles

Cette thèse a un large éventail d'applications pratiques, en partie parce qu'elle a été rédigée dans le cadre d'une collaboration doctorale française entre BNP PRE et l'Université Paris Dauphine dans le cadre d'un contrat CIFRE, qui a permis d'étudier des défis commerciaux réels en combinant des

ressources académiques et professionnelles. L'implication générale de la présente recherche est sa pertinence aussi bien au niveau de l'industrie de l'immobilier commercial ou d'entreprise qu'au niveau de la recherche académique.

En effet, nos travaux contribuent à une meilleure compréhension du marché immobilier commercial en période de liquidités abondantes. Les gestionnaires d'autres actifs autres que l'immobilier commercial ont souvent du mal à intégrer les spécificités de l'immobilier commercial dans un portefeuille multi-actifs. En termes de modèles statistiques, soit nous concevons de nouveaux modèles pour tenir compte des spécificités d'exposition et des exigences de l'immobilier commercial, soit nous appliquons à ces spécifications des modèles déjà créés.

Depuis le XIXe siècle, l'immobilier commercial est un investissement à faible risque et à rendement moyen qui a résisté à plusieurs cycles économiques. Depuis la fin de la Grande Récession, les investisseurs ont recherché des sources alternatives de rendement avec l'immobilier comme une option attrayante en raison de sa génération de revenus stables et de sa faible corrélation avec les actions et les obligations. Cependant, investir dans l'immobilier comporte des risques uniques dont les investisseurs doivent être conscients afin d'allouer correctement le capital et de gérer la performance. Comprendre comment gérer ces risques est essentiel. L'un de ces risques est la volatilité, qui peut affecter à la fois les prix et les flux de trésorerie. En général, la volatilité est causée par des changements dans le sentiment des investisseurs ; alors que le marché est souvent imprévisible à court terme, il réagit généralement positivement aux nouvelles fluctuations positives à moyen et long terme. Dans le secteur de l'immobilier commercial, différents types d'actifs immobiliers présentent différents degrés de volatilité. Par exemple, les REITS se négocient en bourse et sont donc susceptibles de subir de fortes fluctuations de prix en raison des forces du marché boursier. D'autre part, les investissements immobiliers directs ne sont pas aussi affectés par les facteurs boursiers et peuvent être plus prévisibles en termes de flux de trésorerie. Dans chaque chapitre, nous avons examiné une exposition différente de l'immobilier démêlant les spécificités telles que la volatilité pour les foncières cotées, le profil de diversification pour les SCPI et la prime de risque pour l'exposition directe au secteur de la logistique. Nous avons également fourni des informations sur la façon de garder un œil sur ces détails afin qu'ils puissent être gérés plus efficacement.

En fin de compte, cette thèse peut aider les lecteurs à devenir plus efficaces dans leur processus de prise de décision en les aidant à comprendre les différents types d'expositions de l'immobilier commercial et comment les atténuer et les gérer efficacement. Nous vous recommandons également d'examiner de plus près les données de transaction réelles et les tendances historiques afin de pouvoir fournir des informations significatives qui aident à créer et à optimiser la gestion des risques. Les trois composants de la feuille de route que nous suggérons sont l'exposition optimale à l'immobilier commercial, un tableau de bord des cycles immobiliers et une cartographie intelligente dynamique dépassant le clivage de localisation et prix. Essentiellement, une cartographie intelligence permettrait aux professionnels de l'immobilier commercial de reconnaître les risques et les opportunités auxquels ils sont exposés et de les cartographier en fonction de leur importance pour les hiérarchiser en fonction de leur impact potentiel. Le tableau de bord sera un outil qui résumera les risques majeurs d'un portefeuille et permet d'identifier les zones où existent des concentrations de risques. Enfin, l'exposition résumera les expositions actuelles des actifs d'une entreprise sur la base des données existantes et fournira une méthode simple et transparente pour suivre et mettre à jour l'état de ces expositions à l'avenir. Nous proposons un outil en temps réel pour surveiller ces risques dans les entreprises, les secteurs ou les pays afin de suivre les scénarios potentiels, de prévoir les tendances et de prévenir les pertes. Chacune des trois composantes de cette feuille de route peut contribuer à accélérer le processus de création d'un cadre complet de gestion des risques pour les professionnels de l'immobilier commercial et à améliorer les performances de l'entreprise. En adressant chacun des composants de manière séquentielle, chacun sert de bloc de construction pour le suivant.

D'autre part, les régulateurs peuvent également mettre en œuvre nos outils de surveillance et de conformité aux règles et politiques d'intégrité du marché. Celles-ci comprennent, par exemple, l'élaboration de règles, la surveillance et l'analyse de marché. La régulation et surtout les institutions financières monétaires peuvent utiliser ces résultats pour une meilleure gestion de la diffusion et de l'efficacité de la liquidité sur le marché de l'immobilier commercial. Sur la base de cette compréhension, ils peuvent initier des politiques qui contribuent à la réduction du risque systémique et renforcent la stabilité financière dans le secteur de l'immobilier commercial. Par exemple, en se concentrant sur les segments de canal où les politiques monétaires sont bloquées et ne se transmettent pas comme souhaitées, ils peuvent cibler ou mieux encadrer les marchés de l'immobilier commercial en besoin de liquidité.

Ces conclusions peuvent également aider les décideurs politiques à mieux comprendre les implications de certaines politiques budgétaires sur la stabilité du marché des propriétés immobilières et à mettre en œuvre des mesures réglementaires appropriées pour décourager la prise de risques excessifs dans le secteur. Ces résultats peuvent encourager le développement de marchés financiers qui soutiennent les investissements immobiliers privés, ainsi que la participation des ménages à la possession d'actions immobilières ou de parts, en plus des investisseurs institutionnels.

Bien que l'histoire ait changé récemment, nos méthodes peuvent toujours fournir des informations utiles dans ce nouveau scénario inflationniste. L'inflation est l'une des préoccupations les plus sérieuses auxquelles les investisseurs sont confrontés aujourd'hui. Les banques centrales ont inauguré une nouvelle ère de politique monétaire. Ces politiques visent à gérer un environnement fortement inflationniste en augmentant les taux d'intérêt, en stabilisant les taux de change et en stérilisant la liquidité, ce qui réduit la demande de biens et de services. L'immobilier est l'un des meilleurs secteurs d'actifs pour atténuer la hausse de l'inflation. À mesure que les attentes d'inflation augmentent, la demande de biens immobiliers augmente, car les investisseurs recherchent des biens qui fournissent des flux de trésorerie positifs pour répondre à la demande croissante de produits et de services qui maintiendront leurs revenus. Nous percevons maintenant que les investisseurs de l'immobilier commercial ont réorienté leurs investissements vers des actifs résidentiels, de santé, de logistique et de bureaux de premier ordre dans un climat incertain et inflationniste. Les loyers sur ces marchés sont susceptibles d'augmenter le plus en raison de l'inflation et de la forte demande. Les loyers devraient augmenter en raison de : L'inflation. Les prix, en revanche, seront sous pression en raison de la hausse des taux d'emprunt et de la baisse du pouvoir d'achat. En conséquence, la demande de biens locatifs devrait augmenter et la croissance des loyers pourrait devenir le principal moteur de performance.

Travaux futurs

Plusieurs pistes de recherches futures peuvent émerger à la suite de cette thèse sur l'immobilier commercial. L'achèvement de la thèse est une période intéressante car de nouvelles connaissances peuvent être glanées et analysées. Nous avons voulu contribuer à notre domaine de prédilection en apportant une nouvelle production de recherche dans un contexte très particulier de l'assouplissement quantitatif. Nous avons également souhaité utiliser et appliquer des méthodes

statistiques innovantes pour rendre compte de certaines spécificités du secteur de l'immobilier d'entreprise. L'utilisation de certaines approches nous a permis d'identifier des tendances et des caractéristiques intéressantes des propriétés commerciales que nous avons étudiées. Finalement, les résultats de cette thèse permettront de mieux comprendre comment le marché de l'immobilier commercial a évolué au fil du temps et pourraient offrir un aperçu de ce que l'avenir réserve à l'immobilier commercial en Europe. De plus, nous espérons que nos recherches fourniront des informations précieuses aux praticiens de l'industrie et aux décideurs politiques qui travaillent avec l'industrie. Les recherches futures peuvent se concentrer davantage sur les facteurs individuels qui déterminent les tendances du marché de l'immobilier commercial dans différentes villes. Par exemple, une étude pourrait examiner les facteurs affectant le risque et le rendement de l'immobilier commercial dans différentes villes d'Europe. Un autre pourrait analyser la tarification des propriétés commerciales dans différentes villes ou se concentrer sur un type de propriété particulier, comme les bureaux et les commerces de détail. Certes, le nouvel environnement inflationniste est sur la table, et nos techniques sont adaptables et adaptatives. Ce ne sont là que quelques-unes des nombreuses questions de recherche qui pourraient être étudiées dans de futures recherches.

Un fil conducteur reliant tous les chapitres de cette thèse est la façon dont le risque et les rendements changent dans le temps, dans l'espace, la surexposition et leur influence sur le marché de l'immobilier commercial. Nos recherches montrent que les différences de conditions de marché et macroéconomiques ont un impact significatif sur la performance du marché de l'immobilier commercial sur les marchés paneuropéens. L'incertitude de l'environnement économique et politique crée un risque supplémentaire pour les investisseurs sur les marchés immobiliers sous la forme d'une prime de risque. Différentes villes présentent différents niveaux de risque et de rendement en fonction de plusieurs facteurs, notamment les tendances démographiques, les politiques réglementaires et fiscales, la croissance du PIB et les marchés financiers. Ainsi, l'importance des recherches futures se concentrant davantage sur une granularité différente pour construire une vue d'ensemble.

Le deuxième chapitre prépare le terrain pour le reste de la thèse et fournit un examen approfondi du marché européen des foncières cotées, en soulignant les principaux moteurs qui façonnent cette

industrie à différentes périodes clés. L'étude teste expérimentalement la structure de connectivité des REITS d'actions sur les marchés européens. Notre travail utilise le modèle dynamique temps-fréquence de Barunik et Krehlik (2018) et le modèle de décomposition généralisée de la variance de Diebold et Yilmaz (2012) pour examiner les conséquences du débordement de la volatilité. Dans cette étude, nous utilisons 15 ans de données intra journalières de 42 REITS paneuropéennes, de 2004 à 2018. L'enquête a révélé une relation statistiquement significative entre les REITS paneuropéennes. Des effets à haute fréquence ont également été observés dans l'analyse dynamique, bien qu'ils ne se soient pas révélés statistiquement significatifs. Les recherches futures pourraient étudier comment la pandémie de COVID-19 a affecté le marché des REITS et s'il existe des preuves de contagion ou de crise financière. Une analyse plus approfondie de la dynamique spécifique du marché est également nécessaire afin d'identifier les sources possibles de contagion. En outre, d'autres travaux pourraient envisager l'interdépendance des différents types de REITS sur le marché boursier européen au sens large. Cela aidera également à identifier les moteurs potentiels de la prévisibilité des rendements pour différents types de REITS, ainsi qu'à fournir une meilleure compréhension de leurs risques.

Les conclusions du chapitre 3 contribuent à un nombre croissant de recherches démontrant que les avantages de la diversification peuvent varier en fonction des actifs analysés. Par conséquent, nous avons quelques doutes sur nos résultats car ils ne sont pertinents que pour une période spécifique (1998-2018) et les 44 SCPI de l'échantillon. Cependant, il s'agit d'un bon point de départ pour de futures études et recherches, indiquant comment nous pourrons trouver un équilibre sain entre la diversification géographique et la diversification par type de propriété en tenant compte de divers facteurs. Dans un scénario idéal, nos conclusions seraient reproduites et élargies dans une étude future qui considère les années de récession les plus récentes et si nos conclusions venaient à changer. Par ailleurs, un autre prolongement possible de nos travaux pourrait découler du besoin général d'enquêter sur la pénurie de liquidité des SCPI, sujet particulièrement pertinent, soulignant combien, pour ces métiers de la gestion immobilière, la diversification est fondamentalement une idée essentielle et la seule manière de maximiser les perspectives d'un objectif de rendement prospectif. Les recherches futures devraient se concentrer spécifiquement sur le niveau de liquidité et d'autres paramètres de solvabilité importants pour notre échantillon de SCPI. Nous pensons que de telles informations pourraient être pertinentes pour les décideurs, investisseurs ou gestionnaires de fonds en charge de l'allocation des capitaux aux SCPI. Enfin, la tarification de la diversification

reste une question ouverte que nous abordons dans ce chapitre. Nous estimons que nos résultats confortent l'existence et la pertinence d'une prime de diversification pour les SCPI. Cependant, nous n'avons pas exploré la prime de liquidité, cela montre que le coût plus élevé des fonds propres devrait être un bien pris en compte dans la décision de se diversifier. Néanmoins, des recherches supplémentaires sont nécessaires pour établir le poids relatif de cet effet dans l'explication du ratio cours/bénéfice des SCPI et pour déterminer si cette prime se traduit par des rendements attendus plus élevés à long terme.

Le chapitre 4 donne un meilleur aperçu de la façon dont les nouvelles politiques monétaires affectent l'immobilier industriel à travers l'impact sur les secteurs de la logistique et de la fabrication. Nous avons fourni de nouvelles preuves que les changements de politique monétaire influencent de manière hétérogène la performance des marchés immobiliers logistiques européens. Les travaux futurs devraient se concentrer plus spécifiquement sur l'impact des politiques monétaires (conventionnelles ou non) sur la dynamique des marchés immobiliers industriels spécifiques au niveau de la ville/région en particulier et sur le comportement cyclique du secteur immobilier industriel en général. Ceci est important pour l'analyse macroéconomique et pour la conception de la politique budgétaire. Une analyse plus désagrégée pourrait aider à mieux comprendre l'interaction entre la politique monétaire et l'immobilier industriel. En outre, d'autres déterminants de la performance doivent également être pris en considération pour mieux comprendre les moteurs de la performance des marchés de l'immobilier industriel.

Enfin, ce travail a des implications de régulation compte tenu de l'importance des marchés de l'immobilier industriel pour l'économie européenne. Ceci est particulièrement important dans le contexte actuel de turbulences économiques et financières. Compte tenu de la volatilité des marchés financiers et du rôle des marchés de l'immobilier industriel dans la facilitation du flux de biens et de services des producteurs aux consommateurs, il est crucial que les gouvernements mettent en place les politiques et le cadre réglementaire appropriés. Cela assurera une stabilité à long terme à l'industrie et favorisera le bien-être économique. Le rôle des marchés de l'immobilier industriel dans le développement économique d'un pays est d'une importance primordiale et sa réglementation doit être guidée par une politique solide étayée par des preuves empiriques solides. Nous recommandons aux futurs auteurs : (1) d'examiner le rôle des chocs externes sur la demande d'immobilier logistique, (2) d'analyser si les marchés de l'immobilier industriel réagissent

différemment aux chocs macroéconomiques régionaux, (3) d'identifier le bon mécanisme de transmission des chocs dans l'immobilier industriel marché et le rôle qu'ils jouent dans le cycle économique, et (4) examiner les relations entre les marchés de l'immobilier industriel et d'autres secteurs de l'économie.

Table of contents

Contents

Declaration **1**

Abstract **2**

Avertissements / Warnings **3**

Remerciements / Acknowledgement **4**

Résumé en français **1**

Table of contents **20**

List of figures **24**

List of tables **27**

Chapter 1: Introduction **28**

1.1 General Introduction 28

1.1.1 A first dive into Real Estate as a Real Asset 28

1.1.2 The Commercial Real Estate 30

1.1.3 Understanding the CRE cycle 37

1.2 Presenting the different possible exposures to CRE 40

1.2.1 Direct exposure 40

1.2.2 Indirect: listed, unlisted (private and public) 42

1.3 The current context and situation 45

1.4 Formulating the research problem and questions 47

1.4.1 Presenting the research question 47

1.4.2 Risk and return trade-off 48

1.5 Brief presentation of the chapters along with the methodology 52

1.5.1 State of art 52

1.5.2 Chapter 2: Connectedness Structure of Pan-European Equity REITs 54

1.5.3 Chapter 3: Is Diversification a Good Choice? Evidence from French Real Estate Investment Companies 55

1.5.4 Chapter 4: Spillovers of Direct Commercial Real Estate and Monetary Policy Shocks: To what extent are Euro Area Returns Shifting? 57

References 60

Chapter 2: Connectedness Structure of Pan-European Equity REITs 61

2.1 Introduction 61

2.2 Data and empirical methodologies 65

2.2.1 Data 65

2.2.2 Model specification 66

2.3 Results and determinants of net directional volatility connectedness among the REIT markets 73

2.3.1 Static connectedness (full sample, unconditional patterns 73

2.3.2 Dynamic connectedness 84

2.4 Robustness assessment 88

2.4.1 Robustness test using other measures of volatility 88

2.4.2 Connectedness robustness 89

Conclusion 89

Appendix 1 REITs sample 92

Appendix 2 Connectedness Tables of the periods declined with heat colors and hierarchical clustering dendogram 93

Appendix 3 Total connectedness Index for whole period 97

References 98

Chapter 3: Is Diversification a Good Choice? Evidence from French Real Estate Investment Companies 101

3.1 Introduction 101

3.2 Literature review 103

3.3 Data and empirical methodologies 109
3.3.1 Data 109
3.3.2 Empirical methodology 119
3.4 Results and discussion 120
3.4.1 The preferred model 121
3.4.2 Simulations using Bootstrap resampling 123
Conclusion 126
Appendix 1 128
Appendix 2 129
Appendix 3: Specification tests 130
3.4.3 Test of poolability 130
3.4.4 F Test for Individual and/or Time Effects 131
3.4.5 Lagrange Multiplier Test - (Breusch-Pagan) 131
3.4.6 Hausman test (random vs fixed effect) 132
References 134

Chapter 4: Spillovers of Direct Commercial Real Estate and Monetary Policy Shocks: To what extent are Euro Area Returns Shifting? 136

4.1 Introduction 136
4.2 State of the Arts 139
4.2.1 Industrial real estate empirics 139
4.2.2 GVAR empirics and the real estate sector 141
4.3 Methodology and data 144
4.3.1 GVAR Model 144
4.3.2 The logistics sector and the dataset 148
4.4 Estimation of the GVAR Model 157
4.4.1 Specification and Estimation of the Country-Specific Models 157
4.4.2 Contemporaneous Effects of Foreign Variables on their Domestic Counterparts 157

4.5 Dynamic Analysis Using Generalized Impulse Response Functions and Generalized Forecast Error Variance Decomposition (GIRF/OIRF) 159

4.5.1 Global Shocks 160

4.5.2 Spillovers across countries, GVA Germany Warehouse shock, response of the Total Rate of Return 167

4.5.3 Results overview 169

Conclusion 171

Appendix tables 175

References 181

Chapter 5: Conclusion 183

5.1 Restatement of the thesis 183

5.1.1 General motivation 183

5.1.2 Key point and findings of the chapters 184

5.2 Applications 190

5.3 Future work 192

5.4 A take-home message for the reader 196

References 197

List of figures

Figure 1:1 Global Asset Allocations; Source: Forbes, July 30, 2014 29
Figure 1:2 The Real Estate return and volatility compared with other asset classes; Source: BNP Paribas Real Estate, Blackrock 30
Figure 1:3 Portfolio structures, Source: PMRECON estimates using 2015 EPRA and INREV data 31
Figure 1:4 DiPasquale-Wheaton Four-Quadrant Diagram - Effect of Demand Growth in Space Market: LR Equilibrium 37
Figure 1:5 Market Cycle Quandrants, Source : Mueller, Real Estate Finance, 2017 39
Figure 2:1 Example of Sparsity Patterns 71
Figure 2:2 Rolling window cross-validation 71
Figure 2:3 REIT Network Graph 01/02/2004–12/31/2018 (represented by country flags) 75
Figure 2:4 MSCI Direct Real Estate Total Return for the Pan-European Countries in our sample 77
Figure 2:5 REIT Network Graph 07/02/2007–06/30/2009 (represented by sectors) 78
Figure 2:6 REIT Network Graph 01/02/2015–12/31/2018 (represented by country flags) 82
Figure 2:7 Short-Memory Shocks. The overall spillover index for band 3.14 (π+0.00001) to 0.72 (π/4) roughly corresponds with 1 to 4 days of volatility connectedness 85
Figure 2:8 Medium-Memory Shocks. The overall spillover index for band 0.72 (π/4) to 0.31 (π/10) roughly corresponds with 4 to 10 days of volatility connectedness. 86
Figure 2:9 Long-Memory Shocks. The overall spillover index for band 0.31 (π/10) to 0 roughly corresponds with 10 to infinite days of volatility connectedness 87
Figure 2:10 Connectedness Table of the period 02/01/2004 -31/12/2018 and hierarchical clustering 94
Figure 2:11 Connectedness Table of the period 02/01/2004 -29/06/2007 hierarchical clustering 94
Figure 2:12 Connectedness Table of the period 02/07/2007 – 30/06/2009 and hierarchical clustering 95
Figure 2:13 Connectedness Table of the Period 01/07/2009 – 31/12/2014 and hierarchical clustering 95
Figure 2:14 Connectedness Table of the period 02/01/2015 – 31/12/2018 and hierarchical clustering 96
Figure 2:15 Total Connectedness Index of the 42 REITs Computed in a Rolling Manner Using a Moving Window of 100 days. We used various sources to document these events: La documentation Française, ECB press release 97

Figure 3:1 DVM evolution by quantiles (1998-2018).....111
Figure 3:2 Evolution of the level of typological (asset-class) diversification according to several quantiles (1998-2018).....112
Figure 3:3 Evolution of the level of geographical diversification according to several quantiles (1998-2018).....113
Figure 3:4 Bar plot of the geographical allocation percentage per SPCI (whole period) 115
Figure 3:5 Bar plot of the geographical allocation percentage per year (whole sample) 116
Figure 3:6 Bar plot of the property-type allocation percentage per SPCI (whole period) 117
Figure 3:7 Bar plot of the property-type allocation percentage per year (whole sample) 117
Figure 3:8 Panel Data plot.....128
Figure 3:9 Multicollinearity tests 129
Figure 4:1 Invested Volumes breakdown by Property Type in France. Source: BNP Paribas Real Estate.....150
Figure 4:2 Invested Volumes by Property Type in Europe, Residential is excluded.....150
Figure 4:3 Share of take-up (%), 2017, PMA Deals Database - all recorded lettings/occupier sales of > 10,000 sqm in the Eurozone 151
Figure 4:4 Euro area 18 residential and commercial property price developments, year-to-year %-change; Source: Eurostat 152
Figure 4:5 Average Prime Yields in Europe, source: BNP Paribas Real Estate.....153
Figure 4:6 Industrial Real Estate Total Rate of Return Seasonally Adjusted using Census X-13 155
Figure 4:7 Generalized Impulse Responses of a Positive Unit (+1σ) Shock to Wu Xia shadow policy rate on Total Rate of Return by country. 161
Figure 4:8 Generalized Impulse Responses of a Positive Unit (+1σ) Shock to Global Variable (ECB Excess Reserves) on Total Rate of Return by country. 162
Figure 4:9 Effect of a 1% shock to the ECB Excess Reserves on Short Term Nominal Interest Rate. Breakdown by immediate response, response in the short-term, response in the medium-term and response in the long-term 163
Figure 4:10 Effect of a 1% shock to the ECB Excess Reserves on Short Term Nominal Interest Rate. Squares represent the bootstrapped mean values of the GIRF across the sample, while the 90% bootstrapped confidence intervals are represented by the thinner lines. 164

Figure 4:11 Effect of a 1% shock to the ECB Excess Reserves on Long Term Nominal Interest Rate. Breakdown by immediate response, response in the short-term, response in the medium-term and response in the long-term 165
Figure 4:12 Effect of a 1% shock to the ECB Excess Reserves on GVA Warehouse using industries. Average over the 12 quarters following the shock.....166
Figure 4:13 Effect of a 1% shock to the ECB Excess Reserves on Employment Warehouse using industries. Average over the 12 quarters following the shock.....167
Figure 4:14 Spillover effects Effect of a 1% shock from GVA Warehouse using industries on the total Rate of Return 168
Figure 4:15 Figure 15. Main logistics hub in Europe, source: BNP Paribas Real Estate 178
Figure 4:16 Timeline of the most important events in relation with the international trade 179
Figure 4:17 GVA contributions (y/y, % chg), Source : Eurostat, Haver.....180

List of tables

Table 2-1 Dataset breakdown by stock markets 65
Table 2-2 Dataset breakdown by real estate sector 66
Table 2-3 Different penalties to the VAR 70
Table 2-4 Penalty selection using AIC and BIC, liminated model: OwnOtherL 72
Table 2-5 Average debt ratios of the 42 REITs during different periods 79
Table 2-6 Descriptive statistics 92
Table 3-1 Description of the data and adjustments made 110
Table 3-2 Descriptive statistics 114
Table 3-3 Summary of the estimated results 121
Table 3-4 Summary of the simulation results 123
Table 3-5 Estimation decision tree for selecting the panel model 130
Table 3-6 Oneway (individual) effect within model 133
Table 4-1 Reduced model* (monetary policy price and quantity). 155
Table 4-2 Contemporaneous effect of foreign variables on domestic counterparts 158
Table 4-3 Results overview 169
Table 4-4 Detailed dataset employed in our GVAR model 175
Table 4-5 Investment Volumes (EUR, mil., Transactions, annual), Source: Property Market Analysis 177

Chapter 1: Introduction

1.1 General Introduction

1.1.1 A first dive into Real Estate as a Real Asset

Real Assets, Financial Assets

Real assets are physical assets that have intrinsic value due to their substance and properties. Real assets include precious metals, commodities, real estate, land, equipment, and natural resources. They are acceptable for inclusion in most diversified portfolios due to their low correlation with financial assets such as equities and bonds. Real assets are separate from financial assets, even though they are both classified as tangible assets. Financial assets, unlike real assets, are valued based on a contractual claim on an underlying asset, which could be tangible or intangible.

The stability of real assets is stronger than that of financial ones. Real assets are less affected by inflation, currency value changes, and other macroeconomic events than financial assets. Real assets, which tend to outperform financial assets during inflationary periods, are especially well-suited for investment during these times. Real assets are more stable than financial assets, but they are also less liquid. A tangible investment with inherent value due to its substance and physical features is referred to as a real asset. More importantly, real assets allow portfolios diversification since they frequently move in opposing ways to financial assets such as stocks or bonds. Real assets are more stable but less liquid than financial assets.

Frequently, when an individual considers an investment strategy, he is usually trying to strike a balance between risk and return while considering his investment horizon, the amount of money in possession, the financing possibilities, and his personal objectives. Over the last 50 years or more, real estate has been a popular investment instrument. Figure 1 below presents some of the most popular options for investors from the global asset allocations.

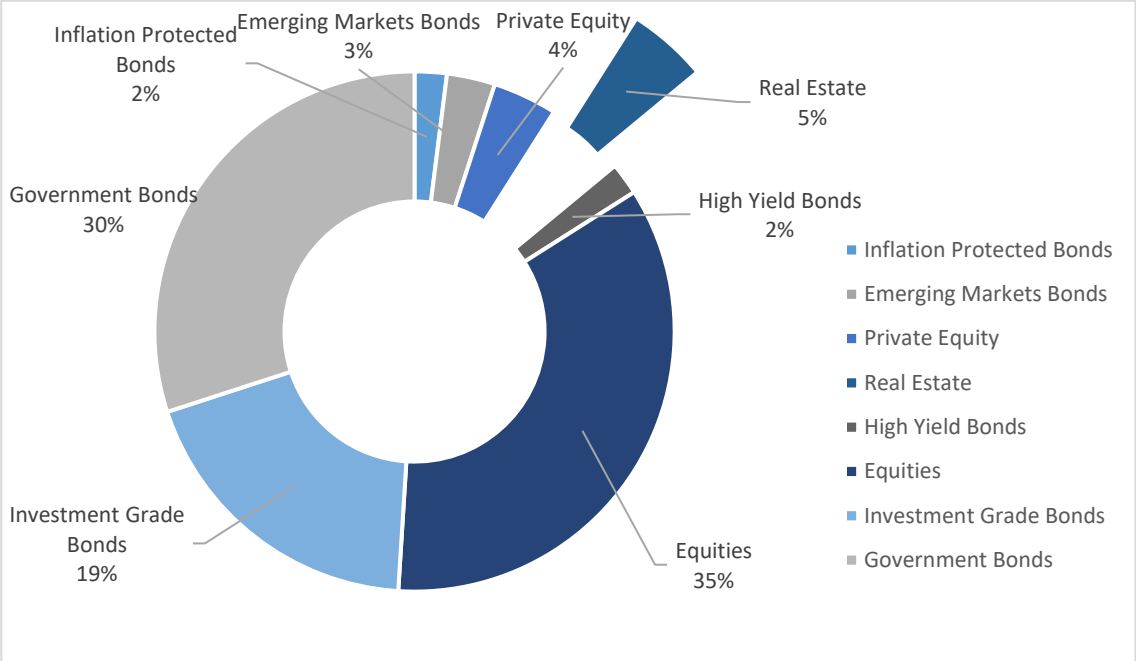

Figure 1:1 Global Asset Allocations; Source: Forbes, July 30, 2014

When we think about real estate investing, the primary residence is usually the first thing that comes to mind. Of course, when it comes to asset selection, real estate investors have a wide range of options beyond physical structures. Becoming a landlord when investing in rental properties is not an easy task. As the landlord, the investor oversees matters like paying the mortgage, property taxes, and insurance, as well as maintaining the property, finding renters, and dealing with any issues that arise.

On the flip side of the coin, we should consider the low volatility that real estate offers as an asset. Of course, the low volatility may be underestimated since the total return also includes capital growth that are given by the appraiser experts. Figure 2 depicts the return and volatility of several asset classes and demonstrates how real estate stands out as an interesting asset class for investment.

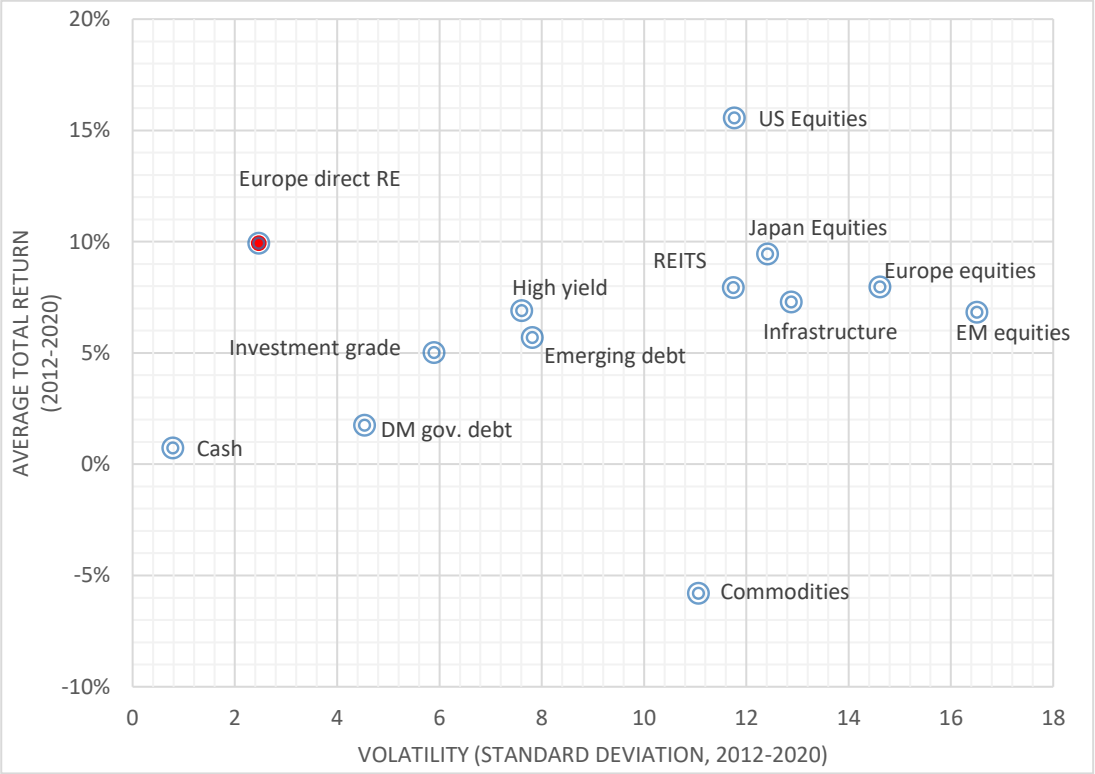

Figure 1:2 The Real Estate return and volatility compared with other asset classes; Source: BNP Paribas Real Estate, Blackrock

1.1.2 The Commercial Real Estate

This thesis focuses on commercial real estate and, more specifically, the many exposures we might analyse in terms of risks and returns. Commercial real estate (CRE) is property that is used solely for commercial purposes or to offer a workspace, as opposed to residential real estate, which is utilized for living purposes. Most commercial real estate is leased to tenants in order to generate income. According to INREV-EPRA[1] studies, real estate in all its forms contributes for about 20% of economic activity. In 2011, the commercial property sector alone contributed EUR 285 billion to the European economy, accounting for around 2.5 percent of overall GDP and exceeding both the European automobile industry and the telecommunications sector. It directly employs nearly four million people, this exceeds the automotive and telecommunications industries combined, and the banking sector.

[1] The European Public Real Estate Association (EPRA) and the European Association for Investors in Non-listed Real Estate Vehicles (INREV) represent the full spectrum of the European property investment industry

1.1.2.1 Property-types specificities

Commercial real estate is often classified into four types based on function: office space, industrial use, multi-family rental and retail. The vast category of real estate can range from a single storefront to a large shopping mall. Retailers of various types, office space, hotels and resorts, malls, restaurants, and healthcare facilities are all examples of commercial real estate. From an investor's standpoint, classic retail and office sectors continue to dominate the portfolio. However, the recent covid crisis has accelerated some trends, raising investor allocation shares of industrial real estate and alternative property sectors.

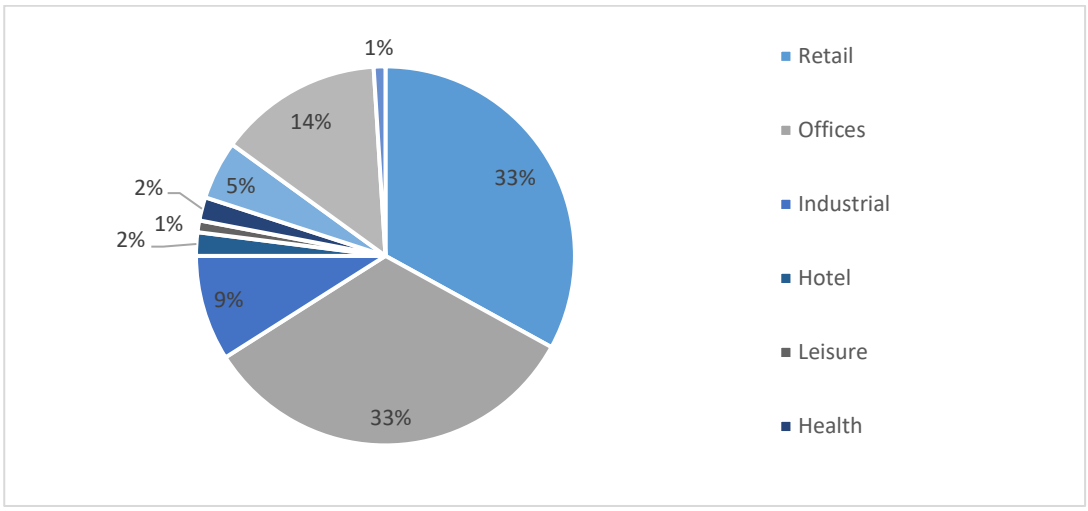

Figure 1:3 Portfolio structures, Source: PMRECON estimates using 2015 EPRA and INREV data

1.1.2.1.1 Office

The office sector was and continues to be the most important commercial real estate asset held by investors. The key reason that the office sector is appealing to investors is the long-term revenue that offices provide. Furthermore, in most situations, the tenant will manage all expenses, leaving the investors with simply the mortgage. Additionally, unlike the residential sector, the value of the building is not solely determined by vacancy alone. For example, if the income rises, the value rises

as well; if there is a higher quality tenant, the value rises as well. Office space is closely linked to the economic activity that determine its value. For instance, job growth and the sector activity turnover

are often key variables for investors willing to invest in an office building. As the economy grows, companies tend to hire more full-time workers which requires more space and from the investor perspective the property will gain value. Likewise, if the economy shrinks, companies tend to lay off and they need less office space, and the income and value of property goes down as well. For this reason, the office sector is characterised by strong cyclicality especially in certain markets. According to the findings of De Wit and Van Dijk (2003), the global determinants of office returns are influenced by factors like as construction, absorption, vacancies, rents, employment growth, and real interest rates. The supply and demand will play a major role in this cyclicality discernible in key variables: vacancy rate of office sub-market, rents, absorption rate and local market supply (deliveries). The office market is astonishingly heterogenous market. This character is derived from both the business activity that comprise it and the tenants who animate it. We can observe strong disparities depending on the type of assets (size and quality) and geographical location. Office space, for example, is often characterized by the CRE practitioners as:

> Class A represents the best buildings in terms of aesthetics, age, infrastructural quality, and location.
>
> Class B structures are typically older and less competitive in terms of pricing than Class A structures. These structures are frequently targeted for restoration by investors.
>
> Class C structures are the oldest, typically over 20 years old, in less desirable locations, and in need for maintenance.

1.1.2.1.2 Industrial/Logistics warehouses

Industrial buildings, which are generally located outside of metropolitan areas along key traffic routes. Based on Alonso's (1964) pioneer work, the distance to a city centre is a frequent measure used to characterize the location of an industrial warehouse. The second most important variable to consider is the size of the property (Ambrose, 1990). The logistics sector is strongly and directly related to international trade, but it also contains industrial operations for a range of tenants.

Because it is less expensive than an office, an industrial warehouse may be a very profitable asset. The sector has known historically very stable rents and relatively high rates of return. The properties are divided into five categories:

- Heavy manufacturing: these structures are highly tailored and house the machinery necessary for manufacturers to function and produce goods and services.
- Light assembly: these are not as customizable and might be utilized to assemble or store products.
- Bulk warehouses: are often big properties that serve as distribution centers.
- Flex industrial: these buildings have a mix of industrial and office space.
- R&D facilities: are a type of industrial that specializes in research and development.

Without a doubt, the industrial revolution with the steam engine was the catalyst for the development of these warehouses, but e-commerce was a significant step forward as well. Not to forget the globalisation and the rapid growth of international trade. Now more than ever, this sector is particularly an oasis for investors looking for income. The only Achilles' heel for this sector is a substantial non-class A offer that is difficult to consume.

1.1.2.1.3 Retail

The retail sector includes the properties that house the stores and restaurants. They can be multi-tenant (typically with an anchor, or main tenant, who drives traffic to the site) or single-use, standalone buildings. The retail sector is considered the second class of real estate held by investors and has recorded a very good performance since 2000. Many households enjoy going shopping on the weekends. Basically, an individual shopping range is very wide from groceries to clothing. This same individual can either go to the local shops or a bigger store in shopping malls. Shopping malls are made up of one or more buildings that form a complex of shops connected by walkways. The retail sector is complicated since the type of shopping center is governed by several characteristics, including size, concept, type and number of tenants, and trade area. They often have one or more anchor tenants, who are the tenants with the highest foot traffic. Department shops are common anchor tenants that offer a wide range of items grouped into various departments. High streets are another famous shopping destination. High streets are city streets that have a variety of retailers and brands, as well as restaurants and other recreational activities. In downtown areas, high streets

are frequently lined with luxury labels. When looking for anything specialized, you should consider visiting a niche retailer. Specialty merchants specialize in a specific sort of items and frequently provide personalized product advice. However, some people prefer to shop at retail parks especially for families. Retail parks are often comprised of some big-box stores and numerous smaller retailers and are conveniently accessible by car or public transportation. To make things even more convenient, retail parks usually feature at least one large parking lot and sometimes even a multi - level car park.

1.1.2.2 Introducing the CRE characteristics

The Commercial Real Estate has five main properties:

- Immobility: most structures cannot be moved unless large costs are incurred; the local economy plays an important influence in the value.
- Heterogeneity: two properties can never be identical (the location, size, quality of building, tenant sector, architecture, etc …).
- Ground Indestructibility: land is indestructible but may no longer be usable for building real estate.
- High unit value: Unlike financial investments, the finance needs important pre-sale strategies for the transactions and use of leverage (debt).
- Commercial Leases: some companies own the buildings in which they operate. The more common scenario, however, is that the commercial property is leased. The building is typically owned by an investor or group of investors, who collects rent from each business that runs there.

Commercial leases normally range from one year to ten years or more, with office and retail space averaging five to ten years. In contrast, yearly or month-to-month residential leases are more short-term. Analyst Alex Krasikov documented in a 2017 study undertaken by real estate market analyst firm CBRE Group, Inc. that the term—length—of a lease was related to the size of the space being rented. Furthermore, the statistics indicated that tenants would sign long-term leases to lock in pricing in a growing market situation. But that is not their sole motivation. Because there is a scarcity of property that meets their needs, some tenants who require huge spaces will sign long leases.

There are four main forms of commercial property leases, each with a varying level of duty on the part of the landlord and tenant.

The tenant is responsible for paying property taxes under a single-net lease.

- A double-net (NN) lease requires the tenant to pay property taxes and insurance.
- A triple-net (NNN) lease requires the tenant to pay property taxes, insurance, and upkeep.
- In a gross lease, the tenant merely pays rent, while the landlord covers all property taxes, insurance, and maintenance.

Commercial real estate can have remarkable returns and significant monthly cash flows in places where the quantity of new construction is either limited by land or by law. Industrial buildings typically have cheaper rents than office towers, but they also have lower overhead expenditures.

Commercial real estate also benefits from tenant lease terms that are far longer than those in residential real estate. As long as long-term tenants occupy the building, this extended lease period provides the commercial real estate holder with significant cash flow stability. Commercial real estate, in addition to providing a consistent and lucrative source of income, has the potential for capital appreciation if the property is well-maintained.

The desire to invest in commercial real estate directly are put off by rules and regulations. Commercial property taxes, purchase mechanics, and maintenance responsibilities are hidden beneath layers of legalese. These standards differ depending on the state, county, industry, size, zoning, and a variety of other factors. Most commercial real estate investors have specialized knowledge or a team of real estate experts. Another impediment is the heightened risk that comes with tenant turnover, which is especially important in an economy where unexpected retail closures leave properties vacant with little warning.

An important process, if not the most important, in the commercial real estate is the valuation (appraisal) of properties by experts to determine their values. This can be done in numerous ways and the two major approaches are: the traditional approach and modern approach.

Traditional approach

Method by comparison

This method involves analysing data from comparable properties that were recently sold to estimate the worth of an object that has not yet been sold. First, we select the comparable properties (in term of size, location, and characteristics) and it is very important to have the most recent transactions or normalize the price of transaction. This method reflects the reality of the market, however, sometimes the heterogeneity of the assets or the lack of transaction can limit the applicability of this method.

Depreciated cost

This method is quite straightforward, we are looking to guess the value with the land price, the cost of a new construction and subtracting the depreciations costs. This method requires a good knowledge of the old and new stock; however, some depreciation costs are not always observable. We need to look at this method rather as a complementary one.

Capitalization

The fundamental idea of this method relies on the principle that the value of a property depends on the income generated. This method consists simply of dividing the gross annual rent by the capitalization rate which is based on the recent transactions. This method is considered the easiest, but we need to avoid falling into the trap of using fixed rents and constant exploitation charges.

Modern approach

Discounted cash-flows

A valuation method that is commonly used in examining real estate assets to determine the worth of an investment based on its future cash flows. A DCF analysis includes variables such as the initial cost. But it is impossible to cover all conceivable values for all calculation parameters (different rates, annual cost, expected revenue, and holding time of a property).

Hedonic method

The core notion of the hedonic approach, which has its roots in the theory of consumption, is that a good's worth is determined by the enjoyment that each of these features offers when used. Valuing a real estate asset entail valuing all its characteristics. This method requires the availability of considerable data.

1.1.3 Understanding the CRE cycle

Commercial real estate is characterized by cyclicality since it is an asset that is closely linked to the economy in general. There are three main cyclical components: one that is economic, one that is annual, and one that is quarterly. To have a better understanding of how the cycle works, we will take a deeper look at the DiPasquale-Wheaton Four Quadrant Diagram, which shows how the submarkets interact. Then followed by the main stages of the cycle in another figure.

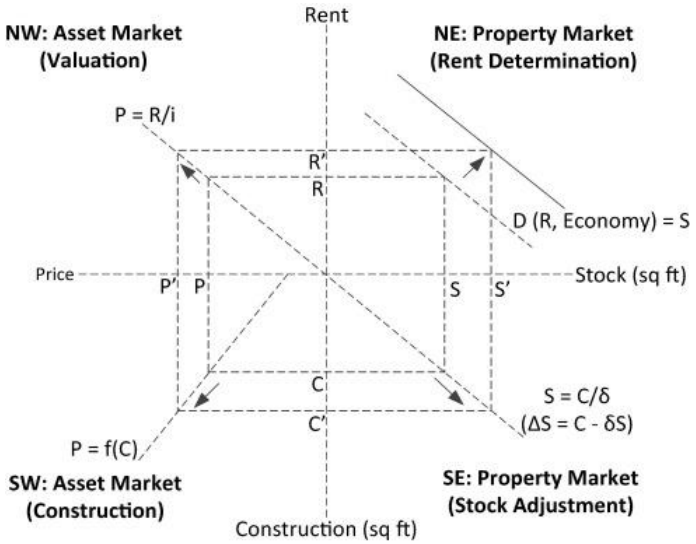

Figure 1:4 DiPasquale-Wheaton Four-Quadrant Diagram - Effect of Demand Growth in Space Market: LR Equilibrium

DiPasquale-Wheaton four-quadrant is a reference model to understand how all the supply and demand markets of commercial real estate are connected, namely: property market, asset market. Moreover, it gives insights of the willingness to pay for commercial real estate independent of the markets for the space itself.

If we start with the upper quadrant (right side), we have a typical demand curve based on the quantity S (stock) and the price (rent) R. The demand curve slopes down because the higher the rent

is, the lesser tenants' demand. Now, looking at the upper quadrant (left side), we have still the rent level R and another price P which represent a willingness to pay for that given rent level by a typical investor. The slope in this case is what the market is paying with price for a given level of rent and we can think of it as a price-to-rent ratio, but it is in fact the inverse of cap rate[2]. This slope in the asset market (valuation) is very important because it reflect how much a property is worth per euro of rent without any leverage. Now, if this slope flattens out this means that people are willing to pay a higher price for a given level of rent and accept lower yields and that would raise the price in the market for an asset even at the same rent level. If on the other hand the yields would get steeper or higher, this will lower the willingness to pay less for a given level of rent and that would lower the price or value of this assets in the market. To recapitulate, this upper quadrant represents the demand side on the space market (right side) and the asset market (left side).

In the lower quadrant, starting from left side, we have a kinked supply curve (fixed on the short-run and then it is elastic) that is on a given price we are going to observe more construction. Notable to say that the price P of that property exceeds construction cost. The kink illustrates the cost feasible value of the property, above that level we have new construction and below none. On the right side (still on the lower quadrant), we have an adjustment of the stock as we add more supply.

The more interesting novelty of DiPasquale-Wheaton four-quadrant diagram is the possibility to consider new scenarios. Considering now an effect of demand growth in space market (upper right quadrant). When the demand increases as shown by the arrow in the figure 4 (upper right quadrant) e.g. in a scenario of population or employment growth. For the same rent level, the quantity increases which mean more stock demanded S' for the same given rent level R. At the current level of quantity supply S, the rents are going to increase R'. If we continue to follow what will happen in the other markets (since they are connected), the P' level is way above the kink (cost feasible construction). Then it hits the asset market curve higher adding new supply in the market. In our case (figure 4), we have an equilibrium stating that the vacancy rate is 0%. However, in the reality, the markets tend to overshoot or undershoot and then goes through real estate cycles.

[2] The capitalization rate (also known as cap rate) is used in the world of commercial real estate to indicate the rate of return that is expected to be generated on a real estate investment property. This measure is computed based on the net income which the property is expected to generate and is calculated by dividing net operating income by property asset value and is expressed as a percentage. It is used to estimate the investor's potential return on their investment in the real estate market.

Glenn R. Mueller (2017) distinguishes four key phases in the commercial real estate cycle, each of which provides decision points for investment and exit options. The long-term occupancy average is the most important determinant of rental growth rates and, ultimately, property values. Phase 2 - Expansion is ideally the best quadrant for real estate investor performance. Equilibrium is the highest peak of the curve between phase 2 and 3. The starting point (phase 1) is a period where demand was higher than supply because no new constructions were available to absorb the demand. Also, this phase is characterized with negative rental growth and below inflation rental growth. Then, vacancy starts improving meaning a decrease in the level, and economy overall is improving. After that, new constructions are occurring adding a portion of new supply and this takes about 10 years to reach the peak. On the top of the market, the new constructions are still happening without noticing this will create hyper supply. The decline is harsh and quick since it takes approximatively 2 years to market to realize that vacancy is increasing. Besides, in this phase 3 we can remark rent concessions happening especially on older assets. To overcome this, real estate investors and managers in the market are offering incentives just to fill up the occupancy. More and more constructions have delays and the market dive into recession. After that, new investors on the buyer-side are taking advantage of the completions that happen and the cycle starts all over again.

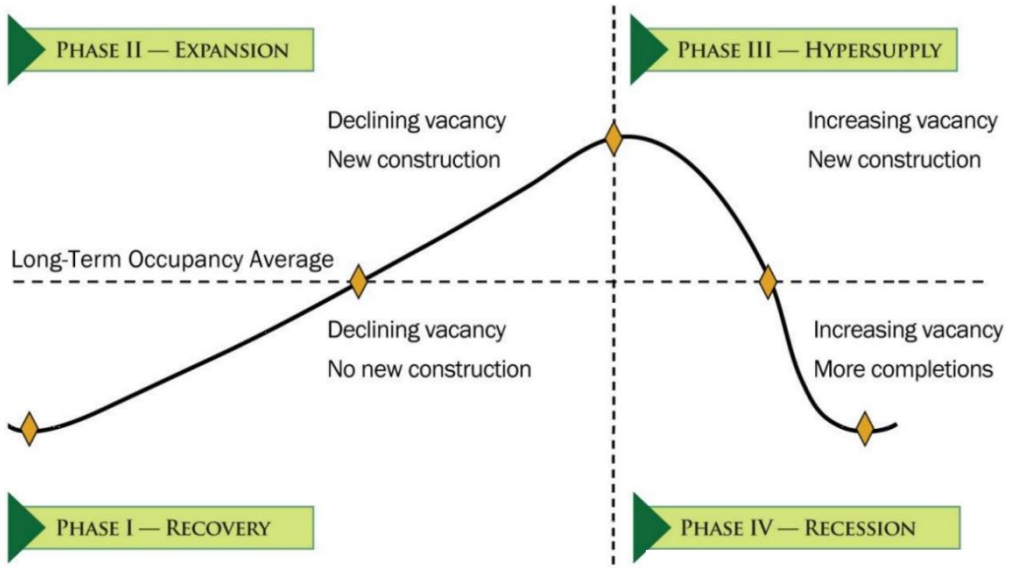

Figure 1:5 Market Cycle Quandrants, Source : Mueller, Real Estate Finance, 2017

1.2 Presenting the different possible exposures to CRE

Commercial real estate is a market that offers heterogeneity and a specific universe; the uncertainties caused by real estate market features such as a lack of liquidity or a high entry price constitute the fear of risk in commercial real estate. We feel that this must be considered in the aggregate of risk measurements, as well as in an overall strategy to consider volatility. Investing in commercial real estate can also be done in numerous ways: through distinct investment strategies (Core/Core+, Value added, Opportunity), through different asset typology, through different attributes and through diverse location. That is to say, the risks and returns will vary depending on how all the dots are connected and all the spheres cross. Thus, as a results, we will get different leverage levels, lease lengths, cash flows, and so on...

Investing in a real estate asset can take numerous forms; the investor might acquire a real estate asset directly through a property acquisition (so-called direct investment), or indirectly through public funds, financial derivatives, or debt. With a diverse investment universe, real estate is not only invested through equities and bond portfolios, but also through purely real estate portfolios based on inter-geographical diversification, real estate assets from different families, or other investment vehicles.

1.2.1 Direct exposure

Investors can use direct investments, in which they become landlords by owning actual property. People who have a substantial degree of information about the sector or who can hire firms that do are best suited for direct investing in commercial real estate. Commercial real estate is a moderate-risk and great-reward investment. Because CRE investing takes a significant amount of capital, the investor is likely to be a high-net-worth individual or an institutional company. The ideal property is in a location with a low CRE supply and a high demand for CRE, resulting in favourable rental rates. The value of the CRE purchase is also affected by the strength of the local economy.

1.2.1.1 Advantages

Directly investing in commercial real estate is a long-term investment with the durability of the properties that makes it a refuge value motivating various buyers: individuals for housing, business for exercise of activity, investors with a LT strategy. Also, we can see it as an investment with high fixed costs at the beginning, but the part of variable costs is hedged with the steady cash-flows that the properties provide. Moreover, on the legislative side, we gain some benefits after a few years of detention, decreasing capital gains taxes. The real estate is known for its mild volatility that originates from the valuation of the property based on some solid economical basis. For some investors, CRE has the reputation for being long-term refuge value (as the gold) and it allows them to keep a public eye on the property. Finally, the most known characteristic of commercial real estate is its low correlation with other assets.

1.2.1.2 Disadvantages

Information Asymmetry

Difficulty in gaining free access to information at any time (transaction prices, interest rates, etc. Thus, the transparency is reduced.

Illiquidity

The specificity of commercial real estate is that units have high value and are heterogeneous. Without considering the time-consuming procedures of transactions, the commercial real estate is inherently illiquid.

Lack of centralized market

Unlike stock markets, the commercial real estate is distinguished by the existence of several sub-markets (business real estate in the central business district for example). Thus, local knowledge for the sub-markets is very important for the transactions.

Unbalanced market

- Inelastic supply (structural and cyclical factors)

- Lack of interdependence between the user market (tenants, space market) and the investor market (owners, asset market)

Transaction costs are high.

- The costs, which are frequently incurred by the buyer, include registration fees, legal fees, such as notary fees, and any brokerage fees.

- These expenses can amount to more than 10% of the object's buying price.

Legal Framework (Bureaucracy)

The legal framework for direct real estate, as well as the lack of an established market, add to the length of time it takes to complete a transaction. According to Devaney and Scofield (2014), the average time to sell commercial property in London (the most liquid market in Europe) is 135 days (i.e., four to five months).

1.2.2 Indirect: listed, unlisted (private and public)

Investing in non-listed funds and other vehicles can be just as advantageous (and provide the same level of confidence) as any other real estate investment. Non-listed vehicles are a component of the entire real estate market as well as the alternative asset class mix. Investors invest in the commercial market indirectly by owning market securities such as Real Estate Investment Trusts (REITs), exchange-traded funds (ETFs) that invest in commercial property-related stocks, or by investing in companies that serve the commercial real estate market, such as banks and realtors. According to Hoesli and Lizieri (2007), there are several ways to gain real estate exposure, and while REITs are the most common, real estate investment can also take the form of debt investment through mortgage loans or securitized debt.

1.2.2.1 Non-listed funds

The indirect investment in the commercial real estate can be done through different ways and that convert an illiquid asset into a liquid investment. One is the acquisition of units in a fund that holds real estate assets and investments vehicles that are not listed on the stock exchange. Investing indirectly in these companies will reduce information asymmetry and will provide profit from the fund's diversification. Additionally, some of these companies take use of financial leverage, which create a multiplicator effect on their properties operations. Legally, these companies also have an obligation to provide a minimum level of liquidity to unitholders.

1.2.2.1.1 Private non-listed funds

Private non-listed funds can be considered over the counter, they are mainly dedicated to institutional investors with considerable liquidity, hedge funds and family office. They are most of the time dedicated to a specific sector either office, logistics, retails and sometimes alternatives. Often, they belong to a parent real estate service company that manages several funds. This can take the shape of a fund for a single, specific investment, or it can take the form of a hybrid structure that mixes present assets with future acquisitions. Such investments have numerous benefits:

The investor benefits from the experience of the sponsor, who often has a full-time emphasis on real estate investing and often has established operations handled by a team of professionals.

The cost of investing is often recognized up front and written out in terms of manager fees, carried interest, and other perks in the contract. Investors can invest in a variety of asset types and sizes, and effective diversification is possible even for a small investor; investors can also invest in structured products such as senior loans, mezzanine debt, preferred equity, or LP equity, each of which requires specialized expertise and relationships and can be difficult to invest in on a one-time basis. Depending on the size of the investor's involvement in relation to the entire fund or project, the investor may have substantial input on decisions regarding asset acquisitions, management, financing, and disposition. At the same time, day-to-day management is normally the responsibility of the sponsor and does not interfere with an investor's other responsibilities. This is especially vital for a diverse manager, who may have additional pressing tasks outside of real estate operational management.

1.2.2.1.2 Public non-listed funds

The typical public non-listed funds that exist in France are SCPIs and OPCIs. The OPCI was primarily inspired by open-ended funds in Germany, which were designed to attract non-professional investors. The OPCI was supposed to be even more transparent than the SCPI and, above all, to be able to ensure its own liquidity by always having the option of buying back its own shares from the bearer without the latter needing to find a buyer in the market (in the case of the SCPI, this liquidity is provided by a "second market"). The spectrum of real estate products is completed by real estate collective investment undertakings (OPCIs). They are more liquid than real estate investment trusts (SCPIs) since the share committed to real estate is limited. Although an OPCI can theoretically invest up to 90% of its assets in real estate, the financial market authority (Autorité des marchés financiers) has decided to grant approval only to those whose assets consist of up to 65% real estate, with the remainder made up of financial assets, which are more liquid than stone. In the case of OPCI, the partners may resell their Units at any moment because the Company is required to purchase at least 10% and no more than 40% of the assets under management. This differs from SCPI, where resale is usually only allowed if there is a buyer. A six-month span may occur under unusual circumstances.

1.2.2.2 Listed funds

The investment in listed funds is basically the acquisition of a portion of a fund holding real estate assets and the vehicles of placement are traded on the stock exchange. As a result, information asymmetry is reduced because the knowledge is now public. As non-listed funds, the unit holders' profit from the fund's diversification. These traded companies have the obligation to provide a minimum level of liquidity to shareholders in the form of dividends. Moreover, it gives the ownership of a fund holding real estate asset and even a superior liquidity to non-listed funds.

1.2.2.2.1 REITs

A real estate investment trust (REIT) is a business that owns, operates, or funds income-producing real estate. REITs, which are like mutual funds, aggregate the capital of multiple investors. Individual investors can now earn dividends from real estate investments without having to own, manage, or finance any properties themselves. REITs are classified into three types:

Equity REITS: Most REITs are equity REITs that own and manage income-producing real estate. Rents are the primary source of revenue (not by reselling properties).

Mortgage REITs: Mortgage REITs lend money to property owners and operators directly through mortgages and loans, or indirectly through the purchase of mortgage-backed securities. Their earnings are primarily driven by the net interest margin, which is the difference between the interest they make on mortgage loans and the cost of funding these loans. Because of this paradigm, they are potentially sensitive to interest rate increases.

Hybrid REITS: these REITs employ both equity and mortgage REIT investment strategies.

1.2.2.2.2 REOCs

A real estate operating company (REOC) is a publicly traded firm that actively invests in real estate, most commonly commercial real estate. Unlike real estate investment trusts (REITs), REOCs reinvest their profits and are subject to greater corporate taxes than REITs.

1.3 The current context and situation

Lately the CRE experienced a continuous yield compression. Despite this, the 10-year government bond compression has been more substantial since 2010. As a result, the spread between long-term interest rates and CRE yields has widened, making the CRE a more appealing asset class. The CRE is a rewarding investment, however it can be challenging for outsiders as discussed earlier with the disadvantages.

The commercial real estate market experienced its most significant transformation in the last 2 years. In the short run, it is difficult to evaluate the effects in the midst of a pandemic-driven

upheaval. Bankruptcies among retailers have increased, and real estate values have fallen in some locations for the first time since the 2008 recession. Nonetheless, there are pockets of stability and even price improvements, especially among industrial buildings, as investors appreciate the physical infrastructure of a more online economy. However, in the long run, there are concerns about further losses coming, and the market has basically been immobilized by uncertainty. It is difficult for investors to decide for a deal in the uncertain times. Buyers are demanding substantial discounts, and sellers are hesitant to sell. In 2020, transaction volumes declined across the board, with retail and hotels experiencing the steepest declines. Meanwhile, global investment volume has fallen to its lowest point since 2010[3]. However, it is also important to highlight the robust side of commercial real estate. For example, if office spaces have seen their workers work partially remotely, the warehouses continued to deliver goods and the retail sector switched to a flexible click and collect situation.

Another unexpected effect from the pandemic crisis was the acceleration of some existing trends and the emergence of new ones. As discussed, commercial real estate had to adapt because the buildings first and foremost must serve their users. The subject that become serious for all the CRE sub-sectors is the sustainability or more broadly ESG[4]. We are all aware that it is vital to make real estate more sustainable and to minimize carbon emissions, but this has primarily been justified from a risk reduction standpoint. In other words, the (risk of) regulation and/or obsolescence is often the driving force behind the necessity for specific long-term investments. We believe that sustainable buildings are those in which the integration of ESG performance is adequately evaluated and enhanced over time, resulting in an increase in return. Leskinen et al. (2020) proved that improving building sustainability through certification has a structurally favourable financial impact. This financial influence is obvious on a variety of components, including operational expenses, rental income, vacancy, and net initial yield, affecting the price. Although not every study shows a considerable benefit, and the range of results is somewhat wide. However, the overall conclusion is clear: there is a positive financial impact.

For the office market, most models existed before but were explored further:

> Co-working space: a more casual office where workers from various companies, freelancers, student shares the building. This model has been questioned during the

[3] source CBRE Research, RCA Q2 2020
[4] Environmental, social and corporate governance

beginning of the pandemic for its lack of control and then re-used when the society understood how to protect against the virus.

Flexible office: co-workers from the same company are not assigned a specific office desk which gives the company a more flexibility thus less space. This model has shown some potential during pandemic since all co-workers are not present the same day at the office. However, with the sanitary measures it requires more cleaning costs.

Conversions: some offices were converted principally to residential buildings

Because it has accelerated the development of new working habits, the current health crisis is likely to leave a lasting stamp on market structure. Employees and employers alike have new workplace expectations and goals. This leads to lively argument about the future of office space.

The retail market was the most affected sector after the crisis especially during total lockdowns. Food stores remained open, but the other stores took a direct hit. Consequently, the retail sector must adapt swiftly. That is why, most of the stores proposed the click and collect option which consist of ordering online and collecting afterwards. Some proptechs[5] used this chance to reinvent restaurants with ghost-kitchens that are more efficient at online delivery than in-person service.

The logistics on the other side, has known prosperous growth since the movement of people has been blocked but not that of goods. Goods continued to circulate freely inside the countries and internationally. Also, since a part of the demand that usually comes from the retail has moved the logistics due to e-commerce, we saw the development of the last-mile warehouses that are close to the cities and the bigger warehouses for an efficient supply chain from both sides.

1.4 Formulating the research problem and questions

1.4.1 Presenting the research question

The purpose of this thesis is to investigate the effects of potential risks on the commercial real estate investment. The study period of 2004 to 2018 include both the Global Financial Crisis and the European Debt Crisis. We hope to contribute to the literature by providing new perspectives on CRE

[5] Property technology is the application of information technology and platform economics to real estate markets.

investment in the context of liquidity injection by monetary financial institutions (MFIs) and uncertainty. Each chapter will emphasis a different CRE exposure, such as indirect listed RE, indirect non-listed RE, or direct RE.

Our secondary goal is to identify relevant econometric approaches for better management of commercial real estate specificities. Then, in order to better monitor financial events that occurred during our study period in the future, we hope to provide concrete responses.

The fact that the risk-return relationship in real estate is not fixed in time or space serves nor in the subsectors of CRE (Office, Logistics, Retail) as the foundation for our thesis. Following that, we wondered if we could modify or condition this risk-return relationship to better understand and analyse it. The concept of working through many CRE exposures in each chapter during the same time period (2004-2018) arose from this. Subsequently, depending on the CRE exposure we assess, the nature of the risk and returns will alter, as will the method we use to tackle the issue. Of course, the data used is another factor influencing the approach we will employ and, by snowball effect, the results to which we as academic researchers aspire.

In the following section, we established a breakdown of the risk and returns at different levels: asset, fund, and type of investment. Because it is in the thesis's standpoint, and the risk will be assessed from many angles.

1.4.2 Risk and return trade-off

Real estate markets present a variety of regimes that correspond to an effective risk-reward combination and hence real estate allocation in a portfolio has been compelled by its ability to reduce risk while providing attractive rewards. Real estate outsiders invest in real estate to diversify their portfolios and achieve good risk-adjusted returns. Direct commercial real estate has long been thought to be a good candidate for diversification within a multi-asset portfolio. Real estate has been designated as a diversifying asset for multi-asset portfolios (Peyton et al. 2006). It is claimed that when added to a stock and bond portfolio, it can produce better risk-adjusted returns. That is one of the reasons why CRE has always been a part of institutional portfolios (at varied levels depending on countries and periods).

Investment, both direct and indirect CRE vehicles provide the combination different risk-adjusted returns and liquidities by markets. The diversification appears to improve the risk-adjusted return for real estate professionals. According to DuCoulombier (2007), two most used techniques to diversify in CRE are diversification by property type and by location.

Managing CRE risk starts with understanding the cyclicality of the markets and sub-asset classes alike. Because commercial real estate is intertwined with so many other sectors of the economy, estimating risk is a large and difficult subject. In regards to CRE investment, we often refer to the risk as a risk premium because it is a mix of danger (uncertainty) and opportunity (unexpected returns). The link between the risk and the investor's projected return gives rise to the concept of a risk premium. Investors' risk perceptions are tied to expectations.

The higher the required return is to invest in an investment, the higher the investor's risk awareness. The needed return has been increased to compensate for the increased risk exposure. To calculate the premium, investors take the return on a low-risk investment and use it as the minimal risk threshold. As a result, the property risk premium is calculated based on expectations. Investors create their expectations and requirements based on the data they have access to today. In the professional literature, the risk premium is sometimes simplified to the yield gap, which is just the difference between the income return and the risk-free rate, excluding capital growth. Investors will invest in a property if the predicted property return meets their total return requirements. Interesting to keep in mind that the risk is not solely the volatility when it comes to CRE investments, but it is more complex than that.

1.4.2.1 Asset-level risks

If we position ourselves on a real estate asset and analyse the risks of this asset in relation to its environment, this means that our asset evolves in a sector that is dependent on specific factors. To name a few factors, we will go through significant sources of risk:

a. Vacancy risk: vacancy risk is considered the main risk for CRE asset holders; however, this indicator alone does indicate the reasons for the problem. This indicator should be indicated by a percentage, over time and over usable space. Then, we must investigate further to find the reasons of this vacancy.

b. legislative and regulatory risk: depending on the country where the investment is localized, we are going to deal with various legislative/regulatory risks:

i. Taxation is the first one to come in mind: responsibility for stamp duty, local property, VAT/GST

ii. Agency/Legal fees

iii. Responsibility for service charges (building, operating expense, audit rights)

c. Tenants' risk: since tenants belong to different sectors of activity, the inherent risk depends on the financial/economic health of these sectors and the company financial situation. That is why, we should monitor the tenants constantly to avoid unpaid rents.

1.4.2.2 Fund Risks

The indirect investment via funds can reduce certain direct CRE risks thanks to diversification, but it can also expose to other types of risks:

- Liquidity risk: including debt maturity, covenant violations, redemption requests, and financing of future contractual commitments)
- Market risk: yield shifts, inflation, location, rental income, voids
- Leverage risk: The real estate market makes leverage vulnerable. If real estate values decline, the property value of your investment may be less than what you owe on it. It is customary for commercial real estate loans to have a term of only five years.
- Fund structure
    - Open-end: an open-ended fund is one that has no set end date. It enables ongoing capital solicitation as well as periodic subscriptions and redemptions. The risk of a liquidity mismatch between assets and liabilities exists for open-ended funds. They are fragile because of the way their liquidity is organized on the liabilities side: it relies on the fund buying back shares from investors looking to reclaim some liquidity.
    - Closed-end: Closed-end funds have a defined termination date, which is usually 10-12 years from the date of creation. At the discretion of the investment manager and with investor consent, the period can be extended for several years on occasion. Closed-end funds, as opposed to open-end funds, have a defined subscription time.

This means that they can only invest for a limited period – typically 12-18 months. After then, they no longer accept fresh capital. Closed-end funds are often associated with market risk and volatility (as open-ended funds are), but more specifically with interest rate changes. This can have a direct influence on the income. Diversification can be Difficult for Closed-End Investors, so fund selection is Important.

- Management risk: tax, regulation, bankruptcy, key employees, reliance on service providers or key advisors and credit risk.
- Interest rate risks: exposure to floating or fixed rate debts; foreign exchange risks (hedging strategy and unhedged exposures)

1.4.2.3 Type of strategies

Markets are complicated systems with a plethora of variables that can influence returns. Simple causal relationships can be misplaced in this setting. Furthermore, one size does not fit all. There are various categories of investors, each with its own set of incentives and time horizons. This is where the ability to make good portfolio allocation decisions comes into play. As assets are heterogeneous, investors embrace likewise different type of investments to gain additional returns. As a result of the discussion between investors and managers, rigorous examination, and selection of the combination of investment's types that match the former's long-run aims is possible. The main difference is that the allocation process is not depicted in terms of markets or sectors in this context. Indeed, these objectives are typically best characterized by a time-varying combination of specific performance and risk measurements.

There is a wide range of strategies among institutional/private CRE investors that is beneficial to the market. The way it works, each investor will have a strategy that reflects its profile. For example, we will find that insurance companies are positioned on CRE assets of good quality with low volatility over time. However, more risky investors will consider adding value to an existing old asset with some refurbishment or renovations. The strategies can be much more complex than that, but this is mentioned as an example just to provide a brief idea.

Basically, core and prime assets will have high quality that helps investors capture the long-term growth. On the opposite side, value assets, help investors to capture mispricing and rental upside. Some investors will prefer markets with potential growth to capture cyclical performance. The

implementation of a risk strategy based on the explicit usage and mix of investment types provides another degree of resilience to investment analysis by making the portfolio allocation process more clear, quantitative, and rigorous.

1.4.2.4 Avoiding confirmation bias

Confirmation bias is the tendency to search for, interpret and recall information in a way that support what we already believe. To avoid confirmation bias i.e., the cross section of evidence and existing beliefs, we adopted a rigorous scientific method:

a. Existing theories and observations (Literature)

b. Building hypothesis

c. Model specification

d. Tests and new observations

e. Old theory confirmed or new theory proposed

f. Robustness

Furthermore, we considered these steps as a virtuous cycle. For example, if the specifications tests inform us of model misspecification, we rethink our model from the beginning and start all over again.

1.5 Brief presentation of the chapters along with the methodology

1.5.1 State of art

Our thesis prioritized outlining the order of information and maintaining a conductive wire. Throughout the chapters, we will redefine the returns and risks we are examining at each level. Each chapter will be given a brief presentation that includes the research topic and how the chosen methodology is appropriate. We went through a complete process to select the relevant literature for each chapter. Basically, we defined the scope, identified the pertinent sources and we collected information by reading organising, taking notes, and keeping track of citations. Below we have the

state of art used for the methodology (econometric modelisation). For chapter 2, the first two papers address the generalized variance decomposition methodology (static connectedness), the third paper focus on the dynamic connectedness. The chapter 3, those papers helped us as a starting point of measuring performance when it comes to non-listed real estate funds. Then, in the fourth chapter, those papers establish the GVAR methodology.

Chapter 2

Diebold, F.X., & Yilmaz, K. (2012). Better to give than to receive: Predictive directional measurement of volatility spillovers - 2012. International Journal of Forecasting, 28(1), 57-66.

Diebold, F. X., & Yilmaz, K. (2014). On the network topology of variance decompositions: Measuring the connectedness of financial firms. Journal of Econometrics, 182(1), 119-134.

Baruník, J., & Křehlík, T. (2018). Measuring the frequency dynamics of financial connectedness and systemic risk. Journal of Financial Econometrics, 16(2), 271-296.

Chapter 3

Fuerst, F. and Matysiak G., (2009) Drivers of fund performance: a panel data analysis. Working Papers in Real Estate & Planning . 02/09. Working Paper. University of Reading, Reading. pp35.

Delfim J-C and Hoesli, M. (2016) Risk factors of European non-listed real estate fund returns, Journal of Property Research, 33:3, 190-213

Chapter 4

M. Hashem Pesaran, Til Schuermann & Scott M Weiner (2004) Modeling Regional Interdependencies Using a Global Error-Correcting Macroeconometric Model, Journal of Business & Economic Statistics, 22:2, 129-162.

Dees, S., Mauro, F.d., Pesaran, M.H. and Smith, L.V. (2007), Exploring the international linkages of the euro area: a global VAR analysis. J. Appl. Econ., 22: 1-38.

1.5.2 Chapter 2: Connectedness Structure of Pan-European Equity REITs

1.5.2.1 Research question

We are interested in unravelling and decomposing REITs' connectedness; our main research question is: What volatility connectedness structure is specific to Pan-European REITs?

To answer this question, we will differentiate between volatility connectedness coming from market noise, from the underlying property, and from monetary policies interventions. As secondary objectives, we will look at the long-, medium-, and short-term impacts. Having several study sub-periods helps us to interpret the variation of these drivers according to market conditions.

1.5.2.2 Methodology

The econometric modelization is done through generalized variance decomposition and time-frequency dynamics framework. Exchange-listed equity REITs have intricate volatility patterns because they are the nexus of two markets: the real estate and the equity market. We employed a sample of 42 Pan-European REITs throughout a 15-year period spanning from 2004 to the end of 2018 and using an intra-day sampling.

1.5.2.3 Expected Results

The results expected from this article will be of interest for practitioners, managers of REITs, investors, and regulators. The volatility of these investment vehicles is multifaceted and has different layers to it, we are willing to decompose those layers as we decompose volatility. Moreover, we want to have answers over different time periods, different sectors of these REITs and try to create a link between the direct CRE and the REITs vehicles. Besides, we will compare our findings to those of the finance literature to identify points of divergence and similarities with other financial assets besides REITs.

1.5.2.4 The different types of risk/returns considered

1.5.2.4.1 REITs Price Return

Since REITs are publicly traded and pay dividends, the most efficient way to account for their return is through price return. Although we study volatility, it was important to use a volatility measure that take into account four price return quotations from the day's open, high, low, and close (adjusted for splits and dividends). This range-based volatility from price return is efficient as the volatility based on high-frequency intraday data and is robust to certain forms of microstructure noise. Volatility in financial markets can be considered a source of return but at the same time a risk.

1.5.2.4.2 Systematic/systemic risk captured through volatility connectedness

In the second stage, we compute a risk measure based on the volatility measure's variance decomposition and forecast errors. One-way to look at this measure is the farthest we are from the true value, the more we are exposed to the risk. This metric will also be used in a connectedness framework, and it is described in greater detail in the chapter.

1.5.3 Chapter 3: Is Diversification a Good Choice? Evidence from French Real Estate Investment Companies

1.5.3.1 Research question

The main research question for this chapter appears to be naive at first: is there a significant link between the property types hold by French SCPIs and their performance? A vast academic literature on American or Asian economies but nothing on French data. Since the American case is not directly transposable to France: SCPI as investment vehicles are very specific to France and their structure is very different from the REITs. We are the first to address this seemingly simple subject, which is of particular relevance to wealth management businesses (SGP), the primary goals of which are:

- Collect public saving
- Buy real estate assets
- Deliver a given amount of cash flow in a very competitive environment

- More specifically we are going to measure the concentration level differently by using Herfindahl indexes

- And considering the property type (housing, retail, office, …) and location (Paris, Paris region, French Regions, Overseas).

1.5.3.2 Methodology

The use of a fixed effect estimator assists us in capturing the unique characteristics that identify each SCPI. In reality, when we merely ran the OLS model, we discovered that the relationship between the SCPI return which is represented with the performance per share, and the concentration indexes is not straightforward. As a result, those models assist us in disentangling those effects. The one-way model excludes time effects, whereas the two-way model includes both individual and time effects.

1.5.3.3 Expected Results

In this article, our starting point is a simple question, however we anticipate bringing answers and new questions about diversifying non-listed funds (esp. SCPIs). We are going to investigate diversification beyond geographical and typology diversifications. Furthermore, there has been no previous research about the performance of the French SCPI market conditional on diversification. Additionally, thanks to the access of a large French database, our research will be the first to address these issues by incorporating spatial considerations, governance impact, and direct real estate market considerations.

1.5.3.4 The different types of risk/returns considered

1.5.3.4.1 Market value distribution rate

The market of the public non-listed funds is a half-way between listed and non-listed real estate companies: unitholders receive an income based on the parts they own, and the price of those parts

is constantly moving, resulting in value growth. For this purpose, the market value distribution rate which incorporates both components are the best candidate.

1.5.3.4.2 Idiosyncratic risk measured through geographic/typology concentrations

On the risk side, we will be looking at concentration as opposed to diversification in a risk strategy for SCPI managers. The question is not whether to be concentrated or diversified, but rather what the optimal combination of location and property type is to hedge against market value distribution rate low performance.

1.5.4 Chapter 4: Spillovers of Direct Commercial Real Estate and Monetary Policy Shocks: To what extent are Euro Area Returns Shifting?

1.5.4.1 Research question

The ECB lowered its policy rate to negative territory, used targeted refinancing operations to boost credit expansion, and tailored its asset purchase program (APP) to the euro area's unique circumstances. On the other hand, the commercial real estate (CRE) in general and the logistics sector specifically have known a continuous yield compression and benefited from growing investment volumes. Investors' interest in logistics real estate investments has risen steeply in recent years thanks to the globalization, e-commerce, and advances in the logistics' supply chain. In recent years, there has been a surge in interest in logistics assets as an investment opportunity in the real estate market.

Did liquidity injection via new monetary policy contribute to yield compression on commercial real estate (CRE)? How can we assess the transmission mechanisms and judge their effectiveness? What are the candidate channels following the literature? Has liquidity injection transmitted heterogeneously in the short- long-run and across countries?

We wish to provide precise answers regarding the propagation mechanisms from the central bank liquidity injection towards the rental income of CRE. The contribution of this article should be of interest for policy makers, real estate practitioners and investors.

1.5.4.2 Methodology

A GVAR model is used to determine the roles of global factors and to assess the spillover effects of country-specific factors on industrial total returns dynamics. Individual country-specific vector error-correcting models are estimated in the GVAR model, in which country-specific weighted variables are related to corresponding country-specific weighted averages of other countries variables plus global (weakly) exogenous factors, such as the shadow interest rate or excess reserves.

1.5.4.3 Expected Results

Our first objective in this paper is to study the systemic shock, i.e., the one taking place in the monetary policy. The post Global Financial Crisis changes associated with unconventional monetary policies, commonly known as quantitative easing, had a profound effect on the logistics real estate market. We will be looking at the demand shocks happening in the occupier market of the logistics real estate sector. These demand shocks occur when there is a rapid and significant shift in private spending patterns, in the form of consumer expenditure. A slowdown in a major export market of a given economy can have a detrimental impact on corporate investment, particularly in export industries. A decline in stock or property prices can cause a negative demand shock when households respond to a loss of wealth by sharply lowering consumption spending. Food and energy, which have price inelastic demand, can potentially generate a demand shock by lowering consumers' actual income.

1.5.4.4 The different types of risk/returns considered

1.5.4.4.1 CRE Total Rate of Return

The total rate of return is the best suitable return metric for our research question, since it accounts for both the occupier demand market and the supply market.

1.5.4.4.2 Systemic Risk via monetary policies

Monetary policies as liquidity injection are not considered as a risk. However, we discuss their effectiveness to reach markets that are under-developed to avoid shortage. Investments in logistics warehouses create in turn: direct and indirect employment, improvement in the supply chain for the customer, development of industries in some regions, provision of goods …

References

- Alonso, W. A., 1964. Location and land use: toward a general theory of land rent, Cambridge, MA: MIT Press.
- Ambrose, W., 1990. An analysis of the factors affecting light industrial property valuation. The Journal of Real Estate Research, 5, 355-369.
- De Wit, I., and Van Dijk, R., 2003. The global determinants of direct office real estate returns. The Journal of Real Estate Finance and Economics 26, 1, 27–45.
- DiPasquale, D., Wheaton, W.C., 1992. The Markets for Real Estate Assets and Space: A Conceptual Framework, Real Estate Economics, Volume 20, Issue 2 p. 181-198.
- Devaney, S., and Scofield, D., 2014. Time to transact measurement and drivers. In Investment Property Forum.
- DuCoulombier, F., 2007. EDHEC European Real Estate Investment and Risk Management Survey, EDHEC-RISK Institute.
- Geltner, D., and Miller, N.G., 2010. Commercial Real Estate Investment and Analysis, 3rd edition, Chapter 2.
- Hoesli, M., and Lizieri, C., 2007. Real Estate in the investment portfolio, report prepared for the Investment Strategy Council of the Royal. Ministry of Finance.
- Leskinen, N., Vimpari, J., & Junnila, S., 2020. A review of the impact of green building certification on the cash flows and values of commercial properties. Sustainability, 12(7), 2729.
- Mueller, G.R., 2017. Real Estate Market Cycle Monitor Second Quarter 2017. Black Creek Group.
- Peyton, M.S., Park T., and Badillo, F., 2006. Why real estate? TIAA-CREF's asset management.

Chapter 2: Connectedness Structure of Pan-European Equity REITs

2.1 Introduction

This paper fits in the ongoing economic globalization context along with the financial integration of real estate investment trusts (REITs). Nowadays, we witness an increasing integration among countries, whether in the commercial sector or financial and stock markets.

Aiming to attract more investors to the listed real estate market, the status of REITs was initially created in the United States in 1960, followed by the Netherlands, which proposed the European version in 1969. This instrument was then adopted in Belgium in 1995, France in 2003, and the rest of Europe starting in 2007. Subsequently, different REIT regimes have emerged in developed Europe, namely the United Kingdom's UK- REIT, the REIT in Ireland, the G-REIT in Germany, the BE-REIT of Belgium, the SIICs in France, the SIIQs in Italy, the FBI in the Netherlands, and Spain's SOCIMIs.

These regimes share many common points, including the obligation to redistribute rental profits in the form of dividends at a threshold of at least 80%. The different REIT regime regulators also agreed that the underlying activity must be dedicated mainly to real estate investment and represent at least 75% of their activity allocation. The REIT regimes are continuously evolving, and some matured earlier than others.

In the current low interest rate environment, REIT regimes have produced attractive returns to their investors. Moreover, they have contributed to the market openness for real estate in general by providing investors with public information. The implication of market openness has been discussed previously Beine and Candelon, 2011; Brooks and Negro, 2004; Buch and Pierdzioch, 2005. In contrast to the past, the result of market openness is that the risk now has many dimensions as to why the risk has forged a link with different economic realms. Recently, the risk is particularly time varying, ergo, efficiently managing the risk is a major concern of regulators, asset managers, investors, and academics. For this matter, we need to scan for all the potentially hidden risks: A well-defined risk is a well-monitored risk against potential uncertainty.

We aim to study the structure of connectedness, which is the linkage state computed from volatility (i.e., how much the volatility patterns share similarities among REITs). Our paper will mobilize a

sample of 42 Pan-European REITs over the period of 2004–2008. To better understand the connectedness structure, we adopt a methodology that decomposes the volatility, thereby differentiating between the volatility transmitted and received by using Diebold and Yilmaz's, 2012 connectedness tool. Furthermore, we opt to disentangle the connected risks from the disconnected ones, because the assets that include disconnected risks could be valuable when targeting portfolio diversification. We offer insights into how Pan-European REITs interact considering different time periods.

We expect different mechanisms and transmission channels to be involved. In particular, the micro foundations unique to each REIT should play a key role: through the investment style, total capitalization, maturity, location of the underlying and the focused sector, or the diversification choice. We expect some effects might be more pronounced than others. For example, country-specific effects could have more explanatory power compared with the underlying sub-sector effects, as Imbs, 2004 demonstrated. Withal, the macro side should not be neglected from the analysis: Policy uncertainty and monetary policy changes might shift the return. Our hypothesis stipulates that in a period of market stress, the volatility will tend to synchronize among the REITs and de-synchronize (or diverge) depending on the level of uncertainty in the market. Maghyereh et al., 2015 found an increase of volatility spillover during the global financial crisis (GFC) for the equity market in general.

In this article, we contribute to the literature by studying the uncertainty interaction through connectedness for the Pan-European REITs. Concerning this market, to our knowledge, only two papers applied the network connectedness methodology. In the first paper, Cashman et al., 2018, studied network connections in REIT markets, where they considered relationships to have a central role across the spectrum of real estate transactions. Their work focused on how firms from the same activity sector and based in the same location could influence managing the REITs and how it creates connections. In the second paper, Liow and Huang, 2018 analyzed the connectedness based on the volatility. However, the authors based their study on a smaller sample of 10 REITs and were interested in the REIT's volatility connectivity changes over time—not how REITs connect to each other. Their approach also differs from the present paper because they estimated a filtered net volatility connectedness index based on economic policy uncertainty, changes in industrial production output, exchange rate returns, changes in long-term interest rate, and current inflation level. However, our work focuses on the individual level because REITs can invest across borders,

and for this reason, a country index might restrict the analysis results. Moreover, we consider that shock sources could be multiple and complex, and thus, accordingly, we regroup them in the error term.

We are interested in unravelling and decomposing REITs' connectedness; our main research question is: What volatility connectedness structure is specific to Pan- European REITs?

To answer this question, we will differentiate between volatility connectedness coming from market noise, from the underlying property, and from monetary policies interventions. As secondary objectives, we will look at the long-, medium-, and short-term impacts. Having several study periods helps us to determine the variation of these drivers according to market conditions. Our major concern is how shocks affect the volatility (and consequently re-turns) of Pan-European Real Estate Investment Trusts.

To begin answering this complex subject, we will begin with some intermediate questions: what description can we provide to these shocks in the context of this indirect exposure via REITs? How can these shocks be detected? Can the nature of these shocks differ depending on the micro-macro-real estate context? What are the underlying causes of this phenomenon? Can we tell the difference between financial market shocks and real estate-specific shocks? How do the shocks spread? Which speed should I use? What channels do they employ? Are they persistent? And, using a two-way funnel, we will progress from the major question to the intermediate questions (and vice-versa). In our method, we will use the volatility extracted from the price as an indirect signal of the occurrence of a shock. We will use the concept of connection to distinguish this measure of volatility from market noise and the volatility of the underlying property in order to examine the spread of shocks. We will be looking at the long, medium, and short-term effects of a shock as secondary goals. Because REITs are tied to the real estate market, which has various holding periods. In a subsequent stage, determine whether the drivers of REIT volatility spillover are due to the underlying real estate or the financial market, or both. We will look at many time periods to see how these drivers change. We will also see whether these drivers vary across countries or whether they are just global factors at play. Finally, we will evaluate the efficacy of common strategies to mitigate these effects, or to hedge against such effects, on portfolio risk and re-turn. We will create a model incorporating all of the risk factors driving these results that will allow us to forecast how the REITs might react in the future.

To start our journey toward understanding how these shocks affect the volatility (and consequently returns) of Pan-European Real Estate Investment Trust. We will review the literature on REITs volatility and financial connected-ness.

There have been many approaches to study REITs' volatility. For example, Jirasakuldech et al., 2009 found heteroscedasticity in REITs and captured it through a GARCH modelization. Studying volatility's persistence, Devaney, 2001 and Cotter and Stevenson, 2008 showed that REITs display long-term memory, but it was limited compared with the stock market in general. Later, Yang et al., 2012 separated the volatility with long memory from the one that displays breakouts in time series.

The literature regarding financial connectedness is growing significantly and gaining interest in various fields. This literature has been dedicated to the financial market because it helps in understanding the markets' workings where multidimensionality is the norm, as well as for successfully navigating core financial market activities such as risk management, portfolio allocation, and asset pricing. Mantegna's, 1999 seminal paper was the first attempt of connecting stocks in a system. Diebold and Yilmaz, 2009 introduced the first version of financial connectedness, called the spillover index, where the authors decomposed the variance from a vector autoregression (VAR) model, then mobilized the forecast error as "uncertainty." However, this method included some strong assumptions regarding the shocks because they must be orthogonalized to ensure the computation of variance decomposition. For this purpose, the authors used Sims's, 1980 Cholesky factorization, but here a second problem arose, that of ordering variables; the ordering may indeed impact the forecast error. A more stable version was released by Diebold and Yilmaz, 2012, 2014, which applied Koop et al., 1996 and Pesaran and Shin's, 1998 generalized variance decomposition framework. In this version, the variance decompositions were unalterable to ordering causality. In addition, this framework allowed for computing the directional spillover (the spillover "from" and "to"), compared with the previous one, where only the total spillover effect was possible.

This dynamic network connectedness research literature has reached many financial applications, covering various asset classes. Yarovaya et al., 2016 studied stock market connectedness, as did Dermirer et al., 2017. Fernandez-Rodriguez et al., 2015 approached bond connectedness. The exchange rate market connectedness was analyzed by Bubak, Kocenda and Zikes, 2011 and Antonakakis, 2012. For the commodity markets, there are also several works: Chevallier and Ielpo, 2013 and Diebold and Liu, 2017 examined the precious metal markets connectedness. For the crude

oil market, refer to Maghyereh et al., 2016. Cross-markets were studied by Antonakakis et al., 2017 and Liow et al., 2018.

In what follows, we will first consider the data used for the analysis and then proceed with the various steps in estimating the model. Then, the third section is devoted to the results in a static and dynamic manner. In Section 4, we run robustness tests to assess the results found, and finally, we conclude in the last section.

2.2 Data and empirical methodologies

2.2.1 Data

Our sample[6] consists of 42 Pan-European REITs, after selecting only those publicly listed in the 01/02/2004–12/31/2018 period. Because the REITs are listed in different exchange markets[7], we based all the listings on the London stock exchange group's market calendar because it has the lowest market opening days. To work with a single currency (euros), the four quotations of UK-REITs were multiplied by the daily ex- change rate GBP/EUR (before computing the daily range-based volatility). We also replaced the missing trading days with the previous day's quotation. Our dataset includes 42 REITs with different sector focus: office, diversified, retail, industrial/logistics, and others. The size of our sample is 3,806, corresponding to the trading days from 04/02/2004 to 12/31/2018. Tables 1 and 2 summarize our sample characteristics and display the breakdown by stock market domiciliation and the underlying real estate sector.

Table 2-1 Dataset breakdown by stock markets

Stock Markets	Number of REITs	Total Capitalization (€M)
Euronext Paris	10	94393.91
Euronext Brussels	7	14956.39
Euronext Amsterdam	3	57244.18
Deutsche Borse	1	1379.93
BME Spanish Exchanges	1	11616.32
London Stock Exchange Group (London)	18	62982.53
London Stock Exchange Group (Milan)	2	4524.12

[6] Source: Bloomberg.
[7] Euronext Paris, Euronext Amsterdam, Euronext Brussels, London Stock Exchange Group (London & Milan), BME Spanish exchanges, and Deutsch Borse.

Table 2-2 Dataset breakdown by real estate sector

Sector Focus	Number of REITs	Total Capitalization (€M)
Office REIT	12	35693.96
Diversified REIT	13	70857.17
Retail REIT	11	115416.89
Industrial REIT	3	13196.80
Others	4	11932.56

2.2.2 Model specification

2.2.2.1 Daily range-based volatility and VAR

Based on intraday data, the method consists of three steps: first, removing intraday periodicity using an average based on four quotations observed per day; then, estimating the intraday volatility; and finally, calculating the connectedness measure.

In our first step, we track the intraday variability using the open, low, high, and close price of REITs. Garman, Mark and Klass (1980) proposed to compute this measure of volatility as follows:

$$\sigma_{it} = \sqrt{\frac{Z}{n}\sum\left[\frac{1}{2}\left(\log\frac{H_{it}}{L_{it}}\right)^2 - (2log2 - 1)\left(\log\frac{C_{it}}{O_{it}}\right)^2\right]} \quad (1)$$

z: number of closing prices in a year.

n: number of historical prices used for the volatility estimate.

$H_{it}, L_{it}, O_{it}, C_{it}$: the daily high, low, opening, and closing prices for REIT equity i

on day t.

Before moving onto the next section, give a quick review and a teaser of what's to come. Think of this as a form of navigation for the reader.

The range-based volatility is efficient as the volatility is based on high-frequency intraday data and is robust to certain forms of microstructure noise, as shown by Alizadeh et al. (2002).

The second step requires incorporating Garman et Klass (1980) daily range-based measure of volatility into a VAR model of order p:

$$x_t = \Phi_1 x_{t-1} + \Phi_2 x_{t-2} + \cdots + \Phi_p x_{t-p} + \epsilon_t$$

(2)

with $\Phi_1, \ldots, \Phi_p$ coefficient matrices; white noise with covariance matrix Σ; $\Phi(L) = \left[I_n - \Phi_1 L - \ldots - \Phi_p L^p\right]$is the lag polynomial with I_n identity matrix. A more compact form of the VAR is deduced $\boldsymbol{\Phi(L)x_t = \epsilon_t}$. The roots of $\Phi(z)$ are required to lie outside the unit circle, allowing the VAR to be written as a moving average representation:

$$x_t = [\Phi(L)]^{-1}\epsilon_t = \Psi(L)\epsilon_t$$

(3)

The third following step is to compute the connectedness measure by decomposing the variance.

2.2.2.2 General variance decomposition

Diebold and Yilmaz, 2009 introduced the first version of variance decomposition based on the forecast error variance decomposition from the VARs. Nonetheless, this version was subject to critique because it assumed the ordering of variables (thus, exogeneity) via the Cholesky factorization that orthogonalizes the system. Thereby, Diebold and Yilmaz, 2012 followed with another version that used the generalized variance decomposition (GVD) instead. The GVD could be interpreted as the contribution of the kth variable to the forecast error variance of the element j, at horizon

h. It allows for estimating the total and directional spillovers (i.e., the total quantity of uncertainty and directional means connectedness “to” and “from”). The GVD that considers h-step-ahead forecast error is:

$$(\boldsymbol{\theta_H})_{j,k} = \frac{\boldsymbol{\sigma_{kk}^{-1}} \sum_{h=0}^{H} \left((\boldsymbol{\Psi_h \Sigma})_{j,k}\right)^2}{\sum_{h=0}^{H} (\boldsymbol{\Psi_h \Sigma \Psi_h'})_{j,j}}$$

(4)

with $\Psi_h(N \times N)$: coefficient matrix from the moving average representation. σ_{kk}^{-1}: the inverse of the kth diagonal element of the covariance matrix i

In their paper, Diebold and Yilmaz (2012) normalized the variance decomposition matrix by the row sum to compute the spillover index:

$$\left(\widetilde{\boldsymbol{\theta}_{\boldsymbol{H}}}\right)_{\boldsymbol{j,k}} = \frac{(\boldsymbol{\theta}_{\boldsymbol{H}})_{\boldsymbol{j,k}}}{\sum_{\boldsymbol{j=1}}^{\boldsymbol{N}}(\boldsymbol{\theta}_{\boldsymbol{H}})_{\boldsymbol{j,k}}}$$

(5)

We are interested in the portions of the h-step ahead error variances when predicting x_i and at the same time, shocking the variable x_j. The total system-wide is deduced:

$$C^H = \frac{\sum_{j,k=1}^{N}\left(\widetilde{\boldsymbol{\theta}_{\boldsymbol{H}}}\right)_{\boldsymbol{j,k}}}{N} \times 100$$

(6)

The pairwise directional is denoted as $C_{j\leftarrow k}^H = \theta_{jk}^H$ (7) and refers to the shock effect from all the REIT k to the REIT j. Then, the net directional connectedness is the difference between the transmitted and received volatility connectedness $C_{jk}^H = C_{k\leftarrow j}^H - C_{j\leftarrow k}^H$ (8). The total directional (from others to j) is $C_{j\leftarrow\bullet}^H = \sum_{\substack{k=1\\k\neq j}}^{N}\theta_{jk}^H$ (9); the total directional (to others from k) is $C_{\bullet\leftarrow k}^H = \sum_{\substack{j=1\\j\neq k}}^{N}\theta_{jk}^H$ (10)

2.2.2.3 Dynamic connectedness methodology

We complete our analysis by implementing Baruník and Křehlík's (2018) approach, which is their spectral representation that distinguishes the short-, medium-, and long- term effects. They estimated the frequency dynamics of the connectedness as the spectral representation of the variance decompositions, based on the frequency responses to the shocks instead of the impulse responses to the shocks as Diebold and Yilmaz (2012) did. This approach consists of estimating the portion of the jth variable spectrum at a given frequency, due to shocks in the kth variable. The spectral density of $\mathrm{x_t}$ at frequency ω (or power spectrum), defined as a Fourier transform of $\mathrm{MA}(\infty)$ filtered series has the following form:

$$S_x(\omega) = \sum_{h=-\infty}^{\infty} E(x_t x_{t-h}')e^{-i\omega h} = \Psi\left(e^{-i\omega}\right)\Sigma\Psi'\left(e^{+i\omega}\right)$$

(11)

with $\Psi\left(e^{-i\omega}\right) = \sum_h e^{-i\omega h}\,\Psi_h$ being the frequency response function obtained as a Fourier transform of the impulse response coefficients Ψ_h.

The general causation spectrum over frequencies $\omega \in [-\pi, \pi]$:

$$\left(f(\omega)\right)_{j,k} \equiv \frac{\sigma_{kk}^{-1}\left|\left(\Psi(e^{-i\omega})\Sigma\right)_{j,k}\right|^2}{\left(\Psi(e^{-i\omega})\Sigma\Psi'(e^{+i\omega})\right)_{j,j}} \text{ (12)}$$

The weighting function is deduced by:

$$\Gamma_j(\omega) = \frac{\left(\Psi(e^{-i\omega})\Sigma\Psi'(e^{+i\omega})\right)_{j,j}}{\frac{1}{2\pi}\int_{-\pi}^{\pi}\left(\Psi(e^{-i\lambda})\Sigma\Psi'(e^{+i\lambda})\right)_{j,j}d\lambda} \text{ (13)}$$

Considering a frequency band $d = (a, b): a, b \in (-\pi, \pi), a < b$, the GVD on frequency band d is defined by:

$$(\theta_d)_{j,k} = \frac{1}{2\pi}\int_d \Gamma_j(\omega)\left(f(\omega)\right)_{j,k}d\omega \text{ (14)}$$

The within connectedness on the frequency band d is then defined as:

$$\mathcal{C}_d^{\mathcal{W}} = 100 \times \left(1 - \frac{\mathrm{Tr}\{\tilde{\theta}_d\}}{\sum \tilde{\theta}_d}\right) \text{ (15)}$$

The frequency connectedness on the frequency band d is then defined as:

$$\mathcal{C}_d^{\mathcal{F}} = 100 \times \left(\frac{\sum \tilde{\theta}_d}{\sum \tilde{\theta}_\infty} - \frac{\mathrm{Tr}\{\tilde{\theta}_d\}}{\sum \tilde{\theta}_\infty}\right) = \mathcal{C}_d^{\mathcal{W}} \times \frac{\sum \tilde{\theta}_d}{\sum \tilde{\theta}_\infty} \text{ (16)}$$

with $\mathrm{Tr}\{.\}$ the trace operator and $\sum \tilde{\theta}_d$ the sum of all elements of the matrix $\tilde{\theta}_d$.

2.2.2.4 VAR estimation

Owing to the high dimensionality of the VAR previously specified, the estimation is done via LASSO[8] i.e., we penalize our estimation by applying structured penalties to the standard vector

[8] Stands for "Least absolute shrinkage and selection operator"

autoregression (VAR) due to the complexity and the number of the coefficients that need to deal with otherwise.

Least-squares estimation: $\hat{\beta} = arg\,min_{\beta} \sum_{t=1}^{T}(y_t - \sum_i \beta_i x_{it})^2$ (17)

Under penalty constraint: $\sum_{i=1}^{k}|\beta_i|^q \leq c$ (18)

Basic VARX-Lasso: $\hat{\beta} = \arg min_{\beta} \left(\sum_{t=1}^{T}(y_t - \sum_i \beta_i x_{it})^2 + \lambda \sum_{i=1}^{K}|\beta_i|^q\right)$ (19)

Selecting q=1 we have LASSO structure, whereas q=2 we fall in the RIDGE structure

2.2.2.5 Penalty Parameter selection

Choosing the appropriate structure of penalty is crucial to have robust estimation and penalty structure adapted to the dataset. To this purpose we used the BigVAR package[9] to decide between three structures: Basic, Lagged and OwnOther.

Table 2-3 Different penalties to the VAR

Model Structure	Penalty	Solution Algorithm
BasicL	$\lambda\|\boldsymbol{\Phi}, \beta\|_1$	Coordinate Descent
Lag VARL	$\lambda\left(\sum_{l=1}^{p}\|\Phi_l\|_F + \sqrt{k}\sum_{j=1}^{s}\sum_{i=1}^{m}\|\beta_{.,i}^{(j)}\|\right)$	Block Coordinate Descent
OwnOtherL	$\lambda\left(\rho_1\sum_{l=1}^{p}\|diag\,(\Phi^{(l)})\|_F + \gamma_1\sum_{l=1}^{p}\|\Phi^{(l)}\|_F\right) + \sqrt{k}\sum_{j=1}^{s}\sum_{i=1}^{m}\|\beta_{.,i}^{(j)}\|$	Block Coordinate Descent

[9] estimation done with R x64 3.5.2 using BigVAR package https://cran.r-project.org/web/packages/BigVAR

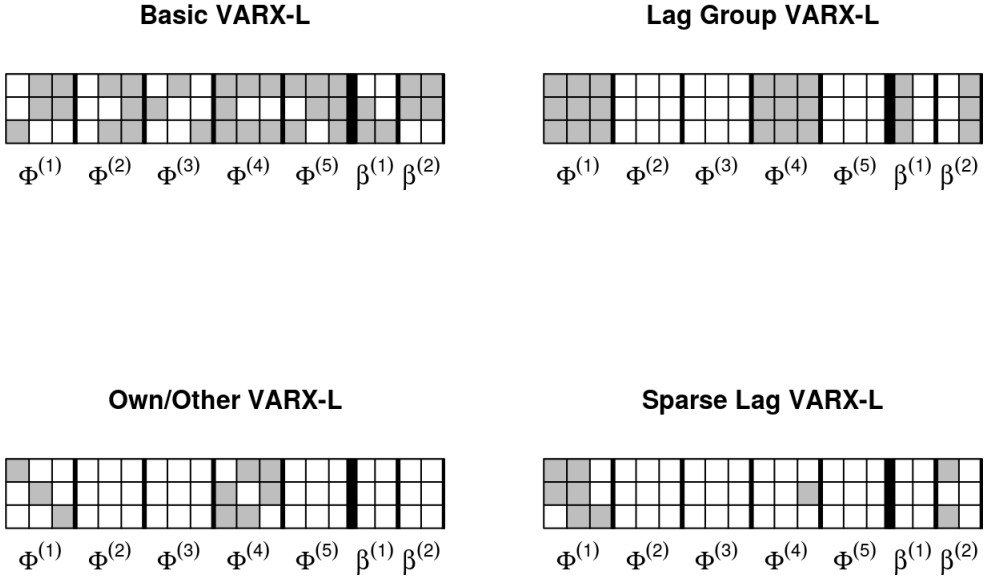

Figure 2:1 Example of Sparsity Patterns

In order to select the relevant structure of penalty for our VAR-LASSO (i.e. the structured penalty to VAR which minimize the forecast error); We conducted a cross-validation within our dataset by rolling manner and the time interval selected are the following:

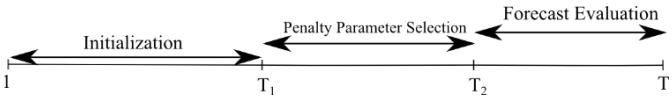

Figure 2:2 Rolling window cross-validation

The penalty parameter is chosen from the training period $T_1 + 1$ through T_2. Then, $T_2 + 1$ through T is to evaluate the forecast error with the rolling manner.

$$T = 3806\ ;\ T1 = \frac{T}{3} = 1268\ ;\ T_2 = \frac{2T}{3} = 2537$$

We evaluate Lambda by minimizing the mean square forecast error (MSFE):

$$MSFE\ (\lambda) = \frac{1}{(T_2 - T_1 - 1)} \sum_{t=T_1}^{T_2-1} \left\| \hat{y}_{t+1}^{\lambda} - y_{t+1} \right\|_F^2 \quad (20)$$

$\hat{y}_{t+1}^{\lambda}$: the one-step ahead forecast based on past observations

In order to select the optimal structure for the LASSO we performed a superior set of model test with the MCS package[10].

The following input arguments have been selected for estimation[11]:

[10] estimation done with R x64 3.5.2 using Model Confidence Set package https://cran.r-project.org/web/packages/MCS

[11] estimation done with R x64 3.5.2 using frequencyConnectedness package https://github.com/tomaskrehlik/frequencyConnectedness

Granularity: for the grid of penalty parameters λ we set the depth to 42 and the number of grid values to 10

Maximal lag order in VAR: 25

Table 2-4 Penalty selection using AIC and BIC, liminated model: OwnOtherL

Superior set of models	Rank	Elimination Rule	Model confidence set	Loss
LagL	2	0.16	0.87	17.88
BasicL	1	-0.16	1	17.86

The set of superior models contains the Basic VAR-L and Lag VAR-L with OwnOther VAR-L being eliminated. The loss which is a combination of Akaike information criterion (AIC), and the Bayesian information criterion (BIC) is in favor of the Basic VAR-L that we choose for the penalty structure. Hence, the Lambda is determined considering the lowest MSFE possible.

2.2.2.6 Network Visualization of High-Dimensional Variance Decompositions

Having a multi-dimensional connected system is challenging when it comes to interpreting the results. As in the literature, we use the ForceAtlas2 algorithm[12] to account for the multi-dimensionality and visualize the connectedness results. This algorithm has been used in various disciplines (social network analysis, biology, genomics…). ForceAtlas2 is a force-directed layout close to other algorithms used for network spatialization. An attempt to integrate different techniques such as the Barnes Hut simulation, degree-dependent repulsive force, and local and global adaptive temperatures.

$$F_a(n_1, n_2) = \frac{d(n_1, n_2)}{\text{indeg}(n_1) + 1} \quad (21)$$

$$F_r(n_1, n_2) = k_r \frac{(\text{outdeg}(n_1) + 1)(\text{deg}(n_2) + 1)}{\log(1 + d(n_1, n_2))} \quad (22)$$

[12] estimation done with Gephi x64 0.9.2 https://github.com/analyxcompany/ForceAtlas2

F_a: attraction force with dissuade Hubs

F_r: repulsion force proportional to the produce of the degrees plus one of two nodes (n_1, n_2)

$d(n_1, n_2)$: distance

k_r: coefficient of gravity

2.3 Results and determinants of net directional volatility connectedness among the REIT markets

2.3.1 Static connectedness (full sample, unconditional patterns

Our sample consists of 42 Pan-European REITs from various REIT regimes. On top of that, we are dealing with a study period from 2004 to the end of 2018 that involved many events in the direct real estate market, financial market, or REIT market. Our study period of 15 years is also located between two real estate market cycles identified by the National Association of Real Estate Investment Trusts (NAREIT): August 1989–January 2007 and January 2007–present. In this respect, our period includes 3 years of recession (mostly) from one cycle and 12 years of recovery and expansion. Accordingly, we opt to analyze this long period by dividing it into parts to fully understand what happens. In this paper, we document only the results of the most important periods (i.e., during the global financial crisis [07/02/2007–06/30/2009] and after the implementation of quantitative easing [01/02/2015–12/31/2018]). The other sub-period results are available upon request from the authors.

2.3.1.1 Full period (01/02/2004–12/31/2018)

We will interpret our results using the hierarchical clustering obtained from the computed connectedness tables (cf. Appendix 2). In short, we distinguish between receivers and transmitters of volatility connectedness among REITs.

Starting with the connectedness spreaders, the first cluster contributed by transmit- ting 17.91% of the total volatility connectedness and is composed principally of four UK-REITs: Shaftesbury PLC,

Hammerson, British L.C, and Land Securities Group (4.47% of volatility connectedness transmitted by each of these REITs on average). The second cluster located in the center of the network graph (Figure 3) contributed by transmitting 31.23% of the total volatility connectedness. This cluster is composed of seven REITs from three countries (France, the Netherlands, and Belgium): NSI NV, Intervest, Klepierre, Warehouses de Pauw, Vastned Retail NV, Unibail RW, and Cofinimmo SA (4.46% of volatility connectedness transmitted by each REIT on average). Finally, the last cluster transmitted 50.84% of the total volatility connectedness and is composed of the remaining 31 REITs, with 1.64% of volatility connectedness trans- mitted by each REIT on average. Concerning the receivers' classification, we found three major clusters of volatility connectedness receivers; as previously, we rank them from the highest to the lowest. The first cluster of receivers is composed of the same REITs that transmitted most of the volatility connectedness per individual, accounting for 14.28% of the total volatility connectedness received, with an average of 3.57% of volatility connectedness received per REIT. The second cluster of volatility connectedness receivers has six UK-REITs: Big YG, Unite Group, Standard Life Investments, Workspace Group, Derwent London, and SEGRO. This cluster received 18.67% of the total volatility connectedness, with 3.11% per REIT on average. The remaining 32 REITs cover the last cluster of volatility connectedness receivers, with 67.04% of the total volatility connectedness received and an average of 2.09% per REIT. From the third-level cluster, we can find the outliers of the network graph (Figure 3). The curiosity behind this cluster of outliers is the fact that they are somehow disconnected from the system. In other words, their quantity transmitted is negligible compared to the quantity received. For this reason, they have been pushed to the extremities. This group of outliers transmitted only 0.551% of total volatility connectedness per REIT on average. Some of these outliers are also characterized by a low float[13] (in comparison with those in the center of connectedness), such as Highcroft Investments Plc (35.95%), Altarea SCA (24.69%), MRM (37.81%), Aedes S. (33.54%), Acanthe D. (48.35%), Town Centre Securities (39.07%), Icade (42.07%), and Wereldhave Belgium (34.10%).

[13] The float is the number of shares available for trading. Float is calculated by subtracting closely held shares (owned by insiders, employees, the company's Employee Stock Ownership Plan, or other major long-term shareholders) from the total shares outstanding.

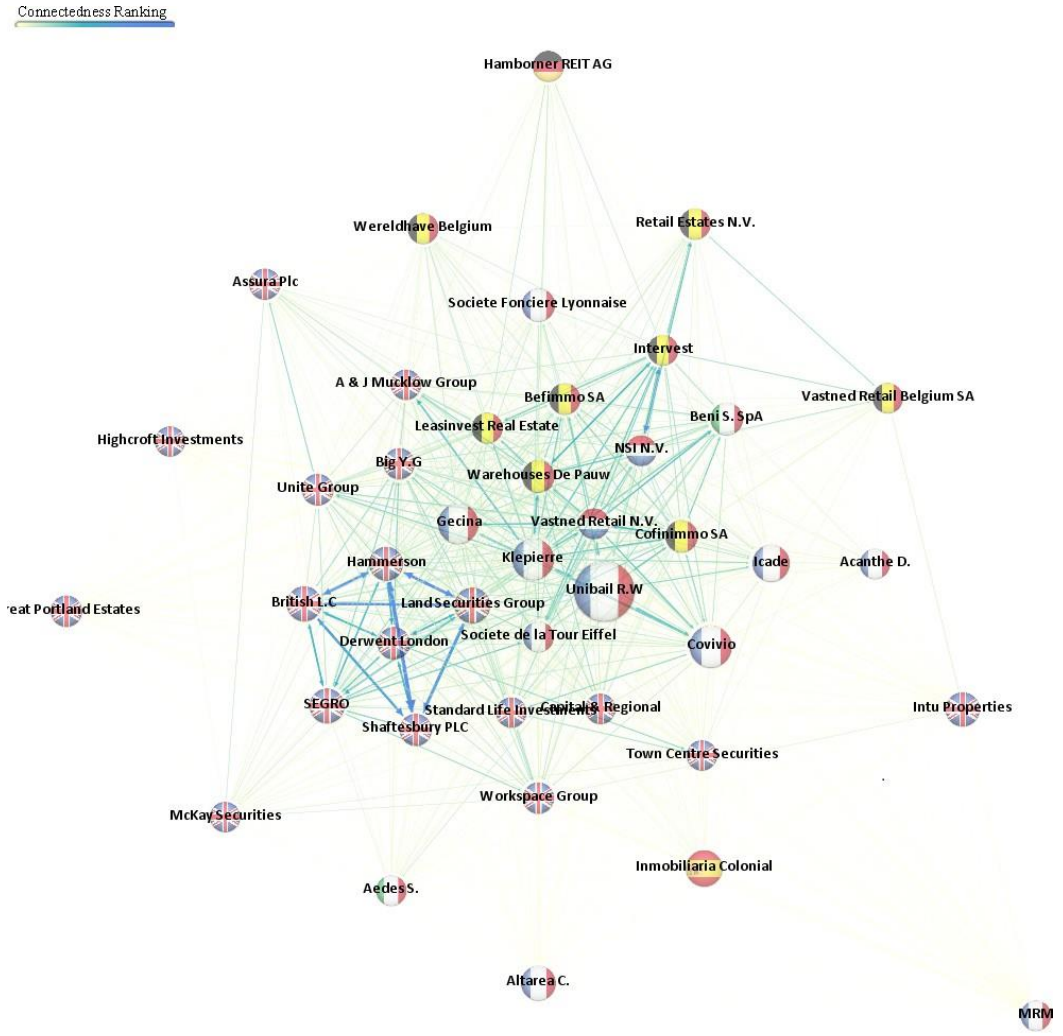

Figure 2:3 REIT Network Graph 01/02/2004–12/31/2018 (represented by country flags)

Node size represent the market capitalization, the color of and size of the arrows represent the total directional connectedness where yellow is the least and blue is the highest

We can see that UK-REITs are both the major receivers and transmitters of volatility connectedness. Furthermore, retail as a focus sector has a strong presence in volatility transmission: mostly in the first group of transmitters (except Land Securities Group, which is diversified). Taken separately, the French retail REIT Klepierre transmitted 5.56% of the total volatility connectedness (which is the highest). Retail has known many uncertainties due to e-commerce growth. This might explain the position of Klepierre at the epicenter of the network graph (Figure 3) and its strong link with the French REITs on the same axis (Covivio, Unibail RW, and Gecina). When we analyze the financial

statements[14], more precisely the ROAA[15] profitability ratio of the transmitters of volatility connectedness, on average, the first group has a ROAA of 4.92%, the second 4.07%, and the third 3.68%. Moreover, the highest market capitalization on average corresponds to the first group at 5228.38 (€M), followed by the second group at 3488.81 (€M) and the third at 1270.52 (€M). Otherwise, the outliers exhibit the highest debt ratios on average: total debt/total equity[16] = 1.52% and total debt/tangible equity[17] = 1.73%. In comparison, the first group of transmitters (Shaftesbury PLC, Hammerson, British LC, and Land Securities Group) have 0.58% on average for the same debt ratios. Figure 2 presents the direct real estate performance for all the commercial real estate (CRE) combined. The United Kingdom MSCI[18] index displays the highest volatility, with an average of 9.87 in terms of standard deviation of total returns[19]. Our guess is that this is due to the traditions of the UK appraisal approach, but also the depth of this same market. This might explain the centrality of UK-REITs in the volatility connectedness in the full sample. However, volatility does not necessarily mean performance, the total return indices (Figure 4). On one hand, the UK index, for example, has the highest volatility with the second highest average total return (8.23). On the other hand, the French index has the highest average total return (8.64), with less average standard deviation (5.83). Unlike standard stocks, equity REITs are perceived by investors as income stock because they provide cash flows with 90% of income as dividends. With this in mind, we find the highest volatility for the UK in the income return[20] as well: an average standard deviation of 0.74. Clearly, the income return displays much less volatility in level, but compared to the other countries, it is still higher.

[14] Source: SNL Financial
[15] Return on average assets; net profit as a percent of average assets
[16] All debt, senior and subordinated, as a multiple of equity
[17] Debt as a multiple of tangible equity
[18] MSCI is a leading provider of critical decisions Support tools and services for the global investment community
[19] Total (investment) return is the most important measure of overall investment performance used to compare different real estate assets across time.
[20] Income return, or direct return, measures the income receivable in relation to the capital employed over a period. This measure is calculated net of all irrecoverable costs incurred by the investor (which will depend upon the terms of the tenant lease contracts in place).

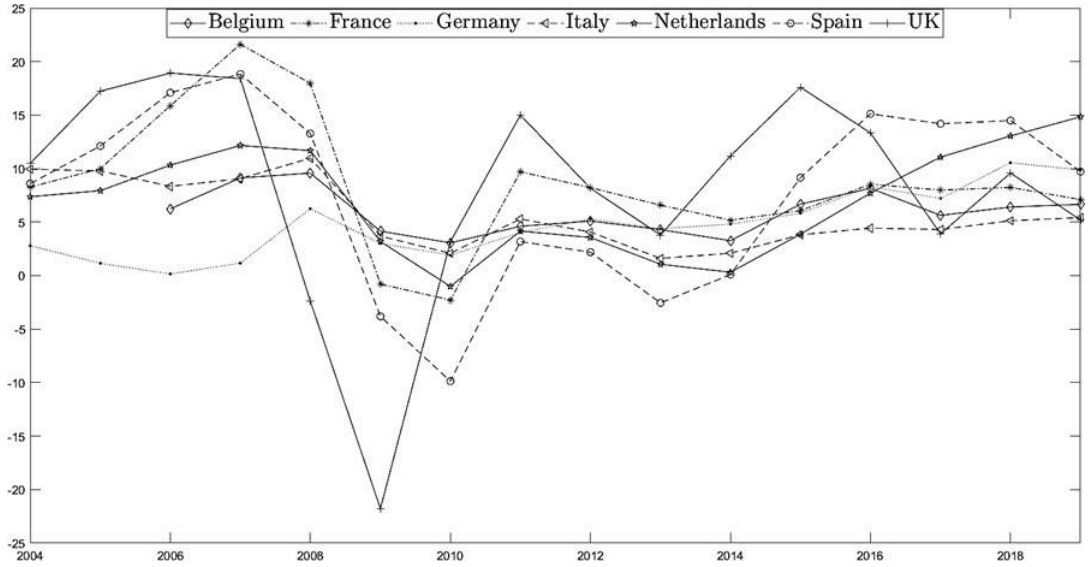

Figure 2:4 MSCI Direct Real Estate Total Return for the Pan-European Countries in our sample

2.3.1.2 During the GFC (07/02/2007–06/30/2009)

The "during crisis" period is of great importance because we included it to compare our results with those of other connectedness literature authors. This period has been documented with a form of connectedness convergence during the GFC, such as the global bank network Diebold et al., 2017 or the Economic and Monetary Union (EMU) sovereign bonds (Rodriguez, 2015). Therefore, the GFC study period will help us corroborate or contradict the results documented in the literature for the other asset classes. In fact, it will help us understand the REITs' connectedness specificities during market distress compared with other stocks, for example. The turmoil of 2007–2009 was disastrous for many spheres of the economy; however, CRE has shown some resilience. The GFC was triggered in the United States by the sub-prime mort- gage crisis and spread through a domino effect. Therefore, this period is an interesting case study in which many shocks occurred and propagated (e.g., Lehman Brothers bankruptcy). In Figure 5, we mapped the REIT network of this period: It is noticeable that the graph is denser at the center. That is to say, the GFC period reveals some form of convergence in volatility connectedness between REITs. This finding is consistent with the literature: When the market is in distress, the connectedness rises as market participants are making related decisions. Another specificity of REIT connectedness we observe is that the convergence occurs throughout the sector activity.

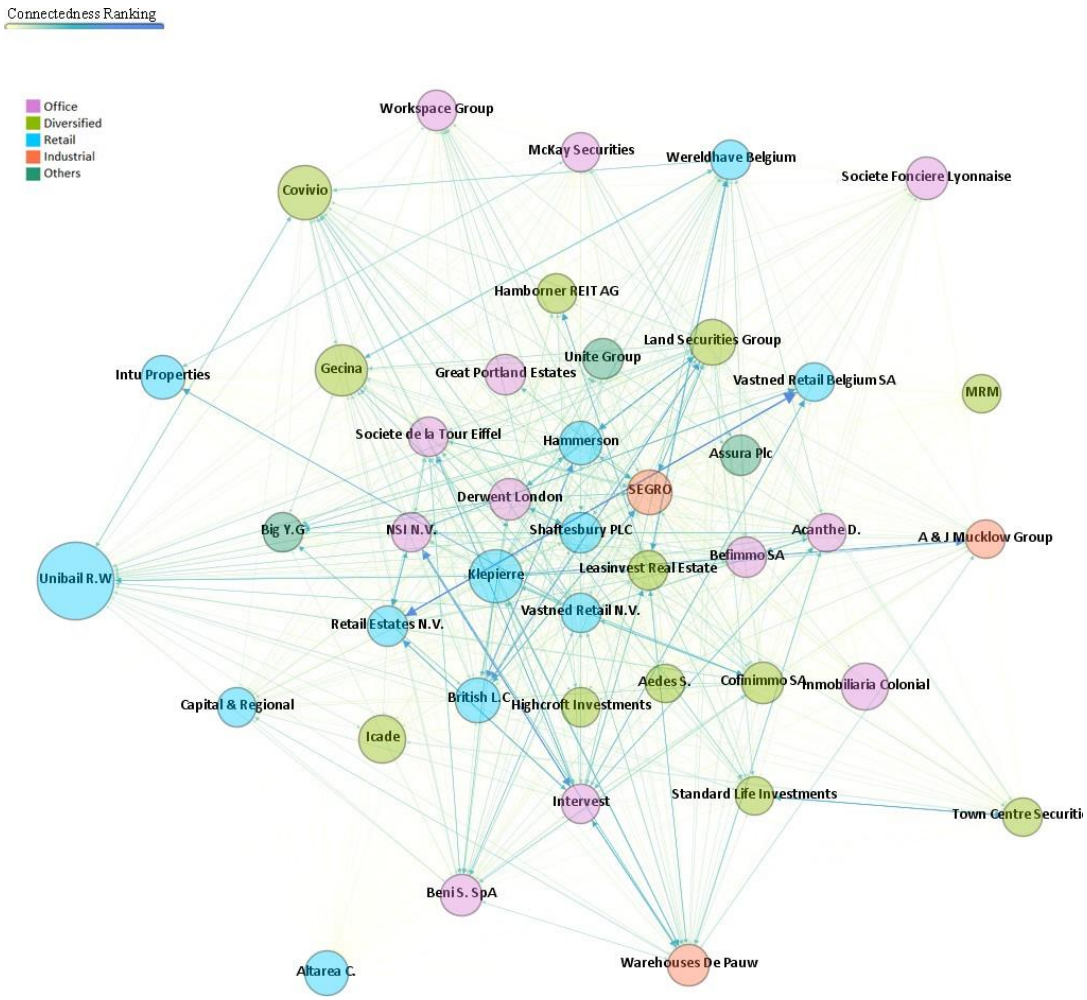

Figure 2:5 REIT Network Graph 07/02/2007–06/30/2009 (represented by sectors)

The volatility connectedness network graph (Figure 5) shows an epicenter of volatility connectedness. The retail sector is represented most in the epicenter, followed by the office sector. Retail, as a cluster, transmitted 35.44% of the total volatility connectedness, followed closely by the office sector, which transmitted 29.31%. The net volatility connectedness (cf. equation 8; i.e., the difference between the quantity of volatility connectedness transmitted and that received) is also in favor of these two sectors (retail and office): retail net volatility connectedness, 3.86%; office net volatility connectedness, 0.30%; industrial net volatility connectedness, -0.29%; other net volatility connectedness, -1.39%; diversified net volatility connectedness, -2.30%. An- other point is that presence in the epicenter of volatility connectedness during the GFC could be translated as being at risk of greater impact from the shocks that occurred. For the office sector, this period clearly involved several redundancies, such as hiring freezes and drop in growth (thus fewer developments). On the other hand, retail is closely linked to the basket of the households; therefore, the impact was even greater because consumption dropped. Due to those fundamentals, the retail

sector responded through a drop in capital values, then lowering the total. The industrial sector was more robust, thanks to its solid linkage with the international trade and supply chain (marginally affected by the GFC). Of course, the diversified REITs, through diversification benefits, managed to absorb GFC shocks.

At the REIT financial level, the retail and office sectors are the lower performing

ones, with a ROAA of -4.43% for retail and -3.25% for office. On the other hand, diver- sified, industrial, and others achieved -3.21%, -3.18%, and -1.10% ROAAs, respectively. Furthermore, the retail and office REITs accumulated a significant debt level: The net debt/equity ratio was 69.43% for retail REITs, 61.72% for office REITs, 56.80% for diversified REITs, 44.79% for industrial, and 58.93% for others. Another interesting metric to observe is the net free cash flow yield[21], which allows us to isolate the size effect: Retail REITs have negative ratios with -0.07%, office REITs have 2.49%, and diversified REITs have 9.54%.

2.3.1.3 During quantitative easing (01/02/2015–12/31/2018)

After the GFC, the Pan-European equity REITs faced difficulties financing their operations. Consequently, funding applications via corporate bonds were reinforced. As shown in Table 5, the debt level increased for the REITs of our sample:

Table 2-5 Average debt ratios of the 42 REITs during different periods

Debt Analysis (%)	Pre-Crisis	GFC	After GFC	During QE
Total Debt/Total Equity	0.89	1.21	1.21	0.66
Total Debt/Tangible Equity	0.91	1.32	1.30	0.67
Net Debt/Equity	66.72	62.06	70.89	55.11
Debt/Tangible Assets	38.88	43.57	42.55	35.04
Debt/Assets	38.74	43.24	42.19	34.82
Secured Debt/Debt	59.04	64.70	62.72	50.79
Debt/Total Enterprise Value	47.36	51.42	48.95	38.24
Net Debt/Total Enterprise Value	44.08	48.83	46.85	34.23

Some heterogeneity also exists amongst the REITs regarding their financing strategies. For instance, the REITs are domiciled in different countries (e.g., France has a financial system that is more bank

[21] Net free cash flow as percent of market capitalization

oriented, whereas the UK has greater reliance on the financial markets). For this reason, we computed average debt indicators per country. Between these two particular periods (during and after the GFC).

The "during quantitative easing (QE)" period allows us to explore to what extent the abundance of the liquidity shifted both CRE and REITs. The price returns of REITs moved in response to 10-year government bond yield movement since 01/02/2015. The price indices representing the national weighted average of REIT prices for France, Belgium, and the UK increased following a decrease in the 10-year government bond yield. However, in the case of the Netherlands, we observe the opposite effect, with an increase in the 10-year government bond yield associated with a decrease in the CRE price index.

Compared with the other sub-periods, total system-wide connectedness was far greater in this period, at 23.71 (cf. Equation 6): pre-crisis (14.6), during the GFC (22.53), after the GFC, and before QE (21.94). Furthermore, this period highlights two major and distinct groups in the network graph segmentation (Figure 6): On the left side, the group has positive net directional connectedness (cf. Equation 8); on the other side, the group is formed mainly by REITs with negative net directional connectedness (i.e., they receive more than they transmit). Furthermore, the REITs transmitting an important magnitude of volatility connectedness receive an important magnitude as well.

We computed the net directional volatility connectedness for each REIT and found that the ones with positive net directional volatility connectedness have a higher market capitalization (6702.73 €M on average). On the other hand, the ones with negative net directional volatility connectedness have a lower market capitalization (1281.72 €M on average). To some extent, the REITs with the capability to invest in the metropolitan cities and the core assets have the highest market capitalization. On top of that, if we divide by two transmitting clusters, we find that the cluster transmitting most of the volatility connectedness is composed of the biggest REITs. This period also experienced an unprecedented yield compression for the direct CRE market that resulted from the QE policies. Of course, the core markets were the most favored ones. Regarding the interesting question from the paper "Better to give than to receive" by Diebold and Yilmaz (2012), we consider that the answer in terms of volatility connectedness will be "it depends." For instance, in the GFC period, it was better to remain as disconnected from the system as possible, whereas in the QE period, trans- mitting volatility was better. That is because, in a period where there is an abundance of liquidity, the size does matter because it reflects a capacity to invest in larger or more premium

properties. Generally speaking, on one hand, the QE period increased the liquidity capacity of the bigger REITs (in terms of financing capability); on the other hand, the core assets saw the yield reaching the lowest threshold: Thus, only the biggest REITs with long-term strategies were positioned in these assets (in turn, they set the pace in volatility connectedness). Figure 6 displays a different center of connectedness (compared with the previous sub-periods). Visually, it is located on the left side, and we can clearly distinguish between two groups: On the left side, they are highly connected, whereas on the right, they are slightly less connected. Interestingly, all the REITs on the right side have negative net directional volatility connectedness, whereas on the left side, most of the REITs have positive net directional volatility connectedness. Among the REITs in this network connectedness system, some are dis- connected, which means that the volatility transmission and reception canceled out in the net volatility connectedness: It is important to consider both transmission and reception metrics and not to focus only on the net. A counter example would be that of Gecina, which transmitted 2.5% of volatility connectedness and received 2.78% but still had a net directional volatility closer to zero than did A & J Mucklow Group (-0.28%).

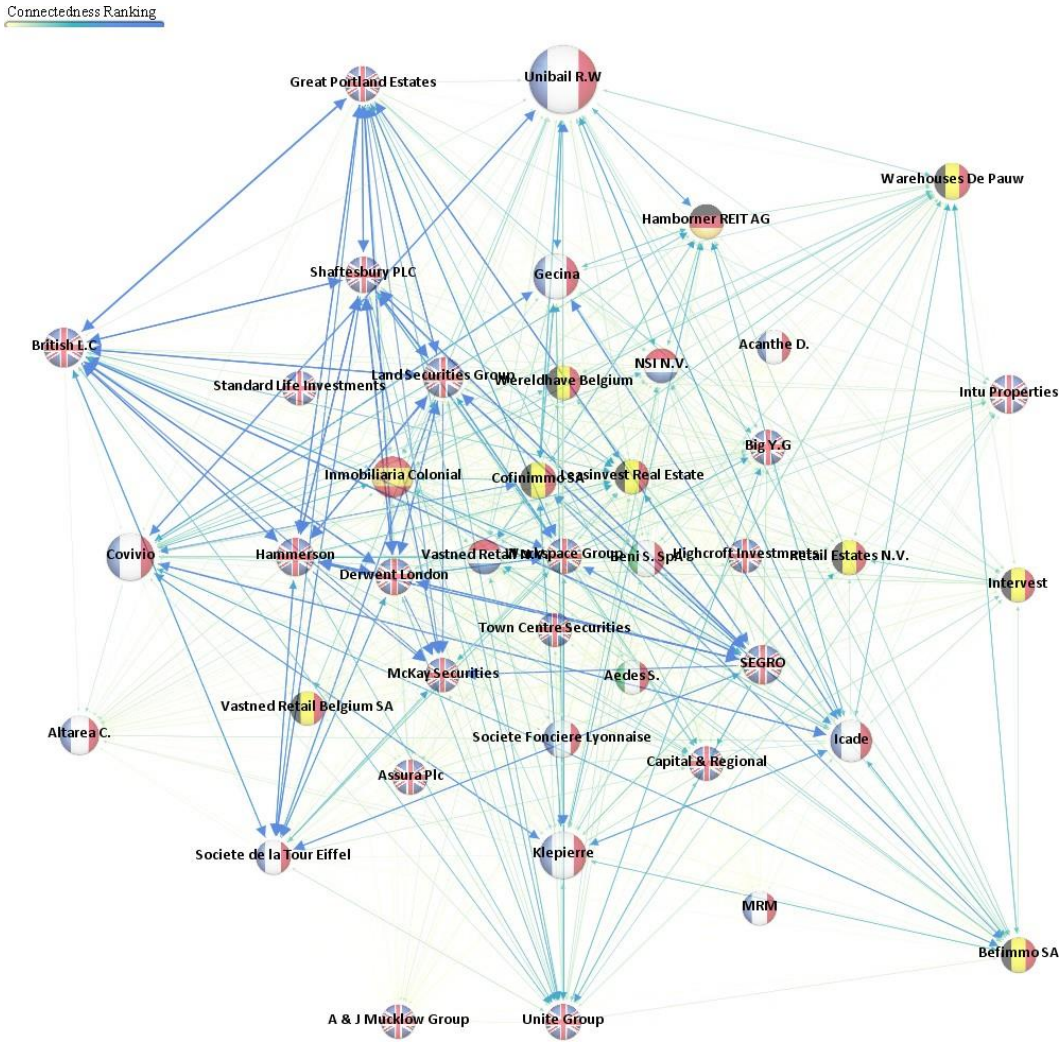

Figure 2:6 REIT Network Graph 01/02/2015–12/31/2018 (represented by country flags)

Pre-crisis period (01/02/2004–06/29/2007): "The calm before the storm"

This period experienced minor volatility connectedness overall and is characterized by bipartite and tripartite relationships between REITs. To some extent, the Italian REIT pair was disconnected from the network system and thus received the least volatility connectedness.

Accordingly, the direct CRE sector experienced good performance in this period, except in Italy: an increase in total returns and yield compression. Correspondingly, the financial statements displayed higher ROAA and return on average equity (ROAE). In contrast, the Italian pair had the lowest ROAA and ROAE ratios. In addition, overall, all REITs showed low debt ratios, and the Italian pair, conversely, had the highest ratio.

During the GFC (07/02/2007–06/30/2009): "Traffic jam"

Overall, the connectedness network displays a convergence in the volatility connectedness. Interestingly, the epicenter of volatility connectedness is formed mostly by the retail and office sectors. In fact, retail transmitted most of the volatility connectedness (35.44%), followed by office (29.31%). That is why we find industrial/logistics REITs outside the epicenter.

On the direct CRE side, the Pan-European retail and office indices show negative performance in the total returns starting from February 2008: The total returns were driven mainly by the decrease of capital values due to uncertainty. Retail was severely impacted compared with office. The industrial sector, thanks to its international trade benefits, was the most resilient. For instance, in the financial statements, we find negative ROAA and ROAE performance for office and retail; moreover, the retail cluster has the lowest ratios. The retail and office REITs accumulated the highest net debt/equity ratios: 69.43% and 61.72%, respectively.

After the GFC and pre-QE (07/01/2009–12/31/2014): "The aftermath of the turmoil"

We found a higher level of connectedness in this period compared with the GFC period. Moreover, five French REITs, two Belgian REITs, and one Dutch REIT form the group that transmitted most of the volatility connectedness.

These results are mainly explained by the UK and France direct CRE indices that recovered faster after the GFC. On the other hand, the UK index dropped again in 2011, and Spain experienced difficulties recovering from the GFC. According to the financial statements, the debt ratio level stayed at the same level compared with that during the GFC. The fact that the debt did not fall shows how high the pressure was of financing debt by emanating corporate bonds.

During QE (01/02/2015–12/31/2018): "Liquidity abundance"

This period exceeded all the others in total system-wide connectedness due to the fact that the liquidity in the market was the highest, but also due to the maturation of the REIT market.

Volatility connectedness divided the REITs into two major groups (i.e., a connectedness group with positive net directional connectedness and another with negative net directional connectedness). We observed an unprecedented yield compression in the direct CRE market. As for the financial statements of the REITs, we noticed that QE has finally absorbed the previous debt level.

2.3.2 Dynamic connectedness[22]

In addition to the connectedness tables, we computed a "rolling sample" of the spillover measures. Unlike static connectedness, the dynamic ranking involves moving sample estimates of the VARs. Subsequently, we used a window composed of hundreds of observations, and we differentiated between short-, medium-, and long-run volatility connectedness using different bands. To avoid generating an unstable VAR that would produce meaningless results at longer steps, we tried different windows. However, some observations were still dropped in the more persistent volatility series. The reason is that the graphed quantities were replaced with the missing values for those observations, which resulted in gaps (with sparse dots in Figure 7). For example, the GFC period contains several missing values, implicitly, which could be an additional indicator.

From the total connectedness rolling sample index (Figure 15, Appendix), we can no- tice minor jumps due to common shocks. We documented each of these shocks with the event that happened on that date. However, this index without bands makes it difficult to disentangle the shocks and their persistence. Thus, we used Baruník and Křehlík's (2018) methodology and employed three bands to account for short-run connectedness (1 to 4 days), medium-run connectedness (4 to 10 days), and long-run connectedness (20 to 365 days or more).

2.3.2.1 Short-run connectedness (1 to 4 days)

From figure 7, The first shock to draw our attention was rather a drop in volatility connectedness that happened on 09/17/2007, where the index decreased suddenly from 45.43 to 13.40. On this date, FOMAC[23] lowered the Fed funds rate (50bps decrease). Moreover, early in August, the turmoil had already started to hit the financial markets. What is interesting to note is that the crisis of 2008 temporarily resulted in a decrease in the short-run connectedness.

The second shock happened in two stages. The first, from 08/12/2011 to 08/31/2011, was an increase in volatility connectedness (average of 62.34) due to the event that occurred in European stock markets: The European stock markets suffered heavy falls due to persistent fears about the

[22] Events with double quote are sourced from: Reuters
[23] Federal Open Market Committee

world economic outlook. The second stage was a decrease in volatility connectedness (shock drop) when Fitch cut Greece's rating to BBB+ from A-, with a negative outlook on 12/07/2011 (resulting in a decrease from 42.99 to 26.05).

The third and last shock was an important increase in volatility connectedness (91.90), which occurred on 07/28/2016, when BoE bought additional £60bn of UK government bonds and £10bn of corporate bonds, to address uncertainty over Brexit and worries about productivity and economic growth.

The frequency band from 1 to 4 days corresponds with the shocks that happened mostly in the financial markets. Notably, in the short term, we observe both shock jumps and shock drops. That is, if the shock jumps correspond with an increase in volatility connectedness, by definition, they correspond with convergence among the REITs. Therefore, the shock drops correspond with divergence of volatility connectedness. For example, the dates 09/18/2007 and 11/07/2011 correspond with a loss of connectedness among the REIT market participants. A huge loss of connectedness taking the form of a shock drop (in the short run) means that REITs reacted in a different way to these two shocks. Meanwhile, some REITs were faster to react, for example, when FOMAC lowered the Fed funds rate, they immediately incorporated this information into the total returns, whereas others incorporated it afterward. Thereby, these two shock drops (i.e., when "FOMAC lowered the Fed funds rate" and when "Fitch cut Greece's rating to BBB+ from A-, with a negative outlook") might refer rather to long-run connectedness.

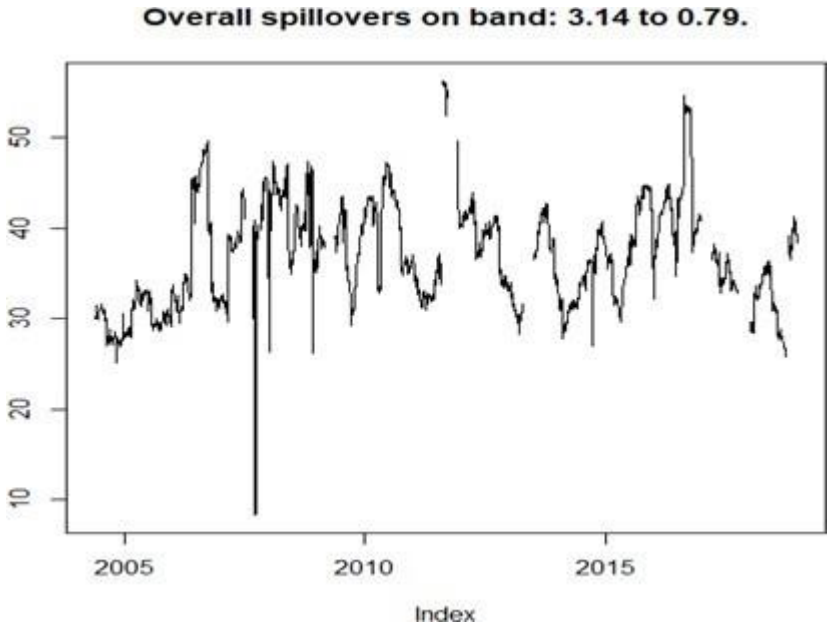

Figure 2:7 Short-Memory Shocks. The overall spillover index for band 3.14 (π+0.00001) to 0.72 (π/4) roughly corresponds with 1 to 4 days of volatility connectedness

2.3.2.2 Medium-run connectedness (4 to 10 days)

In the medium-run connectedness, we are rather interested in the shocks that are specific to REITs or to the CRE market. For instance, the first shock jump occurred on 09/24/2014 with an increase from 7.37 to 35.64 due to the European Public Real Estate Association (EPRA) annual conference, when an announcement was made that Europe would increase its weight in the global market capitalization of REITs. Moreover, during this event that took place in London, investors were reassured because they showed strong international investment flows and a market of leading IPOs.

We did not find a plausible explanation for the shock jump that occurred on 07/13/2016. We found another shock drop following on 07/28/2016, which is the same shock jump found in the first band (1 to 4 days) that corresponds with BoE bought additional £60bn of UK government bonds and £10bn of corporate bonds, to address uncertainty over Brexit and worries about productivity and economic growth. Our guess is that this shock, being so important in the short run, also affected the medium- run connectedness because the level decreased from 13.47 to 2.56.

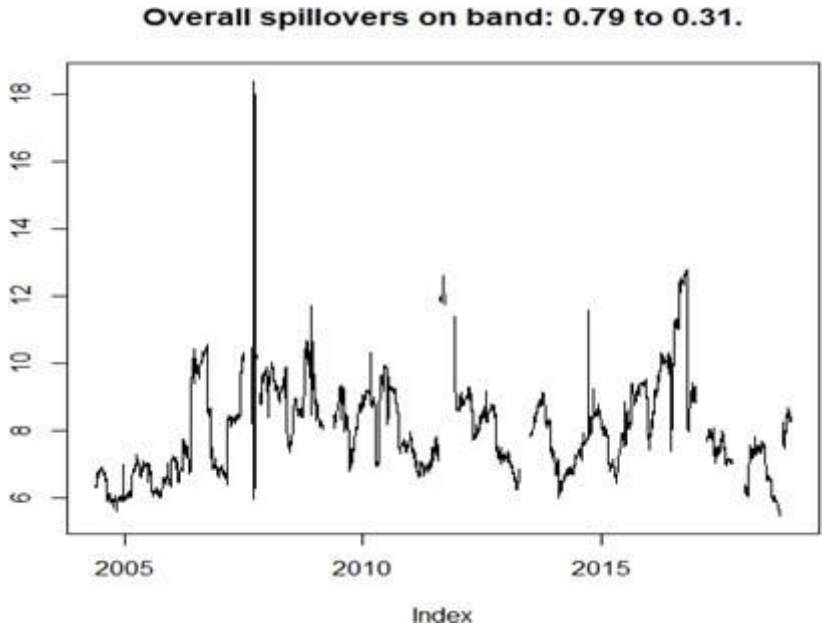

Figure 2:8 Medium-Memory Shocks. The overall spillover index for band 0.72 (π/4) to 0.31 (π/10) roughly corresponds with 4 to 10 days of volatility connectedness.

2.3.2.3 Long-run connectedness (20 to 365 days or more)

In this band, we registered three shock jumps that correspond with shocks leading the major crises: namely the GFC and European Debt Crisis (EDC). The first shock jump registered on 09/17/2007 when FOMAC lowered the Fed funds rate (50bps decrease). This shock jump was important in magnitude because it made the long-run connectedness jump from 8.23 to 59.47. The second shock jump registered on 12/07/2011 with a magnitude of 41.11 from 12.10 the preceding day, referring to the event of Fitch cut Greece's rating to BBB+ from A-, with a negative outlook. These two shock jumps in the long-run connectedness constitute key points for us to identify with precision the starting point of a major crisis. A third shock drop was also registered on 07/28/2016, which is when "BoE bought additional £60bn of UK government bonds and £10bn of corporate bonds, to address uncertainty over Brexit and worries about productivity and economic growth.

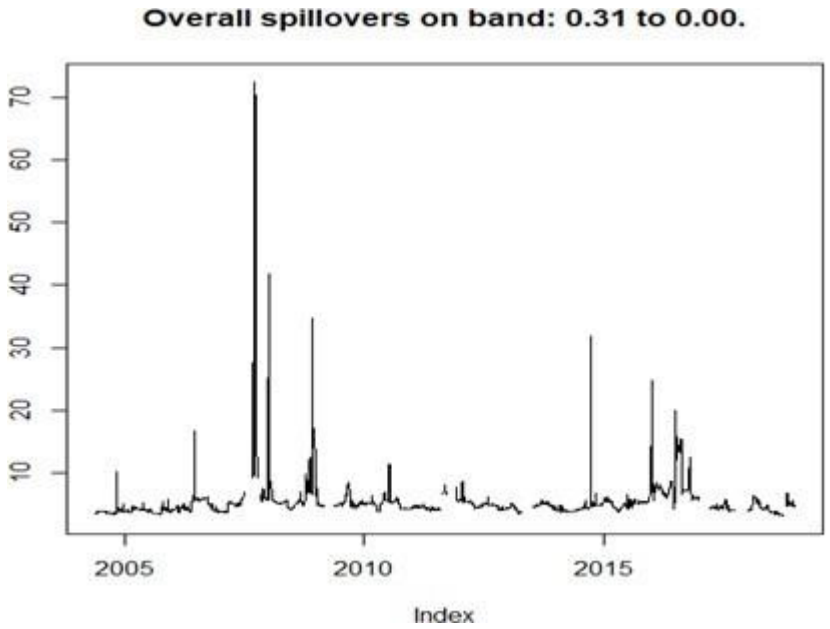

Figure 2:9 Long-Memory Shocks. The overall spillover index for band 0.31 (π/10) to 0 roughly corresponds with 10 to infinite days of volatility connectedness

Two major lessons from these results are as follows: (1) the shock on 07/28/2016 appears in all connectedness bands, in the short run as a shock jump and in the medium- long run as a drop. (2) The shocks on 09/17/2007 and 12/07/2011 appear as shock drops in the short-run connectedness and as shock jumps in the long-run connectedness. In sum, the short term tends to illustrate the effects of equity markets, the medium term is rather characterized by the effects of REITs and the

direct CRE market, and the longer term emphasizes the effects of major imbalances.

2.4 Robustness assessment

2.4.1 Robustness test using other measures of volatility

Nowadays, financial markets permit good circulation of information (quasi- continuous). To account for a good amount of that information, we used four quoting prices per day. We considered the following notation for the next measures:

f = fraction of the day (interval [0,1]) when trading is closed; $C_0 = B(0)$, the previous closing price; $O_1 = B(1)$, today's opening price; $H_1 = \max B(t), f \leq t \leq 1$, today's high; $L_1 = \min B(t), f \leq t \leq 1$, today's low; $C_1 = B(1)$, today's close; $u = H_1 - O_1$the normalized high; $d = L_1 - O_1$, the normalized low; $c = C_1 - O_1$, the normalized close.

Overnight volatility

Because the stock exchanges of our sample are open during specific trading hours, it is interesting to look at the overnight volatility and how it may differ from the trading-hour volatility. We used the following formula: $\widehat{\sigma}_1^2 \equiv \log\left(\frac{O_1}{C_0}\right)$

High-low volatility

High-low prices become relevant in the days where liquidity is important. Parkinson (1976) proposed the following estimator considering that high-low prices contain more information than open-close prices: $\widehat{\sigma}_2^2 \equiv \frac{(\log(H_1)-\log(L_1))^2}{4(\log_e 2)}$

Opening-closing volatility

During a trading day, many events happen in the market. The opening and closing prices give us a summarized picture: $\widehat{\sigma}_3^2 \equiv \frac{(\log(C_1)-\log(O_1))^2}{2}$

Garman and Klass volatility

For robustness matter, we used another version of Garman and Klass's (1980) estimator different from the original paper that does not include sample size and trading days. Instead, this measure of

volatility mobilizes a joint density from which the fourth moments are deduced. It is considered the best analytic scale-invariant estimator:

$$\widehat{\sigma}_4^2 \equiv 0.511(u-d)^2 - 0.019\{c(u+d) - 2ud\} - 0.383c^2$$

The results found show insignificant differences when we change the measures of volatility, either the volatility transmitted or received. Therefore, we confirm the robustness of our results.

2.4.2 Connectedness robustness

We examined different horizons because the h-step ahead of the forecast error in the GVD represents a strong assumption. Some authors choose h in the equity market context as the holding period. To extrapolate this to equity REITs, we need to bear in mind that REITs are perceived as income stock-paying dividends. Thus, an investor buying REITs must hold them for at least one day to benefit from the dividend. On the other hand, to pay less taxes (qualified dividends), an investor should hold REITs for at least 60 days during a 121-day period centered on the ex-dividend date. Therefore, for our robustness check, we chose to compare h = 10, h = 60, and h = 121. The results show little difference, if any. We registered no difference between h = 60 and h = 121 and a slight difference from h = 10 to h = 60, but only for some REITs (that differ depending on the period).

Conclusion

From the static connectedness, the full sample (2004 to the end of 2018) shows that UK-REITs transmitted and received most of the volatility connectedness. The retail market had more uncertainties due to the e-commerce burst; thus, this sector trans- mitted an important quantity of volatility connectedness to other sectors (positively or negatively). For instance, the industrial sector benefited positively from the connectedness shocks that occurred in the retail sector. The pre-crisis period (2004 to mid-2007) displayed bipartite or tripartite connectedness, and the French retail market experienced more significant connectedness in volume compared to its Dutch counterpart. Italian REITs were disconnected from the network system due to their poor performance in this period. During the crisis (mid-2007 to mid-2009), we found results similar to those in the stock market literature: The convergence of connectedness is clearly confirmed during this stress time

period. The retail sector transmitted most of the volatility connectedness (35.45%), followed by the office sector (29.31%). After the GFC (mid-2009 to the end of 2014), French and British REITs were at the epicenter of volatility connectedness on account of their ability to recover much faster after the turmoil. The QE period (2015 to the end of 2018) exceeded the other periods in terms of total system-wide connectedness. The size of REITs was an important determinant

of connectedness transmission during this period because the bigger REITs benefited more from the injection of liquidity given their ability to invest in core markets.

Regarding the dynamic connectedness, we found that the source of a shock (e.g., from the financial market, monetary policy adjustment, or the direct CRE cycle) does not necessarily explain its persistence. A shock's magnitude is rather explained by how REITs interpret it at the high-frequency trading. Indeed, the REITs communicate between them and with the shareholders through volatility connectedness as a channel of uncertainty. After this communication is processed, the shock will be implicitly defined as either short, medium, or long run, as the information about the shock is well integrated in the REIT market.

Our paper contributes to the literature by applying the methodology of Diebold and Yilmaz (2012) to the co-movement among Pan-European REITs and using different bands with a bootstrap rolling window causality. Corresponding to the literature of financial connectedness, we did find similar results in terms of equity connectedness during stress periods. REITs are often considered stocks, but in reality, they do not behave exactly as standard stocks because they are composed by a specific asset class, which is CRE (in our case). We obtained similar findings because the convergence of connectedness during the GFC is confirmed. However, we noticed that unlike stocks, the shock effects persist over time and have difficulty dissipating. CRE is characterized by several specificities, including "price stickiness," "price puzzle," "transaction costs," "illiquidity," "smoothing of rents," etc. Another finding is that depending on the period, the movements in REITs connectedness can be explained by either geographical aspects or sub-sector effects. Moreover, we documented time-frequency dynamics of REITs' volatility connectedness. The results were surprisingly different from our expectations because the source of the shock does not explain the persistency but rather how markets interpret shocks during high-frequency periods. According to the daily range-based volatility measure that uses the four quotations of the day (high, low, open, and close), the REITs at lower frequencies implicitly interpret the shocks and choose to either transmit them or not for a longer duration.

The results of the paper are in line with the literature on financial connectedness, and, more surprisingly, we also uncovered results that were unique to REITs. As these 42 REITs are the largest in terms of size and are well balanced in terms of allocation (office, logistics, retail, and diversified), we cannot consider a survivorship bias and can instead utilize them as a representative sample of the market. These results, however, only apply to the REITs in our study's sample and to the time period we analyzed (2004-2018). Although these results should not be depended upon for the foreseeable future, they can undeniably be utilized to enhance future uncertainty tracking for REITs.

Appendix 1 REITs sample

Table 2-6 Descriptive statistics

ticker	reit name	industry focus	mean	sd	min	max	range	skew	kurto-sis
ACAN.PA	Acanthe D.	Office	0.13	0.46	0.00	16.24	16.24	23.72	720.03
AE.MI	Aedes S.	Diversified	0.23	0.49	0.00	8.84	8.84	7.43	83.75
AGR.L	Assura Plc	Other	0.10	0.35	0.00	12.37	12.37	18.41	512.40
ALTA.PA	Altarea C.	Retail	0.05	0.49	0.00	7.11	7.11	14.02	197.67
BEFB.BR	Befimmo SA	Office	0.04	0.08	0.00	2.10	2.10	9.22	149.66
BLND.L	British L.C	Retail	0.07	0.19	0.00	6.41	6.41	14.93	396.48
BNS.MI	Beni S. SpA	Office	0.10	0.20	0.00	3.32	3.32	7.51	84.07
BYG.L	Big Y.G	Other	0.09	0.17	0.00	3.39	3.39	6.67	73.73
CAL.L	Capital & Regional	Retail	0.18	0.56	0.00	10.17	10.17	9.82	126.05
COFB.BR	Cofinimmo SA	Diversified	0.03	0.05	0.00	0.76	0.76	6.33	59.68
COL.MC	Inmobiliaria Colonial	Office	0.27	0.76	0.00	17.29	17.29	10.37	161.07
COV.PA	Covivio	Diversified	0.06	0.13	0.00	2.43	2.43	7.52	88.80
DLN.L	Derwent London	Office	0.07	0.19	0.00	5.71	5.71	13.80	313.71
EIFF.PA	Societe de la Tour Eiffel	Office	0.08	0.24	0.00	5.00	5.00	10.16	155.18
FLY.PA	Societe Fonciere Lyonnaise	Office	0.03	0.07	0.00	1.55	1.55	8.58	120.62
GFC.PA	Gecina	Diversified	0.07	0.17	0.00	4.28	4.28	10.74	184.06
GPOR.L	Derwent London	Office	0.32	1.62	0.00	50.97	50.97	14.64	363.06
HAB.DE	Hamborner REIT AG	Diversified	0.06	0.22	0.00	3.80	3.80	10.00	131.34
HCFT.L	Highcroft Investments	Diversified	0.01	0.07	0.00	2.60	2.60	19.53	600.86
HMSO.L	Hammerson	Retail	0.07	0.19	0.00	8.49	8.49	23.87	954.93
ICAD.PA	Icade	Diversified	0.06	0.22	0.00	5.39	5.39	13.90	258.85
INTO.BR	Intervest	Office	0.06	0.19	0.00	7.58	7.58	20.83	677.86
INTU.L	Intu Properties	Retail	0.11	1.42	0.00	75.83	75.83	44.07	2199.96
LAND.L	Land Securities Group	Diversified	0.06	0.16	0.00	6.18	6.18	18.37	581.59
LEAS.BR	Leasinvest Real Estate	Diversified	0.05	0.10	0.00	1.83	1.83	7.10	80.41
LI.PA	Klepierre	Retail	0.06	0.15	0.00	3.99	3.99	11.33	209.51
MCKS.L	McKay Securities	Office	0.07	0.15	0.00	5.72	5.72	16.82	532.27
MKLW.L	A & J Mucklow Group	Industrial	0.10	0.20	0.00	5.29	5.29	9.59	165.68
MRM.PA	MRM	Diversified	0.21	1.38	0.00	33.79	33.79	12.65	203.94
NSI.AS	NSI N.V.	Office	0.06	0.17	0.00	4.79	4.79	16.11	369.25
RET.BR	Retail Estates N.V.	Retail	0.02	0.05	0.00	1.05	1.05	9.07	134.66
SGRO.L	SEGRO	Industrial	0.09	0.26	0.00	6.68	6.68	13.30	261.80
SHB.L	Shaftesbury PLC	Diversified	0.07	0.24	0.00	13.41	13.41	43.53	2350.80
SLI.L	Standard Life Investments	Retail	0.04	0.16	0.00	4.57	4.57	14.97	333.97
TOWN.L	Town Centre Securities	Diversified	0.07	0.13	0.00	2.25	2.25	7.04	76.20
URW.AS	Unibail R.W	Retail	0.05	0.07	0.00	1.11	1.11	5.03	40.30
UTG.L	Unite Group	Other	0.12	0.35	0.00	9.72	9.72	12.27	227.35
VASTB.BR	Vastned Retail Belgium SA	Retail	0.03	0.17	0.00	7.81	7.81	29.06	1135.34
VASTN.AS	Vastned Retail N.V.	Retail	0.05	0.10	0.00	1.50	1.50	6.21	55.27
WDP.BR	Warehouses de Pauw	Logistics	0.05	0.11	0.00	2.21	2.21	9.51	133.55
WEHB.BR	Wereldhave Belgium	Retail	0.05	0.19	0.00	9.99	9.99	39.46	2016.37
WKP.L	Workspace Group	Office	0.13	0.36	0.00	10.65	10.65	15.65	354.33

Appendix 2 Connectedness Tables of the periods declined with heat colors and hierarchical clustering dendogram

The connectedness approach of Diebold & Yilmaz (2012) relies on knowing the portion of the forecast error variance that explain the corresponding portion of the jth variable. It uses the variance decomposition technique. The Generalized Variance Decomposition (GVD) of Diebold and Yilmaz (2012) in contrary of the traditional forecast error decomposition: the shocks are not orthogonalized. As a matter of fact, all the variables in the multi-dimensional system are shocked simultaneously. That is why, we obtain impulse responses and variance decompositions for each variable. Ex-ante, all the REITs represented by the nodes are equivalent, then, a single shock propagate through all channels. The connected-ness table summarizes the variance decomposition by showing us what volatility has been transmitted and the one being received. The connectedness table has upper left N×N block that contains the variance decompositions. Also called the variance decomposition matrix and denoted by D=[d_ij]. The sum of each row indicates all the volatility being received from others to j and the sum of each column indicate all the volatility being transmitted to others from k. The diagonal of the matrix is ignored because it covers only the past volatility for each element taken distinctly. In our case, we obtain a connectedness table or variance decomposition table of forty-two groups (42×42) and for fitting purposes we transformed the figures into heat colors. The table 4 represent the standard connectedness table constructed using the variance decomposition matrix.

	x_1	x_2	... x_N	*From Others to j*
x_1	θ^H_{11}	θ^H_{12}	... θ^H_{1N}	$\sum_{k=1}^{N} \boldsymbol{\theta^H_{1k}},\ \boldsymbol{k \neq 1}$
x_2	θ^H_{21}	θ^H_{22}	... θ^H_{2N}	$\sum_{k=1}^{N} \boldsymbol{\theta^H_{2k}},\ \boldsymbol{k \neq 2}$
⋮	⋮	⋮	⋱ ⋮	⋮
x_N	θ^H_{N1}	θ^H_{N2}	... θ^H_{NN}	$\sum_{k=1}^{N} \boldsymbol{\theta^H_{Nk}},\ \boldsymbol{k \neq N}$
To Others	$\sum_{j=1}^{N} \boldsymbol{\theta^H_{j1}}$	$\sum_{j=1}^{N} \boldsymbol{\theta^H_{j2}}$	... $\sum_{j=1}^{N} \boldsymbol{\theta^H_{jN}}$	$\sum_{j,k=1}^{N} \boldsymbol{\theta^H_{jk}}$
from k	$j \neq \boldsymbol{1}$	$j \neq \boldsymbol{2}$	$j \neq \boldsymbol{N}$	$j \neq \boldsymbol{k}$

After creating the connectedness table, we used hierarchical clustering to create different groups of clusters based on different levels of depth.

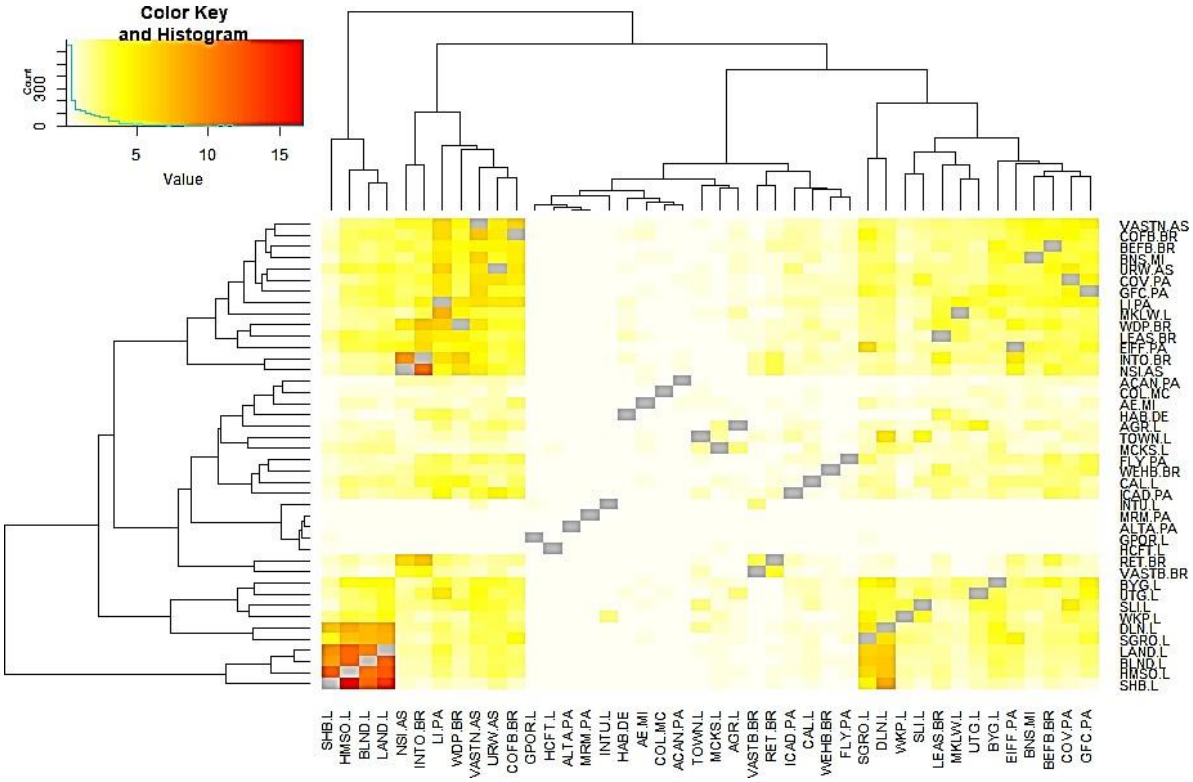

Figure 2:10 Connectedness Table of the period 02/01/2004 -31/12/2018 and hierarchical clustering

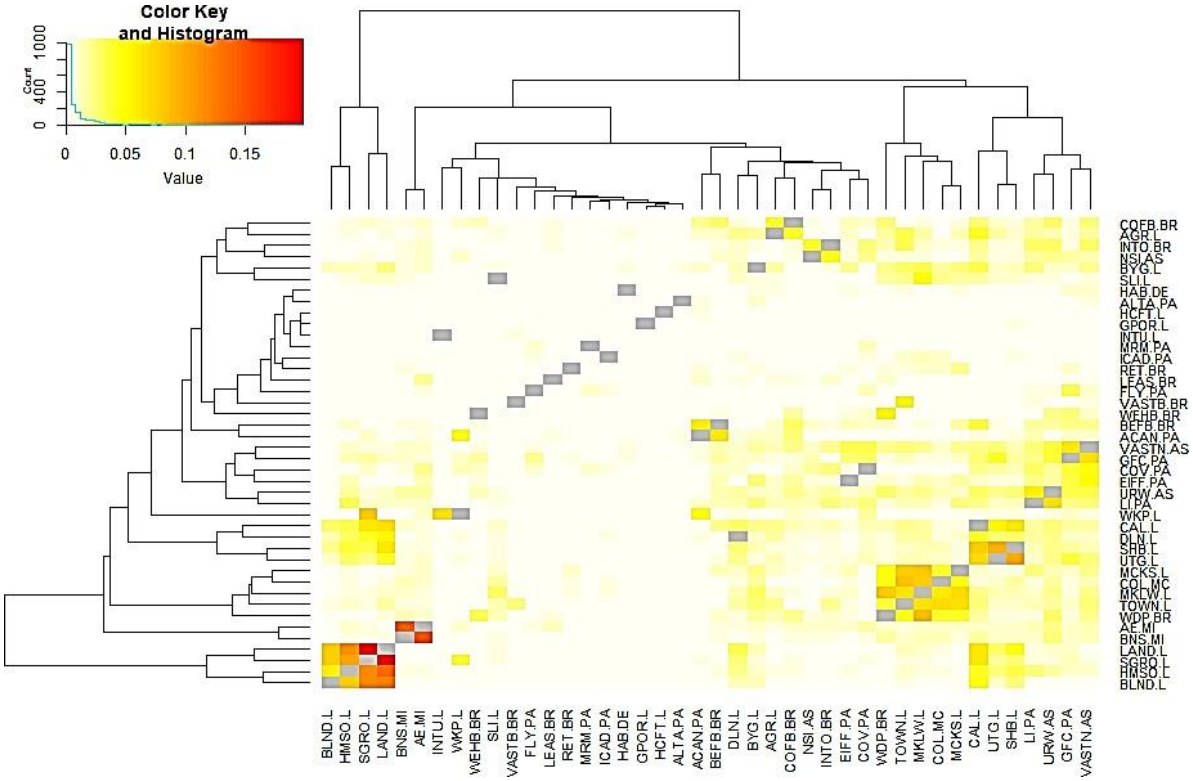

Figure 2:11 Connectedness Table of the period 02/01/2004 -29/06/2007 hierarchical clustering

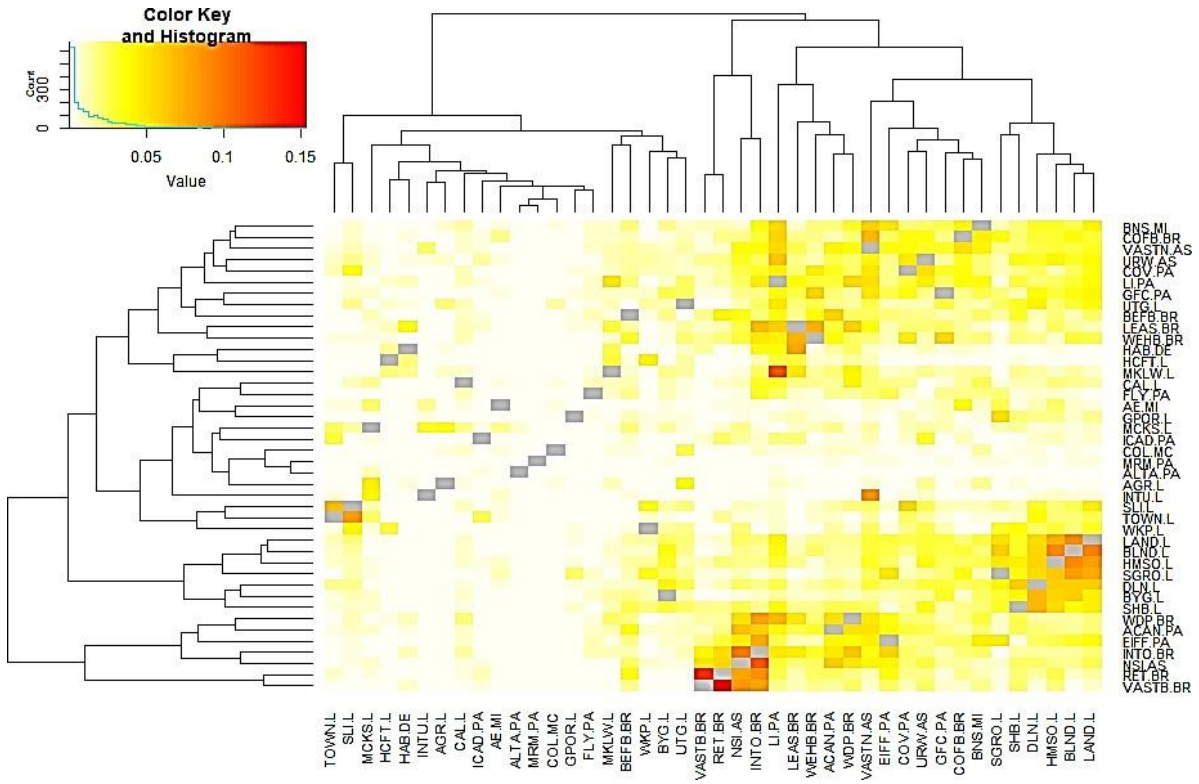

Figure 2:12 Connectedness Table of the period 02/07/2007 – 30/06/2009 and hierarchical clustering

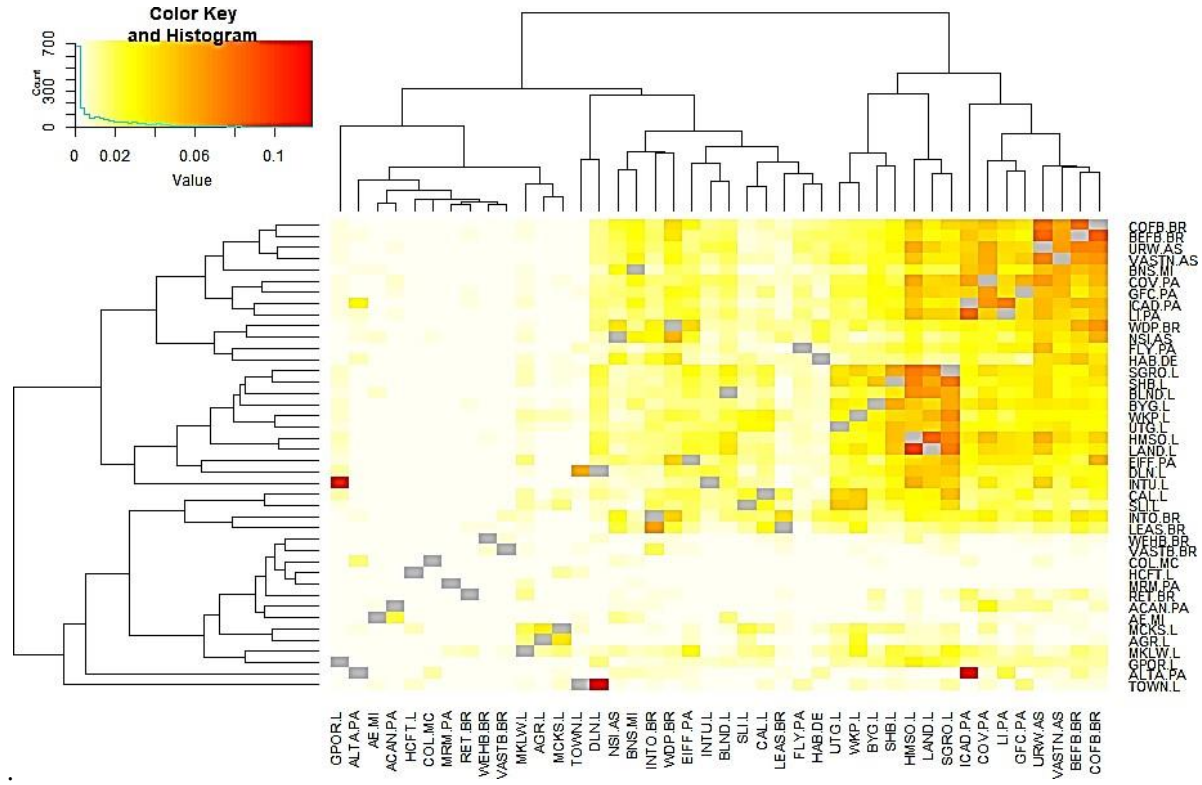

Figure 2:13 Connectedness Table of the Period 01/07/2009 – 31/12/2014 and hierarchical clustering

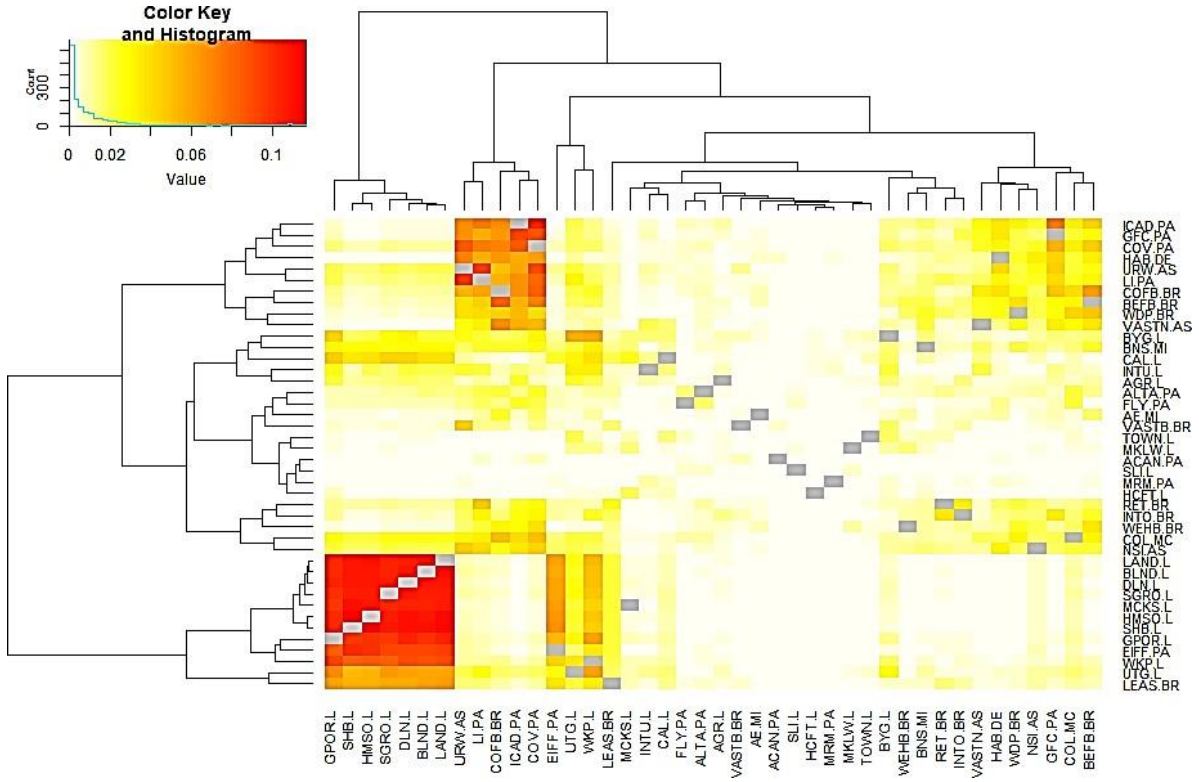

Figure 2:14 Connectedness Table of the period 02/01/2015 – 31/12/2018 and hierarchical clustering

Appendix 3 Total connectedness Index for whole period

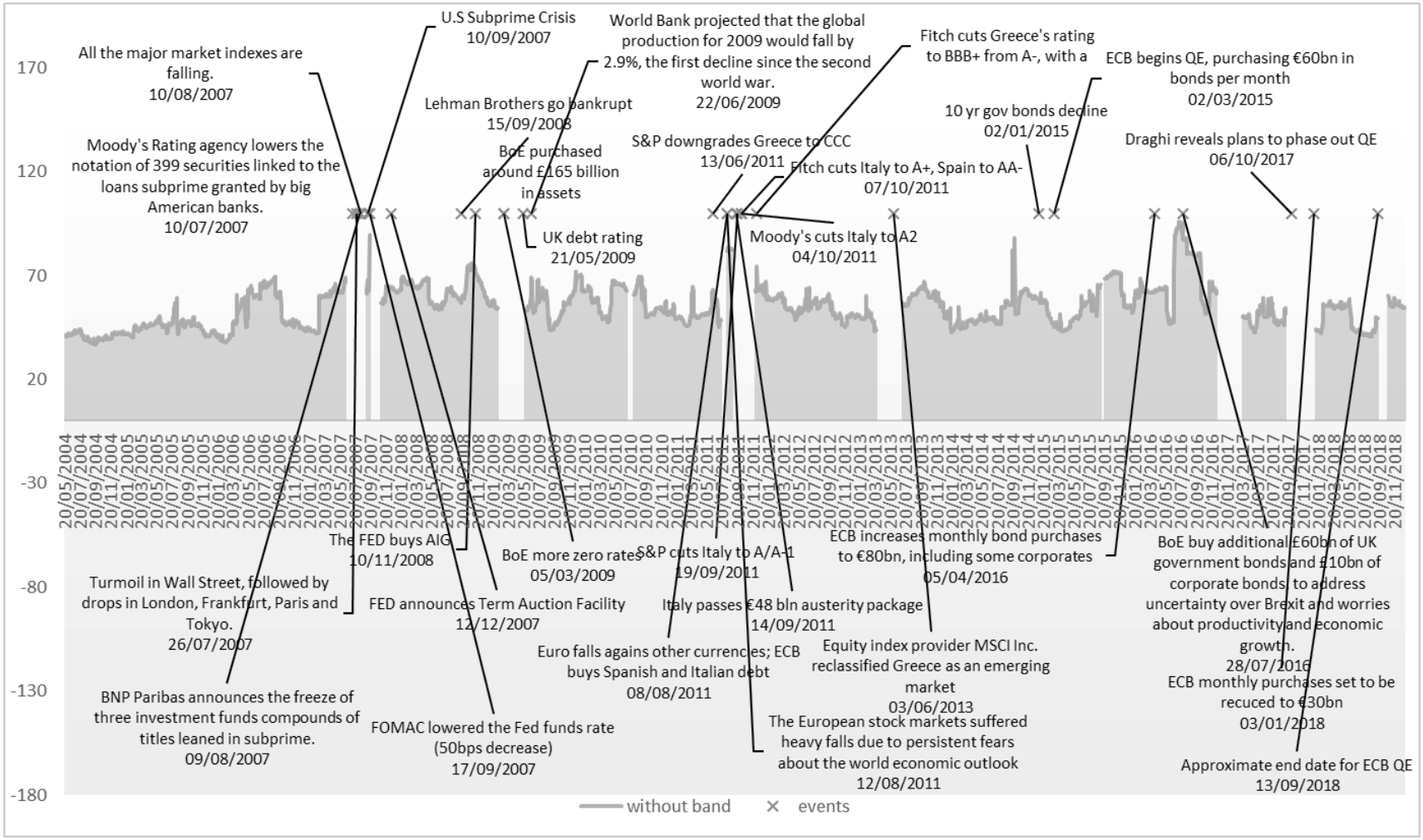

Figure 2:15 Total Connectedness Index of the 42 REITs Computed in a Rolling Manner Using a Moving Window of 100 days. We used various sources to document these events: La documentation Française, ECB press release

References

- Alizadeh S., Brandt M., Diebold F.X., 2002. Range-based estimation of stochastic volatility models. Journal of Finance. 57:1047–1092.
- Antonakakis N., Chatziantoniou L., Filis G., 2017. Oil shocks and stock markets: Dynamic connectedness under the prism of recent geopolitical and economic unrest. International Review of Financial Analysis. 50:1–26.
- Antonakakis N., 2012. Exchange return co-movements and volatility spillovers before and after the introduction of euro. Journal of International Financial Markets. 22:1091–1109.
- Baruník J., Křehlík T., 2018. Measuring the frequency dynamics of financial connectedness and systemic risk. Journal of Financial Econometrics. 16(2):271–296.
- Beine M., Candelon B., 2011. Liberalisation, and stock market co-movement between emerging economies. Quantitative Finance. 11(2):299–312.
- Brooks R., Negro R.D., 2004. The rise in Comovements across national stock markets: Market integration or IT bubble. Journal of Empirical Finance. 11(5):659–680.
- Bubak V., Kocenda E., Zikes F., 2011. Volatility transmission in emerging European foreign exchange markets. Journal of Banking & Finance. 35(11):2829–2841.
- Buch C, Pierdzioch C., 2005. The integration of imperfect financial markets: Implications for business cycle volatility. Journal of Policy Modelling. 27(7):789–804.
- Cashman G, Harrison D, Whitby R., 2018. Network connections in REIT markets. Journal of Real Estate Literature. 26(1):83–102.
- Chevallier J, Ielpo F., 2013. Volatility spillovers in commodity markets. Applied Economics Letters. 20(13):1211–1227.
- Cotter J, Stevenson S., 2008. Modelling long memory in REITs. Real Estate Economics. 36(3):533–554.
- Dermirer M., Diebold F.X., Liu L., et al., 2017. Estimating global bank network connectedness. Journal of Applied Econometrics. 33(1):1–15.
- Devaney M., 2001. Time varying risk premia for real estate investment trusts: A GARCH-M model. The Quarterly Review of Economics and Finance. 41(3):335–346.
- Diebold FX, Liu L., 2017. Commodity connectedness
- Diebold FX, Yilmaz K., 2012. Better to give than to receive: Predictive directional measurement of volatility spillovers. International Journal of Forecasting. 2012;28(1):57–66.

- Diebold F.X., Yilmaz K., 2009. Measuring financial asset return and volatility spillovers, with application to global equity markets. The Economic Journal. 119(534):158–171.
- Diebold F.X., Yilmaz K., 2014. On the network topology of variance decompositions: Measuring the connectedness of financial firms. Journal of Econometrics. 182(1):119–134.
- Fernandez-Rodriguez F., Gomez-Puig M., Sosvilla-Rivero S., 2015. Volatility spillovers in EMU sovereign bond markets. International Review of Economics and Finance. 39:337– 352.
- Garman M.B., Klass J., 1980. On the estimation of security price volatilities from historical data. The Journal of Business. 53(1):67–78.
- Imbs J., 2004. Trade, Finance, Specialization, and Synchronization. Finance, Specialization, and Synchronization, 86(3), 723-734.
- Jirasakuldech B., Campbell R., Emekter R., 2009. Conditional volatility of equity real estate investment trust returns: A pre- and post-1993 comparison. Journal of Real Estate Finance and Economics. 38(2):137–152.
- Koop G., Pesaran M.H., Potter S., 1996. Impulse response analysis in nonlinear multivariate models. Journal of Econometrics. 74(1):119–147.
- Liow K., Liao W.C., Huang Y., 2018. Dynamics of international spillovers and interaction: Evidence from financial market stress and economic policy uncertainty. Economic Modelling. 68:96–116.
- Liow K.H., Huang Y., 2018. The dynamics of volatility connectedness in international real estate investment trusts. Journal of International Financial Markets. 55:195–210.
- Maghyereh A., Awartani B., Hilu K., 2015. Dynamic transmissions between the U.S. and equity markets in the MENA countries: new evidence from pre- and post-global financial crisis. The Quarterly Review of Economics and Finance. 56:123–138.
- Maghyereh A.I., Awartani B., Bouri E., 2016. The directional volatility connectedness between crude oil and equity markets: new evidence from implied volatility indexes. Energy Eco- nomics. 57:78–93.
- Mantegna R.N., 1999. Hierarchical structure in financial markets. The European Physical Journal B. 11:193–197.
- Pesaran M.H., Shin Y., 1998. Generalized impulse response analysis in linear multivariate models. Economics Letters. 58(1):17–29.
- Sims C., 1980. Macroeconomics and reality. Econometrica. 48:1–48.

- Yang J., Zhou Y., Leung W.K., 2012. Asymmetric correlation and volatility dynamics among stock, bond, and securitized real estate markets. Journal of Real Estate Finance and Economics. 45:491–521.
- Yarovaya L., Brzeszczynski J., Lau C.K.M., 2016. Intra- and inter-regional return and volatility spillovers across emerging and developed markets: Evidence from stock indices and stock index futures. International Review of Financial Analysis. 43:96–114.

Chapter 3: Is Diversification a Good Choice? Evidence from French Real Estate Investment Companies

3.1 Introduction

Fundamentally, we need to provide some background for the real estate exposure we are discussing in this essay. The financialization of real estate has seen several changes over the years. These developments aided real estate in overcoming its weaknesses, particularly in terms of liquidity. Non-listed (securitized) and listed (un-securitized) commercial real estate exposures, particularly REITs, differ from listed ones in terms of liquidity, pricing mechanism, leverage, cost levels, and underlying exposures. A property trust can invest in office, commercial, retail, industrial, or alternative properties. Due to the huge initial outlay required, an individual investor may be unable to invest in commercial retail or industrial property. Individual investors, on the other hand, can acquire exposure to options other than residential real estate through property trusts. Investors receive income cash-flows, may be eligible for tax breaks, and may be able to achieve capital growth in exchange for investing money. Fund managers seek property because they want great tenants, long-term leases, new or virtually new buildings, capital growth potential, and a growth location. Unlisted trusts are primarily medium to long-term investments, with a life cycle ranging from five to seven years, but they can endure up to ten years. When buying an unlisted investment, it's important to keep in mind that it's an illiquid investment, meaning that once a decision has been made, withdraw the money is impossible before the property is sold. According to EPRA ’s estimates: the professionally managed real estate (listed and non-listed) account for $9.7 trillion. While the total global investible listed real estate market accounts for around 10% and stands at $2.6 trillion. That is to say, the non-listed real estate is larger with $7.1 trillion (26%). Then inside the unlisted market, we can find two sub-categories i.e., public, and private. Roughly speaking, the private is dedicated to institutional or rich individual investors exclusively. Whereas the public non-listed real estate is dedicated to household willing to save money or create returns over a long-term.

In France, there is two types of unlisted real estate companies: OPCI[24] and SCPI[25]. Each OPCI and SCPI has its own set of benefits and drawbacks. The composition of their assets is the biggest difference between SCPI and OPCI. SCPI's real estate investments are solely for the purpose of leasing, with the goal of earning and distributing a rental return. The OPCIs, on the other hand, also expanded their asset distribution beyond direct real estate to include financial assets. SCPIs were established in 1964; they are tax-transparent vehicles (similar to REITs) and are subject to the rules controlling real estate income and capital gains tax in France. According to regulations, their portfolio must consist solely of real estate assets and money market instruments (cash, deposits, foreign exchange). Financial leverage is permitted, but it must be explicitly approved by investors, who decide on a loan-to-value cap at general meetings (between 20 percent and 40 percent). The total assets under management (AUM) of SCPIs at the end of 2019 accounted for $73 billion.

The yield compression in the commercial real estate coupled with more compression of the government bond yield have allowed the non-listed real estate class to become very attractive. The French non-listed investment funds “SCPI” is an interesting way to invest indirectly to the commercial real estate. However, the performance measurement could vary from the direct sector due to the significant company component e.g., managing several assets. The SCPI is a non-trading company that existed on the market since 1970, the IEIF[26] counter in December 173 SCPI entities. Clearly the market of SCPIs has matured and numerous indications demonstrate this: the net inflows, the number of transactions and the capitalization have grown significantly. On the other hand, the performance indicator representing the distribution rate on market distribution rate or DVM shows a compression from 2009 with 6,07% then reaches 4,37% which confirm the good health of the French property fund (SCPI). Nonetheless, uncertainty coming from direct real estate market, macroeconomic sphere, or the sector itself could drive this performance either way. The uncertainty impact is of interest for the regulator “AMF”, for the non-profit association “IEIF and

[24] OPCI is a way of investing in real estate that has been around since 2008. It is a long-term investment vehicle that combines real estate and financial assets.
[25] SCPI is a civil society whose sole purpose is to acquire and manage a rental property, often for professional use (offices, shops, warehouses, car parks, nursing homes, hotels, shopping centres, etc.). To do this, it uses private investment (fundraising from individuals who acquire units) and its net income is distributed among the holders of its units, the “partners”. The SCPI is therefore a collective investment structure.
[26] French Institute of real estate and land savings, Institut de l’Epargne immobilière et Foncière

ASPIM", the management of the SCPIs and of course the unitholders (in the primary market or over counter).

listed investment funds (SCPIs) through privileged access to IEIF France data base. In particular, we want to study the performance diffusion considering diversification benefits through sectorial-spatial couple. Precisely, our research questions: what were the funds that outperformed the market and at the same time were resilient to uncertainty? How these companies managed to deliver such performance?

Following these research questions, we will mobilize the ALM approach and using the quantities rather than prices merely. Thus, based on some explanatory financial variables inherent to non-listed funds SCPI, we will deduct the fund diversification premium.

This chapter begins with a short review of the literature regarding the diversification in the financial literature as well as in the real estate. Then in the third section, we will present our data and how we adjusted it appropriately. The fourth section the findings are examined. Finally, we will conclude.

3.2 Literature review

According to our knowledge, no prior research has explored the benefits of diversification on the performance of the French SCPI market. However, a recent study by Guedj et al. (2021) analyzed the variance in risk and returns for French non-listed investment trusts using nearly the same data set. According to the authors, a number of characteristics provide significant explanatory power for these inequalities in risk and performance. The authors also discovered that non-listed real estate investment fund portfolios had much lower volatility than the average panel fund, and that 15 SPCIs are adequate to capture more than 90 percent of these diversification benefits. These findings suggest that selection and allocation decisions might generate substantial value, which could serve as the basis for a welfare-improving open architecture multi-management investment strategy for unlisted real estate investment trusts. Our work, on the other hand, will be the first to address the issue of diversification benefits by incorporating spatial considerations, governance impact, and direct real estate market circumstances thanks to the availability of a large database of French non-

listed investment trusts. The contributions should be of broad interest, and our effort will produce a road map for SCPIs managers who wish to launch new funds or who are presently managing one.

The relationship between an investment fund's success and the kind of the assets it holds is a passionately discussed topic, notably in Anglo-Saxon literature. There have been various works proposed on this topic, and we are the first contribution on French non-listed investment trusts to investigate the diversification effects of SCPIs in particular.

Real estate capitalisation has grown steadily, whether through private ownership or securities, and its information clarity has enhanced using indirect investment vehicles. Over the previous few decades, investment vehicles that provide competitive advantages in terms of liquidity and transparency have emerged. As a result, real estate markets present a diverse collection of regimes associated with an effective risk-reward combination, and so real estate allocation in a portfolio has been compelled by its ability to reduce risk while providing adequate returns. Our topic is relevant for both professionals who manage SCPIs and the general public who invests in those instruments. Overall, the primary goal of these property management companies is to collect savings from the general-public. Then, these companies use this specific resource to acquire real estate assets and have a regulatory obligation to do so. These companies only contract is to provide a certain level of income to unitholders. Thus, the economic problem that arises from being a resource collector is the challenge of selecting new real estate assets to ensure the stability of the yield with each investment flow. However, in a competitive environment where the choice of real estate assets is limited, the choice of the asset's general structure is critical. Non-specialist investors generally deploy capital to real estate to diversify their portfolios and achieve excellent risk-adjusted returns. Real estate assets have traditionally been used to diversify multi-asset portfolios (Peyton et al., 2006). Diversification is a well-known academic mechanism in which the expected effects have been integrated but might be hampered by certain perverse effects. Research in finance, for example, shows that diversification gains are not always automatic; it is not enough to mix assets of different types with negative or weak correlations and expect diversification gains. For example, if a company wishes to multiply its business lines in order to diversify its activities, it must develop skills in the management of these various activities. Perhaps managers desire to diversify can be interpreted as a negative signal by shareholders, leading them to fear a lack of skills and lower firm performance, which can result in a diversification discount. The other signal is that a firm's manager, who is often more informed than shareholders in general about the health of the business activity, and

sometimes poor management, may disguise its poor performance through diversification of the firm's activity strategy. This information asymmetry between shareholders on the one hand and governance on the other can effectively bring about informational problems such as the principal-agent problem and generate discounts.

Real estate, according to most experts, deserves to be included in mixed-asset portfolios. Mueller and Mueller (2003) demonstrate the benefits of including real estate assets in mixed-asset portfolios by comparing several mixed-asset portfolios with two alternative allocation strategies: those with real estate investments and those without (i.e., comprised only of financial assets such as equities and bonds). The portfolio with some real estate investments continuously outperforms the portfolio without any real estate investments, suggesting that real estate boosts portfolio performance. When it comes to discuss financial performance, one is required to consider diversification. In fact, it is a must especially when we are dealing with vehicles or portfolios. When managing a portfolio composed of different assets, diversification allows to reduce risk by reducing exposure. The pioneer in this regard is H. Markowitz (1952) in his seminal paper called the modern portfolio theory. Concisely, the author suggests that when maximizing the expected return of a portfolio we need to consider idiosyncratic risk to hedge against market risk. According to Markowitz, there is an optimal portfolio that can be selected with the best risk-return pair thanks to the efficient frontier. To cut a long story short, there has been numerous studies to investigate this question following the two-factors approach of Markowitz (1952). The major one is the capital asset asset pricing model (CAPM) by Sharpe (1964) and Lintner (1965) that augment the previous model to a general equilibrium framework. Basically, the mean-variance efficiency of Markowitz is a one-period horizon and the CAPM theory allow investors on the distributions of returns and may borrow or lend without limit at a risk-free rate. Later, Fama and French (2004) gave birth to the asset pricing theory (APT) by assessing empirically CAPM theory.

Despite decades of research, the question of diversification continues to be debated among practitioners and academic researchers. Furthermore, the empirical studies in finance show that diversification gains are not automatic (informational problems, signal of mismanagement by shareholders, less valued by financial markets). In addition, different mechanisms that make diversification/performance relationship more complex than it seems.

Although there are many studies in Finance, the diversification research in real estate remains limited and mostly on REITs. Several papers show that information mechanisms were at work to explain this massive specialization REITs in the U.S. market. The American literature is oriented mainly to a discount of diversified companies. The companies owning and managing real estate have the possibility to diversify geographically or across property types. The literature in this respect discusses either one or both diversification forms.

The real estate diversification has many facets and a way to look at it the subject is by asking the following question: is real estate reduce risk in a multi-asset portfolio? In short, the consensus is that real estate does warrant inclusion in mixed-asset portfolios. For instance, the literature pertaining to real estate diversification benefits strongly suggests that real estate is decorrelated with the other assets. Thus, for that reason real estate reduce portfolio volatility risk. Yet, the authors have not been able to agree on the optimal percentage that is optimal for real estate allocation. One of these authors are Hartzell, Hekman and Miles (1986), they found that real estate offers attractive diversification opportunities for stock and bond investors as well as substantial inflation protection. Another way to look at the diversification of real Estate is to explore if diversification for real Estate work better than for stocks and bonds. This question has been asked by Einchholtz (1996), his results indicate that property share returns are less strongly internationally correlated than common stock and bond returns. This implies that international diversification can reduce the risk of indirect real estate portfolios even than it can the of common stock and bond portfolios. The authors also assumed that his results might hold for direct real estate investments since direct real estate returns should have lower correlations.

Diversification is essential not only between asset classes, but also within each asset class. The diversification in a portfolio entirely dedicated to real estate might take the form of a diversification by property-type or by geographical allocation. Ducoulombier (2007) indicates that the investors distinguish diversification by property type and diversification by geography as two primary approaches to diversification. The same authors discover that the variable most commonly recognized by both experienced and novice real estate investors refers clearly to the property's specific qualities (e.g., location, use, size, age, architecture). Other important factors, according to real estate specialists, are tenant creditworthiness and lease terms. Geographic and sector exposures are major risk dimensions, according to practitioners. In our case, property types, geographic and economic regions, scale, and urban versus suburban were among the literature

examined. Hamelink and Hoesli (2004) answered that question for listed real estate securities, they found that country factors dominate property-type regarding diversification benefits. The author employed a constrained cross-sectional regression methodology, which prescribes the extraction of the pure effects e.g., country, property-type and common factors. A recent study on the direct real estate by de Wit (2010) examines whether investing across regions or property types can lead to higher diversification gains. The authors confirmed Hamelink and Hoesli (2004) results, they found that geographic factors still have the biggest influence on the volatility of international real estate security returns. The average variance of regional effects is higher than that of property type effects, implying that regional effects have a greater impact on total portfolio variation. Investing in assets from different regions can have the most diversification advantages due to the greater impact on the portfolio's overall risk. Regional effects, on the other hand, are less stable over time as compared to the variation and correlation of property type effects. Often, when the return is expressed in local currency, the property type effect appears to become a more significant factor for the return.

The literature in diversification of un-securitized real estate is the least discussed. To our knowledge, only two papers have used panel modelisation to quantify the non-listed performance considering diversification. However, these two papers dealt with a different scope i.e., private non-listed funds which structure differs from public non-listed funds as discussed in the introduction.

The first paper by Fuerst and Matysiak (2009), applies INREV[27] panel data for the period 2001-2007 of 301 open-ended funds and 166 closed-ended funds. Their methodology consists of Fixed-effects panel regression to identify the main drivers of non-listed fund performance. They specified a two-way error component model in order the test for fund specific cross-section effects and for periods effects. The results found is that Fund characteristics, specifically fund size, investment style, overall macroeconomic performance and performance of competing asset classes were important factors in accounting for non-listed funds' performance. The second paper by Delfim and Hoesli (2016) includes additionally the global financial crisis (a period of high volatility) which provide helpful

[27] INREV is the European Association for Investors in Non-Listed Real Estate Vehicles. We are Europe's leading platform for sharing knowledge on the non-listed (unlisted) real estate industry. Their goal is to improve transparency, professionalism, and best practice across the sector, making the asset class more accessible and attractive to investors

insights on fund performance characteristics. The authors worked on the period 2001-2014 utilizing panel data from the same provider (INREV) but also data of listed real estate and direct real estate. Unlike the first authors, the method introduced by Delfim and Hoesli (2016) is unbalanced Panel Data with random effects. The estimated models for non-listed fund returns include categorical variables to control for the country and the sector of investment, the investment style as well as the vehicle structure. The results shows that open-end funds faced more limited losses than closed-end funds. Moreover, core funds do better than value-added funds during moderate growth periods such as the recent post-subprime period. It also appears that core funds are less sensitive to other fund characteristics such as gearing. The optimal gearing level should be adapted to the economic situation and depends on the investment style. Regarding the macroeconomics risk factors, a positive influence on fund excess returns was reported for real GDP Growth, money supply growth and stock market returns. Inversely, long-term real interest rates have a negative impact on returns.

A more recent study by Fuerst et al. (2021) raises the question if specialist non-listed funds outperform in a European universe of funds. Their study attempts to ascertain whether specialization resulted in improved financial performance for European non-listed real estate funds. Since funds can either specialize in a specific country or property type, or they can manage a broadly diversified portfolio. After controlling for important performance determinants, their results shows that country specialization and country-sector specialization are associated with greater returns, whereas sector specialization is not. Country and country-sector specialist funds outperformed during the European real estate markets' recovery and growth era, which lasted from 2010 to 2019.

In the light of the reported literature, it is conceivable that the opinions about diversification benefits are not decided. Besides, we are interested to investigate to what extent the specificities of the asset SCPI will play a part in giving us different results from the one found in the literature. By comparing our results from the one’s above, we hope to determine what determine the performance from SCPIs. Is it geographical diversification? Property-type diversification? Alternatively, perhaps both? Our research question has previously never been addressed merely because the access to the data of non-listed funds in general are limited.

3.3 Data and empirical methodologies

3.3.1 Data

The data for non-listed real estate funds is often unreachable for academic research. For this study, we would like to thank REFINE[28] that gave us this privileged access to the SCPIs private database collected by the IEIF Institute. The trends in our dataset suggested that panel models may possibly be adequate to fully account of its potential. Indeed, we have cross-sectional dimension for SCPIs by ID number (sufficiently granular) and satisfactory time dimension. This allow us to track the individual SCPI over time which is way better than working with an index that aggregate the information. The database contains economic and geographic data for 173 SCPIs with an impressive sampling from 1964. Notwithstanding, to conduct a balanced panel modelisation we worked only with 44 SCPIs with full historical period from 1998 to 2018 with various individual characteristics for SCPIs (balance sheet, capitalization, asset types, amount collected, share prices).

The "dvm" as a measure of performance is our dependent variable (cf. Appendix 1). The motives behind choosing this measure rather than a price:

- Yield measure, even the regulator AMF[29] does not recommend using the word yield when measuring the performance of a SCPI. Since SCPIs are after all long-term investments.
- Largely used by practitioners
- Commonly quoted in public communication (commercial/financial brochure)
- Well documented in the IEIF database

[28] Real Estate Finance and Economics Network
[29]

Table 3-1 Description of the data and adjustments made

Variables	Short name	Descriptive	Data processing	Coding instructions
Endogenous	ldvm	Market value distribution rate: the relationship between the income paid to unitholders and the average purchase price of the unit in a given year.	LN(1+(IncomeDistributed/AskPrice))*100	Compound annual growth rate
Main Exogenous	HHI_eco	Herfindahl index for Real Estate type focus	We aggregated the initial typologies (office, medical centers, logistics/industrial, residential, hospitality and leisure, business premises retail, industrial premises, mixed premises, nursing homes) to only five typologies (office, logistics/industrial, retail, residential and others)	[0,1]
	HHI_geo	Herfindahl index for geographical focus	We have four modalities: Paris, Paris region, French Regions and Overseas.	[0,1]
Secondary Exogenous	TOF	Financial Occupancy Rate: Actual rental income divided by the potential rental income that could be received if the portfolio was fully leased and occupied during the period	-	Percentage
	NbShares	number of shares of the capital of the SCPI	-	#
Control	Capitaltype	SCPI with fixed capital (CF) or open-ended (CV)	0 – fixed capital 1 – open-ended	0;1
	prctPhysical	Percentage of physical persons managing the companies	-	Percentage

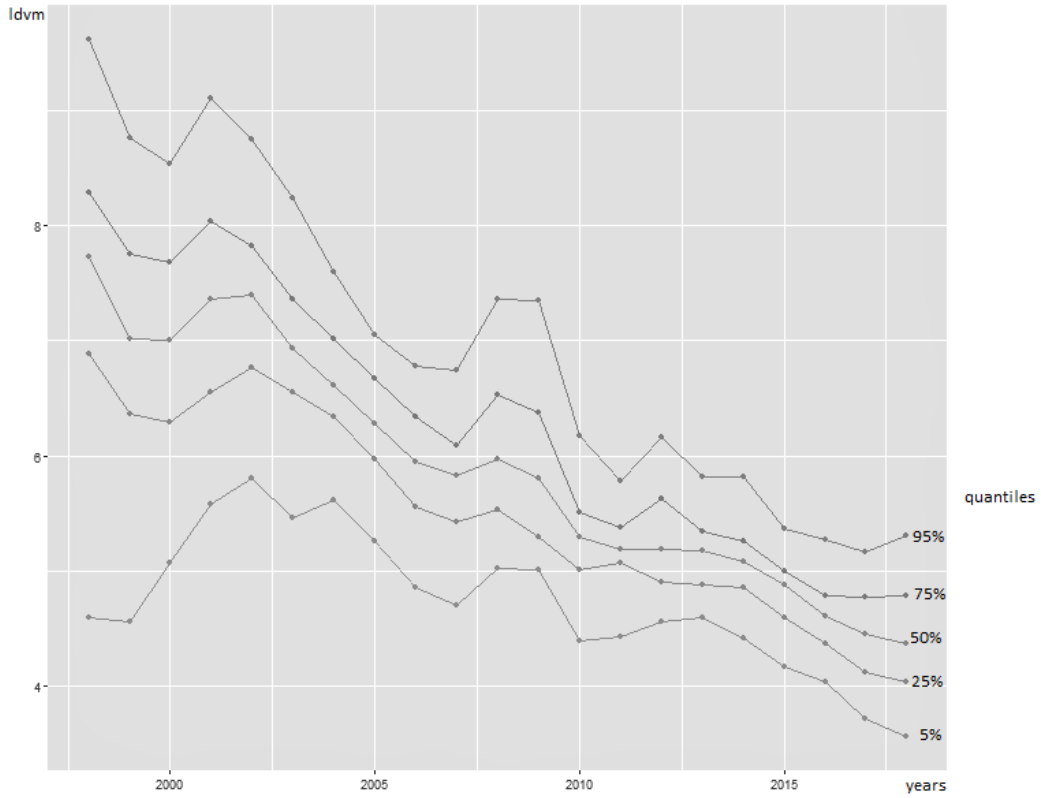

Figure 3:1 DVM evolution by quantiles (1998-2018)

From the figure 1, we observe how the dvm evolves during the observation period moving from 98 to 2018. We can notice very clearly something that real estate practitioners are familiar with, which is the renowned decreasing trend of the dvm over the observation period. Then, in order to avoid averaging and aggregating the trends, we share a subset of the whole sample of these SCPIs. Throughout the distribution, we may get a sense of how this dvm acts at various layers. Then, at the very top, it is the behavior of the top 95% of the SCPIs with the highest dvm, and then, at the very bottom, we have roughly the 5% at the evolution of the dvm for the SCPIs with the lowest dvm. We might also point out that in the first years, we have an upward trend of dvm for the lowest section of 5%.

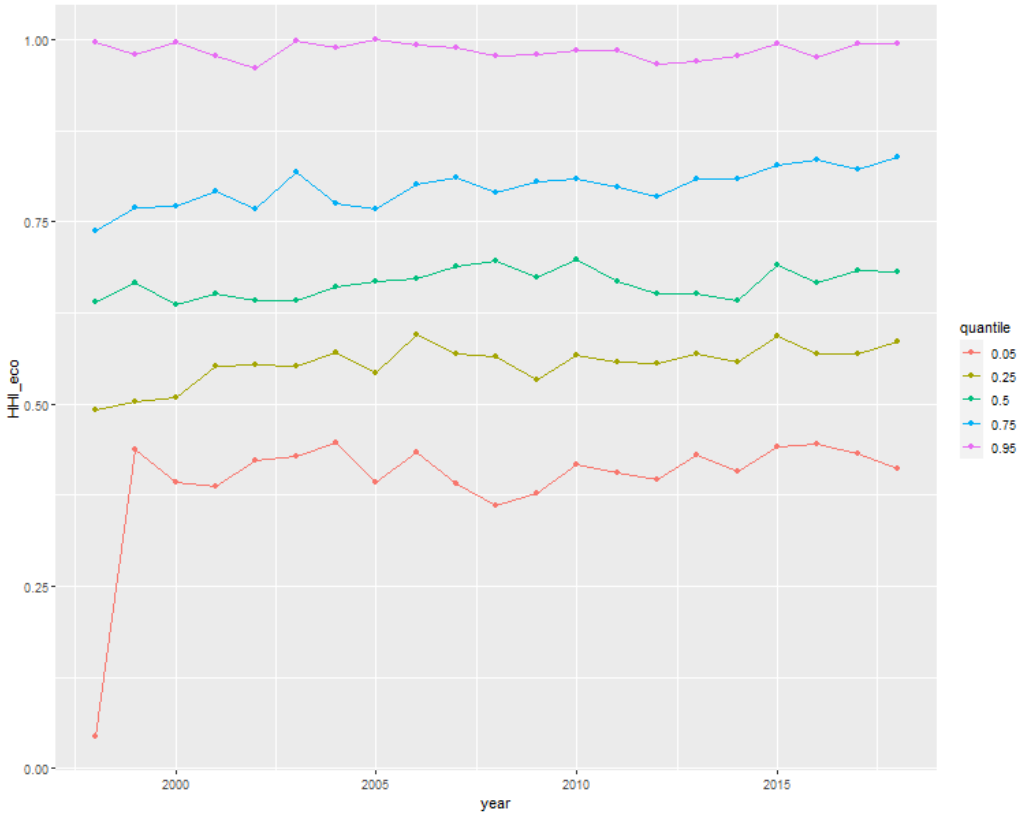

Figure 3:2 Evolution of the level of typological (asset-class) diversification according to several quantiles (1998-2018)

Figure 2 depicts the same quantile breakdown, but this time for the evolution of the level of typological diversification (HHI eco). In other words, how we will be exposed to various types of real estate assets quantile by quantile. As a result, the most concentrated SCPIs are at the top, while the least concentrated are all at the bottom. What is striking and will guide us through the econometric techniques (to be used later) is that when distinguishing the most diverse 5% from the most concentrated 5% at different levels, we can clearly see that the behaviors are significantly different. Above all, the temporal history is relatively smooth, which means that if we apply standard methodologies and econometrics of typical regression models, we will receive incorrect findings because the temporal evolution is relatively smooth. As a result, we already have hints on the methods to be applied later.

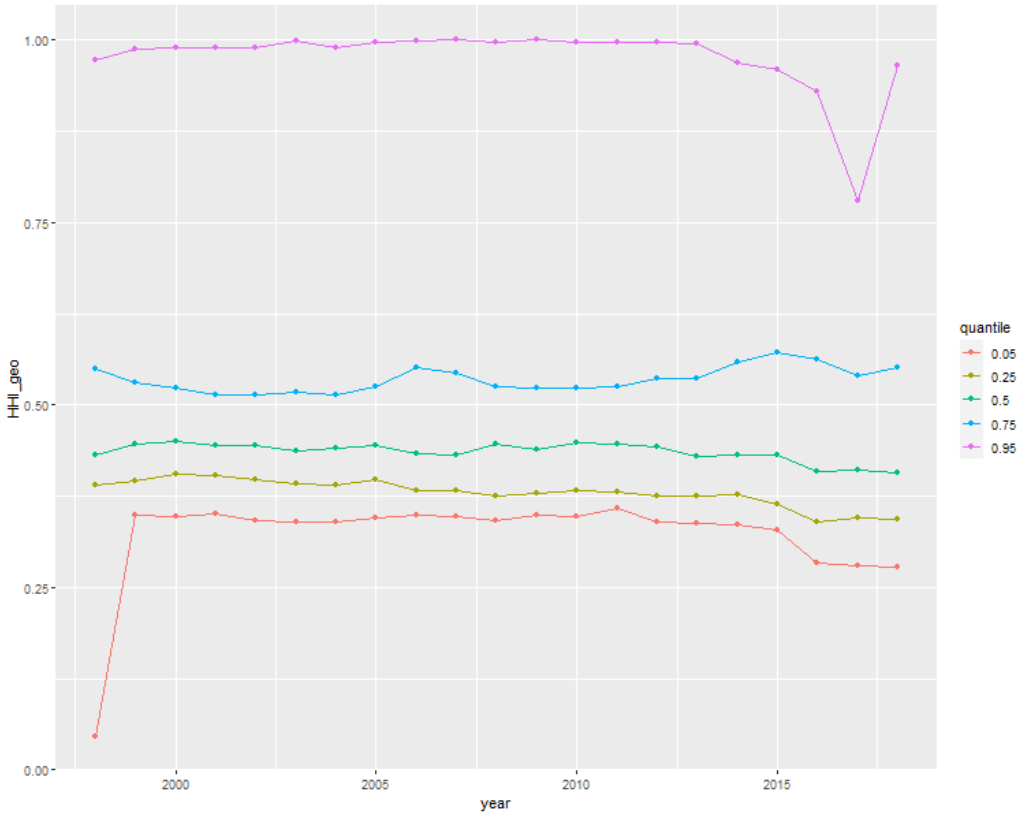

Figure 3:3 Evolution of the level of geographical diversification according to several quantiles (1998-2018)

Figure 3 illustrates rather the geographical diversification. As previously said, the most concentrated SCPIs are the 95% quantile. They remain indeed absolutely concentrated until 2015, suggesting a movement of openness of SCPIs to markets, especially foreign markets, which is done extremely late, and it remains relatively shy. But it is a movement that is developing for the SCPIs that are the most diversified (5% quantile). The movement of openness to diversification is confirmed starting from 2015.What is noticeable here, aside from recent trends, is the very smooth temporal evolution, which plainly disqualifies standard econometric estimation approaches.

For our main exogenous variables, we needed a measure of diversification of the assets held by SCPIs that will suit the structure of our data. The initial data comprises the percentage capital value held by SCPIs by typology and geography across years. Thus, we used something standard in economics, which are the Herfindahl indices that are indices of concentration; we computed Herfindahl indexes to quantify the degree of focus/diversification. Moreover, Herfindahl indexes are very convenient for our research question:

$$HHI_{i,t} = \sum_{j=1}^{n} S_{j,i,t}^2$$

$$0 \leq HHI_{i,t} \leq 1$$

If $HHI_{i,t} \rightarrow 0$: Diversification

If $HHI_{i,t} \rightarrow 1$: Concentration

Then, we have split into two different indicators to track focus and diversification:

-Real Estate type focus (HHI_eco)

-Geographical focus (HHI_geo)

In terms of concentration, we shall focus on two dimensions. The first dimension is the typological concentration, which refers to the asset type to which we are exposed, such as residential, logistics/industrial, office, or retail. The second dimension refers to the location of the assets held by these SCPIs. When we discuss geographic concentration, we ask the following questions: Is my entire portfolio in Paris? Is it rather between Paris and the Ile de France? What percentage do I have in the provinces or even abroad? The objective is to initiate a dialogue and come to nourish the industry in some way through the reflections that we conduct, as well as to collect comments from our readers. We employ Herfindahl indices to take advantage of the normalized value between 0 and 1 or 0 percent and 100 percent. Particularly, we will consider the office share, the trade share, and the residential share from the overall assets.

Table 3-2 Descriptive statistics

Variable	N	Mean	Std. dev.	Min.	25 %	Median	75 %	Max.
dvm	924	6.088	1.345	2.213	5.076	5.860	6.961	11.139
TOF	924	92.515	4.961	65.830	89.335	93.150	96.320	100.000
NbShares	924	937,453.9	1,523,801.8	6,168.0	124,108.2	327,025.0	1,065,365.7	12,752,574.0
prctPhysical	924	82.630	16.233	1.760	73.685	87.010	96.000	100.000
HHI_eco	924	0.676	0.183	0.000	0.555	0.661	0.803	1.000
HHI_geo	924	0.501	0.193	0.000	0.380	0.438	0.536	1.000

Table 2 shows that the concentration indices range from 0 to 1, and that there are differences between geographical diversification (HHI geo) and typology diversification (HHI eco). Indeed, the quantile distributions show that the HHI geo distribution is more centered around 0.5, whereas the HHI eco distribution is right-skewed, with 75% of the sample falling into the category of highly diversified (0.8). The dvm representing the market value distribution rate range between 2% and 11% with a mean of 6%. The dvm used by practitioners has a mean of 4%; the reason our measure differs is that we use the logarithm of compound annual growth. From the table 4, we can read that the minimum TOF financial occupancy rate represents 65%, the mean 92% and the max 100%. These figures reassure us about our sample of 44 SCPIs financial health since all of the SCPIs have the majority of their property rented. At the governance level, physical persons control the majority of the companies, as shown by the mean of 82%. However, we can notice that there are some outliers as shown with the minimum of 1.7% only held by physical persons. Notwithstanding, the trend in the overall sample is in favor of a majority ownership by physical persons. The number of shares (NbShares) that we interpret as volume variables is closely related to our other control variable, Capital type, which is whether the funds are closed-ended or open-ended. Specifically, if the structure of these real estate managing companies (SCPIs) is open-ended, they can change the number of shares without even increasing capital. From the table 4, we can observe that the distributions are heterogeneous since we have small, medium and large SCPIs.

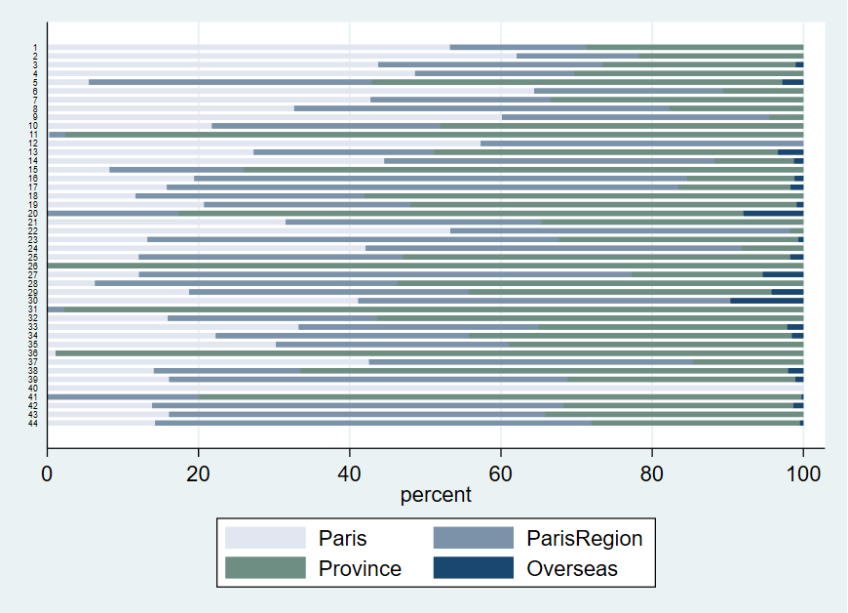

Figure 3:4 Bar plot of the geographical allocation percentage per SPCI (whole period)

Figure 4 shows that 7 SCPIs had an average allocation of more than 50% in Paris, with one SCPI being practically entirely concentrated in Paris. Then, in the Paris region, we have 11 SCPIs with allocations greater than 50%. Regarding the SCPIs that are mostly allocated in French-regions (> 50%), we have 14 SCPIs, 5 of which are highly specialized in French-regions with allocations greater than 80%.

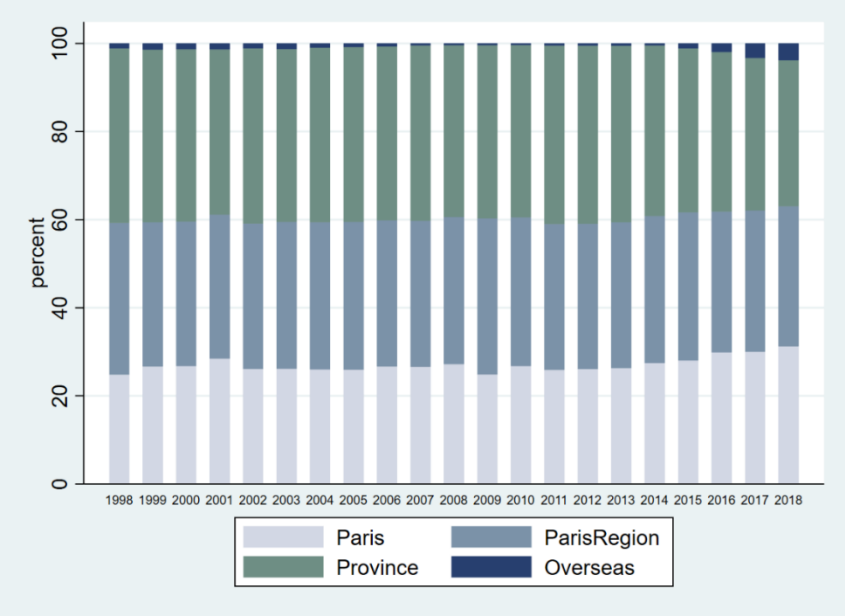

Figure 3:5 Bar plot of the geographical allocation percentage per year (whole sample)

When the entire sample is included (figure 5), the allocations are reasonably balanced between Paris, Paris-region, and French-regions. We can see that the recent trend in Overseas allocation is increasing.



Figure 3:6 Bar plot of the property-type allocation percentage per SPCI (whole period)

Using the entire period once more, but this time for property-type (figure 6). Most of the property-type allocation is for offices, with 27 SCPIs receiving more than 60% of the allocation. The retail sector comes in second, with 13 SCPIs receiving an allocation of more than 60%. This indicates that we are left with only four fully diverse SCPIs.

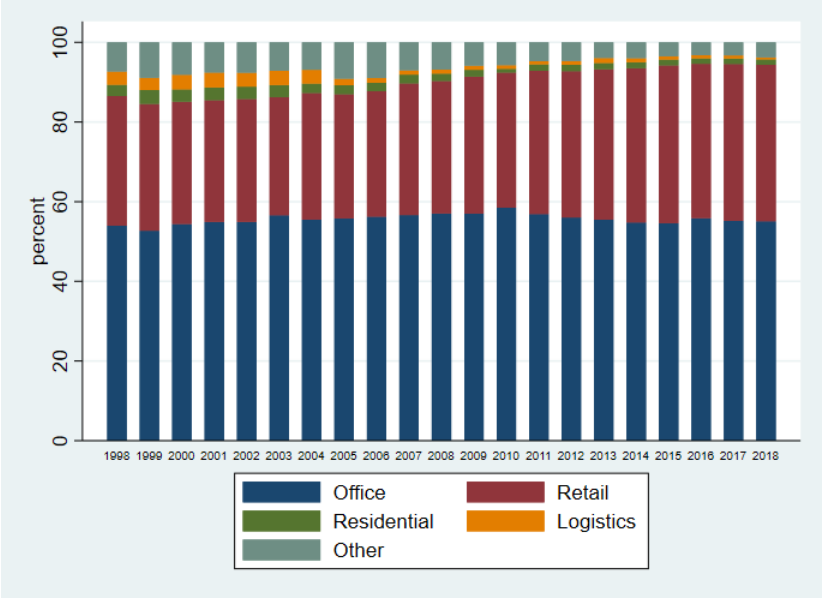

Figure 3:7 Bar plot of the property-type allocation percentage per year (whole sample)

Figure 7 shows that the trend in our sample is toward increased specialization, with office and retail competing for the lead. Based on these figures, we may conclude that we have a sample of 44 SCPIs between 1998 and 2018. We wanted to make sure that we could follow those SCPIs from beginning to end and that our panel was balanced. Second, when we aggregate, as shown in figure 5, the year-to-year fluctuation is not discernible. That is why we wanted to emphasize the temporal effects by combining them with the individual ones. Another example is that we can see an earlier temporal decline year after year on Figure 7 where we have the sectoral distribution of the assets of these SCPIs, from SCPI 1 to SCPI 44. In order to see how the SCPI's asset sectoral distribution may have changed over time. We rapidly realized that favoring one effect over the other might be costly to the econometric modelling.

Prior to the final modeling, we needed to disentangle the relationship between diversification and our performance indicator dvm. To accomplish this, we created a scatterplot to visualize the relationship between the two over the course of the entire period. First, the point cloud did not show an obvious relationship between the two, making it difficult to accept that the trend-line was negative. As a result, we realized that a simple regression will not adequately account for the dimensions of our data. Following that, we replicated the same scatterplot over the beginning (1998), mid-period (2008), and end-period (2018). In terms of typological diversification, we discovered that the behavior is unstable throughout the period, beginning almost non-existent or zero at the beginning of the period, decreasing in the middle of the period, and increasing again at the end. We suddenly realized that if we reasoned over the entire period, the link between typological concentration and dvm performance could not be found. Otherwise, we will be unable to consider regime changes in the evaluation. When it comes to geographical diversification, we have exactly the same problem: at the beginning of the period, the relationship between geographical diversification and dvm appears non-existent; in 2008, we see the birth of a kind of growing relationship linked to a change in management company strategy, and this relationship becomes negative at the end. As a result, we have a form of instability over the entire period; we must evaluate this instability and incorporate it into our methodology.

3.3.2 Empirical methodology

In order to define the relevant model that capture most of our data features we ran specification tests (cf. Appendix 3). Model definition is a crucial step in the process of building a statistical model: it entails picking an appropriate functional form for the model and deciding which variables to include.

3.3.2.1 Standard OLS model

$$Y_{it} = (X_i)'(\beta_i) + \epsilon_{it}$$

$$ldvm_{it} = \begin{pmatrix} Capitaltype_i \\ lTOF_i \\ lprctPhysical_i \\ lnbShares_i \\ HHI_{eco_i} \\ HHI_{geo_i} \end{pmatrix}' \begin{pmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \\ \beta_5 \\ \beta_6 \end{pmatrix} + \epsilon_{it}$$

For $i = 1, \dots, 44$ and $t = 1, \dots, 21$

ϵ_{it}: the error-term

Why a standard OLS is irrelevant for our study case?

The spirit of panel data econometrics is that we do not run a regression for each SCPI. Rather, we consider the panel model to take advantage of the double dimension of the data. Panel data provide us a rich source of information since it is allowing us to benefit from both dimensions of our dataset i.e., individual and time. Indeed, French non-listed investment funds (SCPIs) are moral individual with a managing company investing on the behalf of investors and each SCPI has its own wealth investment strategy. Thus, panel data modelisation offer us the possibility to study the yield differences among those companies in their diversity and dynamic. Moreover, it is offering us the possibility to deal with unobserved heterogeneity. According to Wooldrige (2010), pooled OLS is employed when we are dealing with different sampling in our panel data i.e., unbalanced data. Fixed effects or random effects are used when the same sample of individuals is available. An additional reason for using panel instead of pooling model is motivated by the omitted variables problem. In fact, there is an unobservable random variable that could be correlated with the regressors.

3.3.2.2 Two-way model

The two-way include both individual and time effects

$$Y_{it} = (X_{it})'(\beta_i) + \boldsymbol{\alpha_i} + \boldsymbol{\theta_t} + \epsilon_{it}$$

$$ldvm_{it} = \begin{pmatrix} Capitaltype_{it} \\ lTOF_{it} \\ lprctPhysical_{it} \\ lnbShares_{it} \\ HHI_{eco\,it-1} \\ HHI_{geo\,it-1} \end{pmatrix}' \begin{pmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \\ \beta_5 \\ \beta_6 \end{pmatrix} + \alpha_i + \theta_t + \epsilon_{it}$$

For $i = 1, \dots, 44$ and $t = 1, \dots, 21$

α_i: the individual effect captures effects that are specific to some SCPI but constant over time.

θ_t: the time effect captures effects that are specific to some time period but constant over SCPIs.

ϵ_{it}: the error-term

the unobserved individual effect α_i can be correlated with X_{it}

The resulting estimator is frequently referred to as the "two-way fixed effects" (TWFE) estimator. Including unit fixed effects in a linear regression is equivalent to removing unit-specific time averages and applying pooled ordinary least squares (OLS) to the modified data, as is well known. The fixed-effects controls for all time-invariant differences between SCPIs, so the estimated coefficients of the fixed-effects models cannot be biased because of omitted time-invariant characteristics.

3.4 Results and discussion

The extensive specification tests carried out are in the favor of the fixed effect model (with individual and time effects). Additionally, we conduct other tests such as unit root tests, tests for serial correlation, tests for cross-sectional dependence and heterogeneity tests (all of them turns out to

be negative). Which means, we accept that the SPCIs have different intercept between them and across time. Moreover, we conducted naïve regressions and multicollinearity tests (cf. Appendix 2) that helped us selecting the variables.

Endogeneity is a serious issue when it comes to panel data modelisation, also the sources of this endogeneity can be numerous: omitted variables, measurement errors, simultaneity, and causality. All three first sources were checked in the specification step. In order to guard against causality, we needed to ensure that our exogenous variables (especially the concentration indexes) caused the ldvm to move and not the opposite. That is why, we tested several specifications with lagged variables and quadratic forms to make sure that significance is maintained. Also, to choose the best specification.

3.4.1 The preferred model

Table 3-3 Summary of the estimated results

	Dependent variable:		
	ldvm		
	OLS	panel linear	
	Ordinary least squares dummy variable (1)	one-way individual (2)	**two-ways (3)**
Capitaltype	-0.383***	-0.593***	**-0.290*** **
	(0.079)	(0.140)	**(0.105)**
lTOF	1.813***	6.147***	**1.212****
	(0.137)	(0.657)	**(0.513)**
lnbShares	-0.212***	-0.841***	**-0.093****
	(0.025)	(0.046)	**(0.044)**
lprctPhysical	0.212*	0.191*	**-0.046**
	(0.115)	(0.101)	**(0.075)**
lagHHI_eco	-0.369*	-1.051***	**-0.634****
	(0.204)	(0.347)	**(0.252)**
lagHHI_geo	-0.422**	0.788*	**0.618****
	(0.200)	(0.424)	**(0.309)**
Observations	880	880	**880**
R2	0.967	0.448	**0.032**
Adjusted R2	0.966	0.415	**-0.049**
Residual Std. Error	1.089 (df = 874)		
F Statistic	4,214.885*** (df =6; 874)	112.184*** (df=6; 830)	**4.507*** (df=6; 811)**
Note:			*p<0.1; **p<0.05; ***p<0.01

All the F-statistic are significant which reinforces our variables choice. The adjusted R² of OLS is high but fallacious and for the one-way model with individual effect is convincing with 44%. Whereas the R² for the two-ways model is quite low which is typical when considering both the individual and time effects i.e., within variation (over time) and between variation (across SCPIs). Basically, the residuals are so low which in turn lower the sum of squares of residuals. About the negative sign on the adjusted R² it is because $R^{2}(0.032) < \frac{k-1}{n-1}\ (0.046)$.

For our preferred model (two-ways), All the t-statistics are significant (<0.05) except for lprctPhysical (our control variable) which confirms the significant influence of each variable on ldvm (our dependent variable):

- Capitaltype (CV; CF): having an open-ended SCPI decrease the ldvm by 0.29% on average per SCPI relatively to the reference (closed-ended).
- lTOF: when the financial occupancy rate increases by 1%, the ldvm increase by 1.21% on average per SCPI.
- lnbShares: the size of SCPI behaves like a premium discount against it by lowering the ldvm by 0.09% on average for 1 more share added.
- lagHHI_eco: the more SCPIs specializes in the property-type, the more it decreases the ldvm (-0.63% on average).
- lagHHI_geo: the more SCPIs specializes in the location, the more it increases the ldvm (+0.61% on average).

We were able to account for the individual and time effects thanks to the two-way fixed effect panel modeling. The fact that we have temporal effects that move throughout the entire period (1998-2018) and those effects may not be exactly the same according to each SCPI that we follow. We aim to avoid aggregating because we want to maintain the individual differences that contribute to the heterogeneity in our sample. In a nutshell, we analyzed all of the individual heterogeneity and unobservable factors that influence and interfere with the link between the dvm and the level of diversification.

The first straightforward result shows that sector diversification is rather desirable. In other words, the sector concentration negatively influences the dvm roughly if you increase your level of

specialization by 1% you will have on average a decrease of 0.63%. This finding show that sector diversification is desirable, and we believe that there is some agreement on that among practitioners as well. Conversely, what is more astonishing it is the result regarding the geographical diversification. According to the findings, geographical diversification would have a negative impact on the dvm. Similarly, the idea is that geographical concentration contributes positively to the evolution of the dvm. To be more specific, increasing your geographical concentration by 1% will result in an increase in your dvm of 0.62 percent on average. As a result, geographical diversification is undesirable if we are looking for dvm performance. So, we can clearly see the two effects appearing slightly different, opposite but almost mutually compensating for the fact that asset-type diversification tends to pull the dvm upwards while geographical diversification tends to pull it downwards. Perhaps because geographical diversification is still in its early stages, it tends to weigh on the performance of SCPIs in terms of dvm for the time being.

3.4.2 Simulations using Bootstrap resampling

A simple exercise that we do often to give meaning to these very generic results is to compare profiles of virtual SCPIs and which have needed settings, we will compare the differences in performance in terms of dvm. We used a common technique called bootstrap, where the resampling approach consists of a large number of samples of the same size are drawn repeatedly from our original sample. Our need to operate simulations comes from the need to have a better understanding of the relationship between ldvm and the concentration indexes in scenarios that are more of interest. Therefore, we have chosen to fix the average level of the other covariates and determine HHI_eco and HHI_geo values using bootstrapping technic. We have chosen four profiles: weakly diversified (HHI_eco ≥ 0.9; HHI_geo ≥ 0.9), highly diversified (HHI_eco ≤ 0.1; HHI_geo ≤ 0.1); mix profile 1(HHI_eco ≥ 0.9; HHI_geo ≤ 0.1), mix profile2 (HHI_eco ≤ 0.1; HHI_geo ≥ 0.9).

Table 3-4 Summary of the simulation results

	Realized ldvm	Weakly diversified (spe eco, spe geo)	Highly diversified (div eco, div geo)	Mix profile1 (spe eco, div geo):	**Mix profile2 (div eco, spe geo)**

Model 1: one-way individual lagged HHI's	5.85	5.93 (+8bps)	6.14 (+29bps)	5.30 (-55bps)	6.77 (+92bps)
Model 2: two-ways contemporary HHI's	7.40	7.53 (+13bps)	7.67 (+27bps)	6.74 (-66bps)	8.46 (+106bps)
Model 3: two-ways lagged HHI's (preferred model)	6.91	7.02 **(+11bps)**	7.03 **(+12bps)**	6.52 (-39bps)	7.53 **(+62bps)**

What we can draw from all the panel models is that they agree pretty much on the same simulated profiles but with different scale:

Mix profile1 is a weak management decision worsening the ldvm.

Highly diversified is proven to be better than weakly diversified.

From the table 4, when we choose the setting weakly diversified, where diversification is very low (or concentration is very high) for both geographical and asset-type diversification, and compare it to past performance, we get a concentration premium (or diversification discount) of +11 bps. The second configuration seeks significant diversification, i.e., both sectoral and geographical diversification, given the balance between the two effects it yields to a diversification premium of +12 bps. The last configuration we looked rather for a high sector diversification and a strong geographical specialization; we can affirm that this technique combination will allow us to realize a +62 bps performance surplus. In this context, it demonstrates that, regardless of the period studied, the relationship between diversification and dvm performance is not always the one expected. In terms of sector diversification, we have dvm performance that is more in line with our initial intuition. Geographic diversification, on the other hand, has the opposite effect; the more geographically diverse the SCPI is, all else being equal, the more it will weigh negatively on the dvm. Therefore, from this point of view, geographical specialization consequently appears to be the best strategy.

The first result reached is when we consider all of the individual variability that we observe in countries as well as all of the unobservable elements that are predicted to play and interfere in the link between the dvm and the amount of diversification. We plainly see that sector diversity is preferable, implying that sector concentration has a negative impact on the dvm. This suggests that

increasing the level of specialization in the makeup of a company's portfolio of real estate assets by 1% results in a 0.63 percent loss in yield per unit. The simple conclusion is that sector diversification is desirable. This is an agreement among SCPI practitioners. The most startling result, however, is the one involving regional diversification; geographical diversification, according to the data, would have a detrimental impact on the dvm. Alternatively, the notion is that geographical concentration would improve the performance of the dvm. In other words, increasing your geographical concentration by 1% results in an increase in dvm of 0.62 percent on average. As a result, regional diversification is not desirable if one seeks portfolio success. We can extrapolate from this that the two impacts work in different directions, but practically cancel each other out: typological or sectoral diversification tends to draw the dvm upwards, but geographical diversification, perhaps because it is still a new trend for these companies, generates the opposite effect (and of almost same magnitude). The final and most intriguing configuration is one in which the company in charge of the SCPI seeks a high level of sectoral diversification and geographic specialization. So, we discovered that it is this configuration or strategy that will allow us to extract the performance surplus, which is + 62 bps in this case.

To establish a connection with the literature, the results demonstrated in the regression and simulation does not match exactly the state-of-the-art methods i.e., where geographical diversification is advocated: Hamelink and Hoesli 2004 (listed real estate), de Wit 2010 (direct real estate). In our case, the results are in favour of a mixed profile diversified in the property-type but specialized geographically and the opposite profile lowers the ldvm. Nevertheless, regarding the SCPI structure (Capitaltype) a similar finding was reached by Delfim and Hoesli (2016) where non-listed open-end private funds faced more limited losses than closed-end funds. At a more European scale, Fuerst et al. (2021) found almost similar results as ours, where the funds either country specialized, or country-sector specialized are associated with superior returns while sector specialization is not. For our case, it is true for the geographical specialization, however the best profile is to be diversified in property-type and specialized geographically. In the literature, it is not clear which diversification (property-type or geographical) improves dividend yield or returns. It is vital to emphasize that the current finding of our article applies to French SCPIs from 1998 to 2018. It is unknown to what extent this will be relevant to other forms of non-listed real estate funds with differing exposure (private versus public) and located in different countries. A reasonable explanation for this counter-intuitive outcome of our research, which indicates that it is better for

SCPIs to diversify property-types and concentrate geographically it is mostly related to the productivity. Certainly, labour productivity explains a portion of it, while capital productivity serves as a secondary layer. It should be noted that the companies managing the SCPIs have their strategies relatively orthogonal, but it is necessary to have a common strategy in one dimension: once the SCPI is well localized where the productivity is found. The second stage consists in feeding the dividend yield (dvm) by capital values growth regardless of the property type: residential sector, offices, retail, and logistics.

Conclusion

Diversification is a fundamental concept for all real estate management companies, and it is the only way to maximize the odds of a very prospective yield target. However, the diversification is not always as planned and as anticipated by the fund's managers. The key conclusion that can be reached for all intents and purposes is that the diversification subject when it comes to SCPIs is definitely not uni-dimensional or there is a straightforward answer in a subtle sense.

Broadly interpreted, our findings imply that property type diversification has a significant and beneficial impact on SCPI performance. Geographical diversification, on the other hand, tends to work in the opposite direction, i.e., it has a net negative influence on the market value distribution rate (dvm), which is often rather large. Thus, geographical concentration, all things being equal, is the almost best strategy for SCPIs, which we found extremely significant.

In addition, it should be noted that we are evaluating certain unlisted French funds. First, it is essential to keep in mind that the 44 commercial real estate SCPIs analyzed in our sample are designed for the regular distribution of income or rents in the form of dividends. Overall, SCPI's mission is to gather savings from the general public, which is collective interest. They collect public savings, then use this particular resource to acquire real estate assets. As a resource collector, you are faced with the economic challenge of selecting new real estate assets in such a way that, with each investment flow, you may maintain some sort of commitment to the yield target's stability. Variations in share revaluation mostly account for the discrepancies in overall performance. In fact, we observe that the total return increases according to the degree of share revaluation, although the distribution rate remains rather stable across SCPIs. The total return is the performance that a

SCPI unitholder would realize if he or she decided to systematically reinvest dividends in additional SCPI units. Diversification of asset types appears to be a matter of widespread agreement. However, geographical diversity is typically highly dependent on a range of criteria, such as the type of exposure (direct or indirect), whether the real estate fund is listed or not, and whether it is primarily a private or public fund, among many others.

Our findings add to the growing body of literature illustrating how the value of diversification can vary across assets. Because of the limitations of our sample (only 44 SCPIs) and time frame (1998-2018), we cannot draw firm conclusions about their generalizability. Still, this serves as a solid foundation for further investigation into the optimal mix of property types and locations. Our findings should ideally be reproduced and expanded upon in a future study that factors in the most recent years of recession to see if our findings hold up. Furthermore, another possible continuation of our work can come from the general need to study liquidity shortage of the SCPIs, which is an especially pertinent topic, highlighting how, for these real estate management businesses, diversification is fundamentally a crucial idea and the only way to maximize the prospects for a prospective yield objective.

Appendix 1



Figure 3:8 Panel Data plot

Appendix 2

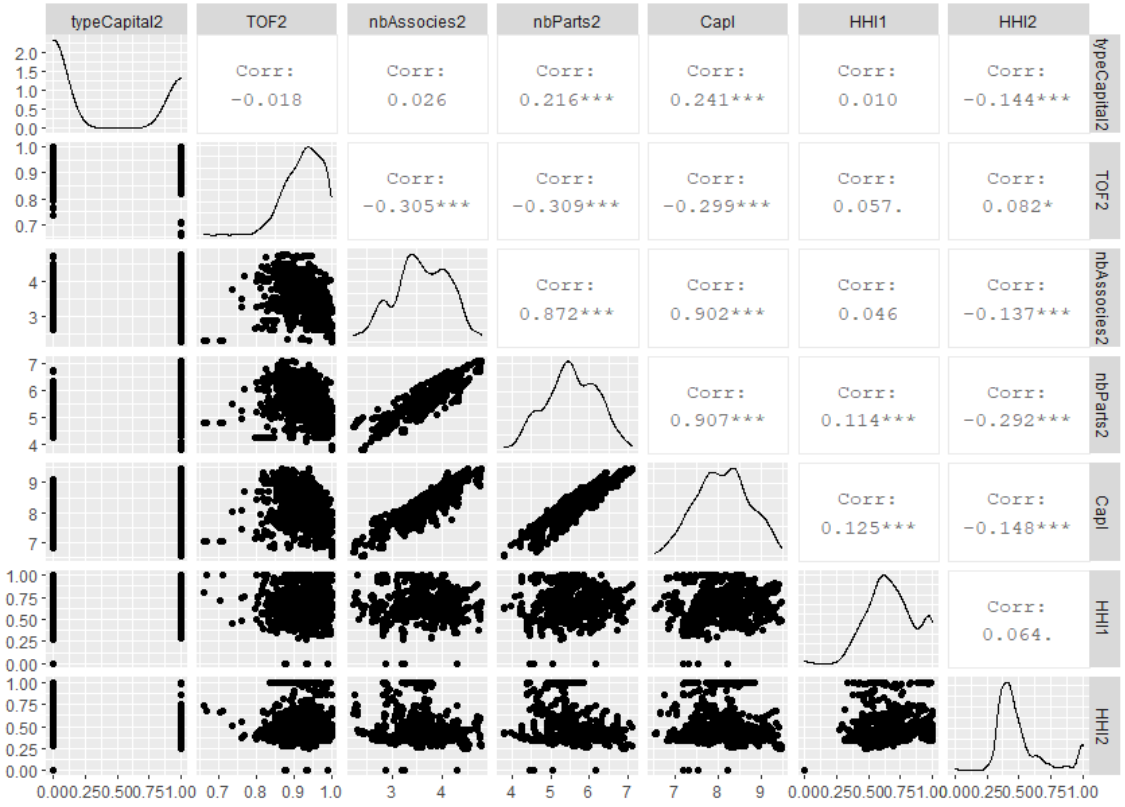

Figure 3:9 Multicollinearity tests

Appendix 3: Specification tests

In order to define our model, we conducted the required specification tests. The following table by Hun Myoung Park (2011) helped us as a guideline to define our panel model:

Table 3-5 Estimation decision tree for selecting the panel model

Fixed effect (F test or Wald test)	Random effect (Breusch-Pagan LM test)	Our model
H0 is not rejected (no fixed effect)	H0 is not rejected (no random effect)	Data are poolable. Pooled OLS
H0 is rejected (fixed effect)	H0 is not rejected (no random effect)	Fixed effect model
H0 is not rejected (no fixed effect)	H0 is rejected (random effect)	Random effect model
H0 is rejected (fixed effect)	H0 is rejected (random effect)	(1) Fixed and random effect model or (2) Choose one of the two depending on the result of Hausman test

3.4.3 Test of poolability

Chow test for poolability asks if the slopes are the same across group or over time (Baltagi, 2001). One simple version of poolability test is an extension of the Chow test (Chow, 1960). The null hypothesis of this Chow test is the slope of a regressor is the same regardless of individual for all k regressors, $H_0: \beta_{ik} = \beta_k$. Remember that slopes remain constant in fixed and random effect models, only intercepts and error variances matter.

The Chow test assumes that individual error variance components follow the normal distribution, $\mu \sim N(0, s^2 I_{nT})$

$$F[(n-1)(k+1), n(T-k-1)] = \frac{(e'e - \Sigma e_i' e_i)/(n-1)(k+1)}{(\Sigma e_i' e_i / n(T-k-1)}$$

Where $e'e$ is the SSE of the pooled OLS and $e_i' e_i$ is the SSE of the pooled OLS for group i. If the null hypothesis is rejected, the panel data are not poolable; each individual has its own slopes for all regressors.

p-value < 0.05, coefficient stability is strongly rejected i.e., individual effects are present in our model. In other words, the slope coefficients differ significantly between individuals.

3.4.4 F Test for Individual and/or Time Effects

A F-test is any statistical test in which the test statistic has an F-distribution under the null hypothesis. We test of individual and/or time effects based on the comparison of the within and the pooling model. The null hypothesis (H0) is the absence of individual effects i.e., pooling model. The F test follows a Fisher-Snedecor distribution with N-1 and NT-K-N+1 degrees of freedom.

-Time effect vs. pooling: p-value < 0.05 then the within estimator with time effect is better than ols

-Individual effect vs. pooling: p-value < 0.05 then the within estimator with individual effect is better than ols

-Two-ways vs. pooling: p-value < 0.05 then the two-ways estimator with individual effect is better than ols

3.4.5 Lagrange Multiplier Test - (Breusch-Pagan)

The Lagrange multiplier test Breusch T, Pagan A (1980) use only the residuals of the pooling model. It is a general principle for testing hypotheses about parameters in a likelihood framework. The hypothesis under test is expressed as one or more constraints on the values of parameters.

The form of the test statistic:

Let $L(\theta)$ be a log-likelihood function of $k \times 1$ parameter vector θ, and let the score function and the information matrix be

$$q(\theta) = \frac{\partial L(\theta)}{\partial(\theta)}$$

$$I(\theta) = -E\left[\frac{\partial^2 L(\theta)}{\partial\theta\partial\theta'}\right]$$

Let $\tilde{\theta}$ be the maximum likelihood estimator (MLE) of θ subject to an $r \times 1$ vector of constraints $h(\theta) = 0$. If we consider the Lagrangian function: $\mathcal{L} = L(\theta) - \lambda' h(\theta)$

Where λ is an $r \times 1$ vector of Lagrange multipliers, the first-order conditions for $\tilde{\theta}$ are:

$$\frac{\partial \mathcal{L}}{\partial \theta} = q(\tilde{\theta}) - H(\tilde{\theta})\tilde{\lambda} = 0$$

$\frac{\partial \mathcal{L}}{\partial \lambda} = h(\tilde{\theta}) = 0$

Where $H(\theta) = \partial h(\theta)'/\partial\, \theta$.

The Lagrange Multiplier test statistic is given by $LM = \tilde{q}'\tilde{I}^{-1}\tilde{q} = \tilde{\lambda}'\tilde{H}'\tilde{I}^{-1}\tilde{H}\tilde{\lambda}$

Where $\tilde{q} = q(\tilde{\theta}), \tilde{I} = I(\tilde{\theta})\ and\ \tilde{H} = H(\tilde{\theta})$. The term $\tilde{q}'\tilde{I}^{-1}\tilde{q}$ is the score form of the statistic, whereas $\tilde{\lambda}'\tilde{H}'\tilde{I}^{-1}\tilde{H}\tilde{\lambda}$ is the Lagrange multiplier form of the static. They correspond to two different interpretations of the same quantity.

Fixed effect (F test or Wald test)	Random effect (Breusch-Pagan LM test)	Our model
H0 is rejected (fixed effect)	H0 is rejected (random effect)	(1) Fixed and random effect model or (2) Choose one of the two depending on the result of Hausman test

Since we are in the following user-case, we will proceed to the Hausman test.

3.4.6 Hausman test (random vs fixed effect)

Hausman test compares the fixed and random effect models. If both fixed and random effects turn out significant, Hausman test gives us a good idea when choosing one between the two. The null hypothesis is that the (fixed or random) effect is not correlated with other regressors (independent variables) H_0: $Cov(\alpha_i, X_{it}) = 0$ if we consider the following regression: $Y_{it} = \beta_0 + \beta_1 X_{it} + \alpha_i + u_{it}$

The test: $W = \frac{(\hat{\beta}^*_{FE} - \hat{\beta}^*_{RE})^2}{Var(\hat{\beta}_{FE}) - Var(\hat{\beta}_{RE})} \overset{H_0}{\sim} \chi^2$

If the null hypothesis is rejected, a random effect model will be suffering from the violation of the Gauss Markov theorem and the estimator $\hat{\beta}_{RE}$ end up biased and inconsistent estimates. By contrast, a fixed effect model remains unbiased and consistent i.e., $\hat{\beta}_{FE}$ is solely consistent

Since the p-value is small, we can reject the null hypothesis, then the fixed effect model is better. But which fixed effect we need to choose?

One-way Individual effect: $y_{it} = \beta' x_{it} + \alpha_i + u_{it}$

One-way Time effect: $y_{it} = \beta' x_{it} + \lambda_t + u_{it}$

Two-ways (Individual and Time effects): $y_{it} = \beta' x_{it} + \alpha_i + \lambda_t + u_{it}$

We used both F test and Lagrange multiplier test to examine time-fixed effects and we found that both p-values are < 0.05 which means we need to include time-fixed effects are needed in our model.

Without doubt that individual effects are also needed as shown by the significancy of the R-squared in this estimation:

Table 3-6 Oneway (individual) effect within model

Oneway (individual) effect Within Model

Balanced Panel: n = 44, T = 21, N = 924

Residuals	Min.	1st Qu.	Median	3rd Qu.	Max.
	-2.957777	-0.537891	-0.075784	0.480828	3.639328
Coefficients:	Estimate	Std. Error	t-value	Pr(>|t|)	Signif.
Capitaltype	0.572554	0.143540	-3.9888	7.196e-05	***
lTOF	5.269833	0.669491	7.8714	1.036e-14	***
lNbShares	-0.904480	0.045534	-19.8640	< 2.2e-16	***
lprctPhysical	0.209283	0.106390	1.9671	0.04948	*
HHI_eco	-1.474964	0.356737	-4.1346	3.898e-05	***
HHI_geo	0.921681	0.435817	2.1148	0.03473	*
Signif. codes	0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' '
Total Sum of Squares:	1325				
Residual Sum of Squares:	727.33				
R-Squared:	**0.45109**				
Adj. R-Squared:	**0.42031**				
F-statistic:,	119.706 on 6 and 874 DF p-value: < 2.22e-1				

References

- De Wit, I., 2010. International Diversification Strategies for Direct Real Estate. J Real Estate Finan Econ 41, 433–457.
- Delfim J-C and Hoesli, M., 2016. Risk factors of European non-listed real estate fund returns, Journal of Property Research, 33:3, 190-213.
- Ducoulombier, F., 2007. EDHEC European Real Estate Investment and Risk Management Survey, EDHEC-Risk Institute.
- Fama, E. and French, K., 2004. The Capital Asset Pricing Model: Theory and Evidence. The Journal of Economic Perspectives, 25-46.
- Fuerst, F. Mansley, N. and Wang, Z., 2021. Do specialist funds outperform? Evidence from European non-listed real estate funds, Research in International Business and Finance, Volume 58.
- Fuerst, F. and Matysiak, G., 2009. Drivers of fund performance: a panel data analysis. Working Papers in Real Estate & Planning. 02/09. Working Paper. University of Reading, Reading. pp35.
- Guedj, B., Martellini, L. and Safaee, S., 2021. Benefits of Open Architecture and Multi-Management in Real Estate Markets - Evidence from French Nonlisted Investment Trusts, the journal of Portfolio Management -Investing in Non-US Fianncial Markets, Volume 47, number 7.
- Hamelink, F. and Hoesli, M., 2004. What Factors Determine International Real Estate Security Returns? Real Estate Economics, 32: 437-462.
- Hartzell, D., Hekman, J. and Miles, M., 1986. Diversification Categories in Investment Real Estate. Real Estate Economics, 14: 230-254.
- Lintner, J., 1965. Security Prices, Risk, And Maximal Gains from Diversification. The Journal of Finance, 587-615.
- Lintner, J., 1965. The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. The Review of Economics and Statistics, 13-37.
- Markowitz, H. M., 1952. Portfolio Selection. Journal of Finance, 77-91.
- Mueller, A.G. and Mueller, G.R., 2003. Public and private real estate in the mixed-asset portfolio, Journal of Real Estate Portfolio Management, 9:3, 193–203.

- Peyton, Martha S. and Lotito F., 2006. “Real Estate: The Classic Diversifying Asset” Real Estate White Paper, TIAA-CREF Asset Management, 2nd Quarter.
- Piet M. A. Eichholtz, 1996. "Does International Diversification Work Better for Real Estate than for Stocks and Bonds?" Financial Analysts Journal 52, no. 1, 56-62.
- Sharpe, W. F., 1964. Capital Asset Prices: A Theory of market equilibrium under conditions of risk. Journal of Finance, 425-442.

Chapter 4: Spillovers of Direct Commercial Real Estate and Monetary Policy Shocks: To what extent are Euro Area Returns Shifting?

4.1 Introduction

In recent years, there has been an increase in the popularity of Logistics Assets as an investment type in European property markets. Investors' interest in logistics real estate investments has risen steeply thanks to globalization, e-commerce, and advances in the logistics supply chain. In parallel to this growing interest and popularity of industrial/logistics real estate among investors as a yield rewarding asset since 2010, the quantitative easing (QE) by central banks took place. This led in particular to the introduction by the ECB of so-called unconventional monetary policies using targeted refinancing operations to boost credit expansion and an asset purchase program (APP) tailored to the euro area's unique circumstances. It is of interest to quantify this effect on the European industrial real estate market.

This research will aim at answering the following questions: Did the new monetary policy's liquidity injection contribute to an additional risk premium by boosting the performance of the industrial/logistics real estate market in euro area countries? How can we assess the transmission mechanisms and judge their effectiveness? What are the candidate channels following the literature? Has liquidity injection transmitted heterogeneously in the short- long-run and across euro area countries?

Our research focuses on the performance of logistics/industrial real estate as a result of the interaction of supply and demand markets. That is why it is important to emphasize the specificities of these two sub-markets. The logistics segment of the real estate industry is distinct from the office or commercial real estate components. The logistics warehouses are often privately owned, and most leased facilities have only one (long-term) tenant. This implies that many countries' industrial plants were directly developed as a result of investment decisions made by businesses in that sector. Simultaneously, the investment in the logistics industry is frequently confronted by changes in the operational environment for occupiers. Some of these changes include demographic shifts, such as the rise of e-commerce, but also urbanization, technical advancement, globalization, ecological causes, and demand evolution. The transport and logistics industry are highly dependent on

economic cycles, booms, and busts, and like any industry must adapt to respond to broader phenomena affecting the economy.

Investors' interest in logistics real estate investments has skyrocketed in recent years, especially due to progress in globalization, e-commerce, and logistics supply chains. These are investments in buildings that play an important role in a company's supply chain and all require distinct sorts of architectural attributes and locations. In recent years, there has been a surge in interest in logistics assets as an investment opportunity in the real estate market. Most European countries are seeing a delay in new developments because of the interruptions caused by pandemic-related lockdowns. If a new development began prior to the crisis and is now underway, it will be completed. However, future developments will be put on standby. Financing new projects will be more challenging if banks tighten their lending requirements. This will have a significant impact on speculative developments in an environment of greater risk aversion. As used space becomes available, supply will increase.

Firms are increasingly likely to make site decisions based on defined operations due to the rise of contract-related logistics. The corporation is no longer wedded to a long-term location but may be able to follow the ever-changing pattern of flows. This means that planning horizons appear to be significantly shorter than before, consisting of no more than three to five years, rather than up to ten years previously. As a result, renting and leasing are becoming increasingly popular among European distribution organizations.

The initial step is to prioritize the shocks and select the ones that are relevant. Our study addresses the following research question: does liquidity injection via monetary policy contribute positively to industrial real estate performance? For this matter, the main shock we are looking at is the one originating from unconventional monetary policy. Then, we will assess the transmission mechanisms and judge their effectiveness. We will examine to what extent the liquidity injection has been transmitted heterogeneously to the logistics real estate sector in the short- long-run and across the euro area. As a result, in the second stage, we will examine several demand shock scenarios.

In our paper, the most important shock to study is the one taking place in the monetary policy. The recent changes with the unconventional monetary policies (QE) have a profound effect on the logistics real estate market. We will also be looking at the demand shocks happening in the occupier

market of the logistics real estate sector. These demand shocks occur when there is a rapid and significant shift in private spending patterns, in the form of consumer expenditure. A slowdown in a major export market of a given economy can have a detrimental impact on corporate investment, particularly in export industries. A decline in stock or property prices can cause a negative demand shock when households respond to a loss of wealth by sharply lowering consumption spending. Food and energy, which have price-inelastic demand, can potentially generate a demand shock by lowering consumers' actual income. Economists sometimes refer to demand-side shocks as "non-technological shocks."

In this article, we will use a vector autoregressive model (VAR), the Global VAR model, that will allow us to include a macroeconomic multidimensionality while also taking into account the previously mentioned shocks of interest. To feed this model, we choose variables that are both specific to each country and area-wide (monetary), as well as those that will allow us to establish cross-country connections via a link matrix consisting of goods and services exports. To the best of our knowledge, we are the first authors to investigate the impact of unconventional monetary policies on industrial/logistics real estate using both price and quantity instruments of monetary policies. Typically, previous authors used monetary aggregates (particularly M2) that underestimate the liquidity distributed as a result of quantitative easing.

The contribution of this article to the literature is threefold: First and foremost, applying the rigorous GVAR methodology to industrial/logistics real estate. Secondly, bringing a vision of expert practitioner in logistics real estate combined with economic analysis. Last but not least, working on a fairly long period from the beginning of 2001 to the end of 2019 will teach us lessons in terms of the effectiveness of monetary policy transmission on a euro area scale in the logistics real estate sector. The contribution and results of this article should be of significant interest for policy makers, industrial real estate practitioners, developers, occupiers and investors.

We intend to contribute to the literature by gaining a deeper understanding of how unconventional monetary policies affect industrial real estate via the logistics and manufacturing sectors. We also want to know how monetary policy changes affect the performance of the European logistics real estate sector. In addition, we want to identify the most important factors impacting the performance of the logistics and industrial real estate markets.

The rest of this paper is structured as follows. The next section will review existing literature. Section 3 will present the methodology and our data set while emphasizing the recent changes in the logistics segment of the real estate sector. Section 4 will review the estimation of the GVAR model while section 5 will examine the effects on the industrial real estate sector of shocks on excess reserves with the European Central Bank along with some specific shocks of interest and spillover effects. Finally, section 5 will conclude.

4.2 State of the Arts

After surveying the relevant empirical literature on the industrial segment of the real estate sector, we will review the literature on the method, which will be used subsequently in this paper, namely the GVAR (Global Vector AutoRegressive) methodology, as implemented previously in a variety of macroeconomic studies and applied to various assets.

4.2.1 Industrial real estate empirics

Empirical work on the industrial real estate sector has followed several directions. Ambrose (1990), in his pioneering hedonic research of industrial real estate pricing, defined industrial property as the land, structural improvements, and equipment associated with a particular property that is used for the conversion of materials into final produced things. Industrial property includes warehouses and various forms of processing units. The author also discovers a clientele impact between the market for industrial property for sale and the market for industrial property for lease. The real estate market, as Itoh (2013) points out, is one in which supply, and demand are unevenly balanced. The supply and demand interact to determine the value of real estate, where the supply factor functions as a proxy for sales pricing and the demand factor acts as a proxy for willingness to pay. The desire to pay and the sales price are not in balance because the real estate market is imperfect. In other words, participants in the logistics real estate market value property attributes differently when buying vs leasing. In fact, most for-sale properties are larger and have less completed office space than the leased ones.

According to Sivitanidou and Sivitanides (1995), amenities for both the company and its personnel can have a considerable impact on industrial property rental rates. Access to raw supplies and an airport, education in the area, crime statistics, and accessibility to commercial districts are all highlighted. All the property-specific factors are statistically significant. They also describe the pricing trend generated by the firm's and employees' choices for amenities.

In their review of the investment supply market, Fehribach, Rutherford, and Eakin (1993) propose a multivariate hedonic pricing models for industrial real estate sales prices that account for physical, financial, locational, and economic variables for each property. They show that a range of factors influence the selling price of industrial real estate. Ceiling height, office space, building size, number of dock-high loading doors, and single tenant occupant are all related to sales price, although airport distance and age are unrelated. Thompson and Tsolacos' (2000) analysis, using data from the United Kingdom, suggests that there are relationships between real rents, construction costs, and industrial building supply.

The key motivations for corporations to locate distribution facilities in specific areas are linked to the following criteria (Dixon 1999): proximity to customers; land costs/competition; availability of skilled labour; strategic transportation access (long-distance/regional); and provision of transportation infrastructure (e.g., intermodal access).

Several authors have focused on the occupier demand market. Hughes (1994) examines the differences in demand factors for industrial compared to office properties, highlighting that taking account only of population changes may not be enough to predict current and future demand for industrial assets. The author discovers that overall population growth is the major factor influencing demand, with other factors such as technological advancements, natural resources, labour, infrastructure, and trade capabilities also playing a role. Rabianski and Black (1997) offer three ways for analyzing industrial space, citing the issues that result from the assumption that demand for industrial space is synonymous with the need for office space. First, they evaluate the need for industrial assets in comparison to office space; second, they forecast demand for manufacturing space; and finally, they forecast demand for business parks. They emphasize that is critical not to disregard regional and national economic performance, overall economic development, and demographic change as demand drivers for industrial space.

Research by Jones et al. (2014) suggests that risk-free interest rates, as well as other macroeconomic risk variables, such as expected inflation and rental growth, can have a beneficial impact on property returns and are incorporated into the rent-to-price ratio. They consider that Inflation reflects the total return over a certain amount of risk. Thompson and Tsolacos (1999) use the double-smoothing strategy to forecast industrial rent changes, which gives older data less weight in the model. They conclude that GDP growth has an impact on industrial rental rates because of increasing demand. Wheaton and Torto (1990) suggest that time to build may produce a temporary inefficiency in industrial property supply and demand. The authors also propose a way to compute the cost of capital in industrial real estate, involving the after-tax cost of capital, the nominal long-term interest rate, the expected inflation rate and the effective tax rate. Ling (1998) shows how to calculate the risk premium that commercial real estate investors receive. His study concludes that interest rate-related variables generate the most risk. He stresses that there is a major risk linked with usage, and that unobservable characteristics and investor preferences are major predictors of real estate returns.

4.2.2 GVAR empirics and the real estate sector

The GVAR (Global Vector AutoRegressive) methodology is a recent approach to global macroeconomic modelling that integrates time series, panel data, and factor analysis approaches to handle a wide range of economic and financial challenges, from policy research to risk management.

While the GVAR model is suitable for policy analysis, its use is far broader. It has been used for credit risk analysis (Pesaran, Schuermann, Treutler, and Weiner (2006), forecasting (Pesaran, Schuermann, and Smith, 2009), and counterfactual analysis, such as evaluating the UK's membership into the Eurozone (Pesaran, Smith and Smith, 2007). The GVAR Handbook by Chudik and Pesaran (2014) provides comprehensive coverage of GVAR applications.

The model was first introduced in Pesaran, Schuermann, and Weiner (2004), who estimate 11 country/region models from 1979Q1 to 1999Q4. In partnership with the European Central Bank, Dees, di Mauro Pesaran, and Smith (2007, DdPS) enhance the GVAR framework in a number of ways. The DdPS version of the GVAR model contains 26 countries/regions (representing 90% of global

output), with the eurozone represented as a single economy, and is estimated from 1979Q1 to 2003Q4.

Regarding monetary policy, Hajek and Horvath (2017), using monthly data from 2001 to 2006, build a global vector autoregressive model to examine the effects of eurozone and US monetary policy stances, as well as eurozone consumer prices, on non-euro EU economic activity and prices. Along with typical macroeconomic variables, their model includes measurements of the shadow monetary policy rate to handle the zero lower bound and the unconventional monetary policy of the European Central Bank and the US Federal Reserve. The authors discover that, while these monetary shocks have the predicted qualitative effects, their amplitude differs between states, with Southeastern EU economies being less affected than Central European countries. Monetary shocks from the Eurozone have a greater impact than those from the United States. Moreover, they find evidence that the effects of unconventional monetary policy measures are smaller than those of conventional monetary policy measures. The spillover effects of eurozone price shocks to non-euro EU members are minor, showing that the law of one price takes time to take effect.

Besides Georgiadis (2015) estimates the propagation of a common eurozone monetary policy shock across individual eurozone economies. To do this, he creates a global VAR model in which all eurozone economies are individually included and their common monetary policy is treated as a function of eurozone aggregate output growth and inflation. The findings show that there are asymmetries in monetary policy transmission among eurozone economies, which are produced by differences in the structural characteristics of the economies, in line with economic theory. Because interest rate sensitive demand accounts for a bigger share of aggregate production in eurozone nations, monetary policy transmission is stronger. Similarly, while the data is unclear, euro-area economies with higher real wages and/or lower unemployment rigidities appear to have larger monetary policy transmission to real activity.

Because the industrial/logistics sectors are heavily reliant on international trade, our research study is closely related to this sector. Two studies used GVAR modeling to analyze international trade. Hiebert and Vansteenkiste (2009) investigate the extent to which exogenous factors, such as greater sectoral trade openness and technological advances for the manufacturing sector, have influenced labour market trends in the US manufacturing sector during the few decades before the Global Financial Crisis. The empirical strategy used is a GVAR approach, which allows for the analysis of the

effects of specific exogenous shocks on the system's endogenous variables (employment, real labour compensation, productivity, and capital stock) in 12 sub-sectors of the U.S. economy, such as on sectoral trade openness, technology (proxied by R&D spending), and the oil price. Impact elasticities show significant intra-sectoral linkages for employment and capital stock formation, but very modest linkages for real compensation and productivity. According to the results of impulse response analysis, technological shocks appear to have a bigger influence on the labour market in the manufacturing sector than trade openness shocks.

The second paper by Bussière et al. (2009), documents that changes in domestic and international demand have a substantially bigger impact on trade flows than changes in relative trade prices. Furthermore, the authors show how the model may be used to track trade developments using the Great Trade Collapse as an example.

Since, we have not come across any study that has been conducted on the industrial/logistics real estate industry (hence the contribution of our work) we choose to review the literature on the residential market because it can provide us with useful insights. Vansteenkiste (2007), studying the regional housing market spillovers in the US, according to the estimated elasticities, found both real housing prices and real income per capita have strong interregional linkages. The examination of generalised impulse functions shows that the relevance of housing price spillovers is state dependent, with shocks occurring in states with lower land supply elasticities having much bigger spillover effects than shocks occurring in other states. Real interest rates appear to have a slight impact, with a 100-basis point increase in the real 10-year government bond yield resulting in a 0.5 to 2.5 percent decline in house values over time. This shows that the recent increase in US property prices is not primarily due to a drop in long-term interest rates. Subsequently Vansteenkiste and Hiebert (2011) studied the same research question for the euro area. Their findings suggest that eurozone residential price spillovers are limited, with evidence of some overshooting in the first 1-3 years following the shock, followed by a long-run aggregate eurozone impact of country-specific real house price changes, related in part to the country's economic weight. In contrast, changes in domestic long-term interest rates create a long-term shift in house prices after about three years. Underlying this aggregate tendency are country-level house price spillovers, with the economic weight in the eurozone playing a substantial influence in determining their overall scale, while geographical closeness appears to play a role as well.

4.3 Methodology and data

In this section, we will first present the GVAR model briefly from an empirical standpoint. The second sub-section will present the specificities of the logistics real estate market and how we selected the relevant data that fits both the GVAR framework and our research question.

4.3.1 GVAR Model

The GVAR model, will be used in this work, allows for the existence of interdependencies between country-level and Pan-European parameters. This will allow us to examine both the effects of common shocks (such as interest rates) on country-level Logistics total returns dynamics and the spillover effects of Logistics total returns in specific countries.

Our subject involves the understanding of liquidity injection by monetary financial institutions (MFIs) on the prime total returns of Industrial Real Estate, as well as of the potential channels through which this liquidity injection is flowing: Employment, Retail Sales, Industrial Production, and Interest Rates.

The standard vector autoregressive (VAR) model ignores the potential effects of economic events on the surrounding area. In other words, an economic shock that occurs in a certain location is expected to affect solely that location's economic conditions. All effects are contained within geographical boundaries, and there is no system in place to represent locational spillovers. The GVAR (Global Vector AutoRegressive) methodology is a new approach to global macroeconomic modelling that integrates time series, panel data, and factor analysis approaches to handle a wide range of economic and financial challenges, from policy research to risk management. The GVAR model, which will be used in this work, allows for the existence of interdependencies between country-level and Pan-European parameters. This allows us to examine both the effects of common shocks (such as interest rates) on country-level Logistics total returns dynamics and the spillover effects of Logistics total returns in specific countries. Indeed, it allows for transparent dependency at several levels (national and international) that can be objectively examined. It takes into account long-run relationships that are consistent with theory and short-run relationships that are

consistent with data. Finally, it provides a coherent, theory-consistent solution to the problem of dimensionality in such high-dimensional systems.

A GVAR model is used to determine the roles of global factors and the spillover effects of country-specific factors on industrial total returns dynamics. Individual country-specific vector error-correcting models are estimated in the GVAR model, in which country-specific weighted variables are related to corresponding country-specific weighted averages of other countries' variables plus global (weakly) exogenous factors (such as the shadow interest rate or excess reserves).

The GVAR model covers three distinct but interconnected transmission channels for the country-specific variables: Channel 1: the impact of common global exogenous variables such as shadow rates on country-specific factors; Channel 2: a country-specific contemporaneous variable x_{it} relying on the weighted average of this corresponding country-specific variable of all other countries x_{it}^* and its lagged values; and Channel 3: The cross-country covariance measures the nonzero contemporaneous dependence of shocks in country i on shocks in country j.

The GVAR modelling framework is built around a collection of distinct VARX* (VAR with exogeneous variables) models that are connected via weighting matrices to form the global VAR model. We begin by introducing a basic VARX* structure. The GVAR modelling technique differentiates itself with a two-phase procedure, which is based on the theoretical framework of Pesaran et al. (2004a). The first phase is to estimate country-specific VAR models, and the second consists of stacking and solving all the computed coefficients of these country-specific VAR models in one system, the GVAR.

4.3.1.1 Step (1) Estimation of the individual VARX models*

For country i, consider the VARX*(2,2) structure in levels:

$$x_{it} = a_{i0} + a_{i1}t + \Phi_{i1}x_{i,t-1} + \Phi_{i2}x_{i,t-2} + \Lambda_{i0}x_{i,t}^* + \Lambda_{i1}x_{i,t-1}^* + \Lambda_{i2}x_{i,t-2}^* + u_{it} \quad (1)$$

With: x_{it}: $k_i \times 1$ vector of domestic variables

x_{it}^*: $k_i^* \times 1$ vector of foreign variables

The number of co-integrating vectors for each country-specific VAR model can be found once the sequence of integration and the number of lags are specified. Then, the error correction form of the VARX*can be developed. Consider the VARX*(2,2) structure:

$$\Delta x_{it} = c_{i0} - \alpha_i \beta_i' \left[z_{i,t-1} - \gamma_i (t-1) \right] + \Lambda_{i0} \Delta x_{i,t}^* + \Gamma_i \Delta z_{i,t-1} + u_{it} \quad (2)$$

$z_{i,t} = (x_{it}', x_{it}^{*\prime})'$

α_i *is a* $k_i \times r_i$ matrix of rank r_i and β_i is a $(k_i + k_i^*) \times r_i$ matrix of rank r_i

Allowing the possibility of cointegration both within x_{it} and between $x_{it}$and $x_{i,t}^*$, and consequently across x_{it} and x_{jt} for $i \neq j$

$$\Delta x_{it} = c_{i0} + \delta_i ECM_{i,t-1} + \Lambda_{i0} \Delta x_{it}^* + \Gamma_i \Delta z_{i,t-1} + u_{it} \quad (3)$$

$ECM_{i,t-1}$: are the error correction terms corresponding to the r_i cointegrating relations of the ith country model

The main assumption underlying the estimation of the individual country VARX* models is the weak exogeneity of x_{it}^* with respect to the long run parameters of the conditional model defined by eq. 2.

The weak exogeneity assumption in the context of cointegrating models implies no long run feedback from x_{it} to x_{it}^*, without necessarily ruling out lagged short run feedback between the two sets of variables. If the country-specific foreign variables were all considered to be endogenous, the model would be so complex that estimation would be impossible (di Mauro and Smith, 2013). In this case, x_{it}^* is said to be long-run forcing for x_{it} which implies that the error correction terms of the individual country VECMX* models do not enter in the marginal model of x_{it}^*.

Then, using the error-correction form of the individual country models (given by eq. 2), the corresponding cointegrating VARX* models are estimated, and the rank of their cointegrating space is calculated. For models with weakly exogenous I(1) regressors, Johansen's trace and maximal eigenvalue statistics, as described in Pesaran, Shin, and Smith (2000), are used to compute the rank of the cointegrating space for each country/region. The trace statistic, which is known to have better power qualities in small samples than the maximal eigenvalue statistic, is used to establish the final rank order decision.

Between step (1) and step (2), numerous and substantial specification tests are executed: selecting weights, determining the order of integration and lag order, identifying the co-integrating relationships, testing weak exogeneity, and testing for structural breaks.

4.3.1.2 Step (2) Solving the GVAR model

In spite of the fact that the estimation is done on a country-by-country basis, the GVAR model is solved in a stacked system (in terms of $k \times 1$ global variable vector, $k = \sum_{i=0}^{N} k_i$), considering that all the variables are endogenous. Reduced rank regression or ordinary least squares (OLS) can be used to estimate country-specific models. Although the reduced rank technique is favoured, because it permits variables to have unit roots and allows for co-integration, country-specific models can also be estimated consistently with OLS. Starting from the individual country-specific $VARX^*(p_i, q_i)$ models and assuming $p_i = q_i$ for a simplified exposition:

$$A_{i0}z_{it} = a_{i0} + a_{i1}t + A_{i1}z_{it-1} + \cdots + A_{ip_i}z_{it-p_i} + u_{it} \quad (9)$$

$$\text{Where: } A_{i0} = \left(\mathrm{I}_{k_i}, -\Lambda_{i0}\right), A_{ij} = \left(\Phi_{ij}, \Lambda_{ij}\right) \text{ for } j = 1, \dots, p_i$$

Next, we use the link matrix W_i, defined by the trade weights w_{ij}, to obtain the identity:

$$z_{it} = W_i x_t$$

Rewriting the (eq. 4), considering the link matrix:

$$A_{i0}W_i x_t = a_{i0} + a_{i1}t + A_{i1}W_i x_{t-1} + \cdots + A_{ip_i}W_i x_{t-p_i} + u_{it} \quad (5)$$

$$\text{for } i = 0,1,2, \dots, N,$$

The last step consists of stacking the individual equations of the country-specific models as follows:

$$G_0 x_t = a_0 + a_1 t + G_1 x_{t-1} + \cdots + G_p x_{t-p} + u_t \quad (6)$$

where:

$$G_0 = \begin{pmatrix} A_{00}W_0 \\ A_{10}W_0 \\ \vdots \\ A_{N0}W_N \end{pmatrix}, G_j = \begin{pmatrix} A_{0j}W_0 \\ A_{1j}W_1 \\ \vdots \\ A_{Nj}W_N \end{pmatrix} \text{ for } j = 1, \dots, p,$$

$$a_0 = \begin{pmatrix} a_{00} \\ a_{10} \\ \vdots \\ a_{N0} \end{pmatrix}, a_1 = \begin{pmatrix} a_{01} \\ a_{11} \\ \vdots \\ a_{N1} \end{pmatrix}, u_t = \begin{pmatrix} u_{0t} \\ u_{1t} \\ \vdots \\ u_{Nt} \end{pmatrix}$$

The GVAR(p) model is obtained by considering G_0 is a $k \times k$ matrix of full rank which allow us to compute the inverse G_0^{-1} in order to find the solution for x_t:

$$x_t = G_0^{-1}a_0 + G_0^{-1}a_1 t + G_0^{-1}G_1 x_{t-1} + \cdots + G_0^{-1}G_{1p}x_{t-p} + G_0^{-1}u_t \quad (7)$$

4.3.2 The logistics sector and the dataset

4.3.2.1 The rise of the logistics sector

According to the 1998 Real Estate Information Standard published by the National Council of Real Estate Investment Fiduciaries (NCREIF), they are five types of industrial/logistics properties: i) Warehouse properties with at least 50,000 square feet, with up to 15% office space, and the balance of the structure having 18- to 30-foot ceiling height; all loading must be dock-height; ii) Manufacturing buildings with 10- to 16-foot ceilings, or sufficient height to accommodate overhead cranes, must provide floor-height and dock-height loading; iii) Office showrooms that are single story (or mezzanine) with 10- to 16-foot ceilings with frontage treatment on one side and dock-height loading or grade level roll-up doors on the other. Less than 15% of these structures may be used as office space; iv) Flex space structures are single-story buildings with 10- to 18-foot ceilings with both floor-height and dock-height loading, including wide variation in office space utilization, ranging from retail and personal service to distribution, light industrial and occasional heavy industrial use; v) Research and development industrial properties are one- and two-story, 10- to 15-foot ceiling heights with up to 50% office/dry lab space (with the remainder in wet lab, workshop, storage, and other support), and with specific dock-height and floor-height loading.

Industrial markets are segmented in two main categories i.e., manufacturing and distribution, and investment returns are better predicted in sub-markets. Several studies have provided a systematic approach to classifying industrial property types. Industrial properties exhibit clustering because of infrastructure, government incentives, and natural cost advantages (e.g., labour, transportation, marketing costs). Thus, economic integration has some advantages in improving this asset class.

In recent years, there has been an increase in the popularity of logistics assets as an investment type in European property markets. Meanwhile, the logistics investment sector and the occupiers of logistics properties have been put to the test by constant changes in their operational environments. These changes include demographic changes, the rise of e-commerce, urbanisation, technological development, globalisation, ecological tends and changing demand. The transportation and logistics industry are heavily reliant on economic cycles, booms, and busts, but it, like other industries, must adapt to respond to larger phenomena affecting the global economy. During the last few decades, the world's motion has been rapid, and the logistics sector has been forced to adapt to the requirements of, for example, the transition from an industrial to an information technology-driven society, accelerating the movement of goods, labour, and capital, globalization, and new ways of consuming.

Today, the industry structure is changing, with large international operators competing on price and/or delivery and a growing number of retailers selling online. Automation is becoming increasingly important in facilities that serve online retailing. The delivery of parcels is complicated, and warehouse occupiers are looking for efficient and cost-effective methods to deliver as many parcels as possible. The need to bring the logistics chain closer to the end consumer is increasing demand for "last mile" logistics, not only for delivery but also for collection. It is possible that more warehousing dedicated to reverse logistics[30] is required. The competition is clearly based on delivery speed rather than price alone. Here, competition is based on labour and transportation.

Some specificities of Logistics real estate include: a relatively risky asset in exchange for a good expectation of return; increased specialization of the sector; the weight of turnkey and proprietary operations; a substantial “non-class A” supply that is difficult to absorb in the occupier market; very

[30] Reverse logistics is a type of supply chain management that moves goods from customers back to the sellers or manufacturers. Once a customer receives a product, processes such as returns, or recycling require reverse logistics

few speculative developments (value-added); market values falling sharply after 2009; historically very stable rents and relatively high rates of return.

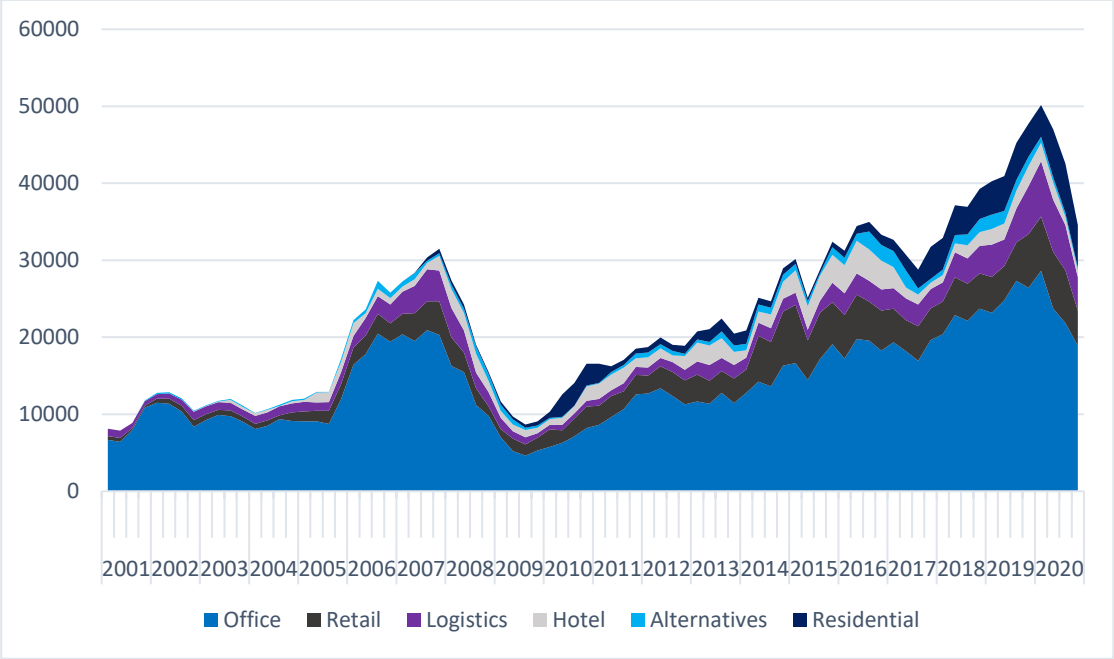

Figure 4:1 Invested Volumes breakdown by Property Type in France. Source: BNP Paribas Real Estate

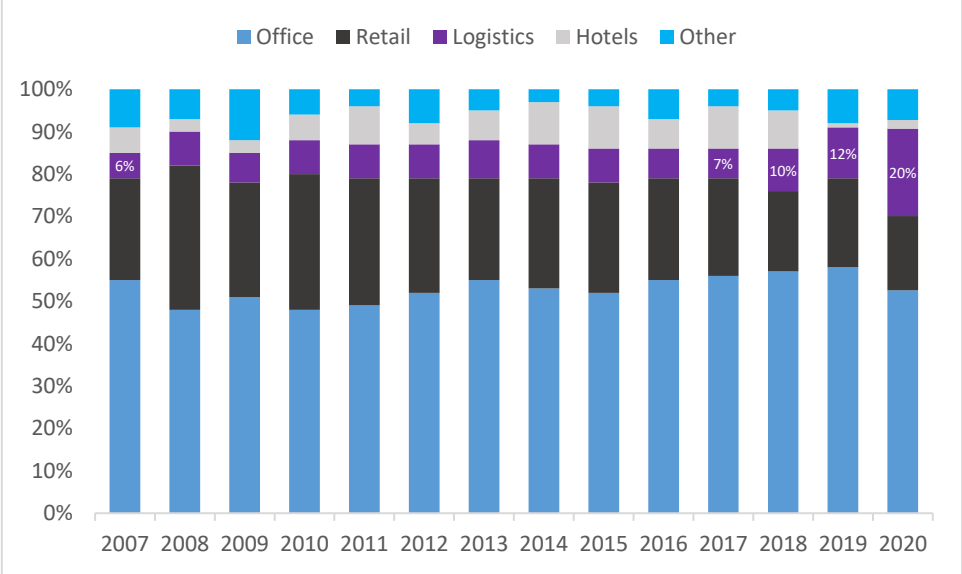

Figure 4:2 Invested Volumes by Property Type in Europe, Residential is excluded.

Figures 1 and 2 depict how, since the end of 2001 and 2007 respectively, the share of logistics real estate in European investor portfolios has increased drastically. The office sector remained stable, whereas the retail sector was the most unpredictable. Historically, industrial real estate was seen

as a high-risk investment sector since buildings often held only one tenant who required specialized infrastructure.

Currently, logistics real estate returns are high, paired with a low risk tolerance. Historically, however, logistics real estate was seen as a dangerous investment class since buildings typically housed only one tenant who required customized facilities.

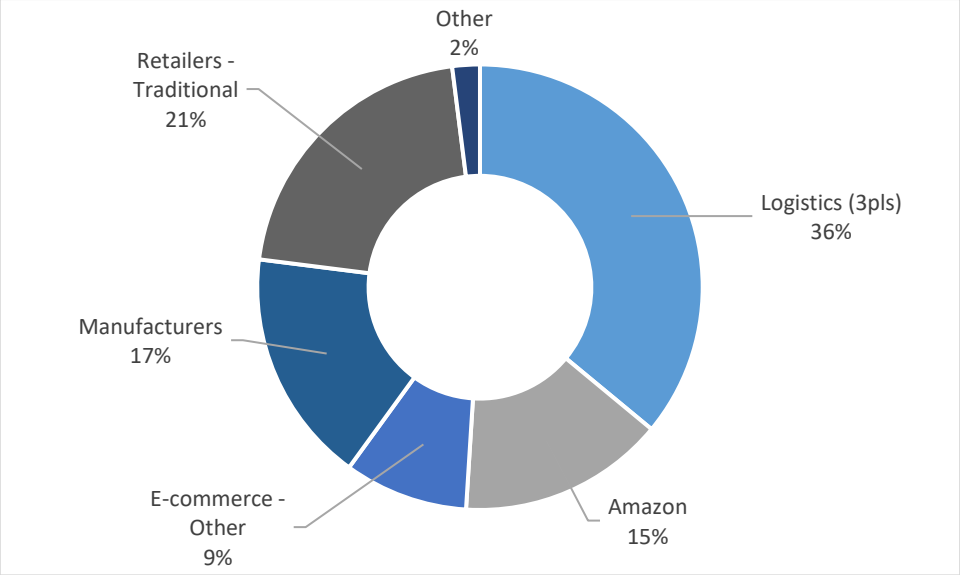

Figure 4:3 Share of take-up (%), 2017, PMA Deals Database - all recorded lettings/occupier sales of > 10,000 sqm in the Eurozone

Industrial firms, wholesale, retail, and core transport distribution companies, as well as logistics service operators, are among the demand side players in the logistics real estate sector. Each occupier type has unique requirements in terms of the purpose of usage, whether for task and contract-related or company-related duties, property attributes, and the length of occupation, which can range from short- to long-term. Price per square foot decreases as building size increases, and demand is strongest for buildings of 25,000 square feet or fewer, regardless of market conditions. Figure 3 above highlights the main occupiers by sector. We witness the rise of e-commerce accounting for 24% of take-up if we include Amazon.

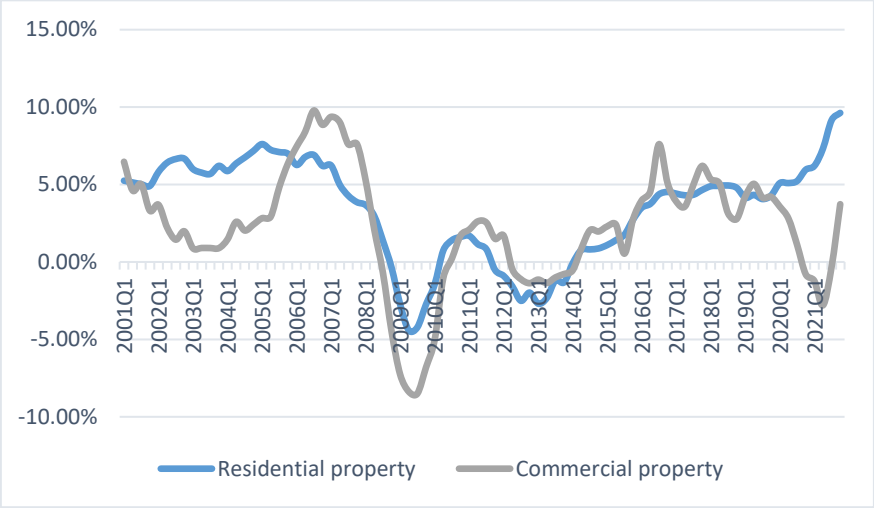

Figure 4:4 Euro area 18 residential and commercial property price developments, year-to-year %-change; Source: Eurostat

As shown in the Figure 4, the non-residential real estate market has seen much stronger price/yield movements than that of residential real estate. The literature on residential Global VAR also confirms this low response; for example, the results of Vansteenkiste and Hiebert (2009) suggest that spillovers of country-specific house prices shocks in the euro area are of a relatively low magnitude.

As show in Figure 5, the logistics sector is the most resilient as yields continue to fall. As a result of central bank monetary policies, government bond yields remained low for a long period of time, while the risk premium remained high. This combination drove higher demand for logistics services as the effective cost of capital remained negative. As a result, the logistics sector remained one of the most attractive industries for potential investors. The logistics real estate sector was the most resilient during downturns, as demand remained high despite the weak economic conditions. As the economic outlook improve, we expect the industry to continue growing as companies seek to expand their global supply chains to reduce operating costs and boost efficiency.

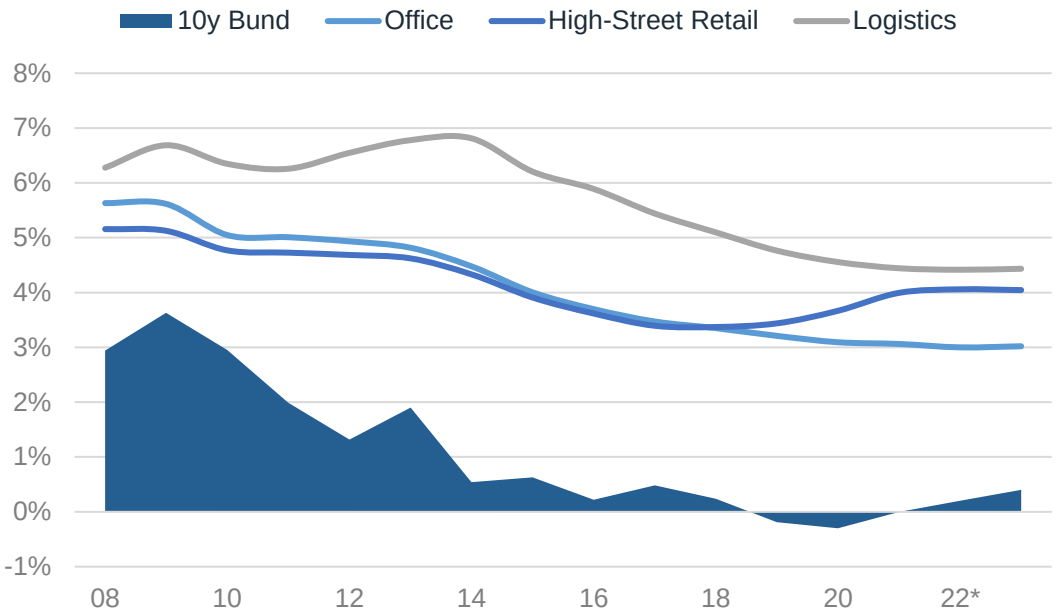

Figure 4:5 Average Prime Yields in Europe, source: BNP Paribas Real Estate

4.3.2.2 The dataset

For all the variables, quarterly data is used covering the period from 2001Q4 to 2019Q4, collected from various sources. The industrial real estate data is used as the endogenous variable, the macroeconomic data comes from national sources and international institutions. Then we completed this dataset with global monetary policy data from ECB. Our choice of sample consists solely of Euro area countries. This choice is motivated by the fact that we want to avoid the volatility induced by the exchange rate. Specifically, we are studying the effect of monetary liquidity injection by the ECB on the euro-area industrial real estate markets. Naturally, this liquidity flows also to neighbouring countries, but our study focuses only on the first countries concerned: Belgium, Finland, France, Germany, Ireland, the Netherlands, Portugal and Spain.

In the light of the literature review in Section 2, the following main series of variables should be included in our empirical analysis: namely, monetary policy related variables, international trade, and industrial/logistics real estate market specific variables (investment supply and occupier demand). This helps us choose tailor-made variables to capture the industrial sector specificities more thoroughly. First, rather than GDP, as used by Thompson and Tsolacos (1999), we opt instead for a more precise measure which is the gross value-added of warehouse-using industries as sector-

specific variable. Second, as many authors point out the importance of the interest rate either as the return on the risk-free asset or as representing the cost of capital, we are using both the nominal short-term rate (2 year) and the long-term interest rate (10 year) as macro variables. Third, the inflation rate is also considered because it impacts the consumer side and by ricochet the retailers (thus asset price). That is why, we also include the consumer price index (CPI) among the variables since inflation is important to deflate the variables but not considered a main variable. Fourth, since, we do not have data for labour cost, we rather use the employment in the industries using warehouses. Finally, for monetary policy transmission, we decided to account for both the quantity of this massive liquidity injection led by the ECB during unconventional measures but also for its price. For monetary quantity we choose the excess reserves of the commercial banks. The central bank reduces the money supply by boosting the IOER (interest on excess reserves). The central bank can cut the IOER rate to conduct expansionary monetary policy. This will cause commercial banks to reduce their excess reserves. This rise in excess reserves also comes from the asset purchases by the ECB in exchange for newly created reserves.

Our main variable accounting for Industrial/Logistics Real Estate performance is the total rate of return, using data provided by PMA[31], and computed as follows:

$$TR_t = \left(\frac{CV_t - CV_{t-1} - CExp_t + CRpt_t}{CV_{t-1} + CExp_t}\right) * 100 + \left(\frac{NI_t}{CV_{t-1} + CExp_t}\right) * 100$$

where:

TR_t is the total return in quarter t

CV_t is the capital value at the end of quarter t

$CExp_t$ is the total capital expenditure (includes purchases and developments) in quarter t

$CRpt_t$ is the total capital receipts (includes sales) in quarter t

NI_t is the rent receivable during quarter t, net of property management costs, ground rent and other irrecoverable expenditure.

[31] Established in 1981, PMA has an unrivalled track record in property forecasting, and remains one of very few truly independent research houses globally.

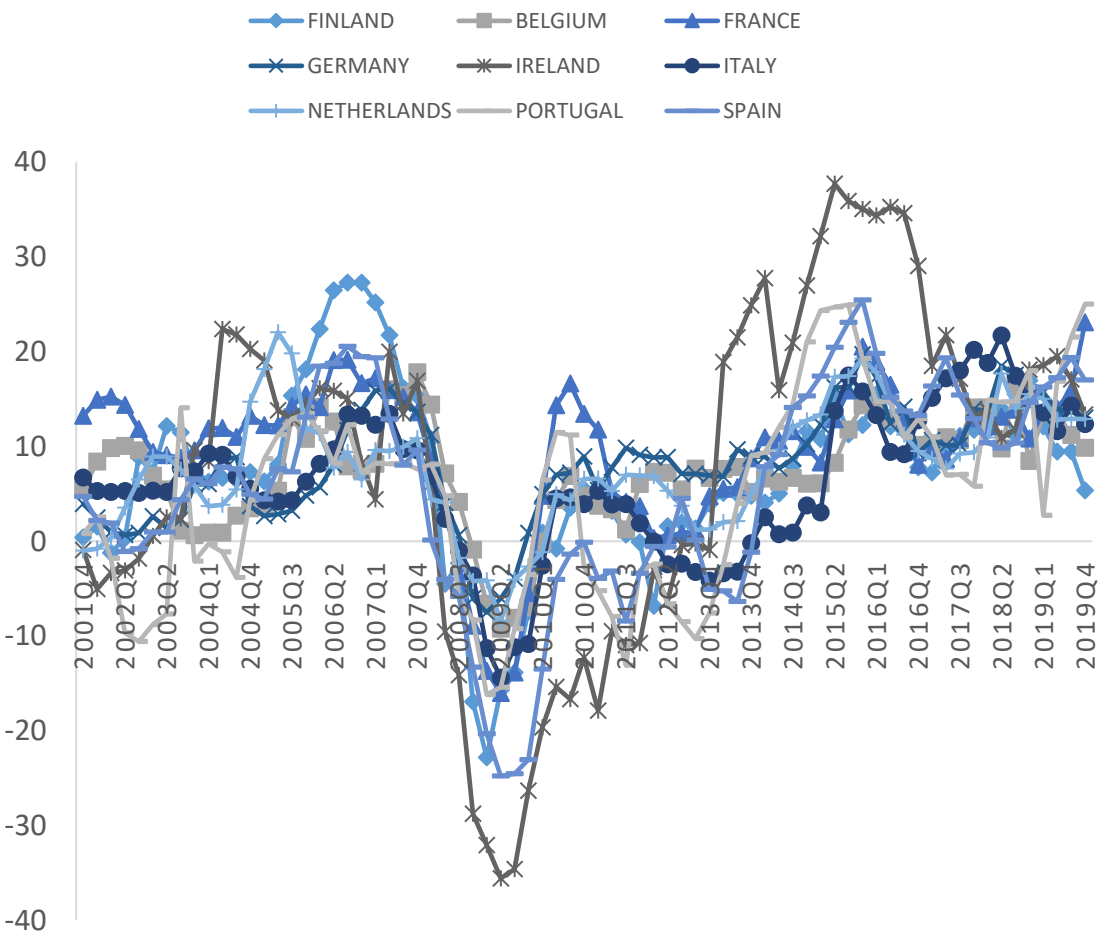

Figure 4:6 Industrial Real Estate Total Rate of Return Seasonally Adjusted using Census X-13

Table 4-1 Reduced model* (monetary policy price and quantity). (*) In terms of dimensionality, the model has been simplified (less variables)

	Domestic Variables (5 variables)				**Foreign Variables (3 variables)**		**Global Variable (2 variables)**	
Total Return	Employment	Nominal S Rate	Nominal L Rate	GVA Warehouse	Total Return	GVA Warehouse	Shadow Rate	Excess Reserves

We will estimate 2 reduced models with alternative global variables: Model 1 with Excess Reserves of commercial banks with the central bank; and Model 2 with the Shadow Rate.

We summarize in Table 1 the data utilized in our GVAR model. The detailed version of the dataset can be found in the appendix containing the definition of the variables, the sources used to collect

the data and the adjustments made. Domestic variables and country-specific foreign variables are included in country-specific VAR models. These extraneous variables frequently contain (i) global common observable components and (ii) domestic variable analogues. These counterparts are weighted averages of the domestic variables of the nations included in the model, allowing for interactions between the different countries' variables. National variables' counterparts also serve as proxies for common unobserved elements like technological change (di Mauro and Smith, 2013).

Preliminary estimates revealed that too many parameters needed to be estimated. As a result, the robustness of such estimates was questionable. Thus, we chose to reduce the number of variables. To shrink our model for that purpose, we must first identify the key variables. This assignment, however, is rather difficult because each of the chosen variables explains an important segment of the performance of industrial real estate. We thus arranged the variables in order of priority and substitutes, although the substitutes variables are rather complementary: industrial production, retail sales and GVA warehouse using industries. The industrial production variable informs us about the output of the light and heavy industries operating in the warehouses. In addition, this variable is cyclically sensitive and has a potential of showing us some declines per country. Retail sales, on the other hand, contain all information about private consumption in goods. Thereby, it will also gather the performance of a specific type of warehouses e.g., storage, food distribution market or e-commerce. The Gross Value of warehouse-using Industries is our preferred selection because it includes the total percentage of GDP generated by warehouses. We would choose industrial production above retail sales.

4.3.2.3 Construction of weights

The main weight matrix, computed using trade flows, is used to build the foreign country data within the framework of GVAR model. We choose to use time-varying weights to account for trade activities' changes. For the estimation of the GVAR we selected fixed weights from 2012 to 2015. Besides, we also used real estate market size for constructing aggregation weights used for feedback variables that enter the dominant unit.

4.4 Estimation of the GVAR Model

4.4.1 Specification and Estimation of the Country-Specific Models

Following the construction of the foreign variables, the next step is to determine the order of integration of both the domestic and foreign variables in order to ensure the time-series data is non-stationary. Since we are working with a cointegrated structure, our aim is to work with a linear combination of non-stationary variables that is stationary. The Augmented Dickey-Fuller and Johansen tests can be used to look for unit roots and test for cointegration respectively. When variables have the same order of integration, a co-integrating relationship can exist. The Augmented Dickey-Fuller test told us that most variables are non-stationary in levels for a critical value of 5%, with the exception of a few cases that are stationary but non-stationary for a critical value of 10%. In contrast, most variables are stationary in first and second order differences. These findings support our decision to use level variables because we need non-stationary variables to work in a cointegrating environment. Then, the Johansen cointegration test, under the null hypothesis of no cointegrating equation, was run on the variables' level form. Because the results support a long-run relationship, we can proceed to estimate the VECM.

The main assumption underlying the estimation of the individual country VARX* models is the weak exogeneity of x_{it}^{*} with respect to the long run parameters of the conditional model defined by eq. 2. The weak exogeneity assumption in the context of cointegrating models implies no long run feedback from x_{it} to x_{it}^{*}, without necessarily ruling out lagged short run feedback between the two sets of variables. In this case, x_{it}^{*} is said to be long-run forcing for x_{it} which implies that the error correction terms of the individual country VECMX* models do not enter in the marginal model of x_{it}^{*}. The results indicate that all variables are weakly exogeneous at a 5% significance level, indicating that these variables have a one-way long-term impact on other variables in the model, that is, they are not influenced long-term by other variables.

4.4.2 Contemporaneous Effects of Foreign Variables on their Domestic Counterparts

The contemporaneous effects are relatively straightforward to interpret. The effects of a shock in one explanatory variable on one of the domestic counterparts can be read directly from the

parameter value. For the residual serial correlation test consider the l(th) equation of the estimated i(th) country error correction model given by:

$$x_{it,l} = \hat{\mu}_{il} + \sum_{j=1}^{\hat{r}_i} \hat{\gamma}_{ij,l} \widehat{ECM}_{ij,t-1} + \sum_{n=1}^{\hat{p}_i - 1} \hat{\varphi}'_{in,l} \Delta x_{i,t-n} + \sum_{s=1}^{\hat{q}_i - 1} \hat{\vartheta}'_{is,l} \Delta x^*_{i,t-s} + e_{it,l} \quad (8)$$

Table 4-2 Contemporaneous effect of foreign variables on domestic counterparts can be interpreted as impact elasticities between domestic and foreign variables. T-ratios are computed using Newey-West's Adjusted standard errors. Non-significant values are denoted

	Model 1		Model 2	
	tr-tr*	gva-gva*	tr-tr*	gva-gva*
Belgium	0.49	0.34	0.54	0.30
Finland	0.61	1.93	0.63	1.99
France	1.02	0.55	1.03	0.56
Germany	0.36	1.18	0.36	1.12
Ireland	1.41	-2.09†	1.39	-1.69†
Italy	0.61	0.93	0.64	0.93
Netherlands	0.19	1.14	0.19	1.02
Portugal	0.85	0.82	0.76	0.80
Spain	0.97	0.60	0.98	0.55

These contemporaneous effects are given by the estimated coefficients on the contemporaneous foreign specific variables and can be interpreted as impact elasticities between domestic and foreign variables. They are particularly informative as regards the international linkages between the domestic and foreign variables. High elasticities between these variables imply strong co-movements between the two. Consider the l(th) equation of the estimated i(th) country error correction model given by (eq 4). The White and Newey-West adjusted variance estimates of the individual VECMX* regressors collected are then computed. From table 2, Models 1 and 2 have contemporaneous effects of the same magnitude between the foreign and domestic variables. The spillovers effect on the total rate return is the highest in Ireland followed by France and Spain. The GVA spillover is the highest for Finland, Germany, and Netherlands.

4.5 Dynamic Analysis Using Generalized Impulse Response Functions and Generalized Forecast Error Variance Decomposition (GIRF/OIRF)

The GVAR model provides us with a wide range of options for analysing global dynamics in the industrial/logistics real estate sector, as well as their interactions with the monetary market and sectoral output. The time profile of the impacts of variable-specific shocks or identifiable area-wide (global) shocks (such as monetary policy in our case) on the future states of a dynamical system and hence on all variables in the model is referred to as impulse responses. The impulse responses of shocks to specific variables considered for the GVAR model are generalized impulse response functions (GIRFs), the results of which do not depend on the ordering of variables; such GIRFs were presented in Koop, Pesaran, and Potter (1996) and applied to VAR models in Pesaran and Shin (1998). Moreover, for some of the impulse responses the bootstrap data can be generated using an inverse resampling of the residuals. This approach, after recentring the residuals by the population mean zero, uses the inverse of Cholesky factor associated with the Cholesky decomposition of the sample covariance matrix.

Economic shocks are considered to investigate the influence of the factors of interest on one another. According to real business cycle theory, economic shocks have long-term effects on the economy and are the primary cause of recessions and economic cycles (RBC). Economic shocks are defined as any change in fundamental macroeconomic variables or relationships that has a significant impact on macroeconomic outcomes and economic performance measures such as unemployment, consumption, and inflation. Shocks are frequently unpredictable and are usually the result of events that are considered to be outside the scope of normal economic activity. Four categories of shocks can be considered. First, we can classify them as either supply or demand shocks. Second, they can also be classified according to their origin or impact on a particular sector of the economy. Third, shocks can be classified as real or nominal, depending on whether they are caused by changes in real economic activity or changes in the nominal values of financial variables. Furthermore, they can be classified according to their origin or impact on a specific sector of the economy. Because the economic spheres and sectors are interconnected, major supply or demand shocks in any sector of the economy can have far-reaching macroeconomic consequences.

We will concentrate on occupier demand shocks, investment supply and monetary policy shocks in our study.

4.5.1 Global Shocks

In commercial property projections, the spread between the logistics real estate yield and the 10Y German Government Bond yield, as a risk-free return, (figure 5) is often used by practitioners as a measure of the risk premium. High spreads imply that there is space for cap rate compression and property price appreciation, whilst low spreads pose the risk of expanding cap rates and declining property prices. Using impulse response functions, we want to explain these fluctuations in risk premiums. Our starting point will be the total return as a measure for the yield. We are considering first a global shock on the price of money (Shadow Rate) followed by a second global shock on the quantity of money (ECB Excess Reserves). The first and most significant shock to be examined in our article will be the one caused by a global, i.e. area-wide, variable of monetary policy, Excess Reserves, focusing on its impact on the performance of industrial/logistics real estate assessed by the Total Rate of Return. Then, we will further explore the propagation of the global shock with the help of the demand drivers of the total rate of return, namely: short-term and long-term interest rates, GVA warehouse-using industries, and Employment in the warehouse using industries.

4.5.1.1 Global Shock on Shadow Rate

The first thing to notice about the shape of the GIRF after shocking one standard deviation the Shadow Rate of Wu and Xia (2017,2020) is the smooth response of the total Rate of Return. The reason for this particular shape is that the monetary policy stimulus via interest rises has a more continuous smoother effect than the amount of money that arrives in quantity. From figure 13, the immediate response is positive for almost all countries (except for the Netherlands), with Ireland registering an increase of 1.20% of its total return as the highest response in our sample, followed by Belgium, and Spain (0.40%); Portugal has the lowest response. For some countries, the short-term response (4 quarters) is marked by a quick decline into negative territory. On the other hand, the Netherlands sees an increase in its total return in the short run. The medium-term change in

total returns towards zero indicates a lack of sensitivity in our impulse responses. Then, in the long run, there is convergence, and the impulse response vanishes over time.

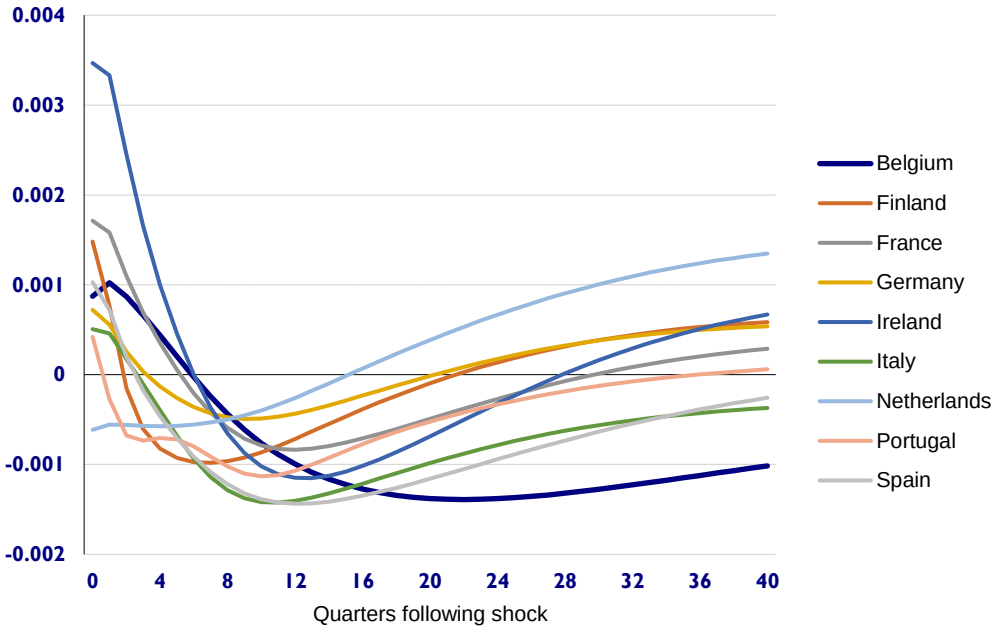

Figure 4:7 Generalized Impulse Responses of a Positive Unit (+1σ) Shock to Wu Xia shadow policy rate on Total Rate of Return by country.

4.5.1.2 Global Shock on the ECB Excess Reserves

Figure 8 depicts the effects of ECB Excess Reserves shocks on the total Rate of Returns in our sample countries. The first reassuring discovery is that the initial response in all but one country. The Netherlands feature opposite results, and one likely explanation is that the country is considered a logistical hub, with the port of Rotterdam being Europe's busiest and largest seaport. To elaborate, the industrial/logistics real estate sector in the Netherlands with this substantial trade activity is saturated, resulting in a 0.10 percent loss in total return, which means that the industrial/logistics real estate sector of the Netherlands is counter-cyclical compared to the other European markets.

We can also take note of the most important increases on impact in the total rate of return: Ireland, Italy, Portugal, and Spain (+0.80%), in increasing order, followed by Belgium, Finland, and France (+0.40%). Germany, being the biggest industrial country in our panel, features only a small increase (+0.10%) which corresponds (in absolute value) to the same magnitude as in the Netherlands. Then,

in the short-term (after 1 year), we have a decline towards 0 for all countries and an increase towards 0 for the Netherlands. This convergence towards 0 represents a return to the level before the shock. In the medium-term (1 to 2 years) we observe a positive increase, followed by a stabilization for all the markets. Then, in the medium-term (2 to 3 years) a decrease marks the end of the stimulative effects of the rise in the quantity of money. We can also notice that the response among the following two groups of countries has a similar shape: France, Belgium and Germany on the one side, and Spain, Portugal and Italy on the other.

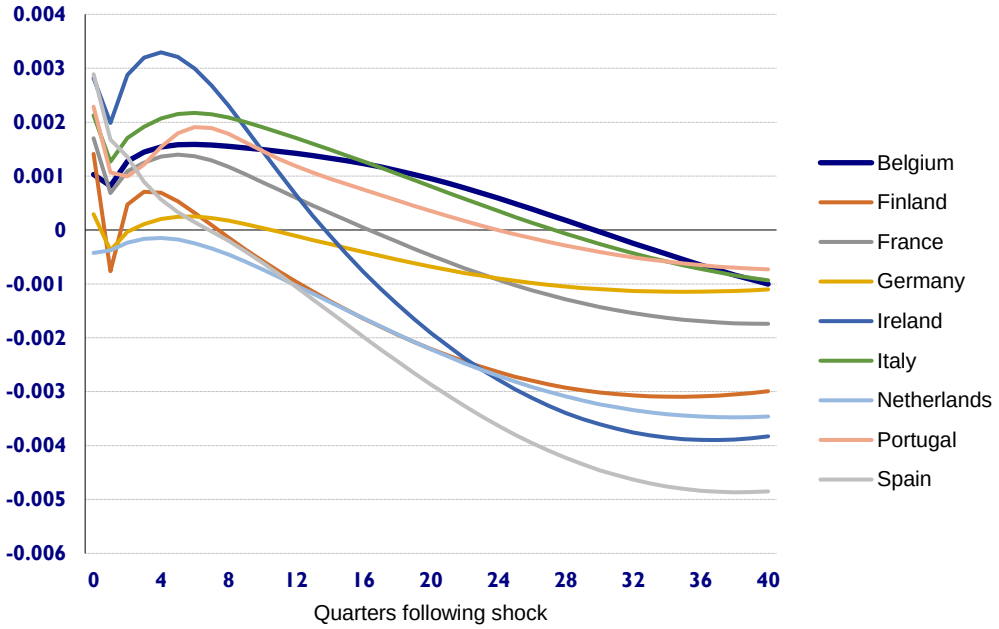

Figure 4:8 Generalized Impulse Responses of a Positive Unit (+1σ) Shock to Global Variable (ECB Excess Reserves) on Total Rate of Return by country.

Response of the short-term interest rate

In this and the following section, we will look in depth at the interest rate channel, along the lines of Mishkin (1995). Frederick Mishkin provides a compendium for evaluating how monetary policy is transmitted. Following a Keynesian framework, the author acknowledges that the interest rate channel is the primary channel: tightening monetary policy raises the real interest rate, which raises the cost of capital, reducing investment spending. As a result, total demand falls. More in-depth, John Taylor (1995) demonstrates how consumer decisions influence and are influenced by

investment decisions. As a result, short-term nominal interest rates are among the first variables to rise.

The short-term interest rate (2-year government bond) is considered as a short-term risk-free rate by commercial real estate practitioners. Looking at Figure 9, on impact we have the expected response following an expansionary monetary policy which is a fall in the short-term interest rate for almost all the countries in the panel, except Finland, which experiences a small rise. Ireland experiences the sharpest fall due to a higher sensitivity (volatility) of the Anglo-saxon interest rate. All the countries experience a rise in the next periods except for the Iberian Peninsula (Spain and Portugal) and Ireland that stay in the negative territory.

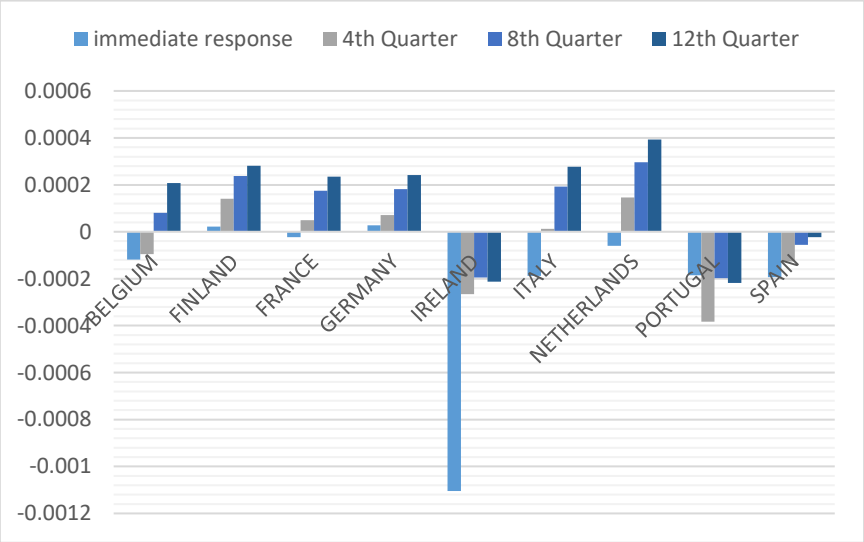

Figure 4:9 Effect of a 1% shock to the ECB Excess Reserves on Short Term Nominal Interest Rate. Breakdown by immediate response, response in the short-term, response in the medium-term and response in the long-term

When we examine all quarters following the shock, we discover a different side of the story in Figure 10. Except for Ireland, Spain, and Portugal, the result is very confusing because the bootstrapped mean values are all positive. This is an unsettling result since it contradicts the Keynesian thinking. One plausible explanation is that the short-term interest rate reacts only after a brief time lag.

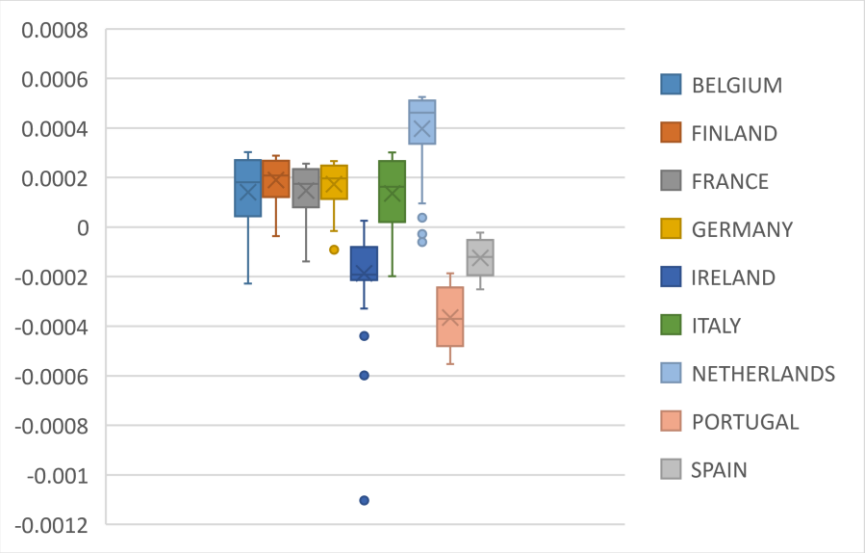

Figure 4:10 Effect of a 1% shock to the ECB Excess Reserves on Short Term Nominal Interest Rate. Squares represent the bootstrapped mean values of the GIRF across the sample, while the 90% bootstrapped confidence intervals are represented by the thinner lines.

Response of the long-term interest rate

According to Mishkin (1995), the real long term interest rate rises after the monetary policy impulse because of a combination of sticky prices and rational expectations. The Figure 11 shows the effect of a shock on Excess Reserves on the long-term nominal interest rate. The usual practice when computing the risk premium for commercial real estate is to use the long-term interest rate (10-year government bond) and, in particular, the Bund (Germany) rate. Germany's response is quite stable. All countries' initial reaction of the long-term interest rate is negative, as expected after an expansionary monetary shock (except for Spain).

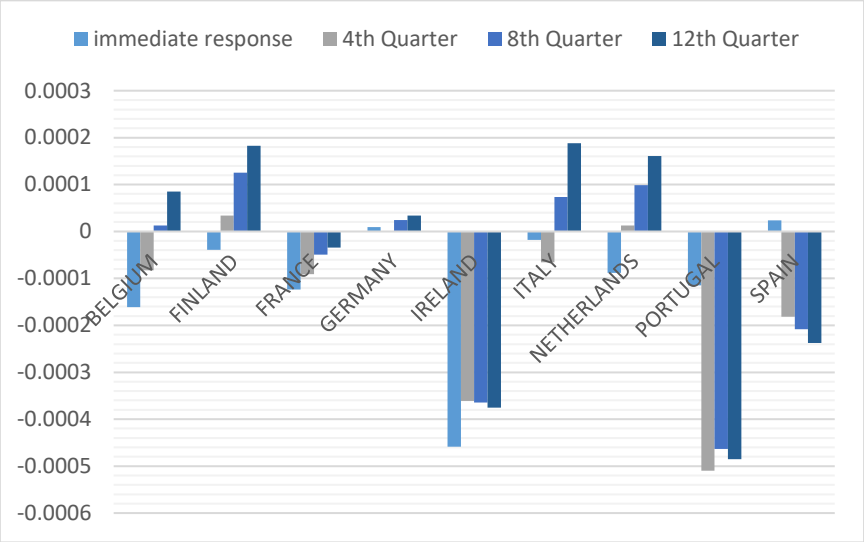

Figure 4:11 Effect of a 1% shock to the ECB Excess Reserves on Long Term Nominal Interest Rate. Breakdown by immediate response, response in the short-term, response in the medium-term and response in the long-term

Response of the GVA warehouse-using industries

Following Mishkin's (1995) interest channel, the transmission of monetary policy towards GVA will be as follow:

$$M + \Delta M \Longrightarrow i \downarrow \Longrightarrow I \uparrow \Longrightarrow Y \uparrow \Rightarrow GDP \uparrow \Rightarrow GVA\,w \uparrow$$

where ΔM corresponds to a positive shock on the quantity of money (Excess Reserves), leading to a decline in real interest rates ($i \downarrow$), which in turn decreases the cost of capital, thereby causing a rise in investment spending ($I \uparrow$). As a result, aggregate demand rises, raising GDP and, in turn, the gross value added of warehouse-using industries (GVA ↑). This is precisely the story pictured in Figure 12, which depicts the influence of the monetary policy shock on the GVA of warehouse-using industries. Nonetheless, transmission varies across nations, with Finland and Spain reporting the highest impacts. Ireland, on the other hand, reacts negatively. We can assume that Ireland is benefiting from the Bank of England's liquidity injection in an indirect manner. In our work, the BoE liquidity is considered exogeneous, our outside of the model control. Besides, the Irish economy structure is more service oriented, which mean that a liquidity injection from ECB will be redirected to other activity sectors detrimental to the logistics industry. Another interpretation can be provided

considering GVA warehouse-using industries levels (as shown in the Figure 17 of GDP contribution in the Appendix). While Germany has the highest GVA manufacturing level amongst the panel, Portugal with the lowest still reacts positively, as the theory would suggest. Ireland is the second lowest with Spain in term of GVA level. France on the other hand, also reacts poorly to this injection of money despite having a high GVA manufacturing level. We conjecture that the latter effect is due to the structure of the economy as proxied by the breakdown of GDP.

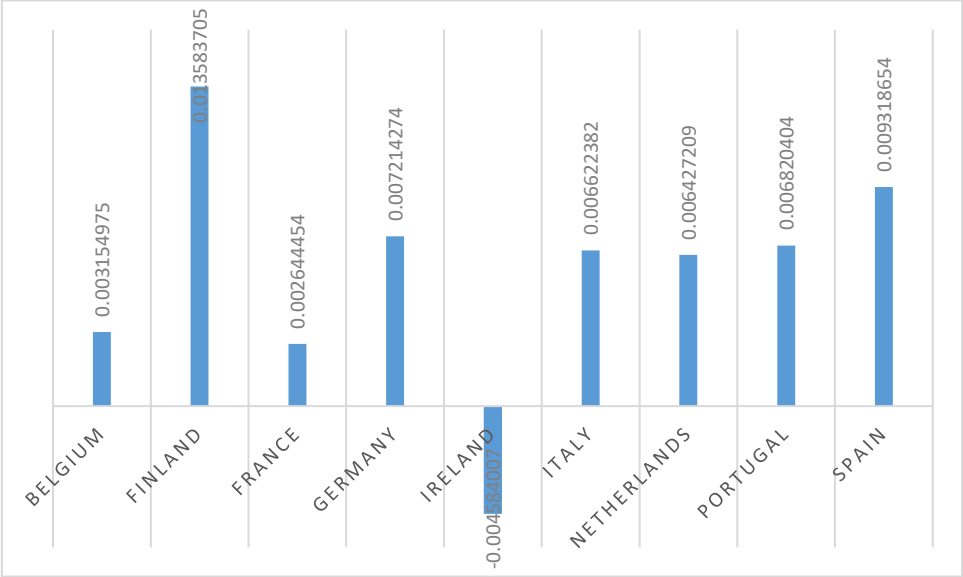

Figure 4:12 Effect of a 1% shock to the ECB Excess Reserves on GVA Warehouse using industries. Average over the 12 quarters following the shock

Response of the Employment in warehouse-using industries

Labour availability and cost are crucial factors in occupier location selections, as well as for developers determining the cost and time frame in which they can create structures. From figure 12, we can see that the countries that benefit the most from the liquidity injection in terms of employment are Spain and Portugal. We believe that when the new developments emerge from investments, these two marketplaces will have a workforce readily available. Also, the factor missing in this chart is the workforce coming from Eastern Europe which helps fill the gap in the western countries: Belgium, France, Germany and Netherlands.

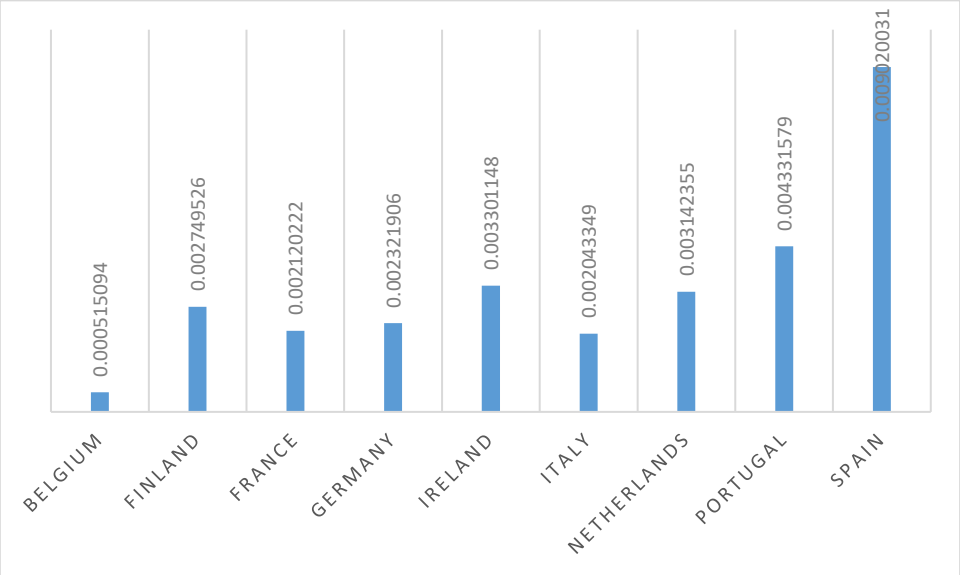

Figure 4:13 Effect of a 1% shock to the ECB Excess Reserves on Employment Warehouse using industries. Average over the 12 quarters following the shock

4.5.2 Spillovers across countries, GVA Germany Warehouse shock, response of the Total Rate of Return

Another exercise we can consider is studying the spillovers effects that can take place between countries when we simulate a country-specific shock. We shock the GVA of warehouse using industries in Germany the largest country in term of GDP but also the most industrialized one. Then, we look at the impact on the total return as presented in figure 13 and we segment the countries of our sample between western (Belgium, France, Germany and the Netherlands), southern (Italy, Portugal and Spain) and northern countries (Finland and Ireland). This segmentation makes sense because the shape of the impulse response is comparable across the board. The western European panel responds slowly, if at all, in the short term, with France, Germany, and the Netherlands leading the way. Belgium's response, on the other hand, has a positive slope. This means that these countries' logistics total stocks are saturated, and the total return falls as a result, because the investment supply raises prices faster than rents, lowering the total return. The immediate response of the southern countries to this liquidity injection is positive, except for Portugal. Subsequently, the increase is similar across the panel and Portugal slowly catches up in the medium term. Finally, a decrease in the total return over the longer term (12 quarters) is entirely representative of the industrial/logistics real estate cycle. The Northern European countries experiences the highest rate

in the immediate response. Then Finland's total rate of return starts to decrease right after, whereas Ireland goes through an increase in the medium term. In the longer term, the decrease corresponds to an irresponsiveness of the total rate of return for Finland, while Ireland is still in positive territory, with a +1.6% total return.

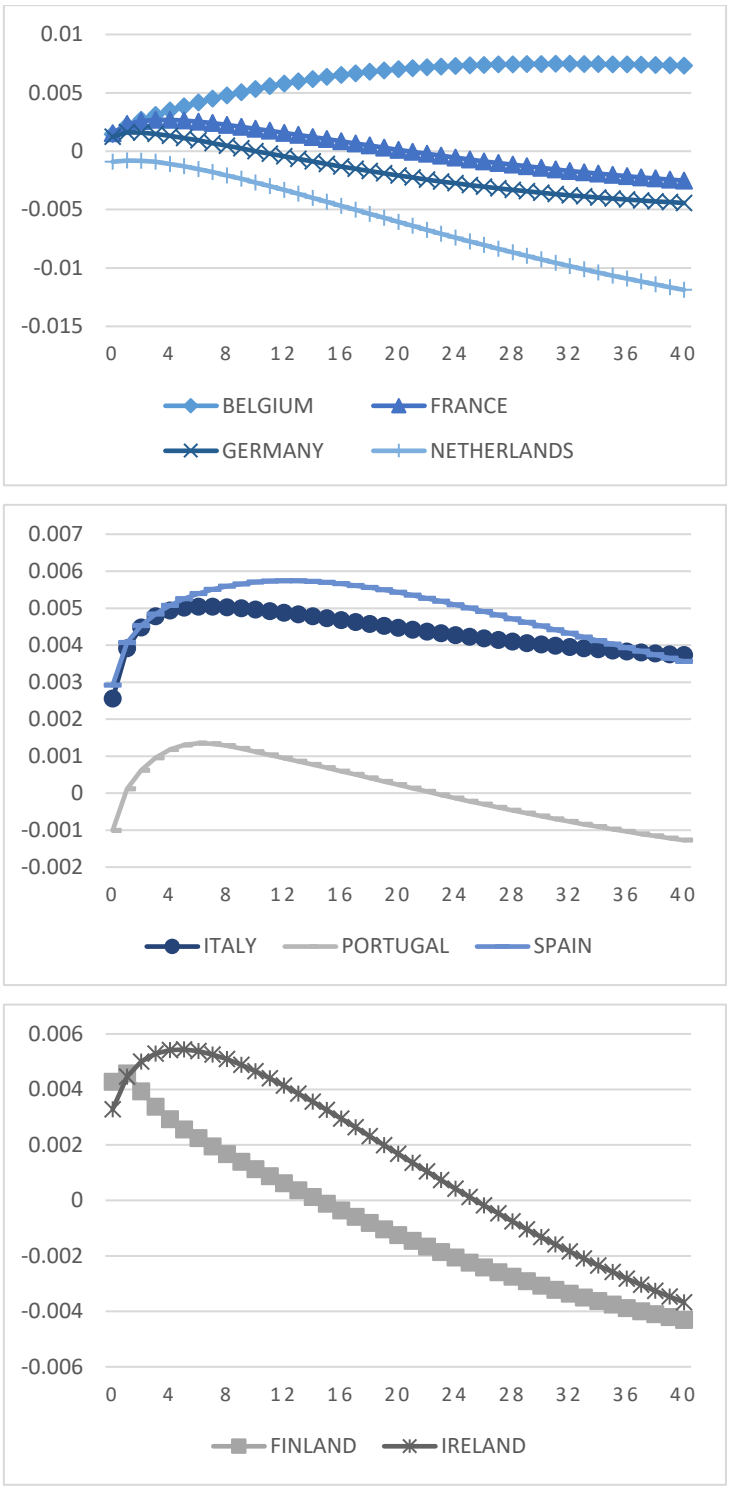

Figure 4:14 Spillover effects Effect of a 1% shock from GVA Warehouse using industries on the total Rate of Return

4.5.3 Results overview

Table 4-3 Results overview

	Source of Shock	Response	Initial Impact	Persistency	Transition dynamics
Global Shocks	Global Shock Shadow Rate	Total Rate of Return	Positive for all countries (except Netherlands)	Persistent shock for 12 quarters	U-Shaped
	Global Shock Excess Reserves	Total Rate of Return	Positive for all countries (except Netherlands)	Transitory shock of 1 quarter only followed by another persistent rebound that lasted 5 quarters	V-Shaped
		Short-term IR	Fall on the short-term interest rate for almost all the countries in the panel except Finland experiencing a small rise.	Permanent shock for Spain, Portugal, and Ireland. Persistent shock for Belgium. Transitory shock for the remaining countries.	-
		Long-term IR	All countries' initial reaction is negative, as expected after a monetary expansionary shock (except for Spain).	Permanent shock for Ireland, Portugal, Spain and France. Persistent for Belgium. Transitory for the remaining countries	-
Spillovers	GVA Germany	Total Rate of Return	Western panel responded slowly, Southern panel responded positively except for Portugal and the Nordics experienced the highest response rate	Persistent for Western panel, permanent for the Southern panel and transitory for the Nordics	Inverted U-Shaped

Logistics has a few distinct characteristics in terms of real estate returns. Because warehouses sell poorly, its 'capital return' component (property appreciation/depreciation) may be smaller than for other real estate assets. The resale can happen once, twice, or three times, but after that, obsolescence takes over. However, since warehouses are inexpensive to demolish and construct, this hypothesis is held after a given period of time. The building's worth falls to zero, but not the lands. The yield return (rent/price) is higher, more so than for other asset classes. This is what draws many investors to this type of investment today; other real estate segments, in their opinion, offer insufficient rental returns. It is possible, and even likely, that these two components of profitability react differently to monetary shocks. These assets represent globalization and maritime trade. In this respect, one may suppose that the industrial/logistics sector is partially dependent on the Chinese economy. It is hardly surprising that Portugal has odd responses in some cases. It is an outlying market with a tiny size. It has no bearing on logistics. The relative size of the Portuguese market has not changed over the years. It may be a difficult market for foreign players to access but this is not a barrier to development. The same can be said for Spain, Poland and the Baltic states. While other factors may affect demand, most of the sector's expansion is likely to come from organic growth. Established markets tend to be more resilient than emerging markets in economic downturns. On the other hand, FDI is concentrated on a few leading hubs in more advanced countries, such as France, the Netherlands and Germany. These hubs are mature and are not expanding so there is a little scope for new entrants. This means that logistics real estate investment decisions should factor in the likelihood that supply and demand will change in the future. Factors that are likely to affect demand and supply include changing demographics and technological advances.

Our results are a little more unexpected for Ireland. The currency (euro/pound) and the fact that Ireland would serve as a bridgehead for the United Kingdom could be an explanatory factor (outside the euro zone). According to the first two components analysed above, Ireland is peripherally located relative to the rest of Europe and offers high returns for investors in this sector. From a theoretical standpoint, this type of activity should be related to distribution and logistics and not production, but both sectors stand to gain from improved infrastructure. For example, companies like Amazon require large amounts of storage space from which to ship goods to their various distribution centers. Land suitable for industrial development is already in short supply in many

countries, so an increase in demand for warehousing facilities could provide a boost to the industrial sector. Of course, the prospect of increased investment in facilities and equipment is likely to boost employment levels in the related industries as well.

Conclusion

This research delved into the complexities of monetary policy transmission and spillovers in the logistics real estate market by employing the GVAR model. Because of the way the model is set up, we were able both to assess the nature and magnitude of such transmission and dig into the details with specific shocks. Subsystems including variables such as proxies of the labor market, interest rates, gross value added of warehouse-using companies can be affected by global impacts on fundamental domestic variables according to the VARX* structure, and the VARX* models can be regularly integrated to form a Global VAR. As a theoretical explanation, the VARX* allowed us to over-identify long-run theoretical relations to be explored as cointegrating vector limits and used where applicable. Our GVAR model specification explored the interplay between the euro-are wide financial market and the various sectors of the manufacturing and logistics industries. An impulse response analysis described the temporal impact of a shock to a dynamical system and all model variables, whether the shock is variable-specific or a recognizable monetary policy euro-area global variable.

With the 10-year government bond of Germany taken as the risk-free yield, spread of the logistics yield with respect to this benchmark yield constitutes a risk-premium. High spreads allow for cap rate compression and price appreciation, but low spreads carry the risk of cap rate growth and value loss. Impulse functions bring information on the fluctuations of risk premiums. A global shock to the price of money price (Shadow Rate) was first examined, followed by a global shock to the money supply (ECB Excess Reserves). In this article, the euro-area wide effect of the money price (Shadow Rate) and then quantity of money (Excess Reserves), on industrial/logistics real estate performance as assessed by Total Rate of Return was investigated. Using short- and long-term interest rates, warehouse GVA, and warehouse employment, the propagation of the global shock was then studied.

The global shock was studied in two segments, on Shadow Rates and then on Excess Reserves. The GIRF has a smooth reaction to a shock on the Shadow Rate. The reason for this shape is that monetary policy stimulus through interest rate hikes has a more consistent effect than shocking the quantity of money (Excess Reserves). The early response is positive for almost all countries (excluding the Netherlands), with Ireland seeing a 1.20 percent increase in its total return, followed by Belgium and Spain (0.40 percent). Portugal had the lowest response. Some countries' short-term (4-quarter) response represents a drop into negative territory. In the Short-term, the Netherlands' total return rises. In the Medium-term the decline in overall returns implies an absence of impulse response. Finally, in the long-run, convergence takes place and the impulse response fades. After a shock on Excess Reserves, the initial response in all countries is favorable (except for the Netherlands). The Netherlands displayed the opposite findings, which may be because Rotterdam is Europe's busiest seaport. Industrial/logistics real estate in the Netherlands is saturated, resulting in a 0.10 percent loss in total return, making it counter cyclical compared to other European markets. Ireland, Italy, Portugal, and Spain (+0.80%), in order, followed by Belgium, Finland, France (+0.40%). Germany, our largest industrial country, had a slight increase (+0.10%), which is the same as the Netherlands. In the short-term (after 1 year), the total return in all countries dropped near 0 while in the Netherlands it increased toward 0. This convergence toward 0 indicates a restoration to pre-shock levels. In the medium term (1 to 2 years), all markets expanded before stabilizing. After 2 to 3 years, a decline ends the money's stimulus. France, Belgium, and Germany on one side, Spain, Portugal, and Italy on the other, had comparable responses.

Our next step was an analysis of Mishkin's (1995) interest rate channel. The interest rate channel is preeminent within a Keynesian framework, as monetary policy tightening results in an increase in the real interest rate, which in turn increases the cost of capital and reduces investment spending and lowers the demand. When nominal rates increase, they do so most noticeably in the short term. Short-term interest rates tend to decrease in reaction to monetary policy expansion everywhere except Finland, where they increase slightly. The volatility of interest rates in the United Kingdom has an impact on Ireland since we observed a counter-cyclical response. Countries like Spain, Portugal, and Ireland stayed in negative territory for a while. Finland, Italy, and the Netherlands experienced increases in their long-term interest rates over the medium term, while most other countries saw declines. Rates on longer maturities were falling as a result of the yield curve reflecting monetary policy. Real long-term interest rates, according to Mishkin, are higher due to

sticky pricing and rational expectations (1995). We then looked at how changes in Excess Reserves affect the nominal interest rate in the long run. Based on our findings, we know that Germany's is in line with its economy structure. A rise in the money supply is widely seen as bad news across the countries (except for Spain). Finland, Italy, and the Netherlands all saw increases in their long-term interest rates, while most other countries' rates responses remained negative. Falling long-term interest rates as a result of monetary policy transmission makes logical sense.

The monetary policy shock had the largest impact on Finland and Spain's warehouse-using industries. Ireland may be affected by the BoE's liquidity injection. We do not directly control BoE liquidity. An ECB cash infusion will propagate to other sectors rather than the logistics real estate industry because Ireland's economy is service based. While Germany has the highest GVA manufacturing level within the panel, Portugal with the lowest reacted positively as the theory suggests. Ireland's GVA is second to Spain's. France reacts poorly to this money inflow despite a high GVA. We hypothesize that the latter effect is related to GDP's breakdown by sectors (economy structure).

Warehouses may have a lower "capital return" (appreciation/depreciation) than other assets because of the particular nature of logistics returns. A single, double, or triple resale might lead to the warehouse obsolescence. This idea has lasted for so long because warehouses are so simple and cheap to put together and take down. Since logistics offers the best rate of return of any asset type (office, retail, alternatives), the value of land can only increase. Many investors favour logistics properties because they offer higher rental yields than other forms of real estate. The two components of total return (income return and capital growth) may have distinct responses to monetary shocks. Property used for logistics is a symbol of international trade over the seas. There is a reasonable assumption that this real estate sector is partially reliant on the Chinese economy in this regard. The results showing Portugal reacting poorly to monetary injection is not surprising since it is considered a modest logistics real estate sector. The scale of the Portuguese market is consistent with its historical role. The same holds true for Poland, the Baltic countries, and Spain. While external variables may have an impact on demand, internal growth is more likely to drive the expansion of the logistics sector. During economic downturns, established markets are typically more stable than emerging ones. The majority of foreign direct investment, however, goes to just a few major European countries including France, the Netherlands, and Germany. These nodes are established and no longer growing, leaving limited room for new competitors. As a result, investors

in logistics real estate need to think ahead about how supply and demand can shift. Alterations in population and technical development are two potential influences on the market.

Some of our findings were not expected, at least for Ireland. Possible explanations include the relative values of the euro and the pound and the fact that Ireland would operate as a foothold for the United Kingdom (outside the euro zone). Ireland's outer location in relation to the rest of Europe and the high profits it offers investors in this sector are supported by the first two factors examined above. However, this belongs in the realm of distribution and logistics, not manufacturing. Nevertheless, advancements in infrastructure would benefit both industries. Retailers like Amazon, for instance, need massive warehouse facilities from which to distribute products to their many distribution hubs. An increase in the need for storage space could be beneficial to the manufacturing sector at a time when land suited for industrial growth is in short supply in many nations. Employment in associated industries is predicted to expand as a result of the expected increase in capital expenditures on infrastructure.

Appendix tables

Table 4-4 Detailed dataset employed in our GVAR model

	Variable	Descriptive	Source	transform
COUNTRY-SPECIFIC / FOREIGN VARIABLES	TOTAL RATE OF RETURN	Total Return on an annually reviewed prime & fully let property. Calculated as follows: PMTR = Capital Growth + Income Yield (net yield) - Capital Costs.	Property Market Analysis	Seasonally adjusted using Census-x13 0.25*ln(1+Tr/100)
	EMPLOYMENT WAREHOUSES	Employment warehouse using industries	National statistics, Eurostat, European commission	ln(EMP)
	GVA WAREHOUSE	Gross Value Added – Warehouse-using industries, (Bil. 2015 EUR)	National Central Banks	ln(GVA)
	NOMINAL S RATE	Short-term interest rates refer to government bonds maturing in two years.	MacroBond	0.25*ln(1+Rs/100)
	NOMINAL L RATE	Long-term interest rates refer to government bonds maturing in ten years.	OECD	0.25*ln(1+Rl/100)

	Variable	Descriptive	Source
GLOBAL VARIABLES	EXCESS RESERVES OF CI	Excess reserves of MFIs within ECB excluding Eurosystem not subject to minimum reserve requirements and Non-MFIs sector, denominated in Euro, data Neither seasonally nor working day adjusted	European Central Bank
	SHADOW RATE	European Central Bank Shadow Rate (Wu-Xia) The shadow rate is typically defined as the economic interest rate that would prevail if the lower bound on interest rates did not exist.	Macrobond
WEIGHT MATRICES	Trade Flows	International Transactions, Exports, excluding services bilateral between countries (USD)	IMF
	Market size	Real Estate Market Size Estimate History (USD mns) average 2015-2019	MSCI

Table 4. (continued) Detailed dataset employed in our GVAR model

Table 4-5 Investment Volumes (EUR, mil., Transactions, annual), Source: Property Market Analysis

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Belgium	2,750	2,820	2,130	2,870	2,240	4,600	4,840	2,800	1,460	1,400	1,850	2,202	2,240	3,406	4,377	3,755	3,490	4,870	4,840
Finland	2,300	2,300	2,400	3,200	2,620	5,320	6,150	4,020	1,500	2,213	1,513	1,848	1,850	3,612	4,368	4,588	9,370	7,632	5,750
France	11,735	10,116	10,384	12,136	17,100	26,395	30,832	15,063	8,555	13,657	17,895	17,845	18,862	28,113	31,799	31,935	27,563	34,942	41,469
Germany	12,704	15,602	13,924	13,454	23,650	49,379	59,446	20,680	10,587	19,573	23,521	25,567	30,872	40,154	56,264	52,583	58,219	61,536	73,436
Ireland	500	800	717	937	1,887	3,232	1,948	493	92	242	222	530	1,641	4,076	3,360	4,230	2,166	2,610	4,824
Italy	2,200	5,000	4,720	4,168	4,811	7,300	7,100	6,912	4,617	4,410	4,300	2,509	4,488	5,980	7,858	9,437	11,100	8,660	12,240
Netherlands	4,508	4,410	4,472	5,418	6,958	7,860	10,225	8,730	5,044	5,020	3,700	3,251	4,060	7,250	8,850	11,914	17,138	12,946	14,183
Portugal	356	231	839	1,382	802	986	1,401	946	514	819	251	179	417	839	2,072	1,440	1,997	3,184	3,240
Spain	2,601	3,741	5,273	4,728	5,727	7,626	10,700	7,051	3,818	3,287	2,476	2,323	4,917	10,483	10,013	8,707	11,907	11,452	13,652

Appendix figures

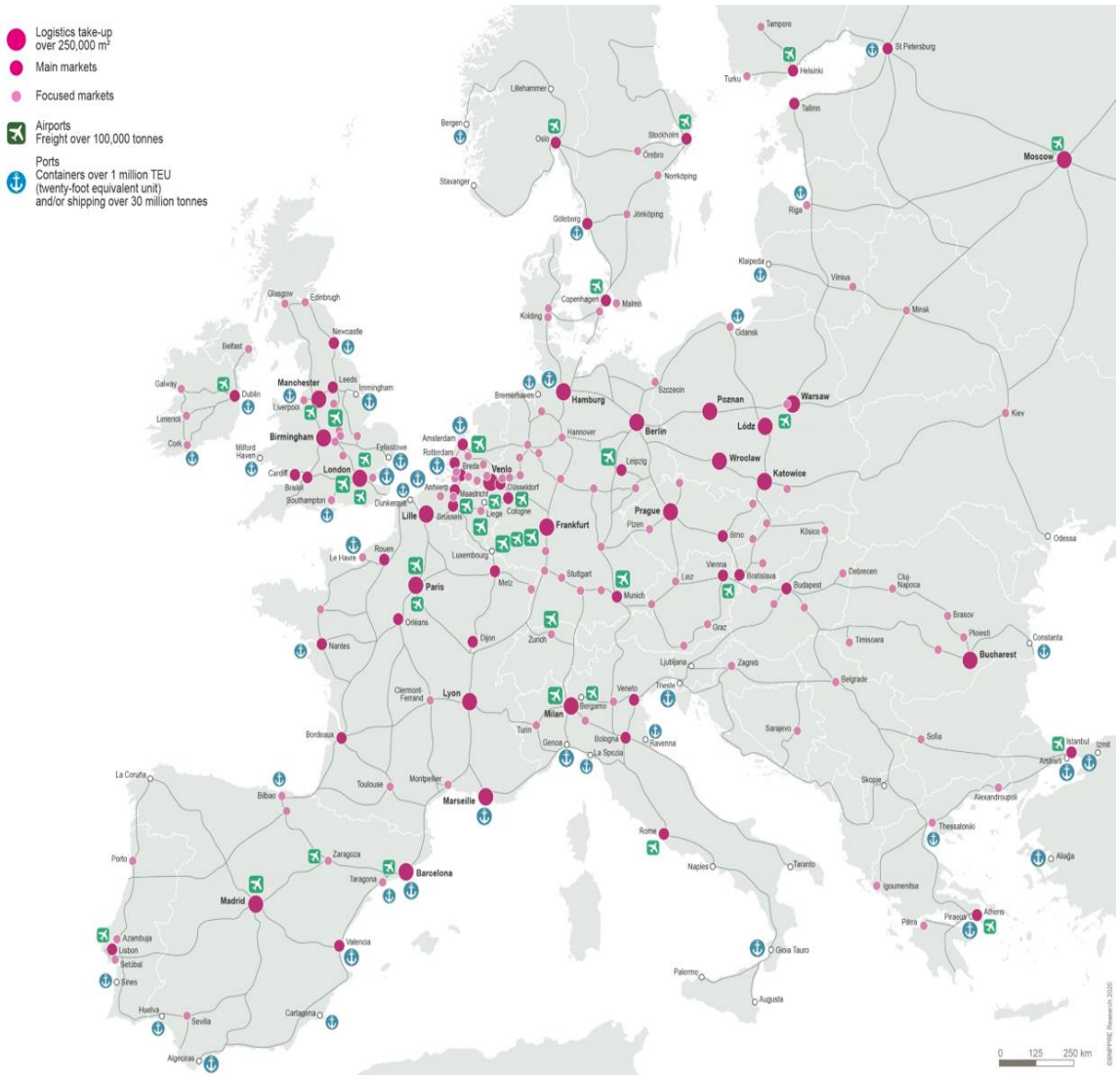

Figure 4:15 Figure 15. Main logistics hub in Europe, source: BNP Paribas Real Estate

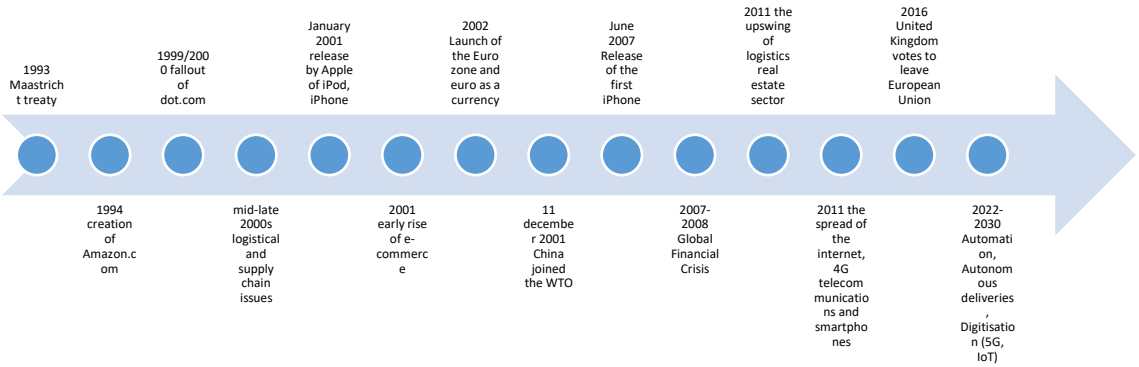

Figure 4:16 Timeline of the most important events in relation with the international trade



Figure 4:17 GVA contributions (y/y, % chg), Source : Eurostat, Haver

References

- Ambrose, B. W., 1990. An Analysis of the Factors Affecting Light Industrial Property Valuation, Journal of Real Estate Research, 5:3, 355–70.
- Bussière, M., Chudik, A., Sestieri, G., 2009. "Modelling global trade flows: results from a GVAR model," Working Paper Series 1087, European Central Bank.
- Dees, S., Mauro, F.d., Pesaran, M.H. and Smith, L.V, 2007. Exploring the international linkages of the euro area: a global VAR analysis. J. Appl. Econ., 22: 1-38.
- Dixon, R., 1999. How to Select an Optimal Distribution Site. In: Site Selection magazine.
- Fehribach, F. A., Rutherford, R. A., and Eakin, M. A., 1993. An Analysis of the Determinants of Industrial Property Valuation, Journal of Real Estate Research, 8:3, 365–76.
- Georgiadis, G., 2015. Examining asymmetries in the transmission of monetary policy in the euro area: Evidence from a mixed cross-section global VAR model, European Economic Review 75, 195-215.
- Hajek, J., Horvath, R., 2017. International Spillovers of (Un)Conventional Monetary Policy: The Effect of the ECB and US Fed on Non-Euro EU Countries, IES Working Paper, No. 22/2017, Charles University in Prague, Institute of Economic Studies (IES), Prague.
- Hiebert, P. and Vansteenkiste I., 2011. Do house price developments spillover across euro area countries? Evidence from a global VAR, Journal of Housing Economics, Volume 20, Issue 4, Pages 299-314.
- Hughes, W.T., 1994. Determinants of Demand for Industrial Property, The Appraisal Journal, 62:2, 303-309.
- Hiebert, P., & Vansteenkiste, I., 2009. International trade, technological shocks and spillovers in the labour market: A GVAR analysis of the US manufacturing sector. Applied Economics, 42(24), 3045-3066.
- Itoh, R., 2013. Estimating the Willingness to Pay of Industrial Firms for Japanese Industrial Parks. Urban Studies, 50(13), 2753-2765.
- Jones, C., Dunse, N., & Cutsford, K., 2014. Implications for Property Yields of Rising Bond Yields. London: IPF Research Programme 2011–2015.

- Ling, D.C., and Naranjo A., 1998. The Fundamental Determinants of Commercial Real Estate Returns, Real Estate Finance, 14:4, 13–24.
- Pesaran, M.H., T. Schuermann & S.M. Weiner, 2004. Modeling Regional Interdependencies Using a Global Error-Correcting Macroeconometric Model, Journal of Business & Economic Statistics, 22:2, 129-162.
- Rabianski, J. S., and Black, R. T., 1997. Why Analysts Often Make Wrong Estimates About the Demand for Industrial Space, Real Estate Review, 27:1, 68–72.
- Sivitanidou, R. and Sivitanides, P., 1995. Industrial Rent Differentials: The Case of Greater Los Angeles Environment and Planning, 1995, 27:7,1133–46.
- Taylor, John B., 1995. The Monetary Transmission Mechanism: An Empirical Framework, Journal of Economic Perspectives, n° 9, p. 11-26.
- Thompson, B. and Tsolacos, S., 1999. Rent Adjustments and Forecasts in the Industrial Market, Journal of Real Estate Research, 17:1 /2, 151–67.
- Vansteenkiste, I., 2007. Regional Housing Market Spillovers in the US: Lessons from Regional Divergences in a Common Monetary Policy Setting. ECB Working Paper No. 708.
- Wheaton, W. C. and Torto, R. G., 1990. An Investment Model of the Demand and Supply for Industrial Real Estate, American Real Estate and Urban Economics Association Journal, 18:4, 530–47.
- Wu, Jing Cynthia and Xia, Fan Dora, 2017. Time-Varying Lower Bound of Interest Rates in Europe. Chicago Booth Research Paper No. 17-06, Available at SSRN.
- Wu J, C, Xia F, D., 2020. Negative interest rate policy and the yield curve. J Appl Econ. 35:653-672.

Chapter 5: Conclusion

5.1 Restatement of the thesis

The initial goal of this thesis was to contribute to the state of the art by adding an additional stone to the commercial real estate portfolio management literature. In the context of financialization of this asset class, subjects about risk diversification arise, and thus return in a larger global setting, but always with local consequences related to the asset itself.

5.1.1 General motivation

In a synthetic manner, throughout this thesis, we have examined how the conceptions of risk and return may have evolved as a result of the period and monetary regime, the downturn or bear market (cycle), and exposure to commercial real estate (direct, indirect). In this section, we retrieve all prior results in order to extract the contribution of our work to the scientific literature. First and foremost, it is important to recall that our study period spans from 2004 to 2018: this period is marked by the end of a cycle that lasted from August 1989 to January 2007, followed by the start of a new cycle in 2007 characterized by the global financial crisis, and then by an accommodating expansionary monetary policy. Prior to starting the thesis, our main purpose was to improve the corpus of study by presenting novel breakthroughs on commercial real estate investing in times of liquidity surplus. As the thesis progressed, we realized that the potential was far greater than that. In fact, the form of risk and return can alter as we analyze different types of exposure and time-variant behavior. This was complex at first, but as time went on, we discovered that it could be understood as a different approach to answering our research question. This challenge manifested itself in the methodology approach that we required to adapt for each chapter, and therefore each exposure to commercial real estate: indirect listed REITs in the first chapter, indirect non-listed public SCPIs funds in the second, and direct CRE in the third chapter. Thus, we handled the issue of quantifying and researching the risk and rewards on commercial real estate investment. Our model is built on the assumption that the risk-return relationship in real estate is neither time-bounded nor geographically defined. Following that, we wondered if we could condition or confine this risk-return relationship in order to better understand and analyze it. Strategic frontiers, such as

geographic or industry divides, inevitably raise questions about the extent to which certain types of risk may be contained. The asset's idiosyncratic features are important, but so are the additional layers of systemic and systematic risk that sit atop the idiosyncratic risk. The purpose of risk management in real estate investment is to assess the underlying systematic risk component while reducing the unsystematic risk component to the greatest extent possible, making it an essential topic for both academics and practitioners. Exposure assessed, context, and, by extension, time and location of investment all have a role in determining the relative importance of these risks.

The broad introduction emphasizes the motivations for producing this thesis. The primary motivation was a shortage of academic research in the commercial real estate industry, notably in Europe, and the fact that real estate is the fuel of the economy in general because it is the host of every company regardless of the sector activity. This thesis can also be considered as a practitioners guide for a better understanding of the commercial real estate and its specific risks. The literature review helps to provide an international representation of the current state of research in the field.

5.1.2 Key point and findings of the chapters

Connectedness Structure of Pan-European Equity REITs

What volatility connectedness structure is unique to Pan-European REITs? This is our core research issue. We are interested in unravelling and decomposing the connectedness of REITs.

To answer this question, we have constructed a line between the connectedness of volatility caused by market noise, fundamental property, and monetary policy activities. We will look at how this will play out in the long, medium, and short term as a complementary consideration. We can learn how these factors vary in relation to the economy and the market by examining many different sub-periods.

We found similar results for static connectedness to those found in the literature assessing equity connectedness during a stress time, i.e., convergence of connectedness among REITs. Furthermore,

the performance of commercial real estate sub-sectors and geographical features help to explain REIT co-movements.

The entire sample of static connectedness (2004 to the end of 2018) demonstrates that UK-REITs transmitted and received the majority of the volatility connectedness. Because of the e-commerce boom, the retail market saw increased uncertainty; as a result, this sector transmitted a substantial amount of volatility to other sectors (positively or negatively). For example, the industrial sector benefited from the retail sector's connectivity shocks. Prior to the crisis, connection was bipartite or tripartite, with the French retail market experiencing higher interconnectedness in volume than its Dutch counterpart. Because of their poor performance during this time period, Italian REITs were isolated from the network infrastructure. Throughout the crisis (mid-2007 to mid-2009), we identified outcomes similar to those published in the stock market literature: During these challenging times, the convergence of connectedness is firmly confirmed. The retail sector (35.45%) had the highest volatility connectivity, followed by the office sector (29.31%). Following the GFC (mid-2009 to the end of 2014), French and British REITs were at the epicenter of volatility connectedness due to their potential to rebound significantly faster. In terms of total system-wide connectivity, the QE period (from 2015 to the end of 2018) outperformed the preceding periods. During this period, the size of REITs was a significant driver of connection transfer because larger REITs benefited more from the injection of liquidity due to their ability to absorb it.

In a dynamic system, the source of the shocks (e.g., monetary policy or financial markets) does not explain the persistence as much as how markets perceive the shocks at high-frequency intervals. The magnitude of a shock is described more by how REITs interpret it in high-frequency trading. Indeed, REITs communicate with one another and with their shareholders via volatility connectedness as an uncertainty channel. As the information regarding the shock is highly integrated in the REIT market, the shock will be implicitly characterized as either short, medium, or long run after this communication is processed.

The chapter's findings are consistent with the literature on financial connectedness; interestingly, we also found findings specific to REITs. This chapter investigates a subset of 42 REITs that were

listed throughout the research period; we cannot consider a survivorship bias because these REITs are the largest in size and are well balanced in terms of allocation (office, logistics, retail, and diversified) to better reflect the market. These findings, however, are only applicable to our sample of REITs and throughout the time period of our study (2004-2018). Despite the fact that these findings cannot be relied upon for the coming years, they can undoubtedly be used to improve the tracking of future uncertainty.

Is Diversification a Good Choice? Evidence from French Real Estate Investment Companies

At first glance, this chapter's overarching study topic seems simplistic: does the sort of property held by French SCPIs have any bearing on their performance? There is a significant amount of material on the American or Asian economies, but very few on French market. Since SCPI as investment vehicles are unique to France and have a fundamentally distinct structure from REITs, the American example cannot be directly transposed to France. This study is the first to tackle this deceptively straightforward subject, which is crucial for wealth management companies (SGP) whose primary goals are to collect public savings, buy real estate assets, and other assets, and to generate a specified cash flow in a highly competitive market. In particular, we take into account the property type (housing, retail, office, etc.) and location when calculating our Herfindahl indices, this provides a unique metric for measuring concentration (Paris, Paris region, French Regions, Overseas).

Property type diversification has had a significant and positive impact on SCPI performance. Geographic diversification, on the other hand, reduces the market value distribution rate. We documented that the best strategy for French non-listed funds is to be both diverse in property types and specialized in a market (location), resulting in a 62-basis point increase in average returns.

Diversification is a fundamental notion for these real estate management organizations, and often practitioners adopt it to enhance the odds of a prospective yield objective. The key conclusion that can be reached is that the topic of SCPI diversification is neither one-dimensional nor has a simple response. Indeed, diversification is not always as intended. The results suggest that property type diversity has had a significant and favourable influence on SCPI performance. Geographical diversification, on the other hand, has the reverse effect, i.e., it has a negative influence on the market value distribution rate. As a result, targeting a specific geography is an effective strategy for

SCPIs. In comparison to the literature, we documented both comparable and contradictory results. Asset diversification appears to be widely accepted. Geographic diversity, on the other hand, is extremely reliant on a range of circumstances, including the kind of exposure (direct or indirect), whether the real estate fund is listed or not, whether it is a private or public fund, and many other considerations.

In France, no previous studies have investigated this research topic for SCPIs. As a result, it is difficult to examine and compare it to previous studies on real estate funds. However, this is just the beginning point for additional debate and investigation. These findings should ideally be reproduced in a study that considers previous years of recession and how our results might alter. Furthermore, there is an urgent need to address liquidity issues with SCPIs.

Our findings add to a growing body of research suggesting that the benefits of diversification may differ depending on the assets studied. As a result, we have some reservations about our findings because they mainly apply to an important time period (1998-2018) and the 44 SCPIs in the sample. Of course, if one has access to a more extensive database than ours, there are other approaches to tackle our study question: spatial panel var, dynamic panel models, generalized methods of moments. Despite the limitations of our dataset, the fixed effect two-way models yielded interesting and practical results. Indeed, we are the first to use panel modelisation to examine the diversification benefits of French non-listed investment funds (SCPIs). We were able to identify the profiles of interest and go beyond uni-dimensional diversifications using bootstrap resampling. Furthermore, the overall necessity to explore the SCPIs' liquidity issue may lead to another potential expansion of our research., which is a particularly relevant topic, highlighting how, for these real estate management businesses, diversification is fundamentally a critical idea and the only way to maximize the prospects for a prospective yield objective.

Spillovers from Direct Commercial Real Estate and Monetary Policy Shocks: To what extent are Returns Shifting?

The primary goal of this article is to examine the effects of unconventional monetary policies, sometimes referred as quantitative easing, on the logistics real estate market. The performance of logistics/industrial real estate as a result of market interactions between supply and demand is the focus of our research. As a result, the cyclical nature of these two submarkets must be emphasized. Is it possible that the new monetary policy's liquidity injection improved the performance of the industrial/logistics real estate sector, resulting in a reduced risk premium? This article's contribution and findings should be of great importance to policymakers, industrial real estate practitioners, developers, occupiers, and investors. Using the GVAR model, this research examines monetary policy transmission and spillovers in the logistics real estate market. Our statistical approach allows us to assess the scope of the issue at hand and provide a general solution before narrowing in on any particular shock. According to the VARX* structure, subsystems like the labor market, interest rates, and warehousing companies' gross value added can be affected by global effects on underlying local factors. To take things one step further, a Global VAR can be derived by combining the VARX* models. Over-identifying theoretical long-run relations can be analyzed as cointegrating vector limits using the VARX*. Our definition of the GVAR model considers how the global financial market's affects manufacturing and logistics. Impulse response defines the temporal impact of a shock on the dynamical system and its global variables such as monetary policy liquidity injection.

Logistics real estate investment has certain unique features. Due to the low demand for storage space, the "capital return" (property appreciation/depreciation) on warehouses may be lower than on other types of real estate investments. Obsolescence sets in after one, two, or three reselling cycles. However, this notion is only applicable after a certain amount of time has passed because warehouses are inexpensive to disassemble and reconstruct. The yield return (rent/price) is greater in comparison to other asset classes. Many modern investors are attracted to this sector because they believe that rental returns in other real estate markets are lacking.

Shadow Rates and Excess Reserves were studied for the global shock. After startling Shadow Rate, GIRF reacts smoothly. Monetary policy stimulus through interest rate hikes has a more consistent effect than money quantity shocks (Excess Reserves). Ireland saw a 1.2% increase in its total return, followed by Belgium and Spain (0.40 percent). Portugal responded least. Some countries' 4-quarter responses are negative. Short-term, Dutch total return rises. Medium-term decline in returns implies no impulse response. Long-term, convergence stabilizes and impulse response fades. After shocking Excess Reserves, all countries are responding positively (except Netherlands). Rotterdam, Europe's busiest seaport, may explain why the Netherlands had different results. The Netherlands' industrial/logistics real estate market is saturated, resulting in a 0.10 percent loss in total return. Ireland, Italy, Portugal, Spain (+0.8%), then Belgium, Finland, France (+0.4%). Germany's (+0.10%) increase is the same as the Netherlands'. All countries drop near 0 after 1 year, but the Netherlands rises. This convergence on 0 indicates pre-shock levels. All markets expand 1 to 2 years before stabilizing. The money's stimulus ends in 2 to 3 years. Spain, Portugal, and Italy had similar responses to France, Belgium, and Germany.

Portugal's poor response to monetary injection is not surprising given its modest logistics real estate exposure. Portugal logistics market size matches its historical role. Poland, the Baltics, and Spain are similarly affected. Inner growth is more likely to drive logistics sector growth than external variables. Established markets are more stable during economic downturns. Most FDI goes to France, the Netherlands, and Germany, these established nodes no longer grow, leaving little room for new competitors. Logistics real estate investors must anticipate supply and demand shifts. Population and technological changes can affect the market.

Our findings are unexpected for Ireland. Possible explanations include the euro and pound's relative values and Ireland's role as a U.K. foothold (outside the euro zone). The first two factors support Ireland's central location and high profits for investors in this sector. This is distribution and logistics, not manufacturing. Infrastructure improvements would help both industries. An increase in storage space could help the manufacturing sector when land for industrial growth is scarce. Increased infrastructure spending should boost employment in related industries.

5.2 Applications

This thesis has a wide range of practical applications, in part because it was written as part of a French doctorate collaboration between BNP PRE and the University Paris Dauphine under the terms of a CIFRE contract, which allowed for the investigation of real-world business challenges using academic resources.

The broad implication of the present research is its relevance within the CRE industry. In fact, our work contributes to a better understanding of the commercial real estate market in a time of abundant liquidity. Asset managers that are outsiders to CRE frequently find it challenging to handle the CRE in a multi-asset portfolio. In terms of statistical models, we either design new models to account for exposure specificities and CRE requirements or apply already created models to those specifications.

Since the nineteenth century, commercial real estate has been a low-risk, medium-reward investment that has weathered several economic cycles. Since the end of the Great Recession investors have sought out alternative sources of returns with real estate as an attractive option because of its steady income generation and low correlation with stocks and bonds. However, investing in real estate involves unique risks that investors must be aware of it in order to properly allocate capital and manage performance. Understanding how to manage these risks is essential. One of these risks is volatility, which can affect both prices and cash flows. In general volatility is caused by shifts in investor sentiment; while the market is often unpredictable in the short term, it typically reacts positively to positive news in the medium and long term. In the commercial real estate industry, different types of real estate assets exhibit different degrees of volatility. For example, REITs trade on public exchange and are therefore susceptible to wide fluctuations in price due to stocks' market forces. On the other hand, direct real estate investments are not affected in the same manner by stocks factors and can be more predictable in terms of cash flow. In each chapter, we examined a different exposure of real estate unravelling specificities such as volatility for REITs, diversification profile for SCPIs and risk premium for direct CRE exposure to logistics sector. We also provided information on how to monitor these particulars so that they can be managed more effectively.

Ultimately, this thesis can help the readers become more efficient in their-decision making process by helping them understand the various types of CRE exposures and how to mitigate and manage them effectively. We also recommend having a deeper look at actual transaction data and historical trends to be able to provide meaningful insights that help create and optimal CRE risk management. The three components of the roadmap we suggest are CRE exposure, CRE scorecard, and CRE mapping. In essence, CRE mapping enables CRE professionals to recognize the risks and opportunities they are exposed to and map them in accordance with their significance to the organization and potential impact. The scorecard will be a tool that summarizes the major risks to a CRE portfolio and helps identify areas where risk concentrations exist. Lastly, the CRE exposure will summarize the current exposures of a company's assets based on existing data and provides an easy and transparent method to track and update the status of these exposures going forward. We suggest a real-time tool to monitor these risks in companies, sectors or countries in order to track potential scenarios, predict trends and prevent losses. Each of the three components of this roadmap can help accelerate the process of building a comprehensive risk management framework for CRE professionals and drive greater business performance. By addressing each of the components in a sequential manner, each one serves as a building block for the next.

On the other hand, regulators can also implement our tools for monitoring and compliance with CRE market integrity rules and policies. These include, for example, rulemaking, surveillance and market analysis. The regulation and especially monetary financial institutions can use these results for a better management of diffusion and effectiveness of the liquidity on the CRE market. Based on this understanding, they can initiate policies that contribute to the reduction of systemic risk and enhance financial stability in the CRE sector. For instance, by focusing on the channel segments where monetary policies are stuck and not transmitting, they can target (better supervise) the CRE markets in need of liquidity.

These findings may also assist policymakers in better understanding the implications of certain fiscal policies on the stability of the CRE market and in implementing suitable regulatory measures to discourage excessive risk-taking in the sector. These findings may encourage the development of

financial markets that support private real estate investments, as well as household participation in the ownership of CRE property shares, in addition to institutional investors.

Although the story has changed recently, our methods can still provide useful insights in this new inflationary scenario. Inflation is one of the most serious concerns that investors face today. The central banks have ushered in a new age of monetary policy. These policies aim to manage a high-inflationary environment by raising interest rates, stabilising exchange rates, and sterilising liquidity which reduces demand for goods and services. Real estate is one of the finest asset sectors for mitigating increasing inflation. As inflation expectations increase, the demand for real estate increases as investors seek property that provide positive cash flow to meet the growing demand for products and services that will maintain their incomes. Now we see CRE Investors switched their investments to residential, healthcare, logistics, and prime office assets in an uncertain and inflationary climate. Rents in these markets are likely to rise the most due to inflation and high demand. Rents are anticipated to rise due to: Inflation. Prices, on the other hand, will be under pressure due to rising borrowing rates and falling purchasing power. As a result, the demand for rental properties should rise, and rental growth may become the primary driver of performance.

5.3 Future work

Several paths for future research can emerge as a result of this thesis on commercial real estate. Thesis completion is an interesting time as new knowledge can be gleaned and analyzed. We wanted to contribute to our chosen field by providing a new research output in a very specific context of quantitative easing. We also wanted to utilize and apply innovative statistical methods to account for some specificities of the commercial property sector. Utilizing certain approaches allowed us to identify interesting trends and characteristics of the commercial properties we investigated. Eventually, the results of this thesis provide a deeper understanding of how the commercial property market has evolved over time and might offer insight into what the futures holds for commercial real estate in Europe. Furthermore, we hope that our research provides valuables insights to practitioners in the industry and policymakers who work with the industry. Future research can focus further on the individual factors that drive trends in the commercial property

market within different cities. For example, one study could examine the factors affecting risk and return for commercial real estate in different cities across Europe. Another could analyze the pricing of commercial properties in different cities or focus on a particular property type such as office and retail properties. Certainly, the new inflationary environment is on the table, and our techniques are adaptable and adaptive. These are just a few of the many research questions that could be investigated in future research.

A common thread linking all the chapters in this thesis is how the risk and returns change over-time, over space, over exposure, and their influence on the commercial real estate market. Our research shows that differences in market and macroeconomic conditions have a significant impact on the performance of commercial property market across Pan-European markets. The uncertainty of the economic and political environment creates additional risk for investors in the real estate markets in the form of a risk premium. Different cities exhibit different levels of risk and return depending on several factors including demographic trends, regulatory and tax policies, GDP growth, and the financial markets. Thus, the importance of future research focusing more on a different granularity to build the bigger picture.

The second chapter sets the stage for the rest of the thesis and provides a thorough examination of the European REITs market, highlighting the key drivers shaping this industry at different key periods. The study experimentally tests the connectedness structure of equities REITs across European markets. Our work uses the time-frequency dynamic model of Barunik and Krehlik (2018) and the generalized variance decomposition model of Diebold and Yilmaz (2012) to examine the consequences of volatility spillover. In this study, we use 15 years' worth of intraday data of 42 Pan-European REITs, from 2004 to 2018. The investigation revealed a statistically significant relationship between the Pan-European REITs. High-frequency effects were also observed in the dynamic analysis, although they did not prove to be statistically significant. Future research may investigate how the COVID-19 pandemic has affected the REIT market, and whether there is any evidence of contagion or financial crisis. A deeper analysis of specific market dynamics is also required in order to identify possible sources of contagion. Additionally, further work may consider the interconnectedness of different types of REITs in the wider European stock market. This will also

help to identify potential drivers of return predictability for different types of REITs, as well as provide a better understanding of their risks.

Chapter 3 findings contribute to a growing body of research demonstrating that diversification benefits might vary depending on the assets analyzed. As a result, we have some misgivings regarding our findings because they are only relevant for a specific time span (1998-2018) and the 44 SCPIs in the sample. However, this is a good beginning point for future studies and research, indicating how we can strike a healthy balance between geographical and property-type diversification by taking a variety of factors into account. In an ideal scenario, our findings would be replicated and broadened in a future study that considers the most recent years of recession and if it would alter our conclusions. Furthermore, another possible extension of our work could stem from the general need to investigate the SCPIs' liquidity shortage, which is a particularly relevant topic, highlighting how, for these real estate management businesses, diversification is fundamentally a critical idea and the only way to maximize the prospects for a prospective yield objective. Future research should focus specifically on the liquidity level and other important solvency metrics for our sample of SCPIs. We believe that such information could be relevant for decision makers, investors or fund managers in charge of allocating capital to SCPIs. Finally, the pricing of diversification is still an open issue that we address in this chapter. We believe our results support the existence and relevance of a diversification premium for SCPIs. However, we have not explored liquidity premium, it illustrates that the higher cost of equity should be property considered in the decision to diversify. Nevertheless, further research is needed to establish the relative weight of this effect in explaining the price-earnings ratio for SCPIs and to determine whether this premium translates into higher expected returns in the long run.

Chapter 4 gives better insight into how the new monetary policies affect industrial real estate through the impact on the logistics and manufacturing sectors. We provided new evidence that changes in monetary policy influence the performance of the European logistics real estate markets heterogeneously. Future work should focus more specifically on the impact of monetary policies (conventional or not) on the dynamics of specific industrial real estate markets at city/region level in particular and the cyclical behavior of the industrial real estate sector in general. This is important for the macroeconomic analysis and for the design of fiscal policy. More disaggregated analysis

could help in a better understanding of the interaction between monetary policy and industrial real estate. In addition, other determinants of performance should also be taken into consideration to better understand the drivers of performance of the industrial real estate markets. Finally, this work has potential policy implications given the importance of industrial real estate markets for the European economy. This is particularly important in the current context of economic and financial turmoil. Given the volatility of the financial markets and the role of the industrial real estate markets in facilitating the flow of goods and services from producers to consumers, it is crucial that the governments put in place the right policies and regulatory framework. This will provide long-term stability to the industry and promote economic well-being in the long run. The role of industrial real estate markets in the economic development of a country is of paramount importance and its regulation needs to be guided by sound policy making supported by sound empirical evidence. We recommend future authors: (1) consider the role of external shocks to logistics real estate demand, (2) analyze whether industrial real estate markets respond differently to regional macroeconomics shocks, (3) identify the right transmission mechanism of shocks in industrial real estate market and the role they play in the business cycle, and (4) examine the relationships between the industrial real estate markets and other sectors of the economy.

5.4 A take-home message for the reader

As the old adage goes, "location, location, location" is everything in commercial real estate. Location is certainly important, but there are many other factors to consider as well, such as financial structure, building type, tenant mix, cyclicality, cash flow, property management, and target market. All these factors will influence the viability of an investment property, so it is important to understand them when evaluating potential investments. Throughout our thesis, we provided factual insights, sometimes hints, to help investors navigate the complex world of real estate finance to make informed decisions when investing in CRE property. It is safe to say that an investor will find the commercial real estate market to be extremely complex. The good news is that investors have access to a plethora of resources for researching and keeping tabs on the market. Investors can benefit greatly from these resources since they enable them to make better informed investment decisions, which in turn increases the likelihood of a positive return on investment. When it comes to developing a plan for investments in the Commercial Real Estate, there is no single factor as more crucial than the others. To formulate a winning plan for the real estate investment sector, investors must enhance their efforts. As a result, I believe that with the appropriate strategy and the correct instruments, it is possible to maximize return for investors while avoiding risk, even though this is easier said than done in today's risky market. In order to achieve optimal outcomes, however, these instruments must be combined with appropriate statistical models that are grounded in solid academic research. Because only rigorous, in-depth research can provide genuine assistance to investors in developing superior investment strategies and achieving their investment objectives, the importance of academic research in this subject cannot be overstated. It is generally accepted that real estate investing is a method that must be pursued over the long term. Therefore, investors can expect to participate in the market for a significant period of time during which market values will fluctuate regularly and exhibit increased levels of volatility. And this can only be done by conducting research utilizing the appropriate suite of tools available to investors, which in turn can only be performed by conducting adequate research. To this end, academic research is crucial since it equips investors with the knowledge and data they need to succeed in the market. While the resources available to investors have their limitations, there is always space for development, and research is a crucial part of that process.

References

Alizadeh S., Brandt M., Diebold F.X., 2002. Range-based estimation of stochastic volatility models. Journal of Finance. 57:1047–1092.

Alonso, W. A., 1964. Location and land use: toward a general theory of land rent, Cambridge, MA: MIT Press.

Ambrose, B. W., 1990. An Analysis of the Factors Affecting Light Industrial Property Valuation, Journal of Real Estate Research, 5:3, 355–70.

Ambrose, W., 1990. An analysis of the factors affecting light industrial property valuation. The Journal of Real Estate Research, 5, 355-369.

Antonakakis N., 2012. Exchange return co-movements and volatility spillovers before and after the introduction of euro. Journal of International Financial Markets. 22:1091–1109.

Antonakakis N., Chatziantoniou L., Filis G., 2017. Oil shocks and stock markets: Dynamic connectedness under the prism of recent geopolitical and economic unrest. International Re- view of Financial Analysis. 50:1–26.

Baruník J., Křehlík T., 2018. Measuring the frequency dynamics of financial connectedness and systemic risk. Journal of Financial Econometrics. 16(2):271–296.

Beine M., Candelon B., 2011. Liberalisation, and stock market co-movement between emerging economies. Quantitative Finance. 11(2):299–312.

Brooks R., Negro R.D., 2004. The rise in Comovements across national stock markets: Market integration or IT bubble. Journal of Empirical Finance. 11(5):659–680.

Bubak V., Kocenda E., Zikes F., 2011. Volatility transmission in emerging European foreign exchange markets. Journal of Banking & Finance. 35(11):2829–2841.

Buch C, Pierdzioch C., 2005. The integration of imperfect financial markets: Implications for business cycle volatility. Journal of Policy Modelling. 27(7):789–804.

Bussière, M., Chudik, A., Sestieri, G., 2009. "Modelling global trade flows: results from a GVAR model," Working Paper Series 1087, European Central Bank.

Cashman G, Harrison D, Whitby R., 2018. Network connections in REIT markets. Journal of Real Estate Literature. 26(1):83–102.

Chevallier J, Ielpo F., 2013. Volatility spillovers in commodity markets. Applied Economics Letters. 20(13):1211–1227.

Cotter J, Stevenson S., 2008. Modelling long memory in REITs. Real Estate Economics. 36(3):533–554.

De Wit, I., 2010. International Diversification Strategies for Direct Real Estate. J Real Estate Finan Econ 41, 433–457.

De Wit, I., and Van Dijk, R., 2003. The global determinants of direct office real estate returns. The Journal of Real Estate Finance and Economics 26, 1, 27–45.

Dees, S., Mauro, F.d., Pesaran, M.H. and Smith, L.V, 2007. Exploring the international linkages of the euro area: a global VAR analysis. J. Appl. Econ., 22: 1-38.

Delfim J-C and Hoesli, M., 2016. Risk factors of European non-listed real estate fund returns, Journal of Property Research, 33:3, 190-213.

Dermirer M., Diebold F.X., Liu L., et al., 2017. Estimating global bank network connectedness. Journal of Applied Econometrics. 33(1):1–15.

Devaney M., 2001. Time varying risk premia for real estate investment trusts: A GARCH-M model. The Quarterly Review of Economics and Finance. 41(3):335–346.

Devaney, S., and Scofield, D., 2014. Time to transact measurement and drivers. In Investment Property Forum.

Diebold F.X., Yilmaz K., 2009. Measuring financial asset return and volatility spillovers, with application to global equity markets. The Economic Journal. 119(534):158–171.

Diebold F.X., Yilmaz K., 2014. On the network topology of variance decompositions: Measuring the connectedness of financial firms. Journal of Econometrics. 182(1):119–134.

Diebold FX, Liu L., 2017. Commodity connectedness

Diebold FX, Yilmaz K., 2012. Better to give than to receive: Predictive directional measurement of volatility spillovers. International Journal of Forecasting. 2012;28(1):57–66.

DiPasquale, D., Wheaton, W.C., 1992. The Markets for Real Estate Assets and Space: A Conceptual Framework, Real Estate Economics, Volume 20, Issue 2 p. 181-198.

Dixon, R., 1999. How to Select an Optimal Distribution Site. In: Site Selection magazine.

DuCoulombier, F., 2007. EDHEC European Real Estate Investment and Risk Management Survey, EDHEC-RISK Institute.

Ducoulombier, F., 2007. EDHEC European Real Estate Investment and Risk Management Survey, EDHEC-Risk Institute.

Fama, E. and French, K., 2004. The Capital Asset Pricing Model: Theory and Evidence. The Journal of Economic Perspectives, 25-46.

Fehribach, F. A., Rutherford, R. A., and Eakin, M. A., 1993. An Analysis of the Determinants of Industrial Property Valuation, Journal of Real Estate Research, 8:3, 365–76.

Fernandez-Rodriguez F., Gomez-Puig M., Sosvilla-Rivero S., 2015. Volatility spillovers in EMU sovereign bond markets. International Review of Economics and Finance. 39:337– 352.

Fuerst, F. and Matysiak, G., 2009. Drivers of fund performance: a panel data analysis. Working Papers in Real Estate & Planning . 02/09. Working Paper. University of Reading, Reading. pp35.

Fuerst, F. Mansley, N. and Wang, Z., 2021. Do specialist funds outperform? Evidence from European non-listed real estate funds, Research in International Business and Finance, Volume 58.

Garman M.B., Klass J., 1980. On the estimation of security price volatilities from historical data. The Journal of Business. 53(1):67–78.

Geltner, D., and Miller, N.G., 2010. Commercial Real Estate Investment and Analysis, 3rd edition, Chapter 2.

Georgiadis, G., 2015. Examining asymmetries in the transmission of monetary policy in the euro area: Evidence from a mixed cross-section global VAR model, European Economic Review 75, 195-215.

Guedj, B., Martellini, L. and Safaee, S., 2021. Benefits of Open Architecture and Multi-Management in Real Estate Markets - Evidence from French Nonlisted Investment Trusts, The journal of Portfolio Management -Investing in Non-US Fianncial Markets, Volume 47, number 7.

Hajek, J., Horvath, R., 2017. International Spillovers of (Un)Conventional Monetary Policy: The Effect of the ECB and US Fed on Non-Euro EU Countries, IES Working Paper, No. 22/2017, Charles University in Prague, Institute of Economic Studies (IES), Prague.

Hamelink, F. and Hoesli, M., 2004. What Factors Determine International Real Estate Security Returns? Real Estate Economics, 32: 437-462.

Hartzell, D., Hekman, J. and Miles, M., 1986. Diversification Categories in Investment Real Estate. Real Estate Economics, 14: 230-254.

Hiebert, P. and Vansteenkiste I., 2011. Do house price developments spillover across euro area countries? Evidence from a global VAR, Journal of Housing Economics, Volume 20, Issue 4, Pages 299-314.

Hiebert, P., & Vansteenkiste, I., 2009. International trade, technological shocks and spillovers in the labour market: A GVAR analysis of the US manufacturing sector. Applied Economics, 42(24), 3045-3066.

Hoesli, M., and Lizieri, C., 2007. Real Estate in the investment portfolio, report prepared for the Investment Strategy Council of the Royal. Ministry of Finance.

Hughes, W.T., 1994. Determinants of Demand for Industrial Property, The Appraisal Journal, 62:2, 303-309.

Imbs J., 2004. Trade, Finance, Specialization, and Synchronization. Finance, Specialization, and Synchronization, 86(3), 723-734.

Itoh, R., 2013. Estimating the Willingness to Pay of Industrial Firms for Japanese Industrial Parks. Urban Studies, 50(13), 2753-2765.

Jirasakuldech B., Campbell R., Emekter R., 2009. Conditional volatility of equity real estate in- vestment trust returns: A pre- and post-1993 comparison. Journal of Real Estate Finance and Economics. 38(2):137–152.

Jones, C., Dunse, N., & Cutsford, K., 2014. Implications for Property Yields of Rising Bond Yields. London: IPF Research Programme 2011–2015.

Koop G., Pesaran M.H., Potter S., 1996. Impulse response analysis in nonlinear multivariate models. Journal of Econometrics. 74(1):119–147.

Leskinen, N., Vimpari, J., & Junnila, S., 2020. A review of the impact of green building certification on the cash flows and values of commercial properties. Sustainability, 12(7), 2729.

Ling, D.C., and Naranjo A., 1998. The Fundamental Determinants of Commercial Real Estate Returns, Real Estate Finance, 14:4, 13–24.

Lintner, J., 1965. Security Prices, Risk, And Maximal Gains from Diversification. The Journal of Finance, 587-615.

Lintner, J., 1965. The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. The Review of Economics and Statistics , 13-37.

Liow K., Liao W.C., Huang Y., 2018. Dynamics of international spillovers and interaction: Evidence from financial market stress and economic policy uncertainty. Economic Modelling. 68:96–116.

Liow K.H., Huang Y., 2018. The dynamics of volatility connectedness in international real estate investment trusts. Journal of International Financial Markets. 55:195–210.

Maghyereh A., Awartani B., Hilu K., 2015. Dynamic transmissions between the U.S. and equity markets in the MENA countries: new evidence from pre- and post-global financial crisis. The Quarterly Review of Economics and Finance. 56:123–138.

Maghyereh A.I., Awartani B., Bouri E., 2016. The directional volatility connectedness between crude oil and equity markets: new evidence from implied volatility indexes. Energy Economics. 57:78–93.

Mantegna R.N., 1999. Hierarchical structure in financial markets. The European Physical Journal B. 11:193–197.

Markowitz, H. M., 1952. Portfolio Selection. Journal of Finance, 77-91.

Mueller, A.G. and Mueller, G.R., 2003. Public and private real estate in the mixed-asset portfolio, Journal of Real Estate Portfolio Management, 9:3, 193–203.

Mueller, G.R., 2017. Real Estate Market Cycle Monitor Second Quarter 2017. Black Creek Group.

Pesaran M.H., Shin Y., 1998. Generalized impulse response analysis in linear multivariate models. Economics Letters. 58(1):17–29.

Pesaran, M.H., T. Schuermann & S.M. Weiner, 2004. Modeling Regional Interdependencies Using a Global Error-Correcting Macroeconometric Model, Journal of Business & Economic Statistics, 22:2, 129-162.

Peyton, M.S., Park T., and Badillo, F., 2006. Why real estate? TIAA-CREF's asset management.

Peyton, Martha S. and Lotito F., 2006. "Real Estate: The Classic Diversifying Asset" Real Estate White Paper, TIAA-CREF Asset Management, 2nd Quarter.

Piet M. A. Eichholtz, 1996. "Does International Diversification Work Better for Real Estate than for Stocks and Bonds?" Financial Analysts Journal 52, no. 1, 56-62.

Rabianski, J. S., and Black, R. T., 1997. Why Analysts Often Make Wrong Estimates About the Demand for Industrial Space, Real Estate Review, 27:1, 68–72.

Sharpe, W. F., 1964. Capital Asset Prices: A Theory of market equilibrium under conditions of risk. Journal of Finance, 425-442.

Sims C., 1980. Macroeconomics and reality. Econometrica. 48:1–48.

Sivitanidou, R. and Sivitanides, P., 1995. Industrial Rent Differentials: The Case of Greater Los Angeles Environment and Planning, 1995, 27:7,1133–46.

Taylor, John B., 1995. The Monetary Transmission Mechanism: An Empirical Framework, Journal of Economic Perspectives, n° 9, p. 11-26.

Thompson, B. and Tsolacos, S., 1999. Rent Adjustments and Forecasts in the Industrial Market, Journal of Real Estate Research, 17:1 /2, 151–67.

Vansteenkiste, I., 2007. Regional Housing Market Spillovers in the US: Lessons from Regional Divergences in a Common Monetary Policy Setting. ECB Working Paper No. 708.

Wheaton, W. C. and Torto, R. G., 1990. An Investment Model of the Demand and Supply for Industrial Real Estate, American Real Estate and Urban Economics Association Journal, 18:4, 530–47.

Wu J, C, Xia F, D., 2020. Negative interest rate policy and the yield curve. J Appl Econ. 35:653-672.

Wu, Jing Cynthia and Xia, Fan Dora, 2017. Time-Varying Lower Bound of Interest Rates in Europe. Chicago Booth Research Paper No. 17-06, Available at SSRN.

Yang J., Zhou Y., Leung W.K., 2012. Asymmetric correlation and volatility dynamics among stock, bond, and securitized real estate markets. Journal of Real Estate Finance and Economics. 45:491–521.

Yarovaya L., Brzeszczynski J., Lau C.K.M., 2016. Intra- and inter-regional return and volatility spillovers across emerging and developed markets: Evidence from stock indices and stock index futures. International Review of Financial Analysis. 43:96–114.

Websites:

- Wikipedia
- Investopedia
- RICS (Cobra)
- CoStar

Database:

- IEIF
- MSCI-IPD
- PMA
- Datastream
- BNP Paribas Real Estate
- CBRE
- Jones Lang Lasalle
- INREV
- EPRA
- RCA
- Oxford Economics
- Moody's

RÉSUMÉ

Le sujet de cette thèse est d'étudier les incertitudes et les risques concernant l'immobilier commercial au niveau paneuropéen dans les années 2004-2018. Trois chapitres traitent des possibilités de ciblage de différentes expositions à l'immobilier ; les éléments de réponse de la thèse peuvent donc intéresser de nombreux investisseurs, experts immobiliers et économistes. Le premier chapitre porte sur les sociétés foncières cotées (REITs), le deuxième sur les sociétés immobilières publiques non cotées (SCPI) et le troisième sur les investissements directs dans le secteur de l'immobilier logistique. Étant donné que ces trois méthodes d'investissement diffèrent en termes de liquidité, de volatilité et de nombreux autres facteurs, la modélisation statistique des risques est réévaluée et ajustée pour chaque risque. Le premier chapitre s'intéresse à la distribution de la volatilité de l'immobilier coté en Europe pour mieux comprendre l'impact de la propagation/absorption des chocs. Dans le deuxième chapitre, nous explorons la configuration optimale de l'immobilier non coté pour une diversification optimale. Le troisième chapitre analyse l'investissement immobilier direct en tenant compte des effets de liquidité de la politique monétaire non conventionnelle.

MOTS CLÉS

Connectivité ; foncières européennes ; diversification géographique et sectorielle ; fonds immobiliers ; modèle GVAR ; politiques monétaires non-conventionnelles ; immobilier logistique ; effets de contagion

ABSTRACT

This thesis aims at studying how the uncertainty is likely to influence the total returns of investment in commercial real estate. The period chosen from 2004 to 2018 spans both the "Global Financial Crisis", "European Debt Crisis" and the "Quantitative Easing Era". We expect to contribute to the research literature by giving some new insights regarding the investment in commercial real estate in the context of an abundance of liquidity. Each chapter will focus on a specific real estate (RE) exposure: indirect listed RE, indirect non-listed RE and direct RE. The rationale is to define the shocks which correspond to the framework of every investment exposure. For the first chapter we will study indirectly the shocks on the European REITs through the connectedness of volatility. The aim of the second chapter is to find the optimal setting of non-listed funds in order to make them shock resilient. The third chapter will focus on the spillover effects on the direct real estate by monetary policy shocks.

KEYWORDS

REITs; Real Estate Connectedness; Shocks and real estate; Unconventional Monetary policies affecting real estate; Non listed commercial real estate; Listed commercial real estate; Public and private real estate funds; Spillover effects; Real estate exposure