Logistics Real Estate Clustering: What's in it for the investor?

A Pan-European study

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Abstract. As a result of globalization, e-commerce and innovations in the logistics supply chain, investors interest in logistics real estate investments has steeply increased over the years. These are investments in buildings that take a vital component within the supply chain of firms and all require different types of building characteristics and locations. Many of these buildings are located within logistics parks, while some are stand-alone units. This thesis examines the possible benefits of buildings clustered in these logistics parks. Various performance indicators of investment returns are assessed using a hedonic price modeling approach. A first-differencing strategy is applied to control for observed and unobserved similarities among the assets. Initially, stand-alone properties are found to perform better compared to those assets. After controlling for confounding variables, stand-alone units are found not to outperform assets in logistics parks. The analysis therefore suggests that return measures should not be interpreted without accounting for the possible influence of unobserved property quality. The findings of this study are useful for investors who aim to develop the highest performing, low risk bearing portfolio in logistics real estate.

Keywords: logistics parks, hedonic price modeling, clustering, first differencing

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1. Introduction

Since the last decades, investments in logistics as an industry as well as the related real estate as an asset class have increased tremendously. Today, logistics real estate returns are high, dialogued with a low risk appetite (Prologis, 2012; Mattarocci & Pekdemir, 2017). Historically however, logistics real estate was viewed as a riskier investment class because buildings normally housed only one tenant which require tailormade facilities (Mattarocci & Pekdemir, 2017). The demand for efficiency in the supply chain has been increasing with next day delivery becoming the standard, generating a large technological innovation in the logistics industry (Savills, 2019). As a result of this evolution in the supply chain, combined with globalization, increases in consumption and retailers moving from high-streets to e-commerce via efficient distribution centers, there is a large increase in investors demand for logistics real estate as a single investment class (BNP Paribas, 2018; Buck, 2019). This increase in the logistics real estate sector as a solitary investment class enables for a relevant and still limited area of research.

Logistic real estate contains of the transportation companies, storage and warehousing and companies supporting activities for transport and logistics which all have a share in the supply chain (Lagneaux, 2008). In 2012, the logistics industry accounted for a market share of €878 billion and is expected to have increased in the consecutive years following 2012 (European Commisson, 2015)[1]. In 2015, the market share of e-commerce in Europe amounted to $480 billion (Mattarocci & Pekdemir, 2017). As the activity on the investment market for logistic real estate is increasing and less investment opportunities are supplied, various return metrics should be researched to evaluate their performance.

With logistics real estate, the distribution and storage purpose buildings facilitating the process of efficient and effective planning, implementing, controlling, transportation and storage of consumption goods as a result of consumer demand makes sure that consumer requirements are meant (Mattarocci & Pekdemir, 2017). The logistics facilities important to the supply chain can either be a warehouse, a distribution center, a fulfillment center, a manufacturing or production center. Dependent of the size of the supply chain and consumer demand the buildings can range from a facility smaller than 10,000 square meters, to properties in excess of 100,000 square meters of floor area. Logistic facilities are used for retail, B2B, B2C, transport, e-commerce and manufacturing purposes which supply to a large

[1] over other asset classes logistics real estate enjoys many benefits. For example, in the risk versus return spectrum, logistics real estate has a relatively high total return (7-8%) over a low risk (9%) as compared to offices and retail (Prologis, 2012). As an example, logistics yields in the Netherlands are under 5% and expected to compress further in the future which represents a low risk appetite (Savills, 2019).

range of customers. Within logistic properties two different tenant structures are used, a single tenant and a multitenant structure (Mattarocci & Pekdemir, 2017). Multitenant facilities are generally of high capital value in certain clustered locations and require specific investors consent and knowledge about the sector and investment, which enables for a sector specific research focus.

Logistic real estate tend to cluster in areas where an extensive amount of related business activity is located, either within the periphery or in rural areas (van den Heuvel et al., 2013). In Europe, interesting settlement clusters are, Venlo, Ruhr-Rhein and Central Poland-Lodź as these are viewed as highly attractive towards logistic operating firms (Prologis, 2017). It should be noted that there are beneficial sources relating to these settlement clusters which can be observed from either a logistics operating firm or from an investor's perspective. Agglomeration economies and their externalities have been covered extensively in research. However, as noted, logistics real estate tends to locate in clusters without a straightforward identification from a real estate investment perspective about the benefits from logistics clustering. This research will focus on the clustering benefits of real estate in logistics parks from an investor perspective which are driven by increasing market interest and the evolution in the supply chain.

As noted, there is limited literature on the investor benefits from clustering in logistics parks available. While many studies elaborate on direct and indirect real estate price dynamics and some partially cover logistics in their data subset, there is no consensus about the price dynamics (Fehribach et al., 1993; Sivitanidou, 1995; Sivitanidou & Sivitanides, 1995; Lockwood & Rutherford, 1996; Hoesli et al., 1997; Buttimer et al., 1997; Slade, 2000; Brounen & Jennen, 2009; Byrne & Lee, 2010; Beekmans et al., 2014). As an example, certain researchers find that factors like distance to the highway or the age of a building have a negative impact on the real estate price, while others are contrasting this, stating that these factors have a positive influence (Sivitanidou, 1995; Sivitanidou & Sivitanides; Slade, 2000; Beekmans et al., 2014) In addition there are contrasting views on the influence of ceiling height and amount of office space. Were some indicate that these have a positive influence on the rent per square meters are others contrasting this view (Fehribach et al., 1993; Buttimer et al., 1997). Many agglomeration studies focus on beneficial sources of clustering, however most of these are focussed on the actual users of logistic real estate, not the investors (Feldman, 1999; Sheffi, 2012; van den Heuvel et al., 2013; Krugman et al., 2014; Rivera et al., 2014). The real estate pricing dynamics should therefore be combined with agglomeration studies to assess their benefits from an investment perspective.

This research aims to connect the benefits of agglomerations and determine the beneficial sources of logistics clustering from an investor's perspective. Explanation of beneficial clustering effects from the owner's perspective relate to economies of scale (Krugman et al., 2014). An economy of scale reveals that a firm enables a competitive advantage when their production size increases so it can increase their production and lower its costs per unit (Ambrose et al., 2005). Larger firms are therefore able to save more costs. The law of increasing returns to scale ensures, within a logistics cluster, that the marginal operations cost per unit can be decreased when the total area of land or number of units is increased (Samuelson & Nordhaus, 2001). This should be beneficial in return metrics which are influenced by operating costs. Looking at the benefits of economies of scale, from a REIT perspective, these tend to benefit from this phenomenon, where a larger REIT is able to lower operation cost on its assets and increase its revenue (Ambrose et al., 2005). It should therefore be likely that a certain clustering benefit in logistics parks is visible from an investor perspective. When owning a larger set of assets within a cluster, the landlord is able to offer a more suitable set of services towards their tenants and reduce the incremental cost per unit (Evans, 2004). This optimal set of services would yield a higher efficiency in groups of properties. The increase in revenues and cost reduction are expressed within a set of different return metrics which should be assessed in order to examine the beneficial effects of clustering.

In general, real estate investment are examined using a set of different performance metrics. In this thesis a hedonic price modeling technique is used to regress a set of different investment return metrics in assessing the benefits of logistics clusters. Especially within clusters, different return metrics are necessary to help the investors decide in which assets to invest (Brueggeman & Fisher, 2011). The direct or indirect returns are able to cover the internal rate of, total, capital and income return over time and are expressed in different indexes. In addition, yields are important to determine the risk of investments in different areas (Chinloy, 1996). Finally, retention rates are generally overlooked, but are of high importance when ignoring diversification strategies and focusing on customer relations (Kusbit & Sutton, 1991).

The empirical strategy of this research relies on the hedonic pricing method established by Rosen (1974). Where a house is viewed as a set of bundled attributes and house prices can be elaborated into implicit prices for physical and locational building characteristics. Evans (2004), used the approach by Rosen in relating economies of scale towards the increased production and decreased cost when the scale is expanded. Using a multivariate regression model, the hedonics price modeling approach is used to elaborate different return metrics in logistics parks versus stand-alone units. As many investors operate on a European level and

logistics real estate varies through different cycles across European regions, a Pan-European dataset is used from a large logistics real estate investor. This study is the first study to combine agglomeration studies with logistics real estate from an investor perspective. It assesses various return metrics to determine performance characteristics of logistics parks versus stand-alone units.

This thesis is structured as follows. The next chapter will construct the theoretical framework for this research, where the choice for different performance indicators is further motivated. In addition, there are two main theoretical perspectives relating to logistics park investments defined: cluster theory and portfolio selection. Section 3 will form the empirical approach for this research where the methodology for this research is constructed. Section 4 will describe the data and analysis? The results for this research are discussed in chapter 5. Interpretation of the results can be found in the discussion in chapter 6. Conclusions will be drawn in chapter 7.

2. Theoretical Framework

An investment decision is a deliberation from the demand and the supply market viewed from an investor's perspective. This research will solely focus on the decision of the investor. The decision is based on various factors such as, where demand for certain real estate investment is high as a result of high interest for investors as well as from users. An investor uses a large set of different performance indicators where the return to risk appetite is weighted to help decide on which areas to invest in. Agglomeration of firms contribute to a large extent to increased investors demand towards certain areas. Agglomeration theory of Marshall (1890) and extended by Porter (2000) and Krugman (2014), who constructs the basis of de location preferences of firms. On the investors side, portfolio allocation, diversification and diminishing return to scale theory are important explanations in the performance of real estate located in logistics parks versus stand-alone assets. These different theories from an investor's perspective will be discussed in further detail.

2.1. The performance of logistics real estate

The performance of real estate is generally understood via a mix of indicators. Initially, it is emphasized that these performance metrics will vary among themselves because of differing agglomeration benefits and in the portfolio allocation theories. Different return indicators determine the rate an investor potentially receives on a property. In the broadest sense, the return of real estate if divided in the direct and indirect return which are interpreted as strong indicators for real estate assets. The direct return is to the rental cash flow of a property. The indirect property return relates to a long-term appreciation in the value of a

property and is affected by capital expenditures. A different, widely researched performance metric to compare properties over time and space are yields, which represents the rental income divided by the value of the property (Chinloy, 1996; Berk et al., 2015). The yield resembles a certain risk factor relating to the investment of single assets. The Internal Rate of Return (IRR) provides a long-term investment performance proposition of properties. The IRR is beneficial in the sense that it uses the Net Operating Income (NOI), where all vacancy and collection losses, capital and operational expenditures are subtracted from the rental income and is calculated over a certain investment period (Brueggeman & Fisher, 2011). Capital expenditures might occur more often in combination with volatile rental contracts and rent renewals. Customer retention rates, which relate to the ability to retain customers, and has almost no theoretical base, it serves as indicator in the long-term performance of companies (Kusbit & Sutton, 1991). Retention rates influence direct and indirect return metrics (Baum & Turner, 2004). To elaborate, retention rates enable for a secure rental income stability over time. These assets show to have a stable customer base compared to assets with lower retention rates. The aforementioned drivers behind this mix of indicators, what characteristics impact these different types of performance returns and how they relate to agglomerations of logistics and optimal portfolio allocations will be further discussed in the next paragraph.

Investment performance mentions that indicators are impacted on many economic levels. In a general meta level analysis, macroeconomic changes should not be ignored but are in a high empirical sense embedded, as a range of proxies, in these performance indicators (Szweizer, 2019). In general, the various indicators are adjusted in the data for these macroeconomic determinants and will not be discussed in full extent as they are specific across various regions and because of sample size constraints. In general, GDP growth is linked to higher property returns as it correlates with higher demand via increased manufacturing output (Thompson & Tsolacos, 1999; de Wit & van Dijk, 2003; Hoskins et al., 2004; McGough et al., 2005; Olatunji et al., 2017). Interest rates, inflation, employment ratios, population growth, income per capita and sector specific outputs are strong determinants that indicate real estate performance (Hoesli et al., 1997; Ling & Naranjo, 1997; Liow, 2006; Ling et al., 2009; Brooks & Tsolacos, 2010; Mattarocci & Pekdemir, 2017; Bouard & Lamari, 2018).

A commonly used measure in bid-rent analysis of property values is the distance to the CBD (Alonso, 1964). However, Lockwood & Rutherford (1996) find that there is no significant relationship between the distance to the CBD and the value of industrial properties. Especially with logistics real estate, where in such a complex intertwined and interlinked transport

system, distance to the CBD is less important and more related to their location within the supply chain. Only 'last mile' distribution facilities locate near the CBD (Jakubicek, 2010). Heitz et al., (2019) find that logistics real estate companies targeting specifically towards logistics (Goodman, Prologis, P3) offer standardized facilities (6000 m_2 for a warehouse) for logistics service providers. These tend to locate near the periphery of the city and contribute to the logistics sprawl. In some cases, real estate companies offer extended services and locate in prime locations in privately planned logistics parks. In industrial real estate literature, industrial facilities are predetermined for two submarkets, manufacturing or distribution. In the study of Black et al., (1997) about the pricing of industrial real estate, they evaluate the two different activities. The literature elaborates that in distribution facilities, characteristics like the cubic feet, office area, site area, dock-high doors, manufacturing wage, air-condition, if the site has access to a railroad and the condition of the property are important in pricing a logistics asset.

Beekmans et al. (2014) found that locations in areas where specialization in the composition of firms occurs is related with higher property values. In addition, their research concludes that the visibility from the highway and the region in which the industrial facility is located, have a significant impact on the value of the property. The study by Byrne & Lee (2010), extends focus by analyzing the concentration of industrial investment in England and Wales. The concentration of investments in industrial facilities are mainly in areas with a high concentration of manually skilled workers and in areas which are characterized by smaller industrial units. According to a Taiwanese study by Lin & Ben (2009), strong industrial agglomerations are related to higher land values. Location choices for logistics asset are difficult since they are negatively perceived by the public. However, public interventions are found to have a negative to no influence on land prices, where the allocation of industrial parks by local governments only leads to inefficient location choices.

2.2. How clusters are important for the industrial real estate sector

Clustering is well acknowledged and frequently researched by sociologists, planners and economists (Harrison, 1992). In the basis, the conceptual explanation of geographical, clustering relates to localization and urbanization of economies (Beckers et al., 2018). Marshall (1890) constructed the theoretical basis of understanding clusters and how agglomeration economies are formed. A cluster is defined as an area where a group of interrelated firms and institutions are connected by commonalities and complementarities which comprise to a certain locational competitive advantage (Porter, 2000). In these clusters, groups of firms operate inter-related, competitive and serve a particular customer. McCann (2013), established three ideal types of clusters that relate to the nature of interaction

between firms: pure agglomeration, industrial complexes and social networks. Memberships in these clusters can be open in a pure agglomeration and closed in an industrial complex. In industrial complexes, where most of the investment in logistic real estate occur, the relations are usually identifiable and consists of interrelated stable trading. In general, spatial agglomerations contain different characteristics of these types of clusters. Previous research has focused on establishing different location quotients that relate to the sizes of clusters when discovering a cluster (Rivera et al., 2014; van den Heuvel et al., 2014; Beckers et al., 2018). In the basis, economic clusters are determined by a share or a certain industry in an area divided by the share of employment and an area can range from regions, states, cities or other predefined area's (Krugman, 1991; van den Heuvel et al, 2014; Beckers et al., 2018). Understanding what drives agglomerations from a tenant perspective is beneficial in the sense that investors can invest in those areas where a high demand from certain firms are present.

In modern clustering theory, there are four beneficial sources accounted to a synergy of firms (Rivera et al., 2016). First, co-locating enables collaboration between firms, where companies are partnering over time to enable lower costs or achieve an improved production standard. Second, co-locating entrenches a market for value added services where firms are able to offer a wider variety of personalized goods to adjust for consumer demand. Thirdly, as a result of co-location employees' career mobility enlarges as the area is more attractive to employees as there is an increasing possibility to gain work experience and promote to higher accountability jobs. Fourthly, and partly relates to the third benefit, co-locating is a driver for further job creations. These beneficial sources can be pinpointed within the Marshall-Arrow-Romer externalities, where agglomerations increase innovation to reduce the cost of supplies or enables for specializations among firms (Glaeser et al., 1992). According to van den Heuvel et al. (2013), these beneficial agglomeration sources can be specified towards the logistics industry. First, synergy of logistic facilities provides a cooperative transport system to save costs. Second, when in a logistics cluster, firms demand short-term storage, supply of extra storage may be provided by third parties. Thirdly, synergy of logistic firms may give a sufficient scale for multimodal transport services. These benefits are constructed from a user perspective but impact investment returns, as demand in clusters should be higher because these aforementioned benefits.

According to Venables (1996), the benefits of agglomerations go beyond the beneficial externalities of labor pooling and knowledge spillover. In their constructed theory, they conclude that within agglomerations, firms would allow to pay relatively high wages. In contrast to what is expected, firms would not want to relocate as they would forgo the benefits from clustering. From an investors perspective this offers an interesting point of view of where

to invest. They indicate that firms' initial reason for clustering is because of observed and unobserved cost advantages. Additionally, the spillovers should be geographically localized. According to Ellison & Glaeser (1999), firms agglomerate because of natural cost advantages and because of natural advantages. Natural advantages relate to either labor or resource advantages. They conclude that 20% of the measured concentration can be related to these observable natural advantages. These advantages are able to supply a reduction in production costs. Reducing costs for the tenants on the production side helps to retain customers and enable for future rent increases. According to Baum & Turner (2004), in the study of the European office market show that lower retention rates are found when inflexible lease structures occur. These lease structures relate for example to "triple net" leases where all operating expenses, non-operating expenses, insurance costs, taxes, certain recurring capital outlies for repairs and internal modifications are all paid by the tenant (Brueggeman & Fisher, 2011). Especially in industrial real estate, where larger amounts of spaces are occupied a triple net lease is required.

2.3. Ideal portfolio allocation using the benefits of clustering

From a real estate investment perspective, an opposing view towards clustering should be accounted. Portfolio allocation and portfolio theory about the composition of a real estate portfolio are of importance in understanding the investment decision in logistics parks. Markowitz (1952), formed the basis of the modern portfolio Theory (MPT). This model shows the second stage of selecting a portfolio, which starts with analyzing the belief of future performance and ends with the choice of constructing a portfolio. An investor would optimize expected return relative to its volatility. Where the volatility is a measure of the variance of historical return. The measured covariance of each security can be calculated which corresponds to these historical returns. With these covariances one can measure the joint movement of securities to construct an optimal portfolio where the unsystematic risk is diversified in such a way it is absent. At each level of expected return, the Modern Portfolio Theory is used to calculate the optimal portfolio composition.

The Capital Asset Pricing Model (CAPM) is a proposed model about risk over return (Sharpe, 1964). The model is elaborates on the equilibrium tradeoff between risk and return. CAPM gives the return of an investment, which is equal to the risk-free rate plus a risk premium which is equal to the systematic risk of an investment (Berk et al., 2015). Each security carries its own independent/unsystematic risk which represents the investment unique characteristics. Increasing and diversifying the allocation of different assets enables this independent risk to be averaged out. Theory states that investors are however not rewarded

for bearing unsystematic risk as the model might imply. The beta is the only measure in the CAPM which takes account of risk.

Diversification in real estate is also of high importance. As different countries and different real estate sectors go through differing cycles (Chinloy, 1996; Wheaton, 1999). In the case when investing only in one sector, logistics real estate, to deal with cycles investments should be diversified over different countries. The former relates to a macro-economic perspective, at the micro-level, the possible benefits from a diversification view are limited. Because real estate is not subjected to daily price changes and are located in local markets with specific market conditions (Friedman, 1971). In an optimal real estate portfolio, different assets in different areas should be acquired to minimize the unsystematic risk within the portfolio. As the assets within a park share similar risk, the portfolio must be of a large enough size to diversify the unsystematic risk of all those assets across the entire portfolio of properties. From a portfolio diversification strategy, the benefits of clustering are counterintuitive from what is expected from agglomeration approaches. Instead of enabling for cost reductions, assets within a logistics park share a similar risk. There might thus be a downside towards logistics parks investments. In investment analysis, one can therefore combine all assets in that logistics park and treat it as one entity.

3. Empirical approach for industrial real estate performance park performance

To understand the differences in performance of logistics parks versus stand-alone units, this is analyzed using various measures of returns of individual assets in hedonic price models. With an OLS regression, attributes that the influence each of the performance indicators can be assessed in separate models. Returns are measured by the total return, appreciation return, income return and internal rate of return. This is in line with common investment analysis, in which usually different performance indicators are assessed to evaluate the possible investment potential in addition to yields.

The model considers Rosen's (1974) notion that the buyers and sellers interact are drivers on the market and establish in a functional relationship an equilibrium in the price of a differentiated product and its attributes. This approach establishes a price scheme where a set of attributes contributes towards the total implicit price of a property (Evans, 2004). This may then reveals how attributes influence these different returns.

Throughout the various models, a similar approach used by Daams et al. (2019) is followed. In hedonic price models, the use of fixed effects to control for certain spatial and attributional characteristics which takes account of subject-specific means is well known. Instead of using

fixed effects, this approach will implement spatial and attributional controls by first differencing the sample data. In this approach either the observed or unobserved shared similarities are cancelled out between paired assets in a country. This process is used to control for possible endogenous omitted variables and considers the sources of potential endogeneity (Gibbons & Overman, 2012). Possible sources of endogeneity are that in countries where assets are higher returning (i.e. UK and NL) are also highly regulated countries in terms of zoning. Building logistics asset in these countries are attractive investments, but to prevent a sprawl the planning permissions are strictly regulated.

Using first differencing to implement spatial fixed effects is documented to perform well in the house price-based valuation of (dis)amenities (Kuminoff et al., 2010). In the first differencing process, the model is controlled based on in-differences per country. The assets within the countries are then first-differenced based on the built year, the size, average gross passing rent per square meter and the market classification as these might endogenously impact returns (Feldman, 1999; Wheaton & Nechayev, 2005). The market classification consists of two types of distribution which serve as a proxy for the distance to the supplier market. This is relevant to observe as, for example, city distribution is located closer to the city as could be expected from basic bid-rent theory (Alonso, 1964). Closer to the CBD, where asset values are higher, higher appreciation returns are likely as the property market interest for properties there becomes more tense.

In a research design where the sample size is limited, and a standard fixed effects model would not fit well, using first differencing is of added benefit. Instead of using dummy variables in the research model, with only few observations per dummy, the fixed effects are controlled by first-differencing the data. By applying this approach the shared similarity is removed in the (un)observed characteristics and returns of properties within the same fixed effect category (Daams et al., 2019). The overall model is constructed as follows:

$$\left(R_{ap}\right) - \left(R_{bp}\right) = \beta_x(Park_{apx} - Park_{bpx}) + \sum_{k=1}^{K} \beta_k\left(X_{apk} - X_{bvk}\right) + \varepsilon_{apb} \qquad (1)$$

Where $\left(R_{ap}\right) - (R_{bv})$ is the first difference between a certain property return indicator[2] (Total return, Income return, Capital return, Internal rate of return and the Net initial Yield – see sections 3.1 to 3.5 for a discussion of each of these variables that are assessed in separate versions of specification 1) of building *a* and building *b*, which are paired for being located in the same country; *Park*

[2] The independent variables have been transformed as the inverse logit or the arcsine. Variables which showed negative observations have been transformed with the arcsine. In all other instances the inverse logit is taken. The transformations are mentioned in the regression results.

is the variable of interest, a dummy variable indicating whether the observed asset is located in a logistics park or not; $v_{apz} - v_{bpz}$ a set of different independent variables: located-in-a-park dummy; $(X_{apk} - X_{bvk})$ is the aforementioned *k*th (*k* = 1, . . ., *K*) property characteristic including structural and locational attributes as well as construction year fixed effects as well as retention rate, vacancy rate, gross passing rent and the initial acquisition costs; ε_{apvt} denotes standard errors that are spatially clustered at the country level in order to account for spatial autocorrelation in returns. Each of the variables has been first-differenced. The interpretation of estimates from such first-differences model is similar to the interpretation of those in a conventional regression model.

The inverse log in the dependent variable is taken to transform the dependent variable, which can be used for non-normally distributed proportion data ($\exp^x$ / (1 + $\exp^x$)). It is recommended to use such a logit transformation for this research reveals clustered returns between 1 > x > 0 and gives a stronger transformation for this type of data (Baum, 2008). In certain cases, with negative returns present, an inverse logit transformation would not be possible, and an arcsine transformation is applied. The variable of interest (whether and asset is located in a logistics park) can be interpreted as such that depending on the outcome of the regression model, comparing a an asset located in a park versus a stand-alone unit, the return will be x percent higher or lower. In a hypothetical example, if the regression coefficient showed a significant hypothetical number 0.532. reverting this would give a coefficient of 0.128 (LN(x)/(1+LN(x))) (McCullagh & Nelder, 1981). Interpreting the coefficient would mean if an asset is located in a logistic park, the return measure would be 12 bps higher.

3.1. Total return

As mentioned, the performance of real estate is evaluated by the direct return and indirect return. The direct return relates to the rental cash flow of a property yield. The direct return of a property is measured by certain indexes to compare the performance of properties. The direct and indirect returns are in relative form compressed in the total return and is represented by the following formula (MSCI, 2014):

$$TR_t = \frac{(CV_t - CV_{(t-1)} - CExp_t + CRpt_t + NI_t)}{(CV_{(t-1)} + CExp_t)} * 100 \qquad (2)$$

TR_t is the total return in month t;

CV_t is the capital value at the end of the month t;

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

$CRpt_t$ is the total capital receipts (including sales) in month t;

NI_t is the day-dated rent receivable during month t, net of property management costs, ground rent and other irrecoverable expenditure.

The total return is very capable in measuring performance as it combines both the capital appreciation as well as the net operating income (NOI) and capital expenditures (CapEx) of a property. The total return can be generalized as a proxy which includes both the direct and indirect return. In an America focused study by Miles & McCue (1984) about a large CREF, indicates that, industrial real estate would yield the highest return compared to other asset classes. In addition, their research concludes that, geographical allocations are linked to dominant sectors, where the performance is reflected by demand factors. For example, important logistics hubs are clustered in certain areas which are easy to reach within a national and international transportation network (e.g. distribution hubs in Venlo and Rotterdam).

3.2. Internal Rate of Return

As Itoh (2013) mentions, that the real estate market is a market where supply and demand act imperfectly. The value of real estate is an interaction between the supply and the demand market. Where the demand market acts as the proxy for willingness to pay and the supply market acts as a proxy for the sales prices. As the real estate market is imperfect, the willingness to pay and the sales price are not in equilibrium. Therefore, the return of a property over several years can be expressed by using the Internal Rate of Return (IRR), where both the direct cash flow and the indirect cash flow are combined and expressed as a required return for the investor (Caselli & Querci, 2009). A certain synergy benefit is expected in this indicator, where if the IRR exceeds the required return from an investor, an investment decision would go through. In general, the vacancy rate is low in industrial properties and is highly correlated with real estate cycles. In general, the vacancy rate is a function of the vacant stock over the total stock and reflects the supply and demand balance within an economy (Brooks & Tsolacos, 2010) The vacancy rate is an important determinant for the IRR of an asset as a period of no rental income has a large impact on short term returns of properties (Chinloy, 1996).

3.3. Appreciation Return

The appreciation return is a well-used indicator in OLS models (Ambrose & Steiner, 2017). The calculation of the appreciation returns follows similar steps as the calculation of the total return but excludes day-dated rent. It therefore differs from the total return parameter as the appreciation returns represent the indirect return of the property, excluding direct revenues.

The appreciation return uses quarterly valuations data and is calculated as follows (MSCI, 2014):

$$CG_t = \frac{(CV_t - CV_{(t-1)} - CExp_t + CRpt_t)}{(CV_{(t-1)} + CExp_t)} * 100 \quad (3)$$

CG_t is the capital return in month t;
CV_t is the capital value at the end of the month t;
$CExp_t$ is the total capital expenditure (includes purchases and developments) in month t;
$CRpt_t$ is the total capital receipts (including sales) in month t;

A research by Fehribach et al. (1993) indicate the following variables to positively influence the sales price of an industrial property: ceiling height, office space, building size, number of dock doors and if there is a single tenant occupant. In contrast, the distance to an airport and the buildings age are inversely related to the sales price. In an extension in this research area, Lockwood & Rutherford (1996), indicate that the log of the sales price of industrial buildings in their sample is only influenced by local market conditions, physical building characteristics and its location. According to their research, property characteristics relate to square meters of land, industrial space and office space. In industrial property valuation, increase in age has a negative impact on the value (Beekmans et al., 2014).

3.4. Income Return

Compared to the total return of a property the income return index calculation is based in the direct return of a property. Where the appreciation return represents the indirect return and does show a moderate change in return over time, can the income return show higher fluctuations over time. It is therefore necessary to use the income return parameter separately from the total return. The income return is calculated as follows (MSCI, 2014):

$$IR_t = \frac{NI_t}{(CV_{(t-1)} + CExp_t)} * 100 \quad (4)$$

IR_t is the capital return in month t;
NI_t is the day-dated rent receivable during month t, net of property management costs, ground rent and other irrecoverable expenditure.
CV_t is the capital value at the end of the month t;
$CExp_t$ is the total capital expenditure (includes purchases and developments) in month t;

In a study of explanatory direct return variables, there are physical and rent characteristics. Where the latter relates to the load factor and physical characteristics relate to the number of floors, building size, number of buildings and age of the property (Slade, 2000). According to Sivitanidou (1995), spatial amenities (firm's amenities, such as, access to freeway and distance to CBD, and workers amenities, such as, education quality and access to shopping facilities) influence direct office returns. In a case study of the Los Angeles area, Sivitanidou & Sivitanides (1995) indicate that firms' amenities are the most important factors determining industrial direct returns.

3.5. Yields

Interest rates among other macroeconomic risk factors, can also have a positive impact on property returns and are combined in the rent-to-price ratio. Which consists of the following (Antipa & Schalck, 2010; Jones et al., 2014):

+	*Risk free interest rate*
+	*Risk premium*
+	*Expected inflation*
-	*Expected rental growth*
	Yield[3]

Towards the relationship between the macro economy and investor's incentives, inflation is used by investors as it reflects the total return (yield) over a certain level of risk. In contrast, to elaborate how the macro economy and the micro economy are interlinked: an increase in the level of employment increases inflation and thus property price (Olatunji, 2017).

4. Data

This study uses a dataset from a large real estate investor who is active in logistic real estate throughout Europe. [redacted]

[3] Where the yield is a proxy for the risk over return for a specific property

[redacted].

Table 1 presents the descriptive table with the data used for this research. Acquisition costs are adjusted for exchange rate and are displayed in euros. The vintage year is the year the property was added to the portfolio and therefore differs from the year built. In some cases, the retention rate is above 100% as this relates to increased profits from the pool of tenants in the building.

Table 1, descriptive statistics of data

[redacted]

The focus of this research is to study logistics parks. In order to understand the investment characteristics, the definition of a park should be established first. Throughout the dataset, there are several definitions that could be used. Foremost, logistics parks are always located in a cluster, which are located in an agglomeration or other industrial focused area and are generally very accessible via roads or railways. In the dataset used, the investors fund management considers three different definitions which should be taken in consideration when analyzing logistics park. First, a logistics park is a logistics park when management have

full control of this widely defined cluster and the park is surrounded by a fence. Second, they do not have full control of the area, but own most of the buildings within that cluster. Third, it can be considered within certain zone that is specifically defined as a park by the management of the fund. In general, a park is considered when there is a synergy of three properties within a close proximity and can only be cross sectioned via a road. According to the Royal Institution of Chartered Surveyors (RICS), which monitors and promotes the highest standards in valuation of real estate internationally, when valuing properties, a premium is accounted towards a portfolio, of which they phrase as a synergistic value for collections and groups of properties (RICS, 2017).

The added value for a synergy relates to a reduction in costs, and/or an increase in revenue and/or a reduction in risk (IVSC, 2019). In valuing a portfolio, collections and groups of properties, it is important to give a clear specification of certain elements when a group is considered (RICS, 2017):

a) The buildings should be physically joined. The properties have been acquired separately, so not as a combined sale;
b) Properties which are occupied by the same entity;
c) Ownership of a number of properties will lead to an increased market share by the owner or occupier as a result of economies of scale. Savings in administration or distribution could be achieved;
d) Each separate property covers an essential share of the operation covered in a large geographical area.

Interpreting the definition by the RICS when determining a group of properties, the definition of a logistics park should contain the following elements:

Two or more physically adjoining properties, they could only be separated by a small road, which are mainly accessed by the occupiers and are owned by the same entity.

According to Sheffi (2012), a logistics park is clearly defined by their ownership and geographical property boundaries. Logistics parks are generally developed by a REIT, port/airport authority or a government agency. Within a park, an occupier enjoys benefits related to easy access to freight capacity, a wide range of transport modes and a range of special services. Special amenities relate to roads that can handle special over-weight cargo.

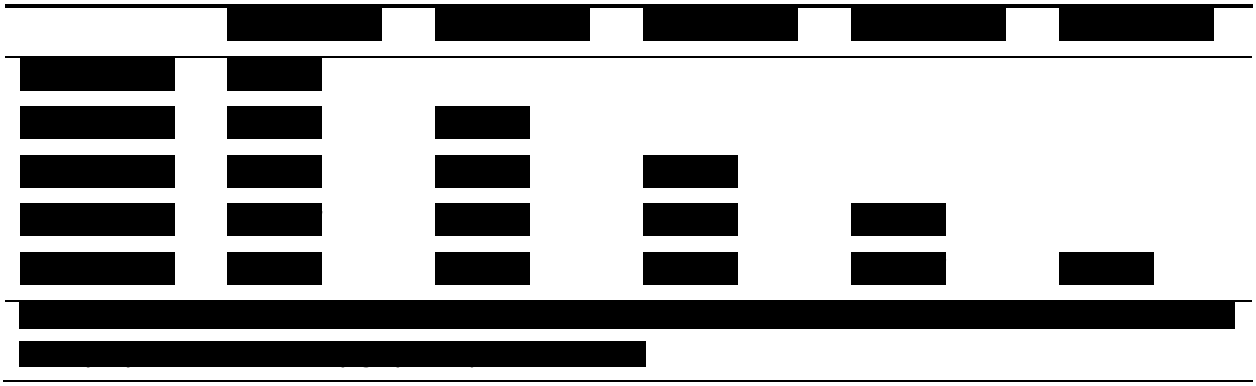
Since there is no consensus on the definition of a logistics parks. This research will use a variety of different definitions. These definitions are used instead of one to evaluate if there is a difference present between their performance metrics when a certain definition is used:

1) Three or more properties where there is full control over the area. The area is fenced and in full ownership by the investor;
2) Three or more properties, but no full control over the area. The buildings in the park are not owned completely by the investor;
3) The park considered within a certain zone and is labeled as a park by the fund management;
4) Two or more physically adjoining properties, they could only be separated by a small road, which are mainly accessed by the occupiers.

A fifth definition is added to the range where the strictest criteria are used: a park consist of a group of at least eight properties which are not necessarily physically joined but are in a close proximity to count them within a park.

To check for the correlations within the these five definitions which are ranked from least strict to most strict and to check for data validity, a Cramér's V measure of association for two binary variables (Cramér, 1946) and is shown in table 2.

Table 2, measure of association between definitions expressed by Cramér's V.



The table shows expected patterns. The bottom row is of most importance as it shows that the measure of association increases when the definition becomes stricter. Definition 4 is the less strict definition, and will have the lowest correlation with definition 5, which is the strictest definition. As the definition becomes stricter from left to right, it is likely that definition 1 will have the highest measure of association with definition 5.

5. Results

Before we turn to the regression analysis, the calculation procedures of the various metrics can be checked via a correlation matrix. As various metrics have similar input values a measure of association analysis will show if the calculation were properly calculated. Table 3

shows the correlation matrix between the various variables used in the regression. As expected, the IRR, total and capital return show high correlations, as in all calculations require similar data[4]. Interesting note relates to the correlation between the vacancy rate and the yields and the varying differences in correlations between the various return indicators.

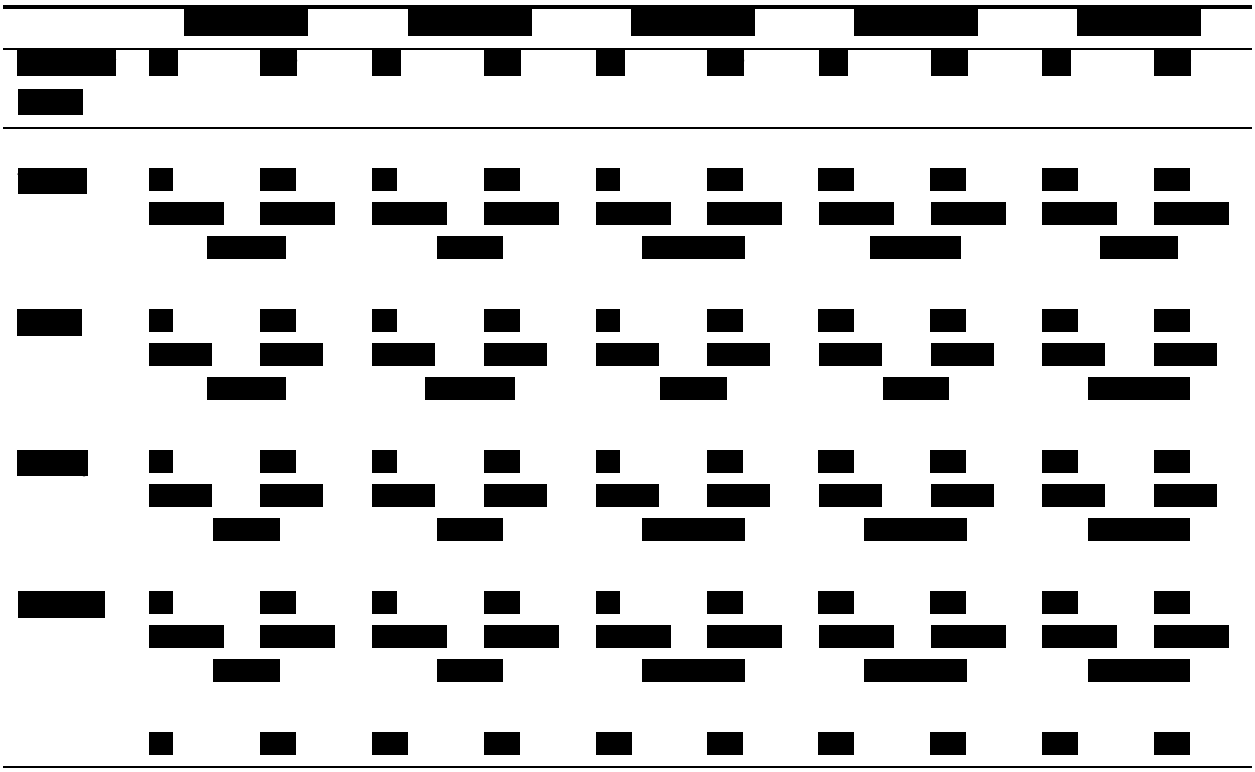
Table 3, Correlation table

To assess if there is a difference between the performance of logistics parks and stand-alone units, a two-sample t-test was run according to the different definitions. This prior analysis shows if there is an initial difference present between both groups, as in further analysis stages, the assets are controlled for in the first differencing technique. These results are expressed in table 4 and is constructed as the definitions get stricter from left to right. The table shows the average performance indicator over 24 quarters. The time period was between 2013 and 2018 and consists only of properties which are not disposed and showed a full data coverage over this time period. As shown, when the definition gets stricter, more indicators tend to significantly differ between logistics parks and stand-alone units on a 90%

[4] This serves as a robustness check for the calculations prior to the analysis

confidence interval level (yes resembles the assets located in logistics parks). This outcome is relatively surprising considering the agglomeration benefits. Except the income return and retention rates, logistics parks seem to perform less well compared to stand-alone units. The total return (TR24q) of assets within a logistics park show a significant underperformance of 87 basis points compared to stand-alone units when using the strictest definition 5. The difference increases when a less strict definition is used like definition 2, where the difference is 135 basis points in the total return. The income return (IR24q) tends to significantly differ using definition 5, with a mean outperformance of 48 basis points for logistics parks units, but no significance is found using the relatively less stricter definitions 2 and 1. The mean difference becomes significant again using the less strict definitions 4 and 3. The appreciation return (CR24q) shows a similar trend as the total return, although with mean differences increasing as the definition becomes more strict. The IRR (IRR24q) follows exactly the same trend as the capital return where the mean underperformance of logistics parks according to definition 5 is 116 basis points. Yields are higher in logistics parks, representing a higher risk profile for these assets. Vacancy rates do not show a trend across the various definitions used. Retention rates did not show a significant difference across all, except definition 5. Higher retention rates can therefore be found in larger logistics parks.

Table 4, independent two sample t-test for different definitions on various performance indicators



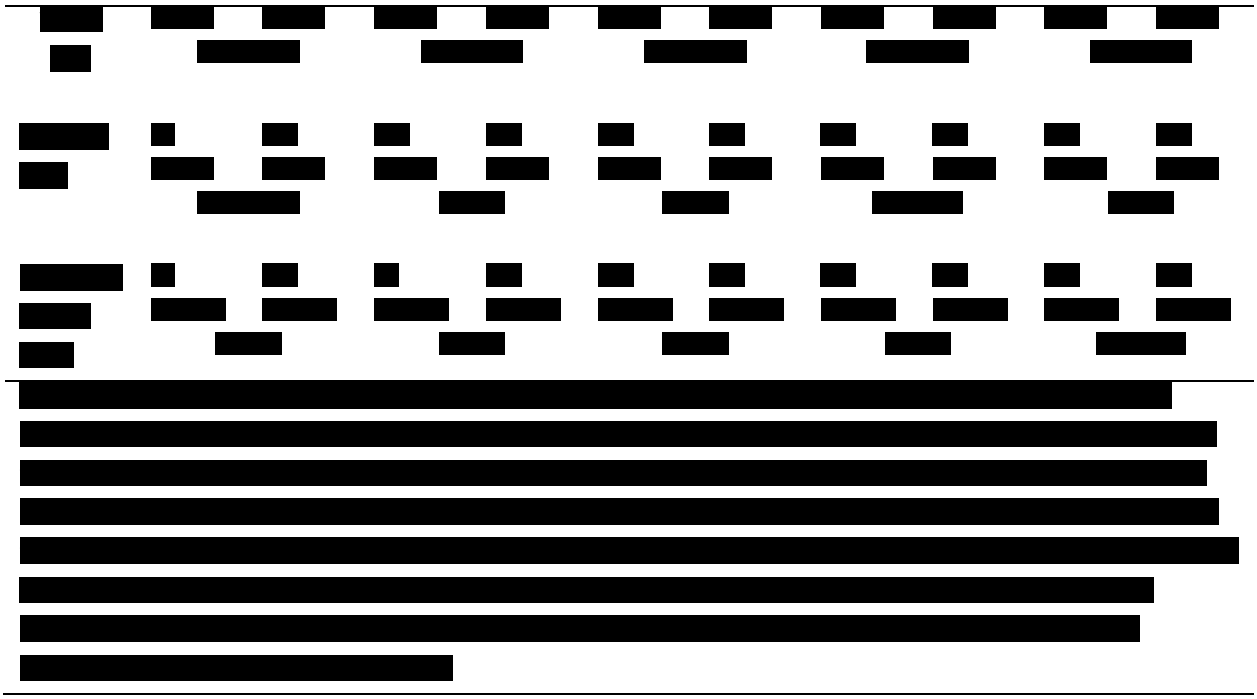


Table 5 shows the regression results of the dependent variables of various performance indicators. Model 1 regresses the total return. The retention rate shows a significant impact on the total return.

Interesting and contrasting result is the insignificant coefficient of the dummy variable logistics park. This result is opposing the outcomes of the t-test in table 4 which shows a significant difference between the total return of logistics parks versus stand-alone units. The first difference approach cancelled out observed and unobserved similarities, where explanatory power initially was likely to be present. Overall the control variables do not show a significant coefficient in model A (see Appendix). Increases in the size of the property positively increases the total return of a property and is partly explained by the strategic locations of larger sized properties.

Model 2 considers the IRR and shows similar results as the model 1, where indeed as the vacancy rate increases, the IRR over that period will decrease by 8bps as less rental income is received in a certain quarter. The CapEx over the calculated period does not show a significant impact on the IRR model. Similarly, as the surprising result of model 1, the park dummy variable shows an insignificant coefficient. As the outcome of table 4 shows, the difference between the IRR of logistics parks and stand-alone units increases when a stricter

definition is used. As the main model only shows the regression results for definition 5, appendix B through E shows the regression results for the different definitions. Similarly, as model 1, the size of the property increases the IRR of a property (See Appendix A). In addition, when the gross average passing rent increases the IRR decreases. Other first-differencing control variables do not show significant coefficients.

Table 5, robust regression results

In model 3, the capital return is regressed. From theory one would expect the capital expenditures to show a significant coefficient, which is proven by the significant coefficient in

the regression model. When capital expenditures are made, the capital value of an asset increases which increases the appreciation return. The model shows that there is a negative impact of the initial acquisition costs on the capital return of logistics properties. This model does show an insignificant dummy variable in the park coefficient, meaning that the coefficients are equal to zero. The capital return therefore does not seem to differ between assets. As with other performance metrics, shown in appendix 'Model A', the size of a property has a positive impact on the capital return. The gross average passing rent has a negative impact on the capital return of assets. Both age and the difference in market classification does not impact the appreciation return.

Based on the significant outcomes of the t-test, the income returns differed in parks versus stand-alone units. Model 4 regresses the average income return. Similarly, as the IRR, the CapEx over the calculated period does not give a significant coefficient in the model. The initial acquisition cost shows a significant decreasing effect on the income return. The park dummy variable does not show a significance in the model. In this model, a larger set of control variables show significant coefficients. In line with the other regression models, the size of a property positively influences the income return. Increases in the gross average passing rent have a positive influence on the income return. The type of market classification of city distribution has a negative and significant on the income return compared to the multi-market distribution. The income returns of properties closer to the city seem to be lower compared to assets further away from the city. This is highly influenced by the correlation with the size of a property.

Yields are regressed in model 5 and uses quarterly net initial yields from 2013 until 2018. Retention rates are not found to be of important explanatory power when modeling yields. Increasing vacancy rates tend to negatively impact yields as this implies higher risks. As the expected rental growth is deducted in the calculation of the yield, it is likely that this negative coefficient was present. Considering the aforementioned outcome of the t-test on logistics parks, a significant coefficient would be expected on the park dummy variable. However, the model shows no significant coefficient. Following the other models, the size shows a significant coefficient. However, increases in the size have a negative influence on the yields of properties which relates to larger properties being more riskier investments. The model shows that increases in the age of properties have a negative impact on yields. In line with model 4, shows model 5 a negative impact of the type of market classification to the yields of properties.

As table 5 uses a theoretical approach for the included independent variables, shows model F (See Appendix) a regression where all variables are included in all models to compare

between the performance indicators. The results show a similar conclusion as in table 5 and are therefore not discussed in detail. It shows that across all return metrics, no significance coefficient is present of logistics parks over stand-alone units. Retention rates only have an impact on the total return, IRR and income return. The vacancy rate coefficient is significant and negatively impacts all metrics. Interesting in comparison to table 5 are both the capital expenditures and the initial acquisition cost are insignificant across all metrics. Increasing in the size of the properties all have a significant positive impact on the performance indicators. The gross average passing rent only has an impact on the capital and income return. The age has an impact on the total return and yields. The type of distribution does only influence the income return and yields.

6. Discussion

Initially, in the outcomes of the t-test in table 4, among the various performance metrics, there seems to be a certain outperformance of stand-alone units over logistics parks. In addition, the t-test shows that definitions matter, where the strictest definition, 5 showed a large underperformance on many indicators of logistics parks. Instead of what would be expected according to agglomeration theory, in this basic case, an optimal portfolio diversification strategy seems to be relevant as unsystematic risk in stand-alone units is easier to diversify in a smaller portfolio. As stated from theory, investors are not compensated for bearing unsystematic risk as this can be eliminated by diversifying, stand-alone units are diversely located, the specific risk, i.e. political or operational risk have a smaller impact on a the portfolio compared to a group of properties in the same location within the same portfolio, which is expressed by the beta of a security. This study uses a wider set of performance metrics to assess the investment benefits of logistics parks to improve explanatory power which leads to the result that logistics parks do indeed underperform. The statistical model uses a first differencing approach to control for endogeneity, where it corrects for observed and unobserved similarities between the observations. The results show that there is no difference in performance present between stand-alone units and logistics parks. The main explanation for the insignificant regression results lie in the unobserved property quality. In the pre-T-test analysis, logistics parks underperformed compared to stand alone units. After controlling for the observed and unobserved property characteristics, it is possible to exclude factors like size and location as drivers for the initial underperformance. Further research could elaborate on a different set of factors when analyzing the performance difference of logistics parks and stand-alone units.

From a risk diversification perspective, the insignificant finding of a performance difference between logistics parks and stand-alone units is supported. Especially the yield and vacancy rate, which represents a certain risk indicator, will be higher in clustered ownership (Chinloy, 1996). in prospering areas, the assets in a logistics parks tend to enjoy the same benefits in catering the need of the area. In contrast, as a region where a logistics parks is located, fails to economically evolve, the assets within that cluster are exposed to the same risk. The properties will therefore share a higher risk when the returns are lacking as a result of this economic bear period. According to Capozza & Schwann (1990), who found that the total risk for house prices dynamics show a larger impact in the total risk from unsystematic risk. However, since investors are not rewarded for bearing unsystematic risk as in a large portfolio this can eliminated by holding a large share of assets. The systematic risk that is shared amongst a group of properties within the same market remains. This risk is underlined by market conditions which a whole region is exposed to. When investing solely in that region, this risk cannot be diversified and is reflected as the beta in the CAPM. Investing across numerous countries can reduce the systematic risks across the portfolio to a certain extend. However, with investing in a group of properties in one logistics parks the shared similar risk is difficult to diversify across a portfolio.

From an agglomeration perspective, the insignificant outcome of the logistics park coefficient in the model is surprising, yet to be motivated from an opposing perspective. As discussed by McCann (2013), agglomeration range in size and therefore differ in benefits, as noted by Rivera et al. (2016). Large clusters are able to share knowledge and labor as a result of the size, the opposite might be true in smaller clusters where competition among firms exists. The logistics parks in the sample might not be of a size large enough to have a significant impact on the different performance metrics. In this context, one can view the regression results using different definitions. An example is the regressions with definition 4 in appendix 'model E'. This model uses a much less strict definition compared to the main model. Comparing both models, one would expect the main model to have significant coefficients on the dummy variable. Similarly, in both models no significant coefficient is shown on the park dummy variable. Definition 5 might not represent a large enough size of enclosed properties for a difference in performance to show. When assessing the size of the units in logistics parks in relation to agglomerations, these assets are smaller than stand-alone units. As table 5 shows, indicators are positively influenced by increases in the size. This shows that these stand-alone units might form their own small agglomeration on one location, like the Google-Plex office in Silicon Valley (McCann, 2013). Stand-alone units are of a larger size and thus likely to have a higher initial return than logistics parks, which are

characterized with smaller units. With those stand-alone units there is a smaller market but attract larger operating clients to which investors are managing as clientele. In addition, as stand-alone units are also closer to the city, these tend to have the largest interest from investors. From a bid-rent explanation, rents closer to the city are higher, accompanying higher returns. It is thus necessary to extend further analysis with a larger set of variables as, despite the first-differencing strategy, as is commonly the case in these types of models there likely are remaining unobserved characteristics that explaining the differences in returns.

Another interesting result is revealed by the impact of the initial acquisition costs of properties and their influence on the appreciation and income return of properties. As suggested in literature, one would expect that capital expenditures to impact the appreciation return of a property (Ambrose et al., 2005; Ghosh & Petrova, 2016). Where, higher acquisition costs per square meter of a property implies a higher appreciation return on properties. However, the regression results in model 3 show no significance on the capital return. The initial acquisition costs per square meter of a property is shown to negatively impact the appreciation return, which is opposing literature where initial acquisition prices seem to positively influence the appreciation returns (Ambrose et al., 2005; Ghosh & Petrova, 2016).

Although, in logistics parks, retention rates seemed to only have a positive influence on the total return of properties. Initial analysis showed that the retention rates in logistics parks to be significantly higher compared to stand-alone units. Since there is limited research covering retention rates so explanations should come from practice, where in a logistics park, a landlord can offer a better package of expansion options. The initial t-test showed a large and positive outperformance of logistics parks over stand-alone units in the retention rate. This is explained by the offered expansion options available in logistics parks (Kusbit & Sutton, 1991). Within a logistics park, a landlord is able to adjust towards the needs of a tenant. Retention rates have a positive influence on direct and indirect returns, which is partly explained by the outcomes of model F (Baum & Turner, 2004). The retention rates have an impact on those direct return measures where rental income is included. Further research should extent on analyzing the impact of retention rates on real estate. Where a quantitative approach could determine the price dynamics associated with retention rates and real estate. In addition, retention rates could be linked with tenants' incentives to understand if there is indeed a better tenant relation and what underlines this relationship. Retention rates do not impact the risk appetite of properties as yields are composed of the risk-free rate, risk premium, expected inflation and expected rental growth. Retention rates do not influence the microeconomic indicators like the expected rental growth or risk towards investors.

Logistic real estate as a real estate asset class is not covered often in literature. In general, logistics are included and phrased under manufacturing and industrial real estate. Since investors show increasing interest in the logistic real estate sector, academics should start focusing research on Logistic real estate. Buildings are more than just a 'square box with a roof', as this thesis proves, the return dynamics and characteristics are more variable than one would expect. This thesis provides a first stage in the analysis of viewing agglomeration benefits from the investor's perspective. A larger dataset covering a different time period is necessary in combination with a larger set of attributes to view differences within the different real estate cycles. Observed and unobserved endogeneity is omitted but provide explanatory power as logistics parks initially underperform compared to stand-alone units. Future research could extend this analysis in combination with a certain time series analysis. As parks are developed over time and space, this time series analysis could be conducted where the development of logistics park over time are considered. This study shows that size and location are important drivers in the difference between the performance of logistics parks and stand-alone units. It provides a first step in elaborating the role of logistics within the supply chain and the impact of logistics parks. Further research should build on these finding to determine if logistics parks closer to cities perform differently compared to other parks located further away from cities. This because the so called 'last mile' distribution buildings are located closer to the city, where higher rents are charged due to high demand. This analysis will also help to determine the differences in performance of assets within the supply chain.

7. Conclusion

This thesis focuses on the relative clustering benefits in logistics parks from an investor or landlord perspective. Following theories on agglomerations, economies of scale, and optimal portfolio allocation strategy, this study hypothesized if certain investment premiums could be observed in the clustering of real estate in logistic parks. To address this hypothesis, [redacted]. Using a hedonic price modeling technique, different performance metrics are modeled. These performances comprised of different return indicators like the total return, income return, appreciation return and the internal rate of return. In addition, yields were regressed which serves as a proxy for the risk over the return. Instead of using fixed effects, this study uses a first difference approach to control for endogeneity between the assets. The findings of this study include a difference between the performance metrics of logistics parks versus stand-alone units, where stand-alone units seemed to outperform assets located within logistics parks. After controlling for observed and unobserved property

similarities, the findings show that stand-alone units did not outperform logistics parks. As assets in logistics parks do not seem to overperform, or underperform, risk is not likely to be diversified when investing in one specific property location type. Retention rates are found to be higher in logistics parks. From a consumer centricity perspective, in logistics parks, a larger set of amenities, services and development options can be provided which should have a positive impact on retention rates. The findings of this thesis are useful for investors optimizing their portfolio strategy.

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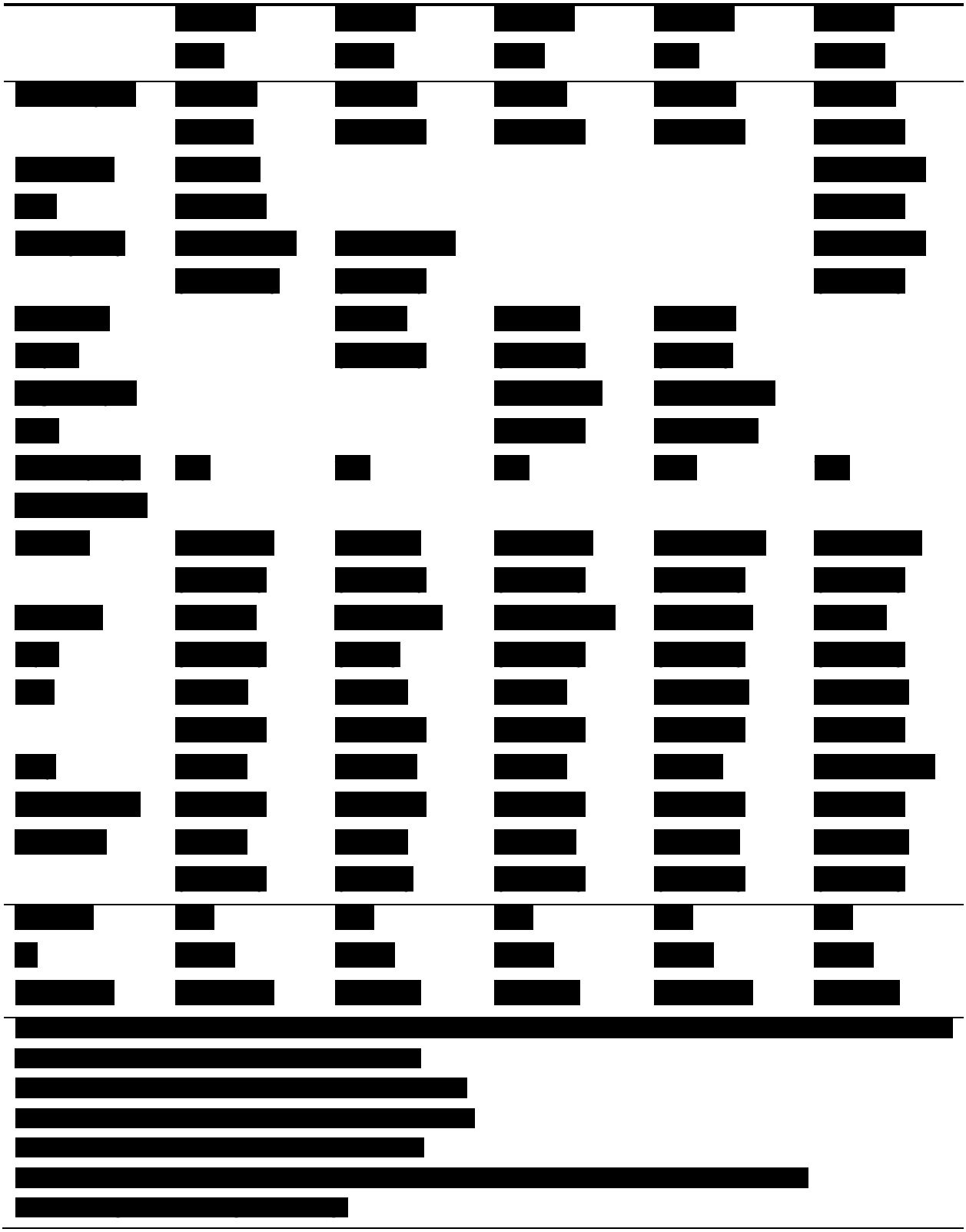
9. Appendix

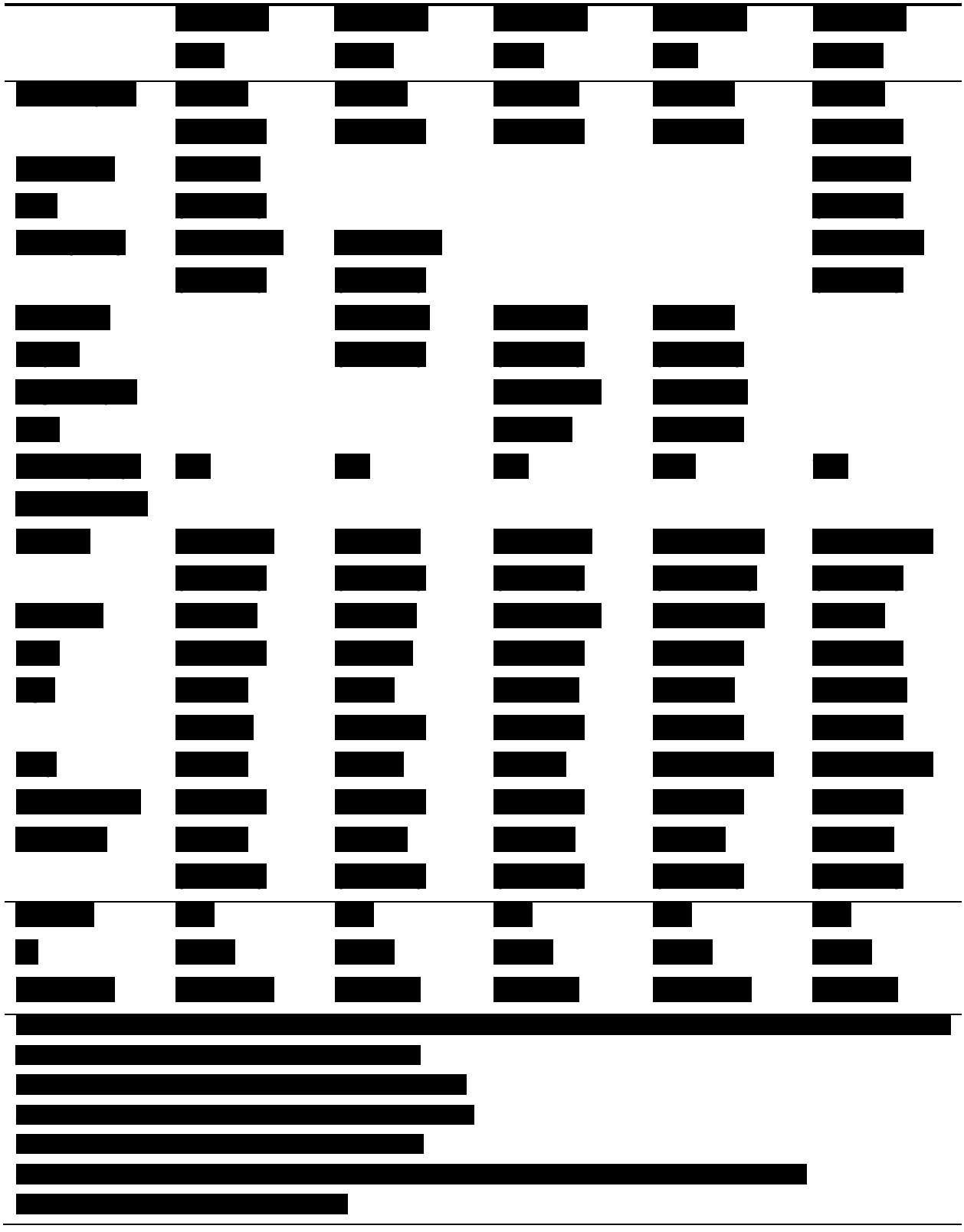
Model A, main regression according to park definition 5



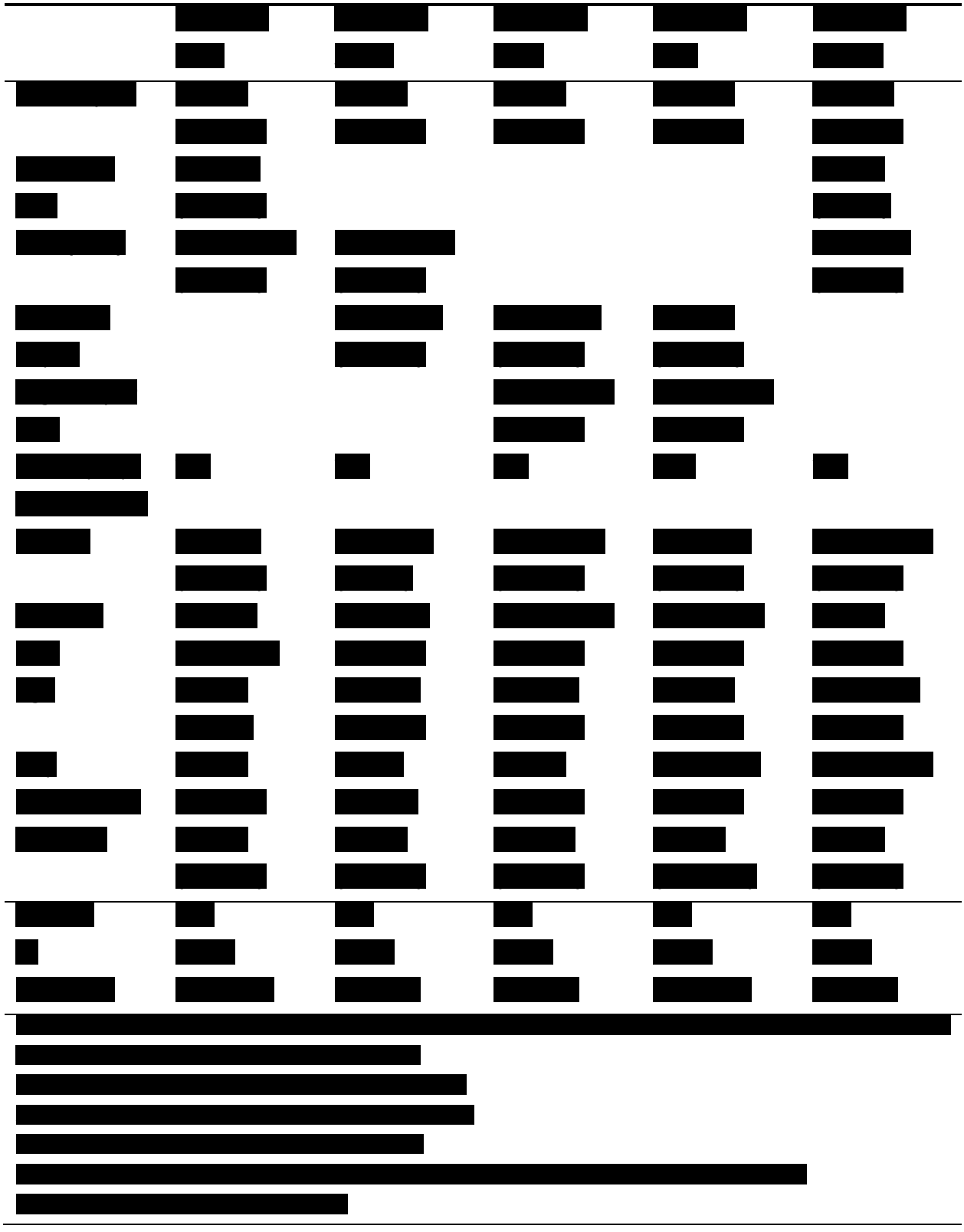
Model B, robust regression results according to park definition 1

Model C, robust regression results according to park definition 2

Model D, robust regression results according to park definition 3



Model E, robust regression results according to park definition 4



Model F, combined robust regression results