Regional Influences on Yields of Logistics Properties

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Purpose: By allocating real estate investments into the logistics sector, investors highly participate in the economic development of the respective country or city. However, the submarket is very cyclical and special economic influences – such as growing online trade and new logistic networks – affect the performance of the properties. Important parameters on the potential returns are found not only within the real estate market, but also within the global economy and the development of specific industries. This paper aims at examining factors affecting the performance of logistics properties.

Design/methodology/approach: Expected dependencies between macroeconomic factors and real estate economic indicators are examined for six major European logistics locations using econometric models, especially correlation and regression. Data series over a period of 25 years were used. The construction of an econometric model was an iterative process integrating both the statistical result and the economic causality.

Findings: An interesting result is the unequal importance of influence factors when comparing the submarkets. This leads to different regression functions and different forecasting models, which have to be configured individually for a certain submarket.

Research limitations/implications: The selection of statistical data to be examined was restricted to certain factors and time periods. Local factors and influences can provide further explanations for ongoing research.

Practical implications: The recognized dependencies between macroeconomic factors and real estate key figures can be of use for forecasting purposes. Thus, for an investment evaluation, an analytical and objectified model is created as a basis for a rational decision-making process.

Social implications: The development of regional logistics markets is also linked to socio-economic factors such as employment and income.

Originality/value: The study identifies macroeconomic indicators explaining the development of the net initial yield of European logistics markets. Using multivariant regression, individual equation systems are set up for the logistics locations under review.

Keywords: Market Analysis, Logistics Properties, Regional factors of influence, Real Estate Portfolio Management, Forecasting

Paper type: Research paper

JEL Classification: C32, C33, C35, C44, C53, L85, O21, R32, R33

1 Introduction

Logistics properties are of ever increasing importance for institutional investors. In 2016, EUR4.2bn were invested into this type of use in Germany alone, representing a year-on-year increase of 54% and a new record high (BNP Paribas Real Estate 2015: 8).

By allocating investments into the logistics sector, investors to a certain degree participate in the economic development of the respective location. The submarket, however, is quite cyclical and subject to specific influences, such as growing online trade, changing commodity prices and the global connection of goods flows.

Parameters not only of the real estate market itself, but also of the location and the economic development of certain industries have a significant influence on property values, rents and yields. The evaluation and forecast of such parameters for investment timings (sale and purchase) plays a more important role for investors than in the case of less volatile types of use such as residential or office properties.

The analysis of relevant factors is supposed to support investment-related decisions as well as revenue planning and exit scenarios. In the sense of a thesis, it is thus to be assumed that the strength of influence and the relevance of certain parameters differ among regions due to specific economic structures. Thus, either region-specific functions would have to be developed or the region-specific structure would have to be mapped as a parameter and to be integrated into the function.

2 Previous Studies

Existing empirical studies currently only occasionally focus on logistics properties. However, results from upstream and adjacent markets can be used for the development of a separate model. The evaluated studies focus on the development or variables of a model or the relevant degree of aggregation when analysing a submarket. Jäger & Voigtländer (2007) identified causal relations between total return (income and change-in-value yield) and macroeconomic influences (growth rate of gross domestic product and change-in-value yield). Spies (2009) identified a significant correlation of the development of office rents in German submarkets and macroeconomic influences, which, however, show considerable fluctuations in the submarkets under review. Differentiated regional analyses have been conducted by Liang/Wilhelmsson (2011). Ho / Muhammad (2009), among others, focussed on submarket-related and sectoral interactions.

In general, previous studies have identified distinctive dependencies between real estate key figures and influence factors at both the micro and macro level. The majority of previous studies makes use of multiple regression as an econometric estimation model. The analysis of different regional submarkets often shows heterogeneous results regarding the accuracy of the model and applied variables. Often, universal economic variables are integrated into the model, such as national interest rate develoment and the Gross Domestic Product. Econometric models integrating more than one variable to explain the target value have most significant. Previous studies show that real estate, as part of the national economic system, is generally dependant on market mechanisms with a stimulating or moderating effect on supply and demand. Known restrictions, that are to be respected, include the focus on submarkets (restrictions on the analysis of individual investments) and the necessary restriction on the number of independent variables (restrictions on integrity of influence detection).

3 Research approach

An econometric analysis is supposed to transfer theoretical hypotheses into quantitative measurable variables. The recognized dependencies between macroeconomic influence factors and real estate key figures can be of use for forecasting purposes. Thus, for an investment evaluation, an analytical and objectified model is created as a basis for rational decision-making. By means of adequate time series, the recognized causality is to be quantified, statistically estimated and thus proved (cf. Schira 2003: 535-536).

The construction of an economic model is an iterative process characterized by the reiteration of single model steps. Should certain time series prove statistically inadequate within the model specification, the economic causality to be analyzed must be called into question. For the model specification, occuring problems must be criticised, adequate model parameters must be identified and an appropriate model for the statistical quantification of input parameters must be selected.

The study aims at identifying macroeconomic indicators as explanatory variables that are in a causal relation with the net initial yields of European logisitics properties. Primarily, the study analyzes whether special indicators have the same effect on all logistics markets under review, or whether a heterogenous development must be expected due to the inefficiency of the real estate market. The determination of the interaction is quantified by means of an econometric model and is tested for significance with the help of statistical tests.

As a first step, endogenous and exogenous variables are to be defined for the specification of the econometric model. The static characteristics and interactions of the time series are examined for this purpose. For the regression model, logistics yields of selected European cargo port cities with a distinct logistics infrastructure are used. In the regression model, these yields represent the explanatory, endogenous variables. The cross-national expansion of the field of analysis primarily helps in identifying regional differences.

4 Explained variable

The knowledge of the type, origin and elicitation characteristics of the data material (cf. Winker 2010: 11 ff.) is essential for creating a model. The development of structural breaks due to the use of different data sources should thus be avoided by selecting one single data source. The used yield time series all stem from the research institute Property Market Analysis (PMA). The currently largest European cargo port markets were selected as logistics real estate markets to be used in the study. However, some cities lack evaluable market data, including Le Havre, Algeciras, Immingham und Valencia. Generally speaking, there is a lack of sufficient availability and quality of real estate data, in particular for smaller cities and geographical units. The thus increasing uncertainty area leads to the model having insufficient validity and limited forecasting possibilities (cf. Spies 2009: 116-117). Yield time series as of 1990 are available for the logistics locations of Marseille and Amsterdam, while the data acquisition of yields for Antwerp and Rotterdam only started in 1998. Yield time series for Hamburg and London are available from 1993 onwards. The lack of longer and comprehensive data series on the real estate market imposes tight constraints on statistical analysis. It is unfavourable that yields are only available on a yearly basis. Data points on a quarterly or half-yearly basis would be of advantage to statistical analysis as an increasing number of samples lead to more valid model results. Unlike stock and finance markets, real estate markets do not see data published at a daily or weekly basis. Instead, surveys are often based on a mixture of real data and expert opinions. This problem of poor data availability is one of the reasons why real estate analyses and forecasts, up to now, have been paid little attention. Further challenges include definition problems and the unclear definitions of regional markets. Economists call this problem “garbage in – garbage out“ (cf. Lange / Löw 2004: 435). The lack of sufficiently long and high-quality time series results in inaccurate analyses and forecasts. The logistics yields used are prime yields corresponding to the net initial yield of a high-quality building in the best possible location. These yields are a combination of transactions and expert opinions, as some years lack a history of transactions (cf. Property Market Analysis LLP 2014a). Specifically, modern logistics areas of more than 10,000 sq m and a scheduled letting period of 5-10 years are under review. In general, initial yields in Europe are indicated as prime yields (cf. Becher / Junius 2008: 110). A difference is to be made between gross and net initial yields, while the latter result from the actual net rental income minus non-recoverable costs in proportion to the property purchase price excluding transaction costs (cf. Brauer 2009: 430).

The following diagramme shows the available yield progressions of net initial yields for logistics properties:

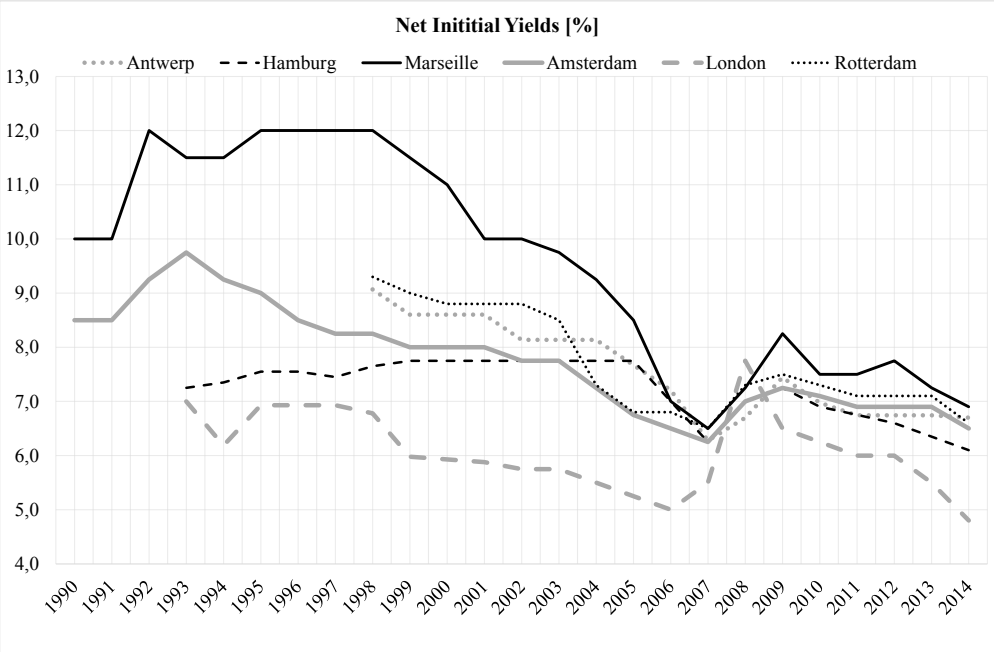

Figure 1: Net initial yields of European logisitcs centres (according to PMA)
Source: Data according to Property Market Analysis LLP (2014b).

The yields progressions of the cities under review indicate a disperse market structure with different economic developments. This suggests that the statistical characteristics of logistics property yields and the explanatory macroeconomic indicators differ in intensity depending on the respective region. Thus during the static preliminary review, the question occurs whether exogenous variables can be identified that have the highest possible explanatory power for all logistics markets under review. This knowledge could be used as a basis for a generalizing econometric model for investors analyzing logistics yields in the context of a Due Diligence.

5 Explanatory variables

In order to evaluate the region-specific yields of the respective logistics locations, indicators must be used that are able to deliver a cross-national explanation for the yields; that have a sufficient level of quality and that show high causality as explanatory variables. Exogenous variables are such factors that cannot be assigned directly to the mechanisms of the real estate market and are systematically quantifiable over a longer period of time (cf. Subroweit 2008: 77).

This particularly includes macroeconomic determinants evaluating different economic areas such as the economic environment or the situation on the labour market (cf. Maier 2007: 188-189).

5.1 Explanation of logistics yields

Successful property investments are often due to economic activities and trends in the respective region. Thus hypothetically, generated yields from the property tend to be higher in regions with a strong economic background than in regions facing economic challenges (cf. Junius 2008: 56).

For this purpose, factors must be found that have either a positive or a negative effect on the development of supply and demand on the real estate markets. Alongside the analysis of global as well as country- and region-specific influences for the explanation of real estate yields, also special features at the micro level (location, potential for alternative uses, building sections etc.) would be of particular significance. Considering that real estate is a part of the entire economic system and that thus all influences are interlinked, the creation of an econometric model is quite challenging (cf. Nitsch 2008: 153). Typical characteristics of real estate

markets, such as time-consuming production and transaction processes, cause timely divergent adjustment processes. Thus it cannot be assumed in principal, that macroeconomic influence factors, such as the Gross Domestic Product, have a direct influence on property yields in the period under review (cf. Füss 2007: 22).

With regard to the selection, processing and consideration of time lags in variables, extensive freedom for the modellation of yields exist. It is thus recommended to keep the model as clear as possible. No more than two variables should be used, the suitability of which is inspected in advance by means of test statistics, graphics and correlation analyses (cf. Subroweit 2008: 75-76; Nitsch 2008: 151). With this iterative process, appropriate variables are filtered prior to the construction of the actual model. Explanatory variables are suitable to be integrated into an econometric model provided they meet the requirements of a statistical preliminary inspection and are useful. Thus, the thesis can be proposed that demand for logistics properties, and thus their profit situation, is determined in particular by the import-export volume, changes of goods flows and the relocation of production locations (cf. Steinmüller / Mahler 2008: 249).

Some correlation hypotheses proposed in advance in order to explain property yields, however, are not verifiable due to lacking statistics and non-detectable processes. The comparison of cross-national real estate markets with only few consistent data sets of an appropriate quality is a additional challenge in this process. Primary trends in the logistics area, such as the increasing significance of online trade or the outsourcing of certain process steps, cannot be integrated directly into the model due to a lacking data basis. Thus, variables must be found that can help in generating a sufficiently reasonable analysis result. Macroeconomic variables that can be concretized by region-economic data if required thus are a good starting point for the first surveys (cf. Subroweit 2008: 83). In order to obtain a meaningful result, these time series must not show seasonal distortions or a strong trend behaviour.

5.2 Potential data sources

For cross-national analyses, it is of advantage to use data material prepared by supranational organisations such as the Statistical Office of the European Communities (EUROSTAT) (cf. Eckey / Kosfeld / Dreger 2011: 7) in order to ensure consistent definitions, surveys and calculation of data sets for the different cities and countries. When surveying time series, it is of advantage to use constant methods and definitions. For the regression model, the majority of time series is purchased from EUROSTAT. The institutions of the European Union provide high-quality databases with a focus on cross-national comparability (cf. Winker 2010: 26). However, the high time delay of data publication is quite unfavourable. For example, there currently are no statistics on the working population for 2013 in the countries under review. The Organisation for Economic Cooperation and Development (OECD) also offers an internationally comparable data collection, in particular for the aggregates of economic total account.

The supply of potential time series is supplemented by data collections of numerous institutions, although these are part of the unofficial statistics, including the ifo Institute for Economic Research and the German Council of Economic Experts. In addition, numerous data sets and index series are published by banks and economic institutions. The Baltric Dry Index (BDI) is particularly suitable as an early indicator for the analysis of European cargo port cities. The BDI is a price index for the shipping costs of important commodities. However, the historic data for analysis purposes are not free of charge. Data from the micro area can also be used in order to specify econometric analyses. Numerous real estate portals, such as the RIWIS databank by BulwienGesa, Thomas Daily, and many consulting and brokerage companies offer data sets for real estate key figures. The majority of portals, however, do not offer free access and show data sets over a relatively short period of time which are thus useless for an econometric analysis. In addition, the existing lack of transparency of the real estate market also has an effect on data volume, depth and validity (cf. Piazolo 2008: 53). In this context, the scope of the respective type of data also plays an important role. In broker reports, variables tend to differ significantly, as there are no consistent definitions of the geographical demarcation of the respective regional units and as different mathematical-statistical evaluation methods are applied (cf. Wernecke 2004: 137).

5.3 Selection of suitable time series

Europe‘s largest cargo ports are attributed a great significance for the competitiveness and economic development of the respective country, due to 74% of European imports and exports being handled across the sea. Approx. 20% of this cargo handling are made by the cargo ports of Rotterdam, Antwerp and Hamburg alone (cf. European Commission 2013: o. S.)

The Gross Domestic Product (GDP) is considered the indicator for the general economic growth of a country. It measures the value of the goods and services produced within the country. A detailed analysis of the GDP’s aggregates is recommended for the specification of logistics yields. This includes import and export volumes as well as the derived foreign trade turnover. The interest rate development on the capital markets has an increasing influence on the real estate markets. Due to increasing rates of debt capital in real estate financing, increasing interest rates result in price increases of the capital used (cf. Maier 2007: 196). Consequently, this influences the required profitability of the investment. There is no general interest rate for the analysis of the real estate market that can prove the dependency of real estate yields (cf. Junius 2008: 69).

In order to ensure a consistent survey methodology and definition, the yield of long-term government bonds according to the convergence criterion of the Maastricht Treaty of the European Economic and Monetary Union is applied. The development of the labour market is also one of the most important indicators of real estate economy (cf. Junius 2008: 63). The decrease in the unemployment rate, for example, can be considered an indication of the increased efficiency of the respective economy, which can lead to increasing consumer demand (cf. Krinner 2012: o.S).

In general, the influence of only one or several times series can be verified against the logistics property yield. It is assumed that influence is not equal in the different cities, but that demand for logistics properties is subject to (structurally conditioned) indicators and weightings typical for the respective location. A correlation and regression analysis can specify the factors that have a strong influence on yield. The following explanatory variables are used for the statistical evaluation of region-specific influences on logistics yields.

Indicator	Source	FRA	GER	NL	UK	NL	BEL
GDP, nominal	EUROSTAT	✓	✓	✓	✓	✓	✓
Commodity export	EUROSTAT	✓	✓	✓	✓	✓	✓
Commodity import	EUROSTAT	✓	✓	✓	✓	✓	✓
Employment rate	EUROSTAT	✓	✓	✓	✓	✓	✓
Unemployment rate	OECD	✓	✓	✓	✓	✓	✓
Bond yields (Maastricht)	EUROSTAT	✓	✓	✓	✓	✓	✓
Incoming orders, industry	German Central Bank	☒	✓	☒	☒	☒	☒
ifo-WK Euro area	Ifo Institute			✓			
Production volume index, manufacturing sector	EUROSTAT	✓	✓	✓	✓	✓	☒

Figure 2: Selection of explanatory model variables

6 Processing of time series

The analysis of trends and seasonal fluctuations is of great significance for a regression analysis based on time series. Particularly economic time series often show trend behaviour and thus do not meet stationarity requirements regarding the average value (cf. Eckey / Kosfeld / Dreger 2011: 227). In order to obtain economically valid statements, data is provided in the form of percentage change factors with the advantage of being independent from a certain level and thus provide more informative results when comparing two times series (cf. Winker 2010: 36). By calculating the quotients of two consecutive observation points, validity is not decreased. At the same time, the correct application of statistical procedures is ensured (cf. Poddig / Dichtl / Petersmeier 2008: 96). A stationary time series can be achieved by creating a constant yield, i.e. logarithmising the growth rate (cf. Komlos / Süssmuth 2010: 155).

$$r_t^s = \ln(\frac{x_t}{x_{t-1}})$$

Figure 3: Constant yield
Source: Auer / Rottmann (2011), p. 41.

The transformation of raw data can be achieved by creating yearly growth rates or the non-logarithmised quotient of both observed values (cf. Winker 2010: 35ff). Ultimately, a statistical procedure must verify which data formation creates stationarity and proves appropriate by applying the Augmented Dickey-Fuller-Test (ADF test). Should all transformations lead to stationarity, the selection is made based on the highest model accuracy.

7 Analysis of the different markets

In order to assess the interaction between two time series, cross-correlation is used as an analysis tool in order to determine the intensity, delayed impact and direction of impact of certain economic indicators on the applied yields of logistics properties. The leading indicator and lag characteristics of both time series are particularly essential. The following tables show the regression results of the logistics locations under review. The two exogenous variables with the largest linear and significant correlation regarding the logistics yield have been determined for every city. For the subsequent interpretation of the correlations, an adjusted coefficient of determination of 0 to 0.2 as weak, 0.2 to 0.4 as moderate, 0.4 to 0.6 as good as values above 0.6 as a high explained variation (cf. Sass 2012: 166; Cohen 1988: 24-27).

7.1 London (UK)

Through the example of the London real estate market, the following table shows the correlative relations between exogenous variables of England and the logistics yields in London. This is also done with the available exogenous variables in other cities under review.

Indicators London [UK]	**LEAD**			**LAG**	
	-2	**-1**	**0**	**1**	**2**
GDP, UK	0.15	**-0.55***	-0.23	0.21	-0.03
Commodity export, UK	0.08	**-0.60***	0.01	-0.15	0.53
Commodity import, UK	-0.11	0.11	0.27	-0.36	0.49
Employment rate, UK	0.13	**-0.68****	-0.04	-0.11	0.40
Unemployment rate, UK	-0.10	0.13	**0.31****	-0.43	0.47
Bond yields (Maastricht), UK	-0.10	0.12	0.30	-0.40	0.50
Incoming orders, industry, UK	0.20	0.60	-0.31	0.05	0.25
ifo-WK Euro area, UK	0.00	**-0.36****	0.06	0.57	-0.04

Figure 4: Cross correlation - London (UK)

Exogenous variables in fields highlighted in grey do not show a statistically significant correlation to the logistics yield and thus cannot be integrated into the regression model. The significance level of the values is labelled by */**/***. This shows a significant correlation using the t test on the safety level 85%/90%/99%. In general, variables with a lower error probability are to be preferred. In case the highest identified correlation of both variables is not significant, the period with the second highest correlation is used. In order to avoid a substantial decrease of the sample size, a maximum of two periods of delayed impact for the model is accepted. The poor data situation can be recognized based on the tabular evaluation. Only five macroeconomic indicators have a significant correlation and thus are suitable for regression analysis. Four of those five indicators are inter-dependent as they represent individual aggregates of the economic total account. The British commodity important correlates most strongly with a lead time of one period. Based on the model parameters determined by means of cross-correlation, the following regression results are achieved:

Regression output London [UK]	**logD(Bond yields, UK)**	**logD(commodity import, UK)**
Regression equation	$logD(NAR_{London})\ \hat{y} = 3{,}16 + (-1{,}19x_1) + (-0{,}16x_2)$	
Time Lead	-1	-1
Observation	19	
R	71.38 %	
R²	50.95 %	
Adjusted R²	44.81 %	
Standard error	7.38	
F value [$F_{0,99,2,16}$]	8.31 [6.23]	
T test (T ≥ t)	0.08 > 0.15	0.11 > 0.15

Figure 5: Regression output London / UK

With an adjusted coefficient of determination of 44.81%, the regression model achieves good explanatory power. The dominating variable is the commodity import of the United Kingdom with a one-year time lead compared to net initial yield. The bond yield of long-term government bonds is the second model variable as it shows a significant independence of import and thus contributes to the accuracy of the model. For the regression model, an F value to the amount of 8.31 is achieved. Thus the null hypothesis on the 1% significance level can be refused.

7.2 Hamburg (Germany)

With an explanatory variance to the amount of 72.32%, the Hamburg regression model has the strongest statistical fit of the cities under review. The exogenous variables determined by means of cross-correlation have the highest significant interaction with a time lead of 2 periods compared to the logistics yield of Hamburg:

Regression output Hamburg [GER]	**logD(Incoming orders, GER)**	**logD(Bond yields, GER)**
Regression equation	$logD(NAR_{Hamburg})\ \hat{y} = -2{,}12 + (0{,}44x_1) + (-0{,}04x_2)$	
Time Lead	-2	-2
Observation	18	
R	86.93%	
R²	75.58%	
Adjusted R²	72.32%	
Standard error	2.39	
F value [$F_{0,99,2,16}$]	23.21 [6.36]	
T test (T ≥ t)	0.15 > 0.01	0.15 > 0.03

Figure 6: Regression output Hamburg / Germany

The high explanatory power of the model primarily results from the positive correlative relation between net initial yields and incoming orders in the German industry, amounting to 0.86. This key figure is an essential early indicator of the future economic performance of a country. Almost all macroeconomic indicators in Germany have a positive significant correlation compared to the net initial yield of Hamburg logistics properties. This corresponds to the same situation as in the French logistics market in Marseille, where a change of sign within the cross-correlation table occurs with a LEAD of two years. The bond yield of German government bonds is the second model variable in the regression model. In general, other variables have a higher correlation than the bond yield. These can, however, not be considered as they fail to adhere to the basic requirements of the regression analysis due to their distinct multicollinearity.

7.3 Amsterdam (Netherlands)

The following results have been achieved for the logistics market of Amsterdam:

Regression output – Amsterdam [NL]	**logD(Commodity import rate, NL)**	**logD (Commodity export, NL)**
Regression equation	$logD(NAR_{Amsterdam})\ \hat{y} = 1{,}72 + (-0{,}59x_1) + (-0{,}37x_2)$	
Time Lead	0	-1
Observation	22	
R	68.98%	
R^2	47.58%	
Adjusted R^2	42.06%	
Standard error	3.29	
F value[$F_{0,99,2,16}$]	8.62 [5.96]	
T test (T ≥ t)	0.15 > 0.10	0.15 > 0.00

Figure 7: Regression output - Amsterdam / Netherlands

The Dutch commodity exports and import rate most strongly illustrate the course of the net initial yield with an adjusted coefficient of determination of 42.06%. It is remarkable that all macroeconomic variables under review have a negative effect on net initial yield. Thus, the continuous upswing of the Dutch economy results in decreasing logistics yields. This phenomenon can be justified by the continuously growing demand for logistics properties having a mitigating effect on net initial yield. In general, however, it must be called into question whether the increase in demand is due to the growing economic power of the country alone. The growing interest in logistics properties in the portfolios of institutional investors might also play a role due to its good diversification characteristics. The most distinctive factor might also be the permanent low-interest environment or the continuous desire for safety by a solid investment into real estate.

7.4 Rotterdam (Netherlands)

The following results have been achieved for the logistics market of Rotterdam:

Regression output – Rotterdam [NL]	**logD(Number of containers, RTM)**	**logD(GDP, NL)**
Regression equation	$logD(NAR_{Rotterdam})\ \hat{y} = 0{,}56 + (0{,}02x_1) + (-0{,}57x_2)$	
Time Lead	0	-1
Observation	15	
R	69.33 %	
R^2	48.06 %	
Adjusted R^2	39.41 %	
Standard error	3.91	
F value[$F_{0,99,2,16}$]	5.55 [3.89]	
T test (T ≥ t)	0.15 > 0.00	0.15 > 0.00

Figure 8: Regression output - Rotterdam / Netherlands

With an adjusted coefficient of determination of 39.41%, the logistics location of Rotterdam only has moderate explanatory power. The distinct multicollinearity of all exogenous variables as well as the non-significant correlations compared to net initial yield are quite challenging. This is due to the short times series including only 19 observations. The Dutch Gross Domestic Product seems to be the only variable with a significant correlation to other indicators. However, the Gross Domestic Product only has a weak correlation compared to net initial yield with a coefficient of -0.17. The number of containers of the Rotterdam sea port, generating Europe‘s largest sea cargo handling by far, shows clear interactions. The regression result is statistically validated on a 5% signficance level.

7.5 Antwerp (Belgium)

The following results have been achieved for the logistics market of Antwerp:

Regression output – Antwerp [BEL]	**logD(Number GDP, BEL)**	**logD(Employed persons, BEL)**
Regression equation	$logD(NAR_{Antwerpen})\ \hat{y} = 5{,}38 + (-2{,}09x_1) + (-0{,}39x_2)$	
Time Lead	0	0
Observation	15	
R	70.15%	
R^2	49.21%	
Adjusted R^2	40.74%	
Standard error	3.99	
F value[$F_{0,99,2,16}$]	5.81 [3.89]	
T test (T ≥ t)	0.15 > 0.00	0.15 > 0.08

Figure 9: Regression output Antwerp / Belgium

Yield surveys for Belgium's largest and Europe's second largest cargo port only are available from 1998 onwards. In contrast to other European logistics locations, the Belgian GDP has the strongest correlation with net initial yield. Due to the relatively short yield time series, a synchronism was aimed for. Thus, the number of observations does not decrease and more valid results are achieved. It can be seen that in cities with more long-term time series, the exogenous variables correlate most strongly with a time lead of 1-2 years on average. This particularly includes Marseille, Amsterdam and Hamburg. This seems plausible as economic fluctuations do not simultaneously have an effect on real estate and thus on the yield development of net initial yields. When analysing the yield development, an inflexion point is visible from 1991-1994, that started with a strong yield increase. This cyclical development changes the correlation behaviour towards economic indicators.

7.6 Marseille (France)

The following results have been achieved for the logistics market of Marseille:

Regressionsoutput – Marseille [FR]	**logD(Anleihenrendite, FR)**	**logD(Warenexport, FR)**
Regression equation	$logD(NAR_{Marseille})\ \hat{y} = -5{,}61 + (-0{,}37x_1) + (0{,}52x_2)$	
Time Lead	-1	-2
Observation	21	
R	74.37%	
R^2	55.31%	
Adjusted R^2	50.35%	
Standard error	5.84	
F value[$F_{0,99,2,16}$]	11.14 [6.01]	
T test (T ≥ t)	0.15 > 0.14	0.15 > 0.00

Figure 10: Regression output Marseille / France

The strongest explanatory power for net initial yield is achieved by the French yield of long-term government bonds and the French commodity export. Increasing bond yields lead to falling net initial yields due to the negative sign in the regression equation. This contradicts preliminary considerations that an increase in the yields of French government bonds tends to result in falling capital values and thus increasing net initial yields. However, if the correlation coefficient for both time series is calculated not on the basis of a permanent yield but on the basis of non-transformed raw data, a positive correlation occurs. A time offset of both time series and a transformation into permanent yields leads to changing signs of the correlation and regression coefficients. The determined regression equation is only valid for the use of logarithmised values. Should the trend of French bond yields and commodity export con-

tinue, this will result in continuous growth of commodity exports while the bond yield will steadily decrease. Should logistics yields be forecasted on this basis, negative values result. This result is plausible as decreasing bond yields theoretically lead to decreasing net initial yields and increasing export numbers are an indicator for economic upswing and thus an increase in demand. Thus, the signs of the regression coefficient cannot be interpretated on the basis of the regression equation for logarithmised growth rates.

8 Heterogeneous results of the submarkets under review

Both the significance test and the multicollinearity test place very tight constraints to the model creation process. Potential indicators, such as the ifo business climate index or the unemployment rate of the respective country cannot be considered due to very poor significance values regarding their correlation to the property yield. An extreme example is the Dutch logistics market in Rotterdam where almost all exogeneous variables have a strong multicollinearity, as the limit value of $-0.5 \leq 0 \leq 0.5$ is exceeded. The main reason for that is the relatively short scope of time series, as yield values are only available for the Rotterdam market as of 1998. Due to the exclusive consideration of continuous yields and time leads, the number of observations decreases further. By comparison, a considerably lower number of intercorrelations of the identical macroeconomice time series are available for the Amsterdam logistics market as a larger sample size is available. Considering the time leads and lags as well as all fixed limit values for significance and correlations, the highest explanatory powers for the respective cities are based on the following exogeneous variables:

Location (Y = Net initial yield)	**x1 (explanatory variable)**	**x2 (explanatory variable)**
Hamburg	Bond yield, GER	Incoming orders, GER
Amsterdam	Rate of commodity imports, NL	Commodity exports, NL
Rotterdam	Number of containers, RTM	GDP, NL
Antwerp	Employment rate, BEL	GDP, BEL
Marseille	Bond yield, FR	Commodity exports, FR
London	Bond yield, GB	Commodity imports, GB

Figure 11: Selection of variables for regression analysis

The heterogeneity of the single markets is shown by the selection of variables. After the cross-correlation analysis and the significancy test, different exogeneous model variables are found for every logistics location. The consideration to not integrate more than two exogenous variables into the model due to the mentioned problems is also confirmed by the regression model. In none of the cities under review did the integration of a third variable improve the explanatory power of the model. This is primarily due to an even stronger intercorrelation. Should the regression analysis be conducted by using a two-factor model, the two variables with the strongest correlation regarding the logistics yield do not inevitably lead to the highest model accuracy. In general, there is a conflict of objectives with regard to the maximisation of explanatory power to the expense of the statistical validity of the model. Thus either restraints for significance values restraints for a multicollinearity to be considered can be reduced in diverse statistical tests.

Alongside the deviating market development and investment interests of the different logistics locations, the heterogeneous market behaviour is also due to the quality of the available data material. For example, the late market survey for logistics yields for Antwerp as of 1998 leads to a lower quality of regression results. This effect is exacerbated by the different availability and survey quality of macroeconomic indicators at the different locations. A general regression model explaining the logistics yields of all cities based on the same variables can thus not be created. The yields of long-term government bonds were integrated into the model for Marseille, London and Hamburg. This confirms the theoretical considerations that interest

rates have a large influence on demand and also on the net initial yield. Undoubtedly, the explaination of logistics yields is a model that cannot be conclusively and unambiguously described by a certain number of variables. Thus, in principal, not only the economic development influences yields but also factors such as locations, technology, structure, legislation and potential for alternative uses (cf. Hofmann 2007: 729). The objective of the iterative process in the model construction thus is to filter the most important influence factors and thus to maximise the explanatory power of the model with a limited number of variables. The created model thus only represents an excerpt of reality and consequently is not able to comprehensivly represents reality.

9 Conclusion and further potential for research

The study aimed at identifying macroeconomic indicators that are able to explain the progression of the net initial yield of European logistics markets sufficiently well on the basis of their time series history. Using the multi-variant regression analysis, equation systems for the logistics locations under review were set up. The results of the regression analysis show a strong heterogeneity in comparison of the different logistics locations in Germany, France, Belgium, the Netherlands and the United Kingdom. The net initial yield of every logistics location is explained by means of different macroeconomic indicators. Thus, a generalising econometric model modelling the net initial yields of all cities with identical variables is not possible. However, the selected variables show a sufficiently good picture of the yield development of the logistics markets and can provide hints to yield dependencies in the different real estate markets.

After stabilising the different region-specific regression functions, the latter might be used in further forecast models. There is specific potential when the respective independent variables show leading parameters or can be better forecasted. A weighting of the single markets might, if necessary, also help in drawing conclusions regarding the entire European logistics market (synthetic index for analyses and forecasts). The forecast quality can be improved continuously by permanently verifying the causality of the variables used based on the actual yields. In case the net initial yields show a considerably different development than what had been forecasted, the causality of the exogeneous variables used is to be called into question. Obviously then other influence factors dominate and the variables integrated into the model only casually show a correlation in the analysis area. The regression analysis for the net initial yield in Amsterdam, for instance, exclusively resulted in dependencies by the Dutch commodity import rate and commodity exports. This is to be criticized as the dominance of other factors, such as the interst rate environment, also has an effect on yield development.

Further need for research also exists regarding the explanation of regionally different influence parameters. In case this difference can be quantified by means of a structural component (e.g. industry share, logistics structure), a cross-market regression function would be possible as well. The pursuing concretisation of the presented model is to be considered an iterative process. The models can be gradually manifested by means of continuous market observation, the development of time series and an analysis of structural breaks.

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