ERASMUS UNIVERSITEIT ROTTERDAM

# Firm relocation and the productivity levels of the Dutch regions

Master Thesis Urban, Port and Transport Economics

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## Abstract

The aim of this thesis is to investigate the current spatial pattern of firm relocations in the Netherlands and identify its relationship with the productivity levels of the Dutch COROP regions. In the first part, a descriptive analysis of firm relocations in the years 2016/2017 is conducted. The findings show that, on balance, there is no flight from the Randstad to the Intermediary zone. The thesis then examines the correlation between firm relocation and regional productivity through the application of a fixed effects model. The analysis reveals a positive relationship between firm relocation and regional productivity. Furthermore, the study identifies variations observed in this relationship when considering the employment associated with firm relocations and when looking at different industries.

## Contents

# 1. Introduction

The economic landscape of a country is shaped by numerous factors, including the emergence of new enterprises, the growth and decline of existing businesses, and the relocation of firms, which can result in the redistribution of economic activity (Pellenbarg, 2005). Yet in firm demography relocation traditionally receives less attention. This observation is noteworthy since the level of mobility exhibited by firms is frequently underestimated or overlooked. Over the past decades, there has been a consistent and significant increase in the number of firms relocating in the Netherlands. Van Dijk and Pellenbarg (2000) recorded a total of 68,000 relocated firms in 1995; however, by 2017, this figure had risen to 96,000.

The phenomenon of firm relocation holds significant importance; studies of firm migration offer valuable insights into location choice processes and contribute to the development of theories on firm relocation. Moreover, studies of firm migration are useful from a policy point of view: understanding and influencing the firm migration patterns are objectives of regional stimulation policies. In fact, according to Mariotti (2005), firm relocation is especially important from a spatial perspective, as it entails the redistribution of economic activity and offers an indication of the changing competitiveness of an economic area. However, despite the extensive literature on the causes and destinations of firm relocations, there is surprisingly little known about the actual effect of the spatial dynamics on a region its competitiveness. Considering that the spatial pattern of firm relocations can have a substantial effect on the competitiveness of a region, it is crucial to study the effects of firm relocations in the Netherlands on regional productivity.

The goal of this thesis is to identify the relocation trends of firms in the Netherlands and whether this has resulted in an enhancement of the productivity levels in the Dutch regions. Accordingly, this paper asks the question:

*What is the current spatial pattern of firm relocations in the Netherlands, and is there a correlation between these firm relocation dynamics and the productivity growth of the Dutch regions?*

Firm relocation can impact regional productivity through various mechanisms. Once a firm relocates to another region, it could enhance regional productivity in various aspects. Prominent aspects are knowledge spillovers, agglomeration effects, and an enhanced network position. However, the existing literature has not explored these aspects as potential facilitators of increased regional productivity following firm relocation. The objective of this thesis is to use longitudinal data on the Dutch Regions to address the broader question of the role of firm relocations in shaping regional productivity. To delve further into the relationship between firm relocations and regional productivity, this study will explore the impact of the employment dynamics associated with the firm relocation processes. Additionally, it will estimate the potential different relationship between firm

relocations and regional productivity across different industries. Specifically, the distinction is made between four broadly defined subsectors that are distinctive in terms of location preferences and growth potential, as identified by Van Oort (2004), These subsectors are as follows: (1) the industrial sector, (2) the distribution sector, (3) the business services sector, and (4) the other services sector.

The research contributes to the existing literature in two distinct ways. Firstly, it provides a recent overview of the firm location processes in the Netherlands, encompassing aspects such as numbers, origins, and destinations. Notably, the most recent review of these spatial patterns dates back to 2007 and was conducted by the Institute for Spatial Research (Ruimtelijk Planbureau)(Van Oort et al., 2008). The need to re-examine the spatial pattern stems from the increase in the number of proprietorships in the Netherlands. Over the past decade, the amount of proprietorships has nearly doubled, indicating a notable transformation in the firm landscape. The increase in small firms could have significant implications on firm relocation patterns, as smaller firms exhibit different relocation patterns compared to larger firms. For instance, previous research by Pellenbarg (2000) revealed that larger firms tend to relocate over shorter distances to avoid moving their staff. While smaller firms are typically managed by a single individual and tend to follow relocation patterns based on residential locations, which can involve greater distances. This research further contributes to the literature by being the first attempt to provide evidence on the relationship between firm relocation and productivity in the Dutch regions. So, this study aims to provide new insights into the role of firm relocation in shaping regional productivity in the Netherlands. By identifying the correlation of firm movements with regional economic performance, the study can contribute to the development of policies that aim to stimulate firm relocation to regions that exhibit limited regional growth and competitiveness.

The thesis is organized into 6 sections to ensure a comprehensive exploration of the topic. Section 1 introduces the topic of firm relocation and the objectives of the study. Section 2 presents the theoretical and empirical background of this thesis. Section 3 provides details on the characteristics of the data and the methodology analysis used to address the research question. The findings are presented in two distinct sections. Section 4 describes the current situation of firm relocation within the Netherlands, while Section 5 discusses the correlation between firm relocation dynamics and regional productivity. Lastly, Section 6 provides both the conclusion and the discussion.

# 2. Literature review

## 2.1 Firm relocation

The ability to adjust to new situations is a crucial aspect of operating a business entity. Business activities carried out in a particular location may be impacted by a range of factors, including market changes, customer preferences, environmental regulations and technological changes. To remain profitable, companies must adapt to these dynamic conditions and effectively manage them. Often, this involves a spatial dimension that is manifested in the relocation of business entities (P. H. Pellenbarg et al., 2002). By moving to another location a firm can benefit from more favourable conditions and therefore remain profitable. Firm relocation refers to the form of locational adjustment of a company, defined as 'the movement of an establishment from one location to another' (Brouwer et al., 2004).

To conduct research on firm relocation several distinctions should be made. The first distinction is between relocation effects and location effects. Firm relocation is different from firm location in that it considers the substitution of one location for another. The firm has a history, and this history is likely to have an influence on the eventual locational outcome of the process. This locational outcome is therefore a conditional one. Understanding the nature of these conditional effects is important for theories related to firm relocation (Brouwer et al., 2004). Another distinction is the fact that firm relocation can occur in two forms – inter-regional and intra-regional. Inter-regional relocation refers to the movement of a firm's operations from one region to another, whereas intra-regional relocation refers to the movement within a particular region. Given that intra-regional relocation does not affect firm demography within a region, this thesis will only focus on inter-regional firm relocation. This is because inter-regional relocations are the most interesting, due to the fact that they truly contribute to changes in regional-economical structures (Pellenbarg, 2005). It is, therefore, crucial to understand the factors that drive inter-regional firm relocation and the resulting effects on the regional economy. A last noteworthy point to consider is that in this thesis, the terms "migration" and "relocation" will be used interchangeably. It is acknowledged that relocation is a semantically narrower category than migration. Relocation specifically refers to the movement of a firm's operations from one location to another, while migration can refer to a broader range of movements, such as the movement of people, firms, or capital.

### 2.1.2 Inter-regional firm relocation in the Netherlands: previous research

Previous research conducted on firm relocation in the Netherlands during the 1990s revealed a pattern of firms moving away from the Randstad to the Intermediary zone. One illustration of this trend is depicted in Figure 2.1, which presents a map displaying provincial boundary crossing firm relocation during the years 1990/1991 and 1994/1995 (Kemper and Pellenbarg 1993, 1999). The map highlights that firms are leaving the provinces of Noord-Holland, Zuid-Holland and Utrecht and moving towards Flevoland, Gelderland, and Noord-Brabant. Atzema and Lambooy (1999) later rediscuss that this pattern is due to the Randstad being oversaturated with firms and people, which forces businesses to move to border regions. Conversely, Atzema and Lambooy concluded that a substantial number of relocations in 1995 and 1996 no longer moves away from the Randstad, but instead relocates within the Randstad itself. It is important to note that Kemper and Pellenbarg derived their findings by examining firms of all sizes within the industrial, retail and services sectors. In contrast, Atzema and Lambooy included firm migration in all sectors but left out migration of firms employing fewer than five persons. In 2007, the Institute of spatial research (Ruimtelijk Planbureau) conducted a study focusing on the inter-municipal movement of employment associated with firm relocations between 1999 and 2006. In the context of employment associated with firm relocations, firm size becomes more important, as larger firms tend to bring more employees with them when relocating to a specific region. The study revealed that, on balance, there was no migration from the Randstad region to the surrounding regions (the Intermediary zone). Additionally, they did not observe any substantial migration from the intermediary zone to the Randstad region (Van Oort et al., 2008).

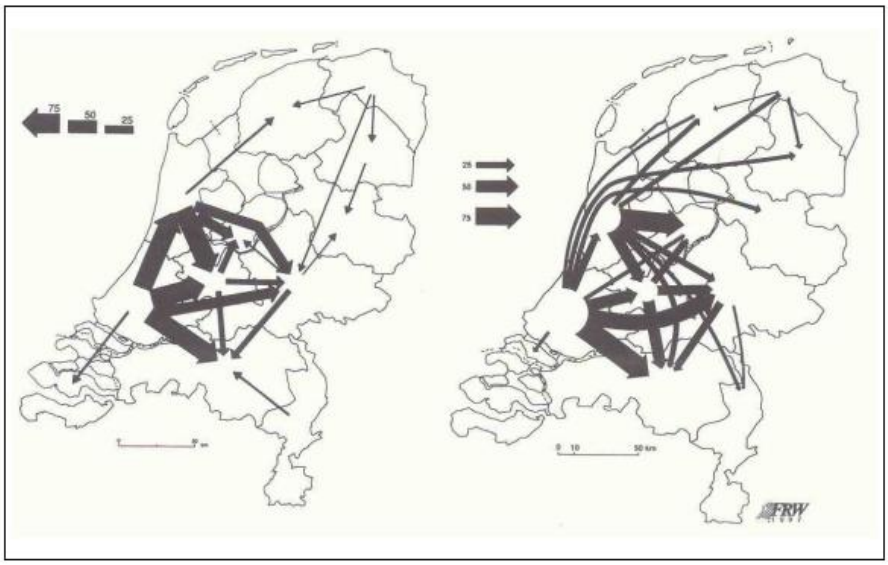

*Figure 2.1 Interprovincial firm relocation (balance) in the industrial, wholesale and business service sectors in 1990 /1991 (left) and 1994/1995 (right) on average per year. Source: Kemper and Pellenbarg 1993.*

## 2.2 Firm relocation and regional productivity

Firm relocations are influenced by a diverse range of push and pull factors that shape the decision-making process. Push factors represent the location-specific factors which prompt firms to leave their present location (Brouwer et al., 2004). These factors include the need for more suitable premises and an unfavourable business environment. While pull factors are the attractive attributes or opportunities that attract firms to relocate in a specific region (Capasso et al., 2010). These factors encompass agglomeration effects, knowledge spillovers and network effects. This discussion aims to investigate the potential effects of firm relocation driven by distinct push or pull factors on regional productivity. Specifically, three relationships will be discussed: (i) regional productivity and agglomeration economies (ii) regional productivity and network effects (iii) regional productivity and location factors.

### 2.2.1 Regional productivity, agglomeration and spillovers

Agglomeration effects in a region are recognized as one of the key determinants of firm relocations. This factor predominantly acts as a pull factor, attracting firms to regions with favourable agglomeration conditions. However, it can also function as a push factor if the current location of a firm lacks the benefits of agglomeration effects. A firm experiences agglomeration effects if it benefits from being located in regions with a high concentration of other firms. The concentration often brings about benefits more than proportional to scale, stemming from reduced search costs for labour and the presence of local indivisibles. On the other hand, it could also bring about negative externalities, including congestion and pollution. Place-based policies are often implemented to stimulate the positive externalities of agglomeration effects while battling the negative ones. Agglomeration effects can be categorized into two parts: localization effects and urbanization effects (Feldman, 1999). Localization economies occur when there are many firms of the same industry in the area, while urbanization economies occur when there are several firms from different industries in the area (Weterings & Knoben, 2013). It is noteworthy that there is a spatial limit beyond which firms can no longer benefit from agglomeration effects, consequently, the advantages for firms can only be obtained by being part of that spatial concentration (Parker & Tamaschke, 2005). As a result, there is argued that these agglomeration economies enhance regional productivity. Notably, the productivity gains derived from agglomeration economies are not merely a result of high-productivity firms naturally clustering together. Instead, these economies generate their own unique effects on regional productivity (Belussi and Hervas-Oliver, 2018).

In addition to agglomeration effects, firms could also benefit from knowledge spillovers when they are situated in close proximity to other firms. These spillovers occur because knowledge is non-rival

and imperfectly excludable (Romer, 1990). This means that firms can gain access to knowledge present in their geographical environment, thereby enhancing their innovative performance (Oerlemans et al., 2001). However, not all firms might be capable to utilize the benefits from these externalities; instead, firms might need to develop a certain level of absorptive capacity. The concept of absorptive capacity, introduced by Cohen and Levinthal (1990), refers to the specific skills or attributes of a firm to use the knowledge available in their geographical environment. Furthermore, knowledge spillovers are considered inherently localized and do not extend beyond the range of face-to-face interactions (Breschi and Lissoni 2001). Due to their localized nature, knowledge externalities are used to explain the emergence and persistence of spatial disparities (McCann and Ortega-Argiles, 2016).

### 2.2.2 Regional productivity and network position

The firm's network position refers to its relational position among the whole of actors present in the economic system in which the firm operates. This includes clients, suppliers, competitors, stakeholders, central and local public administration and consultants (Minguzzi & Passaro 2001). The interplay between a firm and other actors leads to a situation in which the firm becomes embedded in its current network position (Granovetter, 1985). This concept of embeddedness emphasizes that economic action and outcomes are shaped by the firm's specific relations and the overall structure of the network of relations (Oerlemans et al., 2001b).

Face-to-face contacts are known to be more easily maintained over short distances (Howells, 2002). As a result, the geographical location in which a firm operates plays a significant role in shaping its position within its network. The relocation of a firm causes a significant change in its geographical location, which in turn can have a substantial influence on its network position. Therefore, it is not surprising that the network position has been shown to influence a firm's behavioural options for firm relocation (Gnyawali Madhavan, 2001). Because firms that move closer to the main partners with whom they interact are likely to encounter a re-enforcing effect of their relationships with these partners. This can be viewed as a pull factor that attracts firms to relocate nearer to their key partners. On the other hand, if firms move away from their key partners, negative effects could occur in the short run. In such scenarios, firms have to make a choice between preserving their current relationships or terminate them and build new ones (Knoben, 2005)

In conclusion, the network position of a firm primarily functions as a pull factor in the firm relocation decision. Nevertheless, it could also act as a push factor in cases where the firm's current network position is inefficient due to the geographical distance from its partners. Furthermore, the relocation of a firm that aims to enhance its network position has the potential to yield regional benefits.

Besides making its own network more efficient, the firm's interaction with other actors can serve as a catalyst for attracting additional firms and investments to the region. This can create a positive feedback loop, leading to increased productivity in the region.

### 2.2.3 Regional productivity and location factors

There are several other location factors besides agglomeration economies, knowledge spillovers and network effects that are key variables in the firm migration process. Firstly, as documented in the literature, the primary push factor driving firm migration are expansion and the need for more suitable premises (see among others Klaassen & Molle 1984; Bagchi-Sen & Hayter, 2001; Pellenbarg et al., 2002; Kronenberg, 2013). Accessibility problems are push factor number two. Both of these factors also function as pull factors, although then their importance is more or less equal (Pellenbarg, 1999). Thirdly, relocation can be motivated by the desire to take advantage of favourable cost conditions elsewhere such as wage differentials, energy prices, local incentives, real estate prices, and other factors. Other notable motivations are the access to raw materials and energy sources, as well as market-oriented strategies (Brouwer et al., 2004). It is important to note that all factors could act both as push and pull factors. Lastly, in addition to the agglomeration effects and knowledge spillovers, there are also tangible benefits that firms operating in close geographical proximity may receive can access. These tangible benefits include access to specialized labour forces and reduced transport costs (Knoben & Oerlemans, 2005).

In the case of relocations driven by these location factors, the primary focus is on reducing costs rather than accessing agglomeration economies or knowledge spillovers. These lower costs allow a firm to invest in productivity-enhancing initiatives. While these relocations can improve the productivity of individual firms, they are not likely to contribute to the overall productivity of a region. In conclusion, firms moving to another region to enhance their network position, access agglomeration economies, or benefit from knowledge spillovers are more likely to improve the productivity in a region. On the other hand, firms relocating for other location factors may not necessarily improve the productivity of the region they move into.

## 2.3 Reverse causality and selection effect

Research examining the effect of firm relocation on regional productivity has two potential endogeneity issues: reverse causality and the selection effect. Firstly, reverse causality arises as regional productivity may influence firm relocation decisions, as firms may be attracted to regions with relatively high productivity levels. The possible two-way relationship complicates the analysis and raises questions about the direction of the causality. Secondly, the selection effect causes endogeneity concerns. It is possible that more productive firms may have a greater propensity to relocate, as these companies can take on the risk involved in firm movements. As a consequence, this selection effect could imply that the effect of firm relocation on regional productivity is caused by the characteristics of the firms that relocate rather than a true causal relationship. As mentioned before, the relationship between firm relocation and regional productivity has been relatively underexplored in the existing literature. Consequently, the potential reverse causality and selection issue in this context has never been addressed. So, due to the absence of definitive conclusions regarding the issue of reverse causality and the selection effect, it is crucial to approach the interpretation of the findings in this study with caution.

Using the extensive research dedicated to understanding the determinants of the firm relocation decision, insight can be provided into addressing the issue of reverse causality. When looking at the factors influencing a firm's choice of a new location, the productivity of a region has not been mentioned as a significant determinant of firm relocation. For instance, in the study of Weterings and Knoben (2013) on firm relocation determinants, regional characteristics such as specialization, innovation, accessibility and education are thoroughly examined, yet regional productivity is notably absent from their analysis. This omission can also be observed in the research by Jiang et al. (2018), who identify labour costs, market scale, land rent, transport cost and preferential policy as the primary factors for a firm to relocate in a specific area. Additionally, a literature review conducted by Balbontin and Hensher (2018) on the drivers in business location decisions, shows that the most common area characteristics include accessibility, land costs, incentives and labour costs. The absence of regional productivity as a determinant in these studies suggests that it is not a major factor in explaining a firm's new location. Instead, the relocation decision-making process is mostly driven by the specific needs of the firms. This indicates that firms focus on regional characteristics that can enhance their own productivity. As a result, the existing literature provides indications suggesting the absence of reverse causality.

The selection effect in the context of firm relocation has not been addressed in the existing literature. However, the research conducted on the factors explaining the firm relocation decisions, especially the research focusing on the internal firm factors, can provide insights into addressing this selection effect issue. One study that introduced firm growth as an internal factor in the relocation decision is the research conducted by Weterings and Knoben (2013). Their findings show that firm growth, when analysing short-distance relocations, has a positive and significant effect on the likelihood of relocating. However, when analysing inter-regional relocations, they found that firm growth does not have a significant effect on the firm relocation decision. Another study, conducted by Sleutjes and Völker (2012), provides further insights into the selection effect issue. They show that it is not firm growth that determines firm relocation, but rather the growth ambition of firms that drives the decision to relocate. This implies that it is the ambition to achieve growth rather than the actual growth that leads to firm relocations. To conclude, the research conducted by Weterings and Knoben, as well as Sleutjes and Völker suggests that more productive firms are not necessarily more inclined to relocate between regions.

## 2.4 Research questions and hypotheses

The research conducted on inter-regional firm relocations in the Netherlands reveals a lack of consensus among studies regarding the presence of a clear migration pattern. Findings range from firms relocating out of the Randstad region to firms relocating into the Randstad, or even the absence of a clear pattern altogether. Notably, no study specifically researched the firm relocation patterns in the years 2016/2017. Due to this gap in the literature, the following research question is formulated:

*RQ 1: What are the prevailing patterns of firm relocations in the Netherlands in the years 2016/2017?*

Considering the relevance of Pellenbarg's research to this study, it is expected that the same pattern will emerge. Indicating a net movement of firms away from the Randstad region towards the Intermediary zone. Furthermore, there appears to be a distinction between the patterns observed in the interregional movement of employment involved in firm relocation and the interregional movement of firms. This difference in patterns can be attributed to the size of the firms engaged in the relocation processes. Larger firms, with more employees, tend to relocate over shorter distances to avoid moving their staff. On the other hand, smaller firms, with fewer employees, tend to follow relocation patterns based on residential locations, which may involve greater distances (Pellenbarg, 2000). As a consequence, there is expected that mostly small firms move between different zones. Therefore the following hypotheses with RQ1 are formulated:

Hypothesis 1a: *There is an overall net movement of firms away from the Randstad region towards the Intermediary Zone during the years 2016/2017.*

Hypothesis 1b: *The interregional movement of employment involved in firm relocation does not indicate a shift away from the Randstad region towards the Intermediary Zone during the years 2016/2017.*

From the discussion of the literature on causes of firm relocation, three main factors for the improvement of regional productivity surface. The research focusing on agglomeration economies and knowledge spillovers shows that firms could benefit from being in close proximity to each other. These agglomeration economies are causing a unique effect on regional productivity. Studies in the field of network effects reveal that firms that move closer to the primary partners, with whom they interact, are likely to experience a re-enforcing effect of their relationships with those partners. So as the firm relocation could effect the regional economy, the first research question is formulated, followed by a first set of hypotheses that will be tested empirically:

*RQ 2: Does firm relocation correlate with regional productivity in the recipient regions?*

The discussion in the theoretical section suggests a positive relationship between firm relocation and regional productivity. Therefore the following hypotheses with RQ 2 are formulated:

Hypothesis 2a: *A positive mutation balance (inflows minus outflows) is associated with an increase in the productivity of a region.*

Hypothesis 2b: *The inflow rate of a region is positively related to the productivity levels of that region.*

Hypothesis 2c: *The outflow rate of a region is negatively related to the productivity levels of that region.*

The firm relocation rate (total flow) of a region, as measured by the inflow plus outflow of firms, can have an impact on the industry turbulence. Industry Turbulence, as defined by Audretsch and Fritsch (1996), is the movement of firms into and out of a market. The authors argued that higher industry turbulence is positively associated with subsequent growth. According to them, the intensity of the observed turbulence is an indicator of the innovative processes that renew economic activities. The potential productivity increases, resource reallocation, and competitive advantage should foster overall economic development. This insight incorporates the following hypothesis:

Hypothesis 3*: The firm relocation rate in a region is positively related to the productivity levels in that region.*

Consistent with hypothesis 1b, the interregional movement of employment and the interregional movement of firms demonstrate distinct patterns. Consequently, it is anticipated that the employment involved in firm relocation will have a different impact on labour productivity.

Hypothesis 4: *The relationship between the inflow rate, outflow rate, net flow rate and total flow rate of employment and regional productivity varies significantly when considering the context of firm relocation.*

Based on the findings in the literature, it is observed that firms belonging to various industries exhibit varying tendencies and patterns in terms of relocation (Kronenberg, 2013). These differences in relocation propensity suggest that firms of different industries impact regions in distinct ways. Building upon this understanding and the existing discourse on the causes of firm relocation and regional productivity, it is theorized that the effects of firms from different industries on regions differ significantly. On these bases, the second research question is presented, accompanied by additional hypotheses:

RQ 3: *Does the relationship between regional productivity and firm relocation differ between the four chosen industries?*

The literature review suggests a positive relation between agglomeration economies and productivity growth. There is assumed that business services, known for their involvement in innovation and knowledge-intensive activities, contribute to the creation of additional agglomeration effects. Consequently, it is expected that the productivity of a region will increase with the influx of more business service companies relocating to that region. This line of reasoning has led to the following hypothesis.

Hypothesis 5a*: The positive relation between the level of productivity in a region and the level of firm relocations into the region is stronger for business services compared to all sectors.*

Firms in traditional manufacturing industries have a moderate effect on the productivity of a region. While traditional manufacturing firms may not directly contribute to innovation and knowledge creation as much as high-tech firms, they can still contribute to the overall productivity of a region through job creation, supply chain linkages, and local economic multiplier effects.

Hypothesis 5b*: The positive relation between the level of productivity in a region and the level of firm relocations in the region is weaker for manufacturing firms compared to all sectors.*

Firms in the other services industry, such as retail, government agencies and public services, tend to primarily follow people (Van Oort et al., 2008). Therefore there is expected that these companies participate less in activities that contribute to enhancing regional productivity.

Hypothesis 5c: *The positive relation between the level of productivity in a region and the level of firm relocations in the region is weaker for other services firms compared to all sectors.*

Firms in the distribution industry prefer to establish their presence in accessible and spacious locations, benefiting from proximity to major transportation routes. This hypothesis is based on the understanding that distribution firms play a crucial role in optimizing supply chain management, thereby contributing to an enhanced network position not only for themselves but also for the firms located in close proximity. These factors, in turn, positively impact regional productivity levels.

Hypothesis 5d: *The positive relation between the level of productivity in a region and the level of firm relocations in the region is stronger for distribution firms compared to all sectors.*

# 3. Data and methodology

## 3.1 Introduction

The literature review demonstrated that firm relocation is a crucial factor in the Netherlands that significantly affects the regional economy. The subsequent section of this thesis is to evaluate the firm relocation patterns in the Netherlands and to identify the correlation between firm relocations and regional productivity in the Netherlands. Section 3.2 will elaborate on the data and variables used in the empirical methods, while Section 3.3 will describe the empirical analysis adopted in the estimation procedure.

## 3.2 Data

This study employed one dataset to investigate the relationship between firm relocation and regional productivity in the Netherlands. The dataset covers data on all Dutch COROP regions (NUTS 3) from 2012 to 2016. This period is selected due to the unavailability of data on firm establishments beyond this period. The NUTS 3 level are small regions defined by the European Union for the purpose of conducting specific diagnoses. The main reason for this level of analysis is due to the fact that it provides the most comprehensive and detailed information available.

The information for empirical analysis on firm relocation stems from the LISA foundation. LISA is a database containing micro-data on all establishments in the Netherlands where paid work is performed. The core data for each establishment have a spatial component (address data) and a socio-economic component (employment and economic activity). The data on the other relevant variables are retrieved from different databases. Most of the data on the Dutch regions originate from Eurostat, a publicly available database provided by the European Union providing all sorts of information. Other data on the Dutch regions originate from the Central Bureau of Statistics (CBS) of the Netherlands and the Organisation for Economic Co-operation and Development (OECD).

### 3.2.1 Variables

To dependent variable of this study is Labour productivity. Labour productivity is measured as the gross value added per worker in research question 2 and as the gross value added per labour unit in research question 3. A labour unit is calculated by converting all jobs (full-time and part-time) to full-time jobs. The independent variable of interest is firm relocation, defined as a company possessing a different (4-digit) postcode number in year t+1 as compared to year t. This approach allows the identification of relocated firms at the individual level, and the resulting data on individual firms were subsequently aggregated to the COROP regions and provinces in the Netherlands. To assess the

effect of firm relocation on competitiveness, this study uses four different measures of firm relocation, as outlined in Table 3.1: total flow, net flow rate, inflow rate and outflow rate.

In order to account for the impact of variables that change over time, the econometric analysis includes the factors capital-labour ratio (CAPLAB_RATIO), the concentration of human capital (HCAP), stock of technological capital (TECH), the Herfindahl index (HERFINDAHL) and the density (DENSITY). The capital-labour ratio in a region is measured by the regional capital stock divided by the total employment in that region. It is found that capital deepening, an increase in the proportion of the capital stock to the stock of labour, plays a significant role in explaining productivity differences at the regional level. Regions with a relatively high capital-labour ratio are associated with more capital-intensive production and therefore can be expected to yield higher growth. The main explanation for this is that new technologies are to a large extent more capital-intensive than older technologies (Christopoulos and Tsionas 2004). The variable stock of technological capital measures the Patent Applications in each region. The rationale is that the technological stock of a region enhances the production and diffusion of innovations in that particular region, and therefore promotes productivity growth. However, upon examination of this variable in the dataset, it was found that it exhibits limited variation over time, and therefore excluded from the model. Nonetheless, it has been included as a interaction variable with the capital-labour ratio. According to Wolff (1991), there exists a interaction effect between capital growth and technology growth. This relationship is partly attributed to the fact that a high capital-labour ratio is necessary to put new inventions into practice. The variable stock of human capital is proxied by the share of inhabitants in tertiary education divided by the number of inhabitants between 18 and 28 in a COROP region. There is argued that the level of education drives growth because it increases the ability to adapt and implement existing technology or to create new technologies (Lucas, 1998). The degree of competition is controlled for by the Herfindahl index, calculated by squaring the share of each industry in the region and then summing the resulting numbers. High values of the Herfindahl index indicate that the regional industry is concentrated, that is, the competition is low. The sign of the coefficient for Herfindahl will help to judge whether competition increases or decreases growth. Lastly, the variable density is measured by the number of people per squared kilometre. The effect of urban density on regional productivity is generally positive due to factors such as improved infrastructure and agglomeration effects.

Table 3.1. Variables used in the analysis

| **Variable** | Definition |
|---|---|
| **LAB_PROD** | Gross Value Added (GVA) |
| **Inflow_rate** | Proportion of firm relocations into the region to the total stock of firms in that region |
| **Outflow_rate** | Proportion of firms moving out the region to the total stock of firms in that region |
| **Netflow_rate** | Inflow minus outflow of firms in a region to the total stock of firms in that region |
| **Totalflow_rate** | Proportion of firm relocation to the total stock of firms in a region |
| **TECH** | Technological capital of a region |
| **HCAP** | Human capital of a region |
| **CAPLAB_RATIO** | Ratio of regional capital stock (K) to employment (L) |
| **HHI** | Herfindahl index |
| **DENSITY** | The number of people per square meter |

## 3.3 Methodology

The first part of the analysis provides a comprehensive overview of the current situation of firm relocation within the Netherlands between 2016 and 2017. It specifically examines the movements between different geographical layouts, including zones, the provinces, and the COROP regions. The zones are based on the zonation framework used by Wagtendonk and Rietveld (2000) and consist of the Randstad, The intermediary Zone, and the Periphery. The zonation (Table 1 of the appendix) of this paper in 2000 is still relevant, as there have been limited changes in the disparities among these regions. Moreover, the analysis delves into the relocation patterns observed in four distinct industries, namely: (1) Industry, (2) Distribution, (3) Business Services, and (4) Other Services. An

overview of the division of these subsectors is shown in Table 2 in the Appendix. Furthermore, a differentiation is made between large firms (with 10 or more employees) and small firms (with fewer than 10 employees). Lastly, particular attention is given to the employment involved in the relocation process.

This descriptive analysis is used to gain valuable insights into the dynamics of firm relocation and aims to address the research question while testing the associated hypothesis. There is hypothesised that there is an overall net movement of firms away from the Randstad region towards the intermediary zone. Furthermore, it is hypothesised that the interregional movement of employment involved in firm relocation does not indicate a shift away from the Randstad region towards the Intermediary Zone.

In the second part of the analysis, a fixed effect model is used to analyse the relationship between interregional firm relocation and regional productivity. Since Panel data is used, some variables need to be added to the model to control for time-invariant factors that may affect the flow of firms between regions. In this economic specification, there is controlled for human capital, the Herfindahl-Hirschman Index, the capital-labour ratio, density and a interaction variable between the capital-labour ratio and the technological stock. The estimated equation becomes:

$$Yit = \beta 0 + \beta 1(Inflow\_rate\_it) + \beta 2(CAPLAB\_RATIO\_it) + \beta 3(HCAP\_IT\_it) + \beta 4(HHI\_it) + \beta 5(DENSITY\_it) + \beta 6(TECH_{it} * CAPLAB\_RATIO) + \varepsilon it \quad (1)$$

where Yit refers to the productivity levels of the ith region in time period t; Inflow_rate is the proportion of firms that move into region I at time period t; $CAPLAB\_RATIO\_it$ is the (log of the) capital-labour ratio in region i in time period t; HHI_it is the degree of industrial concentration/diversification in region i at time period t; HCAP_IT_it is the human capital of a region i at time t; DENSITY_it is the density in region i at time period t; TECHit*CAPLAB_RATIO_it represents the interaction term between to the technological stock and the Capital Labour ratio in region i at time period t. The working hypothesis for this part of the econometric analysis is that a region that has a higher inflow rate of firm relocations exhibits higher levels of productivity.

In Eq. (1) firm relocation is estimated as the inflow rate in a COROP region. In order to evaluate the impact of the outflow rate, firm relocation rate and mutation balance on regional productivity, a minor modification to equation (1) is made. Specifically, in equation (2) Inflow_rate is replaced by

Outflow_rate which represents the proportion of firms moving out of region i to the total number of firms in region i at time t. It is expected that a higher outflow rate is associated with a lower productivity. In equation (3) Inflow_rate is replaced by Netflow_rate, which is the mutation balance of firm relocations (inflows minus outflows) in region i in time period t. The working hypothesis for this part of the econometric analysis is that a positive mutation balance is associated with an increase in productivity. Lastly, Inflow_rate is replaced by Totalflow_rate which represents the proportion of total firm relocations (both inflow and outflow) to the total number of firms in region i at time t. It is anticipated that regions with a relatively higher firm relocation rate will exhibit higher levels of productivity.

In order to compare the relationship between firm relocation regional productivity with employment dynamics of the firm relocation process and regional productivity the inflow rate, outflow rate, total flow rate and net flow rate will be replaced by their employment counterparts. The same formula as equation 1 will be used, with certain modifications. Specifically, equation 5 replaces Inflow_rate with Inflow_rate_Emp which represents the proportion of employment moving into region i to the total employment in that region at time t. In equation 6 Outflow_rate_Emp is used to represent the proportion of employment moving out of region i to the total employment in region i at time t. Additionally, equation 7 incorporates Netflow_rate_Emp, which is the mutation balance of employment (inflows minus outflows) in region i in time period t. Lastly, in equation 8 Totalflow_rate_Emp is introduced, representing the proportion of total employment movements (including both inflow and outflow) to the employment in region i at time t. It is anticipated that the relationship between employment dynamics and labour productivity will be significantly different comparing it to the context of firm relocation.

In the last part of the analysis, the potential different effects of the inflow of firms belonging to various industries on regional productivity will be estimated. Specifically, a comparison will be carried out between four sectoral models and the total model. The sectors that will be included are industry, distribution, business services and other services. It is hypothesized that regions with a relatively higher inflow rate of firms in the business services or distribution sector will demonstrate higher levels of productivity.

# 4. Firm relocation in the Netherlands: the current situation

## 4.1 Firm relocations in the Netherlands

In 2017, the Chamber of Commerce in the Netherlands registered a total of 96,000 firm relocations, including movements within and between the COROP regions. When only considering the movements between the different COROP regions, the number of firm relocations amounted to 18,000, which accounts for less than 20% of all firm moves. Furthermore, only considering the interprovincial movements, the number of firm relocations is narrowed down to approximately 11,000. These findings are presented in Table 4.1, highlighting that firm migration is primarily short distance, with only a small minority of firms covering larger distances. Nonetheless, inter-regional moves are particularly interesting, as they have the greatest impact on regional economic structures (Pellenbarg, 2005).

Table 4.1 Proportion of movements between different geographical layouts

| | Within | Between |
|---|---|---|
| Province | 88.87 | 11.13 |
| COROP-region | 81.2 | 18.80 |
| N | 96349 | 18117 |

The Netherlands can be divided into three distinct zones based on their level of economic activity. These zones consist of the Randstad, the primary hub of economic activity, as well as the intermediary zone and the periphery. Table 4.2 provides data on the proportion of firms that move between zones. Looking at Table 4.2 there can be confirmed that on balance there is no flight evident from the Randstad to the Intermediary zone. On balance 0.29 percent (2.25 – 1,96) of the moves are more often from the Randstad to the Intermediary zone than the other way round.

Table 4.2. Proportion of firms that moves between zones. in %.. 2016

| | Randstad | Intermediary | Periphery | Total | N |
|---|---|---|---|---|---|
| Randstad | 45,65 | 2,25 | 0,75 | 48,65 | |
| Intermediary | 1,96 | 32,09 | 0,76 | 34,80 | |
| Periphery | 0,72 | 0,84 | 15,00 | 16,55 | |
| Total | 48,32 | 35,17 | 16,51 | 100 | 96349 |

## 4.2 Firm relocation pattern

Table 4.3 provides data on the size of inter-regional firm migration in terms of the balance between in- and outgoing migrations in 2016/2017. Notably, the metropolitan areas in the Randstad region exhibit relatively high levels of firms moving in and moving out of the region. Particularly, the COROP regions Groot-Amsterdam (Amsterdam) and Utrecht (Utrecht) appear as major hotspots, followed by

agglomeratie's Gravenhage (Den Haag) and Groot-Rijnmond (Rotterdam). However, a closer examination of their migration balances shows that most of the COROP regions in the Randstad experience a higher outflow of firms compared to their inflow. Mainly the COROP region Groot-Amsterdam has a particularly high migration deficit. Additionally, Utrecht, Agglomeratie Leiden en Bollenstreek and Delft en Westland experience a loss of firms. However, it should be noted that not all COROP regions in the Randstad exhibit migration deficits, with Groot-Rijnmond being an exception as it attract a substantial amount of firms.

Overall, the net winners in the long-distance migration process are the provinces Gelderland and Overijssel, which are part of the Intermediary Zone and are relatively close to the Randstad. Specifically, the COROP region the Veluwe in Gelderland experiences a relatively high influx of firms, while the COROP region Arnhem/ Nijmegen surprisingly display a migration deficit. The more peripheral provinces, such as Groningen and Limburg, have negative migration balances, which may be due to their greater distance from the Randstad. These provinces appear to be less involved in the national economic redistribution scheme.

Table 4.3. Inter-regional firm migration in terms of the balance between in- and outgoing migrations in 2016/2017

| *COROP region* | *Migration In* | *Migration Out* | *Balance (In-Out)* |
|---|---|---|---|
| *Groningen* | 99 | 79 | 20 |
| Oost-Groningen (CR) | | | |
| Delfzijl en omgeving (CR) | 30 | 62 | -32 |
| Overig Groningen (CR) | 356 | 533 | -177 |
| *Friesland* | 281 | 267 | 14 |
| Noord-Friesland (CR) | | | |
| Zuidwest-Friesland (CR) | 200 | 184 | 16 |
| Zuidoost-Friesland (CR) | 269 | 257 | 12 |
| *Drenthe* | 263 | 168 | 95 |
| Noord-Drenthe (CR) | | | |
| Zuidoost-Drenthe (CR) | 119 | 111 | 8 |
| Zuidwest-Drenthe (CR) | 144 | 153 | -9 |
| *Overijssel* | 385 | 344 | 41 |
| Noord-Overijssel (CR) | | | |
| Zuidwest-Overijssel (CR) | 243 | 147 | 96 |
| Twente (CR) | 281 | 278 | 3 |
| *Gelderland* | 786 | 644 | 142 |
| Veluwe (CR) | | | |
| Achterhoek (CR) | 433 | 319 | 114 |
| Arnhem/Nijmegen (CR) | 720 | 737 | -17 |
| Zuidwest-Gelderland (CR) | 324 | 300 | 24 |
| *Utrecht* | 1673 | 1716 | -43 |
| Utrecht (CR) | | | |
| *Noord-Holland* | 331 | 291 | 40 |
| Kop van Noord-Holland (CR) | | | |
| Alkmaar en omgeving (CR) | 360 | 272 | 88 |
| IJmond (CR) | 281 | 220 | 61 |
| Agglomeratie Haarlem (CR) | 615 | 496 | 119 |
| Zaanstreek (CR) | 385 | 349 | 36 |
| Groot-Amsterdam (CR) | 2164 | 2962 | -799 |
| Het Gooi en Vechtstreek (CR) | 643 | 502 | 141 |
| *Zuid-Holland* | 435 | 363 | 72 |
| Agglomeratie Leiden en Bollenstreek (CR) | | | |
| Agglomeratie 's-Gravenhage (CR) | 874 | 1089 | -215 |
| Delft en Westland (CR) | 332 | 438 | -106 |
| Oost-Zuid-Holland (CR) | 415 | 299 | 116 |
| Groot-Rijnmond (CR) | 1143 | 867 | 276 |
| Zuidoost-Zuid-Holland (CR) | 323 | 296 | 27 |
| *Zeeland* | 55 | 51 | 4 |
| Zeeuwsch-Vlaanderen (CR) | | | |
| Overig Zeeland (CR) | 195 | 175 | 20 |
| *Noord-Brabant* | 452 | 515 | -63 |
| West-Noord-Brabant (CR) | | | |
| Midden-Noord-Brabant (CR) | 447 | 482 | -35 |
| Noordoost-Noord-Brabant (CR) | 553 | 447 | 106 |
| Zuidoost-Noord-Brabant (CR) | 507 | 496 | 11 |
| *Limburg* | 141 | 191 | -50 |
| Noord-Limburg (CR) | | | |
| Midden-Limburg (CR) | 196 | 205 | -9 |
| Zuid-Limburg (CR) | 194 | 282 | -88 |
| *Flevoland* | 471 | 530 | -59 |
| Flevoland (CR) | | | |

Figure 4.1 pictures the pattern of interprovincial firm relocations (balance) in 2016/2017. The map also shows that there is no outstanding pattern, but rather a complex network of firm relocations happening between the provinces in the Netherlands. However, it is interesting to see that many arrows point towards and away from the Randstad region, which is in line with the conclusion made before that the Randstad appears as the hotspot of firm movements in the Netherlands. The figure shows that not any province is a particular 'winner' on balance in the firm relocation process, since there are many provinces both gaining and losing firms. However, there are two obvious 'losers' on balance in the firm relocation process. Specifically, Groningen and Limburg lose the most firms to other provinces.

In summary, most firms relocate within their own province (89 per cent) or even within their own COROP region (81 per cent). When examining the inter-regional movements, there is on balance no flight from the Randstad to the Intermediary Zone, therefore hypothesis 1a is rejected. However, the findings highlight the prominent role of the Randstad in firm movements, with Groot-Amsterdam and Utrecht as key contributors. Interestingly, these two COROP regions also exhibit the largest migration deficits as well, indicating a net outflow of firms.

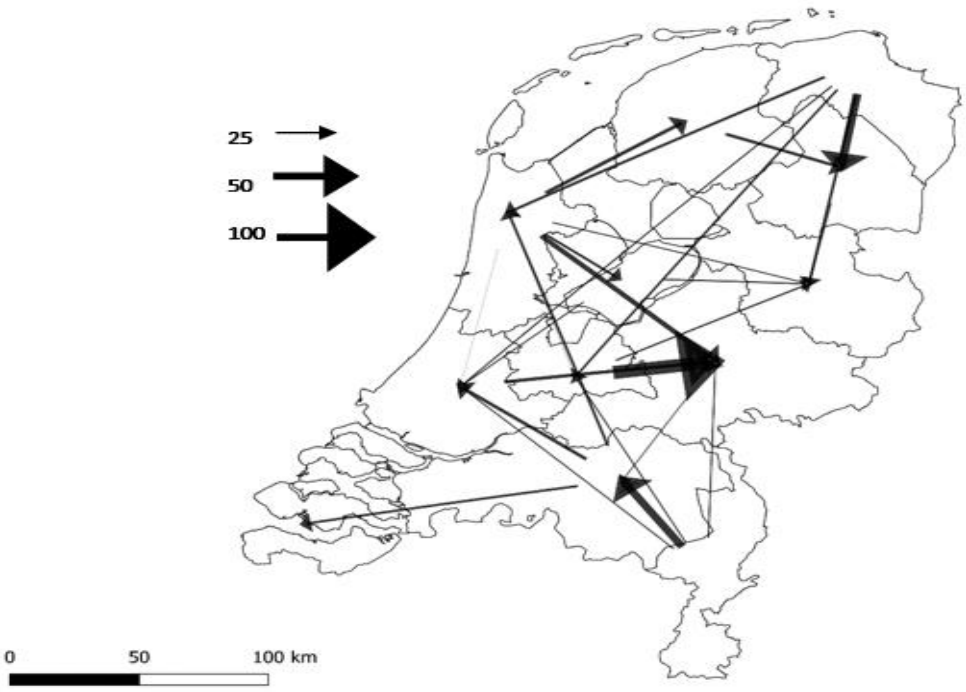


*Figure 4.1. Interprovincial firm relocation in the years 2016/2017*

## 4.3 Firm relocations: Industries and Size

Table 4.4 provides insights into the proportion of relocations between postal codes, regions and provinces for different industries. The business services sector demonstrates the highest level of mobility in all geographical layouts. On the other hand, the industry sector shows the lowest level of relocations. Only 5.40 per cent of the firms in the industry sector relocate, while almost double the per cent of Business Services Firms relocate. Also, the Other Services sectors exhibits a notable level of relocation activity, while the distribution sector falls in between.

As previously mentioned, the analysis does not reveal any substantial flight of firms from the Randstad to the Intermediary Zone. Tables 4.5-4.8 show the proportion of firms moving between the Randstad, Intermediary Zone and the Periphery in different industries. Table 4.5 shows that within the sector Industry a relatively high proportion of firms relocate within the Intermediary Zone or the Periphery, as compared to the overall patterns depicted in Table 4.2. On the other hand, firms operating in the business services sector (table 4.7) predominantly relocate within the Randstad, with relatively fever moves within the Intermediary Zone and the Periphery. Another notable observation is the relatively high proportion of relocations from the Randstad to the Intermediary zone, as well as the opposite direction. This proportion stands out in comparison to the other sectors. The sectors of distribution (table 4.6) and other services (table 4.8) align more closely with the overall relocation patterns depicted in Table 4.2. However, the Distribution sector shows the lowest percentage of moves from the Periphery to the Randstad (0.61), compared to the other sectors.

Table 4.4. Proportion of movements between different geographical layouts. Industries. In %.

| | Postal Code | Between Regions | Between Provinces | N |
|---|---|---|---|---|
| Industry | 5.40 | 0.94 | 0.55 | 55100 |
| Distribution | 6.13 | 1.12 | 0.63 | 263742 |
| Business Services | 8.53 | 1.73 | 1.06 | 353704 |
| Other Services | 7.57 | 1.39 | 0.85 | 333137 |

Table 4.5.Industry. in %

| | Randstad | Intermediary | Periphery | Total | N |
|---|---|---|---|---|---|
| Randstad | 36.43 | 2.19 | 0.50 | 39.12 | |
| Intermediary | 1.48 | 38.65 | 0.94 | 41.07 | |
| Periphery | 0.64 | 0.87 | 18.30 | 19.81 | |
| Total | 38.55 | 41.74 | 19.74 | 100 | 2973 |

Table 4.6. Distribution, in %

| | Randstad | Intermediary | Periphery | Total | N |
|---|---|---|---|---|---|
| Randstad | 41.52 | 2.09 | 0.69 | 44.29 | |
| Intermediary | 1.58 | 35.50 | 0.82 | 38.00 | |
| Periphery | 0.61 | 0.88 | 16.22 | 17.70 | |
| Total | 43.81 | 38.47 | 17.72 | 100 | 16160 |

Table 4.7. Business Services, in %

| | Randstad | Intermediary | Periphery | Total | N |
|---|---|---|---|---|---|
| Randstad | 50.50 | 2.56 | 0.83 | 53.89 | |
| Intermediary | 2.19 | 28.85 | 0.71 | 31.74 | |
| Periphery | 0.75 | 0.87 | 12.75 | 14.37 | |
| Total | 53.44 | 32.28 | 14.28 | 100 | 30175 |

Table 4.8. Other Services, in %

| | Randstad | Intermediary | Periphery | Total | N |
|---|---|---|---|---|---|
| Randstad | 44.20 | 2.29 | 0.80 | 47.29 | |
| Intermediary | 1.92 | 33.00 | 0.71 | 35.63 | |
| Periphery | 0.69 | 0.80 | 15.60 | 17.08 | |
| Total | 46.80 | 36.09 | 17.10 | 100 | 25235 |

Both van Dijk and Pellenbarg (2000) and Brouwer et al. (2004) find larger firms to be less likely to relocate to another municipality, as moving costs will be considerably larger for larger firms. Table 4.9 provides insights into the proportion of relocations between postal codes, regions and provinces for different firm sizes. It shows a distinction between small firms (<10) and bigger firms (=>10). The findings shown in Table 4.9 are In line with the literature on firm sizes and firm relocation. It is observed that smaller firms exhibit a higher degree of mobility across all geographical layouts. Specifically, the proportion of relocations between postal codes is more than double for smaller firms compared to larger ones. Furthermore, as the size of the geographical areas increases, the relative difference in the proportion of firm relocations also grows larger.

Tables 4.10 and 4.11 present the proportions of firms relocating between the Randstad, Intermediary Zone, and the Periphery, categorized by firm sizes. Comparing Table 4.10 to 4.11, there is observed that firms with 10 or more employees have a higher proportion of relocations within the Randstad (49 per cent). Notably, smaller firms exhibit a higher proportion of firm relocations between all different zones. This finding aligns with the previous conclusion that larger firms are less likely to relocate to another municipality.

Table 4.9. Relocations of different sizes, in %

| | Postal Code | Between Regions | Between Provinces | N |
|---|---|---|---|---|
| Firms >= 10 | 3.32 | 0.44 | 0.21 | 103896 |
| Firms < 10 | 7.55 | 1.44 | 0.85 | 1229815 |

Table 4.10. Proportion of firms with less than 10 employees that move within and between zones, in %

| | Randstad | Intermediary | Periphery | Total | N |
|---|---|---|---|---|---|
| Randstad | 45.54 | 2.29 | 0.77 | 48.60 | |
| Intermediary | 1.98 | 32.05 | 0.77 | 34.80 | |
| Periphery | 0.73 | 0.85 | 15.02 | 16.60 | |
| Total | 48.25 | 35.19 | 16.56 | 100 | 92901 |

Table 4.11. Proportion of firms with 10 or more employees that move within and between zones, in %

| | Randstad | Intermediary | Periphery | Total | N |
|---|---|---|---|---|---|
| Randstad | 48.55 | 1.13 | 0.29 | 49.97 | |
| Intermediary | 1.45 | 33.09 | 0.52 | 35.06 | |
| Periphery | 0.26 | 0.49 | 14.21 | 14.97 | |
| Total | 50.26 | 34.72 | 15.02 | 100 | 3448 |

In summary, the business services sector has the highest relocation rate, while the industry sector demonstrates the lowest relocation rate. When examining the inter-regional movements of the different industries no significant pattern is shown. However, there can be concluded that firms in the industry sector relocate more within the Intermediary zone and the Periphery, while the business services relocate more within the Randstad. Lastly, there can be concluded that smaller firms exhibit a higher degree of mobility compared to larger firms.

## 4.4 Firm relocations: Employment

The 96,000 firm relocations involved a total of 271,500 employees, with an average of 2.8 employees per relocating firm. Comparing these numbers to Pellenbarg's (2002) earlier research on firm migration in the Netherlands, there has been a significant increase in recent decades. Between 2001 and 2002, a total of 64,000 firms relocated and covered a total of 231,000 employees. (Pellenbarg, 2005). It is worth noting that the average number of employees per relocating firm has seen a significant decline from 3.6 in 2002 to 2.8 in 2017. This decline underscores the changing dynamics of the labour market, with more people opting for self-employment and entrepreneurship (Centraal Bureau voor de Statistiek,2017). As a result, smaller firms are more prevalent and tend to relocate more frequently, thereby possibly contributing to the overall increase in the number of firm

relocations in 2017. The difference in average employees per relocating firm between 2002 and 2017 highlights the impact of this trend on firm migration patterns in the Netherlands.

The employment data concerning firm migration between provinces in the Netherlands display a distinct pattern compared to firm relocation. In the period of 2016-2017, a total of 39,400 jobs were engaged in the process of interprovincial firm migration. Despite the expectation of higher employment loss in the Randstad due to the majority of firms moving out of the region, Figure 4.2 pictures otherwise. This figure provides the job movements (balance) resulting from firm relocations in 2016 and 2017. Similar to Figure 4.1, many arrows point towards and away from the Randstad. However, a notable difference is that Groningen appears to be a net winner in the job movements, while it seemed to be a loser in the firm relocation process. Another aspect worth mentioning is that within the Randstad, there are winners and losers, with Zuid-Holland emerging as a winner while Utrecht experiences significant job losses. In summary, the findings reveal that there is not a shift away from the Randstad region towards the Intermediary Zone, thereby hypothesis 1b is not rejected.

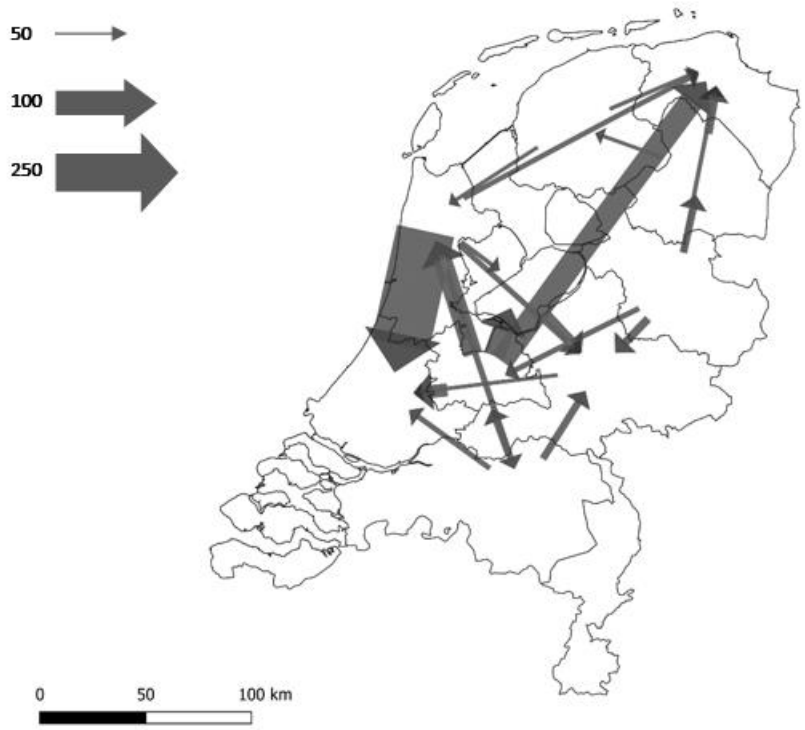


*Figure 4.2. Interprovincial movement of employment associated with firm relocation in the years 2016/2017*

# 5. Firm relocation and regional productivity

The descriptive statistics of the variables used to estimate the determinants of Labour productivity of the Dutch regions are provided in Table 3 of the Appendix. Before conducting the analysis, an investigation was carried out to determine the appropriate method for the panel data. The Hausman test was employed to distinguish between the fixed effects model and the random effects model (Paul Clarke et al., 2010). The results of the Hausman Test, presented in Table 4 of the Appendix, indicate a chi-squared statistic of 31.09, with a p-value of 0.000. This suggests that the random effects model is not appropriate, making the fixed effects model more suitable for the existing panel data set.

The data is also examined for multicollinearity, and based on the findings in Table 5 in the Appendix, it can be concluded that multicollinearity is not problematic in the data due to the low variance inflation factors (VIF). Furthermore, a test was conducted to assess groupwise heteroskedasticity in the Fixed Effects regression model. A modified Wald test was employed to examine whether the variances of the error terms differ across the regions in the panel data. The results shown in Table 6 of the Appendix indicated that the p-value is less than the conventional significance level of 0.05, leading to the rejection of the null hypothesis of homoskedasticity. This indicates the existence of groupwise heteroskedasticity within the fixed effects regression model, leading to the inclusion of robust standard errors in the model.

Lastly, to limit the impact of outliers, the variable "Labour Productivity" was winsorized. This approach involved replacing the extreme values in the dataset. Specifically, the top and bottom 1% of observations were replaced with the $5^{th}$ and $95^{th}$ percentile values of labour productivity, respectively. Winsorization was chosen as a method to address the issues caused by extreme values while preserving the integrity of the original data, as opposed to removing the outliers altogether.

## 5.1 Firm relocation

Table 5.1 shows the results of equation (1) obtained using the fixed effects model. As argued in hypothesis 2a, there is expected that a higher inflow rate is associated with a higher productivity in a region. The results in Table 5.1 show that this prediction is confirmed as the inflow rate has a positive and significant effect in Model 1. The coefficient for log(inflow_rate) is 0.015, this indicates that a 1% increase in the inflow rate is associated with a 0.015% increase in regional productivity holding other variables constant. Therefore, while the effect size of the inflow rate in a region may be considered small, it is statistically significant, suggesting that there is a relationship between the inflow rate and

labour productivity. However, it is important to exercise caution when interpreting this result since the coefficient for the inflow rate is only statistically significant at the 10% significance level.

Table 5.1 also shows a positive coefficient for the regional outflow of firms (0.020 in model 2). This finding implies that the firm outflows are positively associated with regional productivity, in contrast with Hypothesis 2b. The observed result could be explained by the theory of creative destruction, this suggests that less efficient firms move out of the region, thereby creating space and opportunities for more innovative firms to enter the region. The results do not show a significant effect of the net flow (inflow minus outflows) of firms in a region. This suggests that there is no statistically significant evidence to support Hypothesis 2c, which proposed a positive association between a positive mutation balance and an increase in regional productivity. In other words, the data does not provide strong evidence to conclude that a positive mutation balance is consistently associated with an increase in productivity at the regional level.

Lastly, Table 5.1 reveals a significant and positive coefficient for the total flow of firms in a region. This finding suggests that as the firm relocation rate increases within a region, its productivity also increases, which aligns with Hypothesis 3. As outlined above this can be explained by the theory of creative destruction by Schumpeter (2012). According to this theory, higher industry turbulence motivates firms to prioritize innovative processes that renew economic activities, ultimately leading to enhanced productivity. The significance of this result supports existing literature on the topic, but it also extends the literature by offering the first empirical evidence of the direct impact of regional firm relocation turbulence on changes in regional productivity. This finding extends our understanding of the relationship between firm movement and productivity by demonstrating the tangible connection between the two.

Finally, the effects of the controls are worth mentioning. Human Capital (log(HCAP)) is significant in all models and has a positive sign. Thus, having a higher concentration of human capital in a region is associated with a higher productivity. This finding supports the notion that regions with a greater pool of skilled and educated individuals tend to have higher productivity levels. It is important to note that the other control variables do not show any significant effects on regional productivity. This means that the Capital-Labour ratio, Herfindahl Index, and Density do not demonstrate a statistically significant relationship with regional productivity in this analysis. Additionally, the interaction variable between the Capital-Labour ratio and Technological stock does not exhibit statistically significant effects on regional productivity in this analysis.

Table 5.1. Determinants of Labour Productivity: fixed effects (FE) estimates

| | **Inflow** | **Outflow** | **Net Flow** | **Total flow** |
|---|---|---|---|---|
| | **1 (FE)** | **2 (FE)** | **3 (FE)** | **4 (FE)** |
| **Variable** | | | | |
| log(HCAP) | 0.372** | 0.388** | 0.383* | 0.378** |
| | (0.047) | (0.040) | (0.054) | (0.043) |
| log(CAPLAB_RATIO) | -0.000 | -0.004 | -0.002 | -0.002 |
| | (0.996) | (0.774) | (0.875) | (0.880) |
| log(HHI) | 0.149 | 0.112 | 0.154 | 0.151 |
| | (0.796) | (0.843) | (0.798) | (0.791) |
| log(TECH*CAPLAB_RATIO) | -0.000 | -0.000 | -0.000 | -0.000 |
| | (0.329) | (0.345) | (0.405) | (0.318) |
| log(DENSITY) | -0.185 | -0.194 | -0.062 | -0.204 |
| | (0.635) | (0.619) | (0.883) | (0.596) |
| log(Inflow_rate) | 0.015* | | | |
| | (0.059) | | | |
| log(Outflow_rate) | | 0.020** | | |
| | | (0.016) | | |
| log(Netflow_rate) | | | 0.014 | |
| | | | (0.358) | |
| log(Totalflow_rate) | | | | 0.020** |
| | | | | (0.027) |
| Region FE | YES | YES | YES | YES |
| Observations | 240 | 240 | 239 | 240 |
| Number of regions | 40 | 40 | 40 | 40 |
| R2 (Within) | 0.14 | 0.15 | 0.11 | 0.14 |

*10% significance level.
** 5% significance level.
*** 1% significance level

## 5.2 Employment and Firm relocation

Table 5.2 shows the results of equations 5-8 obtained using the fixed effects model. As hypothesized in hypothesis 4, it is expected that the impact of employment involved in firm relocation on labour productivity would differ from that of firm relocation itself. A comparison between the inflow of employment in Table 5.2 and the inflow of firms in Table 5.1 reveals that both the coefficients and the significance level exhibit minimal differences. The coefficient for log(inflow_rate) is 0.015, indicating that a 1% increase in the inflow rate of firms is associated with a 0.015% increase in regional productivity while keeping other variables constant. Likewise, the coefficient for log(inflow_rate_Emp) is 0.014, this indicates that a 1% increase in the inflow rate of employment is associated with a 0.014% increase in the regional labour productivity holding other variables constant.

In Table 5.2, the results reveal that the coefficient for the net flow rate of employment is statistically significant at a 5% significance level, indicating a notable relationship between the net movement of employment and labour productivity. While the coefficients for the outflow rate and total flow rate of employment are statistically insignificant. This implies that log(Outflow_rate_Emp) and log(Totalflow_rate_Emp) do not exhibit a significant relation with labour productivity in the examined model. In contrast, Table 5.1 presents different findings. Here, both the outflow rate and the total flow rate of firms show statistically significant coefficients.

Taken together, the comparison of the variables reveals distinct findings. While the relationship between the inflow of employment and labour productivity is similar to the relationship between the inflow of firms and labour productivity, different conclusions can be made when comparing other employment variables with their corresponding counterparts. Therefore, the overall findings do not provide a clear basis for either rejecting or accepting hypothesis 4.

Table 5.2. Determinants of Labour Productivity: fixed effects (FE) estimates

| | **Inflow** | **Outflow** | **Net Flow** | **Total flow** |
|---|---|---|---|---|
| | **1 (FE)** | **2 (FE)** | **3 (FE)** | **4 (FE)** |
| **Variable** | | | | |
| log(HCAP) | 0.381* | 0.384* | 0.393** | 0.381* |
| | (0.053) | (0.053) | (0.048) | (0.054) |
| log(CAPLAB_RATIO) | -0.002 | -0.001 | -0.003 | -0.002 |
| | (0.874) | (0.918) | (0.843) | (0.899) |
| log(HHI) | -0.057 | -0.013 | 0.060 | -0.041 |
| | (0.921) | (0.983) | (0.920) | (0.943) |
| log(TECH*CAPLAB_RATIO) | -0.000 | -0.000 | -0.000 | -0.000 |
| | (0.488) | (0.498) | (0.402) | (0.500) |
| log(DENSITY) | -0.159 | -0.114 | -0.117 | -0.137 |
| | (0.696) | (0.780) | (0.786) | (0.736) |
| log(Inflow_rate_Emp) | 0.014* | | | |
| | (0.065) | | | |
| log(Outflow_rate_Emp) | | 0.008 | | |
| | | (0.275) | | |
| log(Netflow_rate_Emp) | | | 0.036** | |
| | | | (0.031) | |
| log(Totalflow_rate_Emp) | | | | 0.011 |
| | | | | (0.134) |
| Region FE | YES | YES | YES | YES |
| Observations | 240 | 240 | 239 | 240 |
| Number of regions | 40 | 40 | 39 | 40 |
| R2 (Within) | 0.13 | 0.11 | 0.12 | 0.12 |

*10% significance level. ** 5% significance level. *** 1% significance level

## 5.3 Industries

The results of the firm inflow within specific industries on the level of productivity of a region are presented in Table 5.3. It is observed that regions that have a relatively higher influx of firms in the distribution industry tend to exhibit higher levels of productivity. This supports hypothesis 5d, which posits a stronger positive relationship between regional productivity and firm relocation of distribution firms. However, the proposed stronger positive relation between the level of productivity in a region and the business services firm inflow in the region is rejected. Contrary to the expectation, a negative effect is observed when more business services firms enter the region. Therefore, hypothesis 5a is not supported, which anticipated a (stronger) positive relationship between the inflow of business services firms and labour productivity. This negative effect raises concerns about the effect of incoming business services firms on regional productivity and thus calls for further investigation. One possible explanation for this negative relationship between the influx of business services firms and the productivity of a region is the potential competition for skilled labour. The increased competition for skilled workers may lead to a shortage within the business services sector, consequently resulting in a decline in productivity within this industry. This is particularly true if the new business services firms offer higher wages or better job opportunities, drawing talent away from existing firms.

Finally, there is expected that both industry and other services firms would exhibit a relatively weaker relationship between the inflow of firms and the level of regional productivity. Examining Table 5.3, there can be observed that this expectation is partially true. By comparing the estimated effects of the firm inflow of the industry and the other services sector on productivity with the coefficient of the general model, it can be concluded that the effect is more substantial for firms in these sectors. However, upon considering the estimated effect of the influx of distribution firms, it becomes evident that the relationship between firm inflow and regional productivity is weaker for the industry and other services firms. Therefore, hypotheses 5b and 5c are only partially rejected based on these findings.

Table 5.3. Firm relocation by industries and the productivity of the Dutch COROP Regions

| Independent variable | Dependent variable | Est. (FE) | SE |
|---|---|---|---|
| log(Inflow_rate) | Labour Productivity | 0.015* | (0.058) |
| log(Inflow_rate_Ind) | Labour Productivity Industry | 0.023** | (0.015) |
| log(Inflow_rate_Dis) | Labour Productivity Distribution | 0.025** | (0.037) |
| log(Inflow_rate_Bus) | Labour Productivity Business services | -0.010*** | (0.006) |
| log(Inflow_rate_Oth) | Labour Productivity Other services | 0.022*** | (0.000) |
| Region FE | | YES | |
| Observations | | 240 | |
| Number of regions | | 40 | |

*10% significance level.
** 5% significance level.
*** 1% significance level

# 6. Conclusion

This thesis aimed to investigate the current spatial patterns of firm relocations in the Netherlands and their relationship with the productivity of the Dutch COROP regions. To achieve this, three different sub-questions have been addressed. The first research question focused on identifying the current patterns of firm relocation in the Netherlands for the year 2016/2017. There has been observed that there is on balance no flight from the Randstad to the Intermediary Zone when examining inter-regional movements of firms. Similarly, when analysing the inter-regional movement of employment associated with firm relocation, there was no indication of a flight away from the Randstad. Instead, both firm and employment movements show a distinctive and complex network of movements between the regions. Moreover, there has been noted that, when considering the inter-regional movement of different industries, no significant pattern is shown. However, some insights were still obtained. Notably, business services firms demonstrate the highest relocation rate, while the industry sector exhibits the lowest relocation rate. Besides that, firms in the industry sector relocate more within the Intermediary Zone and the Periphery, while the business services relocate more within the Randstad. Lastly, the study analysed if there is a difference between large and small firms. The study concluded that smaller firms have a higher degree of mobility compared to larger firms.

Furthermore, in the second research question the correlation between firm relocation and regional productivity is analysed. The fixed effects model provides valuable insights into the relationship between firm relocations and regional productivity. The model revealed a (small) positive and statistically significant effect of the inflow and total flow rate of firms on regional productivity. Surprisingly, even the outflow of firms shows a positive coefficient, this suggests that a higher number of flowing out of a region is associated with a higher regional productivity. The variable net flow rate however is not significant. Comparing these results with the findings of the employment associated with firm relocations, there is found that the inflow of employment has a similar effect on regional productivity as the inflow of firms. However, when considering the variables outflow, net flow and total flow, different conclusions can be made.

Lastly, in the last sub-question the relationship between firm relocation and regional productivity for the four chosen industries has been explored. The main takeaway of this part of the analysis is that regions with a higher inflow of firms in the distribution industry tend to exhibit higher levels of productivity compared to the other industries. One possible explanation for this stronger relationship is that the influx of a distribution firm enhances the network position not only of itself but also of firms located in close proximity. Additionally, contrary to the expectations, the entry of business

services firms into a region has a negative effect on the productivity in a region. This negative relationship could be explained by the fact that a higher inflow of business services firms increases the competition for skilled workers, leading to a shortage of skilled labour in the region.

Based on the findings in the three sub-questions an answer can be provided to the main question of this thesis:

*What is the current spatial pattern of firm relocations in the Netherlands, and is there a correlation between these firm relocation dynamics and the productivity growth of the Dutch regions?*

The study concludes that the spatial pattern of firm relocation in the Netherlands is characterized by a complex network of inter-regional movements with no clear pattern of a flight from the Randstad to the Intermediary Zone. Similarly, when examining the employment involved in firm relocation, the same conclusion can be made. Furthermore, the research highlights differences in firm relocation dynamics across industries and firm size. Regarding the impact on regional productivity, there can be concluded that there is a relationship between firm relocation and the productivity of regions. However, this relationship differs concerning employment involved with firm relocations and varies across industries.

While further research is needed to completely understand the mechanisms driving the positive relationship between firm relocation and regional productivity, this study sends an important message to regional policymakers, since it supports the idea that firm relocations are associated with improving regional productivity. In this perspective, policymakers should adopt targeted policies to attract and retain firms in their respective region. Importantly, policymakers must take into account the diverse patterns and effects observed across different industries when formulating these policies. This approach could potentially enhance the region's productivity levels in the long run.

## 6.1 Discussion

The study's findings have to be considered in light of some limitations. The first significant limitation is the potential presence of reverse causality and a selection effect in the relationship between firm relocation and regional productivity. While the results show a positive relationship, it is important to consider that firms may be attracted to regions with relatively high productivity levels. Furthermore, there should be noted that the relationship might be caused by the fact that more productive firms relocate rather than a true causal relationship. This study failed to fully eliminate these issues and therefore the results should be interpreted with caution. As a consequence, the first

recommendation for future research is to perform a instrumental variable analysis. This instrumental variable analysis would solve the endogeneity issues and therefore provide more robust results.

The second limitation concerns the reliance on secondary data sources. The first issue concerning the availability of data is that the variable labour productivity in the general model is measured as the gross value added per worker, while it is proxied as the gross value added per labour unit in the industry models. This inconsistency in the measurement of labour could have a significant effect on the validity of the findings in this study. Another data availability issue is the way technological stock is proxied, namely as the patent applications in each region. The observations of the patent applications in a region do not vary enough over time, resulting in the exclusion from technological capital in the model. The last data concern is caused by the LISA files used to determine the number of firm relocations. In 2012, the Chamber of Commerce (CoC) number from a company at a specific location was as follows 123456780001, with "0001" indicating the dossier number of a branch. However, in 2013, the Chamber of Commerce switched from one CoC number to two separate numbers: a CoC number of the company and a location number. This change created a challenge in accurately determining the number of relocations in the year 2012/2013, as the location numbers were used for matching the LISA datasets. As a result, this data issue may have implications for the accuracy of the findings in the analysis. To address the matching issue arising from the transition in Chamber of Commerce (CoC) numbers, future research could focus on even more recent LISA datasets.

Another point to consider is that the study's findings are specific to the context of the Netherlands. The relationship between firm relocation and regional productivity might differ significantly in other countries or regions, which limits the possibility to generalize the results. Therefore, future research should explore this relationship in other (international) contexts. This would provide broader insights and makes the findings more widely applicable.

Finally, some interesting findings in this study could be used for future research. The positive relationship between firm relocation and regional productivity raises questions about the channels driving this positive relation. Future research could focus on understanding the specific factors contributing to this positive relationship. Additionally, the negative relationship between the inflow of business firms in a region and the productivity in a region calls for further investigation. Exploring the factors that contribute to this finding can offer important insights, and thereby inform policy decisions.

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# Appendix

Table 1. Division of the subsectors

| SBI'2008 | Description | Sector |
|---|---|---|
| 10 | Manufacture of food products | Industry |
| 11 | Manufacture of beverages | Industry |
| 12 | Manufacture of tobacco products | Industry |
| 13 | Manufacture of textiles | Industry |
| 14 | Manufacture of wearing apparel | Industry |
| 15 | Manufacture of leather, products of leather and footwear | Industry |
| 16 | Manufacture of wood and of products of wood and cork | Industry |
| 17 | Manufacture of paper and paper products | Industry |
| 18 | Printing and reproduction of recorded media | Industry |
| 19 | Manufacture of coke and refined petroleum products | Industry |
| 20 | Manufacture of chemicals and chemical products | Industry |
| 21 | Manufacture of basic pharmaceutical products and pharmaceutical preparations | Industry |
| 22 | Manufacture of rubber and plastic products | Industry |
| 23 | Manufacture of other non-metallic mineral products | Industry |
| 24 | Manufacture of basic metals | Industry |
| 25 | Manufacture of fabricated metal products, except machinery and equipment | Industry |
| 26 | Manufacture of computers, electronic and optical products | Industry |
| 27 | Manufacture of electrical equipment | Industry |
| 28 | Manufacture of machinery and equipment n.e.c. | Industry |
| 29 | Manufacture of motor vehicles, trailers and semi-trailers | Industry |
| 30 | Manufacture of other transport equipment | Industry |
| 31 | Manufacture of furniture | Industry |
| 32 | Manufacture of other products n.e.c. | Industry |
| 33 | Repair and installation of machinery and equipment | Industry |
| 45 | Sale and repair of motor vehicles, motorcycles and trailers | Distribution |
| 46 | Wholesale trade (no motor vehicles and motorcycles) | Distribution |
| 47 | Retail trade (not in motor vehicles) | Distribution |
| 49 | Land transport | Distribution |
| 50 | Water transport | Distribution |
| 51 | Air transport | Distribution |
| 52 | Warehousing and support activities for transportation | Distribution |
| 53 | Postal and courier activities | Business Services |
| 64 | Financial institutions, except insurance and pension funding | Business Services |
| 65 | Insurance and pension funding (no compulsory social security) | Business Services |
| 66 | Other financial services | Business Services |
| 68 | Renting and buying and selling of real estate | Business Services |
| 69 | Legal services, accounting, tax consultancy, administration | Business Services |
| 70 | Holding companies (not financial) | Business Services |
| 71 | Architects, engineers and technical design and consultancy; testing and analysis | Business Services |
| 72 | Research and development | Business Services |
| 73 | Advertising and market research | Business Services |
| 74 | Industrial design, photography, translation and other consultancy | Business Services |
| 75 | Veterinary activities | Business Services |
| 77 | Renting and leasing of motor vehicles, consumer goods, machines and other tangible goods | Business Services |
| 78 | Employment placement, provision of temporary employment and payrolling | Business Services |
| 79 | Travel agencies, tour operators, tourist information and reservation services | Business Services |
| 80 | Security and investigation | Business Services |
| 81 | Facility management | Business Services |
| 82 | Other business services | Business Services |
| 84 | Public administration, public services and compulsory social security | Other Services |
| 85 | Education | Other Services |
| 86 | Human health activities | Other Services |
| 87 | Residential care and guidance | Other Services |
| 88 | Social work activities without accommodation | Other Services |
| 90 | Arts | Other Services |
| 91 | Lending of cultural goods, public archives, museums, botanical and zoological gardens and nature reserv | Other Services |
| 92 | Lotteries and betting | Other Services |
| 93 | Sports and recreation | Other Services |
| 94 | World view and political organizations, interest and ideological organizations, hobby clubs | Other Services |
| 95 | Repair of computers and consumer goods | Other Services |
| 96 | Wellness and other services; funeral activities | Other Services |

Table 2. The three zones in the Netherlands

| COROP-Region | Code | Zone |
|---|---|---|
| Oost-Groningen (CR) | 1 | Periphery |
| Delfzijl en omgeving (CR) | 2 | Periphery |
| Overig Groningen (CR) | 3 | Periphery |
| Noord-Friesland (CR) | 4 | Periphery |
| Zuidwest-Friesland (CR) | 5 | Periphery |
| Zuidoost-Friesland (CR) | 6 | Periphery |
| Noord-Drenthe (CR) | 7 | Periphery |
| Zuidoost-Drenthe (CR) | 8 | Periphery |
| Zuidwest-Drenthe (CR) | 9 | Periphery |
| Noord-Overijssel (CR) | 10 | Periphery |
| Zuidwest-Overijssel (CR) | 11 | Intermediary Zone |
| Twente (CR) | 12 | Intermediary Zone |
| Veluwe (CR) | 13 | Intermediary Zone |
| Achterhoek (CR) | 14 | Intermediary Zone |
| Arnhem/Nijmegen (CR) | 15 | Intermediary Zone |
| Zuidwest-Gelderland (CR) | 16 | Intermediary Zone |
| Utrecht (CR) | 17 | Randstad |
| Kop van Noord-Holland (CR) | 18 | Periphery |
| Alkmaar en omgeving (CR) | 19 | Intermediary Zone |
| IJmond (CR) | 20 | Randstad |
| Agglomeratie Haarlem (CR) | 21 | Randstad |
| Zaanstreek (CR) | 22 | Randstad |
| Groot-Amsterdam (CR) | 23 | Randstad |
| Het Gooi en Vechtstreek (CR) | 24 | Randstad |
| Agglomeratie Leiden en Bollenstreek (CR) | 25 | Randstad |
| Agglomeratie 's-Gravenhage (CR) | 26 | Randstad |
| Delft en Westland (CR) | 27 | Randstad |
| Oost-Zuid-Holland (CR) | 28 | Randstad |
| Groot-Rijnmond (CR) | 29 | Randstad |
| Zuidoost-Zuid-Holland (CR) | 30 | Randstad |
| Zeeuwsch-Vlaanderen (CR) | 31 | Periphery |
| Overig Zeeland (CR) | 32 | Periphery |
| West-Noord-Brabant (CR) | 33 | Intermediary Zone |
| Midden-Noord-Brabant (CR) | 34 | Intermediary Zone |
| Noordoost-Noord-Brabant (CR) | 35 | Intermediary Zone |
| Zuidoost-Noord-Brabant (CR) | 36 | Intermediary Zone |
| Noord-Limburg (CR) | 37 | Intermediary Zone |
| Midden-Limburg (CR) | 38 | Intermediary Zone |
| Zuid-Limburg (CR) | 39 | Periphery |
| Flevoland (CR) | 40 | Intermediary Zone |

Source: Wagtendonk and Rietveld (2000)

Table 3. Descriptive statistics

| Variable | Unit | Obs. | Mean | Std.Dev. | Min | Max |
|---|---|---|---|---|---|---|
| Labour productivity | ratio(log) | 240 | 11.049 | 0.155 | 10.594 | 11.495 |
| Inflow Rate | ratio(log) | 240 | -4.850 | 0.591 | -6.557 | -3.503 |
| Outflow Rate | ratio(log) | 240 | -4.878 | 0.504 | -6.395 | -3.719 |
| Net flow Rate | ratio(log) | 240 | -4.543 | 0.225 | -5.322 | -3.990 |
| Total Flow Rate | ratio(log) | 240 | -4.154 | 0.622 | -5.538 | -2.913 |
| Human Capital | ratio(log) | 240 | -1.468 | 0.335 | -2.475 | -0.678 |
| Capital-Labour Ratio | ratio(log) | 240 | 9.556 | 0.266 | 8.928 | 11.519 |
| Herfindahl Index | formula(log) | 240 | -1.327 | 0.057 | -1.464 | -1.159 |
| Technological stock*Capital-Labour ratio | ratio(log)*ratio(log) | 240 | -85.870 | 31.881 | -113.290 | 0.000 |
| Density | ratio(log) | 240 | 6.188 | 0.813 | 4.970 | 8.117 |

Table 4. Hausman test result

b = Consistent under H0 and Ha; obtained from xtreg.
B = Inconsistent under Ha, efficient under H0; obtained from xtreg.
Test of H0: Difference in coefficients not systematic
chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 31.09
Prob > chi2 = 0.0000

From the above results, the P value is 0.000, which is less than 0.05. This leads to reject the null hypothesis. So, this study used the fixed effects model.

Table 5. Multicollinearity Test - VIF(variance inflation factor)

| Variable | VIF | 1/VIF |
|---|---|---|
| Human Capital | 1.84 | 0.543 |
| Capital-Labour Ratio | 1.08 | 0.927 |
| Herfindahl Index | 1.31 | 0.766 |
| Technological Stock*Capital-Labour ratio | 1.38 | 0.726 |
| Outflow Rate | 1.11 | 0.900 |
| Density | 1.78 | 0.563 |
| Mean VIF | 1.42 | |

Table 6. Test for Heteroskedasticity

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (40) = 1146.91
Prob>chi2 = 0.0000

Since the p-value is below 0.05, we reject the null hypothesis H0. This indicates that the assumption constant variance of the error term across al groups is violated.