Google: Groningen's new boost?

A research on the regional effects of the major capital injection by Google in Eemshaven

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Colophon

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Summary

The province of Groningen recently has been fortunate to welcome a major capital investment. At the end of 2016 the American multinational technology company Google LLC announced to invest 600 million euro in a new data centre in Eemshaven, near Delfzijl in the north-east of Groningen. The aim of this research is to give insight in how a spatial microsimulation model could be carried out that investigates the regional economic effects of the capital injection by Google in Eemshaven. This research answers the central research question: *"What are the economic effects of the capital injection by Google for the region of Groningen and how can therefore a spatial microsimulation model be designed?"* The direct and indirect effects are investigated separately.

Based on literature research and structured by research reports on comparable data centre developments, the direct effects of the capital injection for the region of Groningen are listed. First, Foreign direct investments (FDI) help to attract new (foreign) investors to Groningen. Secondly, with Google locating in Eemshaven large amounts of technical, operational and managerial knowledge is brought into the region. Next, Google is taking a lead function in efficient and responsible energy usage and finally, the job creation (and its local multiplier effects) as a result of the capital injection is the most important opportunity for the region of Groningen.

On behalf of the analysis on indirect effects of the capital injection a simplified model based on the technique of spatial microsimulation modelling has been worked out in different scenarios. Next, estimations were made on which locations (at micro level) are affected positively by the capital injection and where the multiplier effects continues. Additionally, a blueprint for an extensive spatial microsimulation model is suggested that can substantiate the importance of this project and help to provide new insights at policy level.

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1. Introduction

1.1 Background

In The Netherlands there are twenty so-called shrinking- and anticipation regions (krimp-and anticipeergebieden). These regions, shown in Figure 1, deal with population decline (or will in the near future) as a result of different phenomena, with the decline in job opportunities as a main reason. In the regions with the highest population decline, a decrease of 16% until 2040 is expected against a growth of 11% in the rest of the Netherlands. Main direct effects on the regional economy can be less new construction, less demand for renting houses, less turnover for retailers, and less recreational expenditures (Rijksoverheid, 2018).

Figure 1: Shrinking and anticipation regions

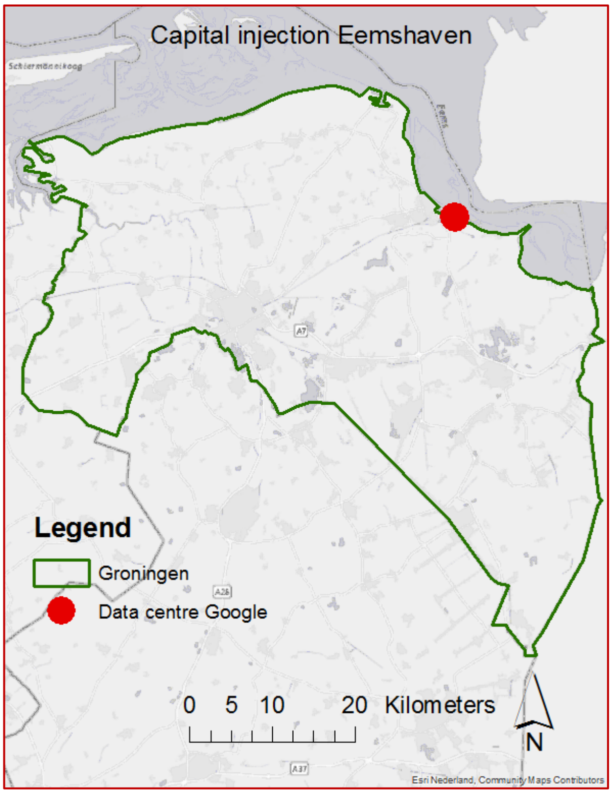
(Rijksoverheid, 2018)

From a historical perspective, it is an argumentative outcome that population decline implicates a less successful economy (Coleman and Rowthorn, 2011). Despite the fact the situation in the Netherlands isn't as dramatic as elsewhere in Europe (Barca, 2009; European Commission, 2010), the challenge of keeping shrinking regions viable in the future is urgent (SER, 2011). As mentioned earlier, employment opportunities have a great influence on regional demographical changes. New business creation plays a big role in securing current and future job opportunities, particularly in declining regions (Andersson and Noseleit, 2011). Of the five Dutch provinces involved, only Groningen dealt with an actual declining regional economy in 2016. The nuance has to be made here that the well-discussed topic about the reduction of gas production has a certain impact on these numbers (CBS, 2017).

Nevertheless, Groningen recently has been fortunate to welcome a major capital investment that perfectly fits within this framework of business creation. At the end of 2016 the American multinational technology company Google LLC announced to invest 600 million euro in a new data centre in Eemshaven, near Delfzijl in the north-east of Groningen (Figure 2). The decision by Google to locate in this rather unknown and anonymous region can be explained in its entirety by the concept of 'Keno capitalism'. Dear and Flusty (1998) argue that on the basis of advanced telecommunication and transportation technologies, the competitive advantage of places within urban areas has disappeared. In addition, and highly relevant for companies like Google, it is stated that when firms are globally connected, the importance of agglomeration economies has disappeared.

According to the internet giant itself the construction of the data centre offered work to a 1000 workers. Meanwhile the project is completed and approximately 150 people found a job (Google, 2018). Comparable additions to the labor market come with great benefits for the regional economy (Moretti, 2010). Every time a local economy generates new businesses, it comes with great certainty that additional jobs are created. What underlies this is the increased demand for local goods and services. This positive effect on employment is partially offset by general equilibrium effects induced by changes in local wages and prices of local services. Moretti introduces a framework based on the effects of local multipliers that will carefully be considered later on in paragraph 2.1. According to Delfmann and Koster (2014) it is the regional context that matters the most for the regional effects of job increase. Therefore, it is essential to find out which local goods and services can expect an increase in demand because of the capital injection in Eemshaven. In the end, it is interesting to find out how these economical changes that affect the viability of the economy as a whole can be explored in future, more extensive, research.

Figure 2: Location capital injection



(Own work, ARCGIS, 2018)

1.2 Research aim and questions

The aim of this research is to give insight in how a spatial microsimulation model could be carried out that investigates the regional economic effects of the capital injection by Google in Eemshaven. The direct and indirect effects are investigated separately. On behalf of the analysis on indirect effects of the capital injection a simplified model based on the technique of spatial microsimulation modelling, that later on will be discussed, has been worked out in different scenarios. Those three scenarios are (partly) based on hypothetical data due to the limitations of this research.

Based on the above research aim and the theoretical framework outlined in Chapter 2, the next central research question has been formulated: ***What are the economic effects of the capital injection by Google for the region of Groningen and how can therefore a spatial microsimulation model be designed?*** For the purpose of a clear structure of the thesis and an overall coverage of the different aspects of the central research question three sub questions have been derived. The direct effects of the capital injection are being covered, estimations on the indirect effects of job creation are made and a blueprint for a future spatial microsimulation model is proposed.

- ***What are the direct effects of the capital injection by Google in Eemshaven for the region of Groningen?***

The first research question is answered by analysing a study by research agency Copenhagen Economics (2015) on the effects of a comparable capital injection in Belgium. Google commissioned Copenhagen Economics to investigate the direct and indirect regional effects of the development of the St. Ghislain-Mons data centre. The four identified main direct effects are explained and substantiated on the basis of academic literature: foreign direct investments (Dunning, 1998), spillovers (Markusen, 1995; Fosfuri et al., 2001; Malchow- Møller et al., 2013; Görg and Strobl, 2005; Görg, 2007), sustainable energy use (Shebabi et al., 2016) and job creation (Heijdra and Ligthart, 1997; Moretti, 2010; Delfmann and Koster, 2014). This last effect also applies as the basis for the estimations on longer-term effects in the second research question.

- ***What are the estimated economic effects of the job creation for the region of Groningen?***

As will be explained later in this report in Chapter 3, it is beyond the scope of this research to actually carry out a spatial microsimulation model. Instead, a more simplified model is built to estimate future economic effects in three different scenarios of job creation. Theory that is central to this is the work on (local) multiplier effects by Heijdra and Ligthart (1997), Moretti (2010) and Delfmann and Koster (2014). First, data by Copenhagen Economics is used to distribute the expected job creation over different sectors. Second, workers are divided into three household groups: Young professionals, Starters and Multiple-person households. Various characteristics are assigned to these groups and their expected future expenditures are calculated on the basis of the Statistics Netherlands Budget Research (2015). To show the relevance of the effects that different distributions of labor can have, three scenarios have been worked out. Finally, insight is provided in which (micro level) locations are expected to benefit the most from the capital injection by Google in Eemshaven.

- ***How can a blueprint for a spatial microsimulation model be developed for the Google project in Eemshaven?***

In this part the performed analysis are reflected to how an actual and complete spatial microsimulation model should be built for the case of the capital injection in Eenmshaven. Structured by four steps of spatial microsimulation modelling, suggestions are made for feature research based on previously conducted research: (1) collecting a micro data set (or constructing when it is not available)(Ballas et al., 2006; Birkin and Rees, 1998), (2) creating a micro-level population by obtaining numerical results derived from random sampling (Monte Carlo Method), (3) implementing different 'what-if' scenarios and (4) adjusting the basic micro data set by dynamically modelling it (Batey and Madden, 1983, 1999, 2001).

2. Theoretical framework

2.1 Concepts and theories

The province of Groningen is an extreme case in terms of projected population decline according to the Netherlands environmental assessment Agency (PBL) and Central Bureau of Statistics (CBS): in the period 2010-2040 some municipalities will face a 20 up to 38 per cent decline (2009). The difficult thing of population decline is that it is very hard to predict the net impact and spatial consequences, developments at household level and changes in the composition of the population. Region specific characteristics like the existing housing stock, land use, labor distribution, patterns of mobility and facilities influence these issues (Van Dam, 2009). The classical economic theory clearly predicts that a smaller population leads to lower productivity (Coleman and Rowthorn, 2011). Population decline must be seen as a major threat for a viable economy. Although the association is not necessarily automatic, population decline is strongly related to economic decline and thus a slower output growth and labor shortage through ageing is expected (Gáková and Dijkstra, 2010). Economic growth can be seen as the increase of the capacity of an economy to produce goods and services, compared from one period to another (Raisová and Ďurčová, 2014).

The large addition to the Groningen labor market comes with an even larger economic output on the long term because of multiplier effects (Heijdra and Ligthart, 1997). Moretti (2010, p. 373) formulates a compact framework on the effects of local multipliers:

> "Every time a local economy generates a new business, additional jobs might also be created, mainly through increased demand for local goods and services. This positive effect on employment is partially offset by general equilibrium effects induced by changes in local wages and prices of local services".

This estimation is the essence of that what this research wants to demonstrate by performing a simplified spatial microsimulation model. To further elaborate on the effects of major capital injections on local economies, it is stated that each city is a competitive economy that uses labor to produce a vector of nationally traded goods (price is set) and a vector of nontraded goods (price is determined locally). Labor is assumed to be mobile across sectors within a region so within this region the marginal product and wages are equalized. Regional labor supply is upward sloping, and its slope depends on the labor of residents' tastes for leisure and the degree of labor mobility. In case of a permanent increase in labor demand, in this case as a result of the capital injection by Google, a general equilibrium effect on local prices occurs and an increase of wages for all workers in the region is very likely (Moretti, 2010). According to Delfmann and Koster (2014), it is the regional context that matters the most for the regional effects of job increase. Therefore, it is essential to find out which local suppliers of goods and services can expect an increase in demand as a consequence of this job creation.

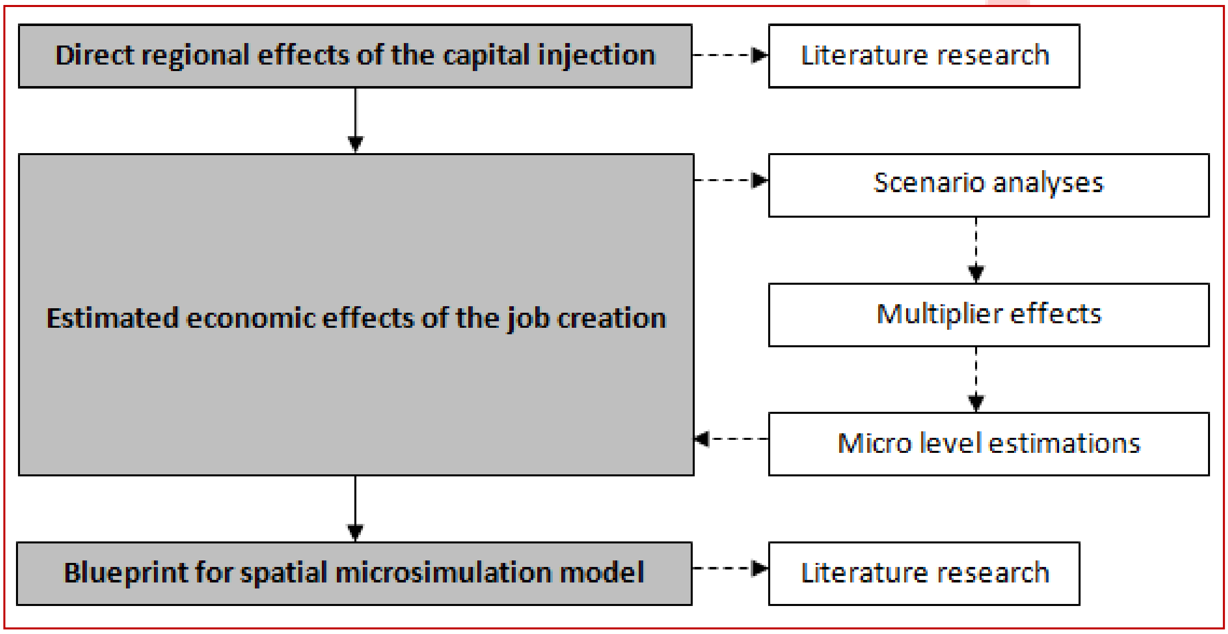
The above theory can be clarified by discussing the local multiplier elements that are set in to motion by the capital injection in Eemshaven at a micro level. Assuming that Google's investment creates 150 FTE jobs, the same number of households will receive an increase in spendable income. Depending on the worker and his households characteristics and preferences, a new expenditure pattern has emerged. It is assumed that the household now spends 100 euros more per month on goods and services. Suppose, the household directly spends 50 euros more on groceries at the local supermarket. The supermarket owner his income has now increased. Due to the fact that many more of the 150 households have also increased their expenditures on groceries, the supermarket owner decides to hire one extra worker and replenish his stock. Some of these groceries are supplied by local firms, positively affecting the regional economy. The extra employed worker now experiences an increase in spendable income and develops a new expenditure pattern on his turn. This again results in a rising demand for goods and services, positively affecting firms across the province of Groningen and the multiplier effect continues. Each time money is spent, more economic activity within the regional market is generated.

A more overarching technique to estimate the impact of major job gains that also includes local multiplier effects is spatial microsimulation modelling. Ballas, Clarke and Dewhurst (2006, p. 130) describe in a comparable study: "The main aim of microsimulation models is first to compile large-scale data sets on the attributes of individuals or households (and/or on the attributes of individual firms or organizations). Once such data sets have been built, the analyst can examine the impacts of changing economic or social policies on these micro-units (Orcutt et al., 1986; Birkin and Clarke, 1995; Clarke, 1996). The use of spatial microsimulation modelling approaches enables researchers to go beyond theories and analyse the socio-economic and spatial consequences of major developments on a regional level (Ballas et al., 2006). The way in which a spatial microsimulation model can be developed will depend on the specific characteristics of the research but also on restricting factors like time and money. For this specific research and its limitations a more compact version of a spatial microsimulation model will be used.

2.2 Conceptual model

The conceptual model in figure 3 visualizes the structure of the framework discussed above.

Figure 3: Conceptual model



(Own work, 2018)

3. Methodology

3.1 Data selection

The aim of this research is to give insight in how a spatial microsimulation model could be carried out that investigates the regional economic effects of the capital injection by Google in Eemshaven. By analyzing secondary data, the direct effects of the capital injection are discussed. On behalf of the analysis on indirect effects of the capital injection, a simplified model based on the technique of spatial microsimulation modelling has been worked out in different scenarios. Data on consumer expenditure patterns is used to put the approach of a local multiplier framework into practice.

The dataset of consumption patterns that is used concerns the Statistics Netherlands Budget Research (2015). The aim of this research was to compile up-to-date and international user data on the consumer spending of households. The research is carried out in 2015 and fifteen thousand households have participated in the survey. During four weeks participants kept up their expenditures and additionally several questionnaires were completed (CBS, 2015). The dataset contains a large number of groups and categories in which goods and services are subdivided. The dataset is suitable for the selection of specific household profiles based on different characteristics. The survey was conducted according to the strict Statistics Netherlands guidelines on privacy (CBS, n.d.). The anonymity of the participants is guaranteed and together with the fact that this research is carried out on a relatively high level of abstraction, there were no problematic ethical considerations to make.

In the previous chapter, it was explained at micro level how a major capital injection can set a multiplier effect into motion: Google's investment creates a number of jobs, this leads to an increase in spendable income among households, households with different characteristics develop a new expenditure pattern and spend money, the money spent leads to an increased income for shop owners, the demand for labor and (local) goods rises and the local multiplier effect continues. The data set discussed above is used as the input for the microsimulation of the unique household expenditures and therefore for the visualization of these local multiplier effects.

3.2 Data processing

On behalf of the analysis on indirect effects of the capital injection a simplified model based on the technique of spatial microsimulation modelling has been worked out in different scenarios. First step in the analysis is to work out the total job creation in more detail. A subdivision into different sectors is required together with the profiling of three household groups to be able to outline multiple scenarios during the next step. These scenarios are based on hypothetical numbers and are not based on theory or data due to the fact that in this research the focus is on the demonstration of the model and not the exactness of the outcome. Then, the expected extra expenditures are implemented on a micro level by mapping the relevant firms (supermarkets). After working out these simplified models, a reflection takes place and a blueprint for an extensive spatial microsimulation model for the capital injection is suggested.

3.3 Hypotheses

Based on the literature it is expected that from all effects of the capital injection in Eemshaven the long term effects of job creation are the most valuable for the region of Groningen. The different theories on multiplier effects indicate large and significant consequences in the socio-economic landscape. By working out this simplified version of a spatial mircosimulation model, it is shown how a more complete and extensive model can be deployed for this or comparable projects. This approach can help to substantiate the importance of such developments and new insights can be provided at policy level.

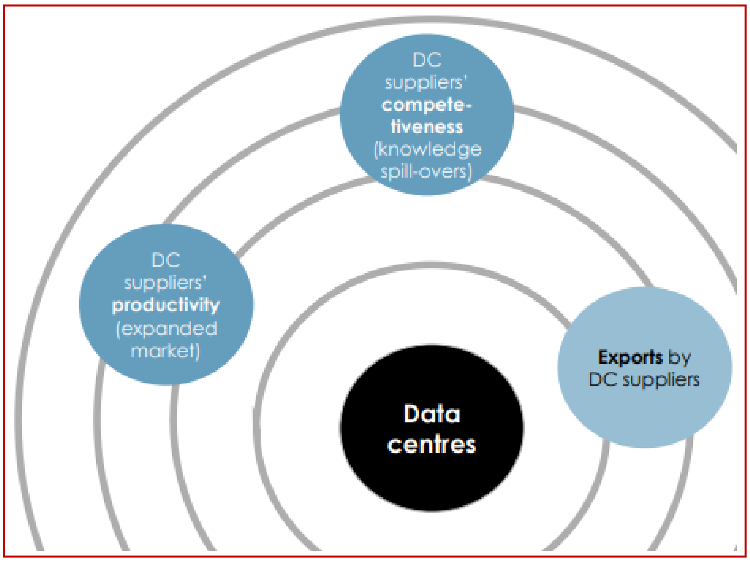
4. Results

4.1 Direct effects capital injection

A Foreign direct investment (FDI) like the capital injection by Google in Eemshaven helps to attract new (foreign) investors. Dunning (1998) appoints four main motives that generally drive FDI's: market-seeking, efficiency-seeking, resource-seeking and strategy. On the basis of a study by Copenhagen Economics (2015) on the effects of a comparable capital injection in Belgium, it can be assumed that Google paves the way for new investors to come to Groningen on behalf of all these four motives. To start, in case of a market-seeking FDI investors move to foreign countries with the aim to reduce transportation costs and improve their market access by locating closer to existing and potential clients. By adding wealth through raising wages and living standards in the region of Groningen, Google makes it more attractive for other firms to enter and serve the local market. Second, efficiency-seeking investors are constantly searching for ways to lower their costs and raise their profitability and competitiveness. When the local economy of Groningen grows and the local suppliers are in a position to benefit from economies of scale, firms can lower their input costs and make the region more attractive to other companies that use the same production factors. Then, resource-seeking firms depend on the sourcing of new talents and technologies to keep up their competitiveness. With the facilitation of knowledge spillovers and the raising of the workers productivity, Google sends a signal to companies abroad that are considering relocation. Last, from a strategic point of view a favourable regulatory framework can help investors with the improvement of their existing products and development of new products. The fact that Google has chosen to locate in Eemshaven signals to other investors that in all probability this is the case. Based on these four motives we can state that with the capital injection by Google in Eemshaven Groningen's chances on attracting (foreign) investors have been significantly improved.

Big multinationals like Google bring large amounts of technical, operational and managerial knowledge with them into the regions they locate. This enables them to enter markets across the world and with that compete successfully against local companies (Markusen, 1995). Already established firms in Groningen are able to take advantage of this when in the first place former workers of Google are hired (labor mobility), and secondly when they sell their goods and services to Google. Labor mobility is an important form of knowledge spillover and a frequently studied phenomenon. Basically the idea is that multinationals cope with this by attracting a number of the most productive workers, then a wage premium is paid so that these workers stay at Google and so their knowledge is secured from spreading through the branch (Fosfuri et al., 2001). Based on a study by Malchow-Møller et al. (2013) it can be assumed that companies like Google also invest more than average in knowledge-improvement of their workers. In foreign firms 75% of the observed wage premium is based on the selection procedure of workers, while the last quarter depends on other factors. Labor mobility can be essential to match workers with certain skills to the right activities. Therefore, labor mobility occurs both between companies and across different jobs within the same company (Copenhagen Economics, 2015). Görg and Strobl (2005) underline the benefits of labor mobility by stating that a regional firm is more productive when the owner has worked for a multinational in the past. In the case of the nearly identical capital injection by Google in St. Ghislain-Mons in Belgium, Google puts a lot of effort on supporting the workers in the data centre with various training programmes. Important point here is that this does not only involve workers employed by Google, but also the employees of supplying companies. Google's e-learning programmes are aimed at learning the workers to combine their original skill set with other new specialist skills that they can apply in the data centre. This continuous focus on the training of workers contributes to the appearance of knowledge spillovers (Copenhagen Economics, 2015). In addition to the benefits of labor mobility, it is estimated that the arrival of Google to Eemshaven positively affects the quality of services and goods across the region. Multinationals set high standards for suppliers and are often willing to provide assistance to regional suppliers to match these required standards (Görg, 2007). Figure 4 contains a visualisation of these and earlier discussed spillovers.

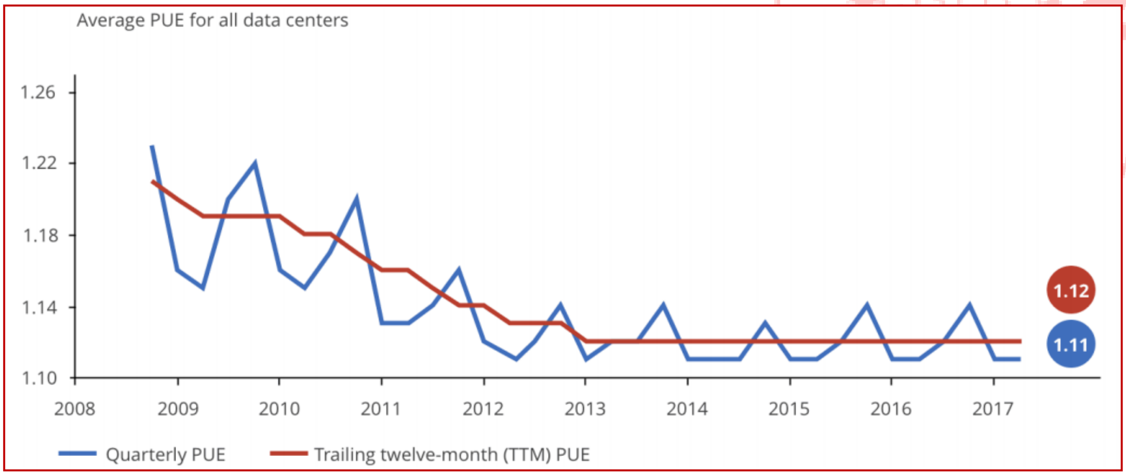
Figure 4: Spillovers visualized



(Copenhagen Economics, 2015)

Other great benefit is that with the data centre in Eemshaven, Google sets a new standard on dealing with energy consumption. From the start of the project in 2014 both the building and exploitation phase have been powered by 100 percent renewable energy from a 63 Megawatt wind farm near Delfzijl. Google is able to purchase enough renewable energy to cover all their operations across Europe due to the signing of corporate Power Purchase Agreements (PPA's). PPA's contain agreements on the buying of power from renewable energy sources at an agreed price and (long-term) time frame (Copenhagen Economics, 2018). In addition to the usage of responsible energy sources, recent history shows that data centres themselves have become more energy efficient. Research on U.S. data centres shows that although a 40% growth in overall server installation bases is estimated, their energy consumption is stabilized. What underpins this decrease in consumption, are technological developments applied to the different processes inside data centres (Shebabi et al., 2016). The energy efficiency in a facility like the Google data centre in Eemshaven is measured in terms of a power usage effectiveness (PUE) scale indicator. The theoretical maximum efficiency, and therefore the minimum of the scale, is 1.00. In 2014, with a usage of 76 Terawatt-hour (TWh) the average PUE of all European data centres was 1.70 (Copenhagen Economics, 2018). As also shown in figure 5, Google has been able to reduce the average PUE for all their data centres to 1.12.

Figure 5: Average PUE European data centres

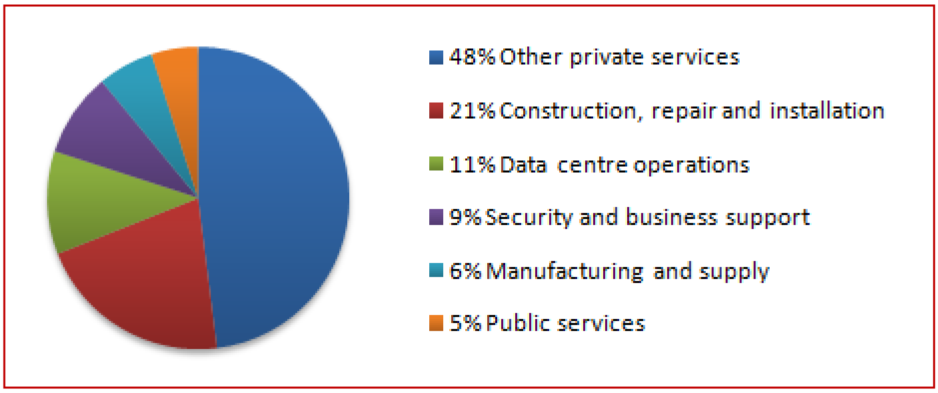


(Google LLC., 2018)

As mentioned above, Google sets a new standard on the handling of energy consumption. It is expected that this has a motivating effect on other firms in the region of Groningen.

Finally, the job creation as a result of the capital injection is certainly the most important opportunity for the region of Groningen. The creation of jobs like IT technicians, electrical and mechanical engineers, catering, facilities and security staff in the relatively remote area of Eemshaven leads to a rigorous change in the socio-economic landscape. In the period 2014-2017 Google's investments have supported 2,200 jobs (FTE's) per year on average. It is assumed that for Eemshaven the same subdivision into different sectors applies as for the St. Ghislain-Mons data centre, as is shown in figure 6 (Copenhagen Economics, 2015).

Figure 6: Subdivision sectors



(Own work, based on Copenhagen Economics, 2015)

The biggest sector, 'Other private services', includes retail trade, transport, hotels and restaurants, real estate, and legal accounting and employment activities. Industries that predominantly concern proximity services like 'Security and business support' most likely influence the local economy. On the other hand, industries that mainly consist of suppliers will also contribute to employment opportunities outside the region of Groningen (Copenhagen Economics, 2015). The next chapter will elaborate on this job creation by estimating the expenditures of future workers and the influence this has on the economy of Groningen.

4.2 Indirect effects job creation

To come to a more precise estimation of economic effects for the region of Groningen, a closer defined profile of the job creation is required. In the period 2014-2017, Google's investments have supported 2,200 jobs (FTE's) per year on average (Copenhagen Economics, 2018). Based on the Copenhagen Economics research on the St. Ghislain-Mons data centre (2018) the 2,200 FTE's are subdivided in six sectors as is shown in Table 1. To be able to analyse the effects of different distributions of labor for the data centre in Eemshaven, three different scenarios of job creation and its economic effects for the region of Groningen are worked out. The workers are divided into three household groups: Young professionals, Starters and Multi-person households. On behalf of the scenario analyses assumptions are made on the sectors they work in and the characteristics of those different groups. The first workers group concerns the Young professionals (Y). These households consist of single men and women in the age of 25 to 35 years that rent a house, are higher skilled and have an above average income. Second, the Starters (S) households are pairs that own an house, have one or no children and are 25 to 35 years old. The last group concerns workers out of Multiple-person households (M) consisting of 3, 4, 5 or more persons, living in an owned house and where the main breadwinner is aged between 25 and 65 years old.

Table 1: Labor distribution

Sector	Labor	FTE's
Other private services*	48%	1056
Construction, repair and installation	21%	462
Data centre operations	11%	242
Security and business support	9%	198
Manufacturing and supply	6%	132
Public services	5%	110
Total	100%	2,200

* includes retail trade, transport, hotels and restaurants, real estate, and legal accounting and employment activities

(Own work, based on Copenhagen Economics, 2015)

The analysis includes three scenarios of future expenditures in the region of Groningen, based on different implemented labor distributions. By working out three scenarios it becomes clear how the distribution of labor and the characteristics of household groups influence future expenses in the region of Groningen. What needs to be emphasized at with this method of analyses is that the input (except from the Statistics Netherlands Budget Research) is hypothetical and not supported by any data or theory. This research focuses on the demonstration of how different scenarios affect local multiplier effects, how a regions social economic landscape is influenced, and the way in which a more extensive spatial microsimulation model can be applied to this.

First scenario outlined includes a distribution of labor (in FTE's) in Eemshaven that is used as a standard and in which the earlier described sectors are divided among Young professionals, Starters and Multiple-person households on a percentage basis. Second scenario outlined a situation in which, compared to the previous standard scenario, a larger part is assigned to Young professionals and Starters. Third and last scenario takes a situation into account in which the Multiple-person household group has a larger share in comparison to scenario 1. Table 2 gives an overview of the three scenarios with corresponding distribution of labor.

Table 2: Scenario analysis distributions of labor

Sectors	Distribution	FTE's	**Young professionals**	Converted FTE's (Y)	**Starters**	Converted FTE's (S)	**Multiple-person households**	Converted FTE's (M)
Scenario 1								
Other private services	48%	1056	15%	158,4	15%	158,4	70%	739,2
Construction, repair and installation	21%	462	20%	92,4	20%	92,4	60%	277,2
Data centre operations	11%	242	35%	84,7	35%	84,7	30%	72,6
Security and business support	9%	198	10%	19,8	10%	19,8	80%	158,4
Manufacturing and supply	6%	132	15%	19,8	15%	19,8	70%	92,4
Public services	5%	110	15%	16,5	15%	16,5	70%	77
Total	**100%**	**2200**		**391,6**		**391,6**		**1416,8**
Scenario 2								
Other private services	48%	1056	5%	52,8	5%	52,8	90%	950,4
Construction, repair and installation	21%	462	10%	46,2	10%	46,2	80%	369,6
Data centre operations	11%	242	25%	60,5	25%	60,5	50%	121
Security and business support	9%	198		0		0	100%	198
Manufacturing and supply	6%	132	5%	6,6	5%	6,6	90%	118,8
Public services	5%	110	5%	5,5	5%	5,5	90%	99
Total	**100%**	**2200**		**171,6**		**171,6**		**1856,8**
Senario 3								
Other private services	48%	1056	25%	264	25%	264	50%	528
Construction, repair and installation	21%	462	30%	138,6	30%	138,6	40%	184,8
Data centre operations	11%	242	45%	108,9	45%	108,9	10%	24,2
Security and business support	9%	198	15%	29,7	15%	29,7	70%	138,6
Manufacturing and supply	6%	132	25%	33	25%	33	50%	66
Public services	5%	110	25%	27,5	25%	27,5	50%	55
Total	**100%**	**2200**		**601,7**		**601,7**		**996,6**

(Own work, 2018)

The dataset of consumption patterns that is used concerns the Statistics Netherlands Budget Research (2015). Based on the selected household characteristics the dataset places expenditures of Young professionals, Starters and Multiple-person households in fifteen different categories. These group-specific expenditure patterns are included in Appendix 1. Hereafter the earlier distinguished FTE's per household group are multiplied by the expected future expenditures in the region of Groningen, derived from the Statistics Netherlands Budget Research. Tables 3 to 5 contain the elaborations of the three scenarios and give insight in the underlying calculations.

Table 3: Scenario 1

Scenario 1

Expenditure categories (1 000 euro)	Converted FTE's Y	Average expenditures Y	Total expenditures Y	Converted FTE's S	Average expenditures S	Total expenditures S	Converted FTE's M	Average expenditures M	Total expenditures M	Total expenditures YSM
Foods and non alcohol	391,6	€ 2,76	€ 1.081,80	391,6	€ 4,42	€ 1.729,57	1416,8	€ 4,56	€ 6.460,61	**€ 9.271,97**
Alcohol and tobacco	391,6	€ 0,94	€ 367,13	391,6	€ 1,05	€ 411,18	1416,8	€ 1,03	€ 1.459,30	**€ 2.237,61**
Clothes and shoes	391,6	€ 1,24	€ 484,61	391,6	€ 2,05	€ 802,78	1416,8	€ 2,06	€ 2.918,61	**€ 4.205,99**
Housing, water and energy	391,6	€ 9,24	€ 3.617,41	391,6	€ 11,42	€ 4.470,77	1416,8	€ 11,44	€ 16.208,19	**€ 24.296,36**
Upholstery and household appliances	391,6	€ 1,26	€ 494,40	391,6	€ 2,17	€ 848,47	1416,8	€ 2,18	€ 3.088,62	**€ 4.431,49**
Healthcare	391,6	€ 0,34	€ 132,17	391,6	€ 0,50	€ 195,80	1416,8	€ 0,50	€ 708,40	**€ 1.036,37**
Transportation	391,6	€ 3,35	€ 1.311,86	391,6	€ 5,73	€ 2.245,17	1416,8	€ 5,70	€ 8.075,76	**€ 11.632,79**
Communication	391,6	€ 0,96	€ 376,92	391,6	€ 1,30	€ 509,08	1416,8	€ 1,30	€ 1.841,84	**€ 2.727,84**
Recreation and culture	391,6	€ 2,49	€ 974,11	391,6	€ 3,88	€ 1.520,71	1416,8	€ 3,97	€ 5.624,70	**€ 8.119,51**
Education	391,6	€ 0,51	€ 200,70	391,6	€ 0,55	€ 215,38	1416,8	€ 0,80	€ 1.133,44	**€ 1.549,52**
Restaurants and hotels	391,6	€ 1,71	€ 670,62	391,6	€ 2,55	€ 998,58	1416,8	€ 2,44	€ 3.456,99	**€ 5.126,19**
Diverse goods and services	391,6	€ 1,90	€ 744,04	391,6	€ 3,30	€ 1.292,28	1416,8	€ 3,27	€ 4.632,94	**€ 6.669,26**
Consumption related taxes	391,6	€ 0,43	€ 166,43	391,6	€ 0,77	€ 300,23	1416,8	€ 0,75	€ 1.062,60	**€ 1.529,26**
Charity	391,6	€ 0,10	€ 39,16	391,6	€ 0,12	€ 45,69	1416,8	€ 0,15	€ 212,52	**€ 297,37**
Total expenditures	**391,6**	**€ 27,15**	**€ 10.631,94**	**391,6**	**€ 39,78**	**€ 15.579,15**	**1416,8**	**€ 40,10**	**€ 56.813,68**	**€ 83.024,77**

(Own work, based on Statistics Netherlands, 2015)

Table 4: Scenario 2

Scenario 2

Expenditure categories (1 000 euro)	Converted FTE's Y	Average expenditures Y	Total expenditures Y	Converted FTE's S	Average expenditures S	Total expenditures S	Converted FTE's M	Average expenditures M	Total expenditures M	Total expenditures YSM
Foods and non alcohol	171,6	€ 2,76	€ 474,05	171,6	€ 4,42	€ 757,90	1856,9	€ 4,56	€ 8.467,46	**€ 9.699,41**
Alcohol and tobacco	171,6	€ 0,94	€ 160,88	171,6	€ 1,05	€ 180,18	1856,9	€ 1,03	€ 1.912,61	**€ 2.253,66**
Clothes and shoes	171,6	€ 1,24	€ 212,36	171,6	€ 2,05	€ 351,78	1856,9	€ 2,06	€ 3.825,21	**€ 4.389,35**
Housing, water and energy	171,6	€ 9,24	€ 1.585,16	171,6	€ 11,42	€ 1.959,10	1856,9	€ 11,44	€ 21.242,94	**€ 24.787,19**
Upholstery and household appliances	171,6	€ 1,26	€ 216,65	171,6	€ 2,17	€ 371,80	1856,9	€ 2,18	€ 4.048,04	**€ 4.636,49**
Healthcare	171,6	€ 0,34	€ 57,92	171,6	€ 0,50	€ 85,80	1856,9	€ 0,50	€ 928,45	**€ 1.072,17**
Transportation	171,6	€ 3,35	€ 574,86	171,6	€ 5,73	€ 983,84	1856,9	€ 5,70	€ 10.584,33	**€ 12.143,03**
Communication	171,6	€ 0,96	€ 165,17	171,6	€ 1,30	€ 223,08	1856,9	€ 1,30	€ 2.413,97	**€ 2.802,22**
Recreation and culture	171,6	€ 2,49	€ 426,86	171,6	€ 3,88	€ 666,38	1856,9	€ 3,97	€ 7.371,89	**€ 8.465,13**
Education	171,6	€ 0,51	€ 87,95	171,6	€ 0,55	€ 94,38	1856,9	€ 0,80	€ 1.485,52	**€ 1.667,85**
Restaurants and hotels	171,6	€ 1,71	€ 293,87	171,6	€ 2,55	€ 437,58	1856,9	€ 2,44	€ 4.530,84	**€ 5.262,28**
Diverse goods and services	171,6	€ 1,90	€ 326,04	171,6	€ 3,30	€ 566,28	1856,9	€ 3,27	€ 6.072,06	**€ 6.964,38**
Consumption related taxes	171,6	€ 0,43	€ 72,93	171,6	€ 0,77	€ 131,56	1856,9	€ 0,75	€ 1.392,68	**€ 1.597,17**
Charity	171,6	€ 0,10	€ 17,16	171,6	€ 0,12	€ 20,02	1856,9	€ 0,15	€ 278,54	**€ 315,72**
Total expenditures	**171,6**	**€ 27,15**	**€ 4.658,94**	**171,6**	**€ 39,78**	**€ 6.826,82**	**1856,9**	**€ 40,10**	**€ 74.461,69**	**€ 85.947,45**

(Own work, based on Statistics Netherlands, 2015)

Table 5: Scenario 3

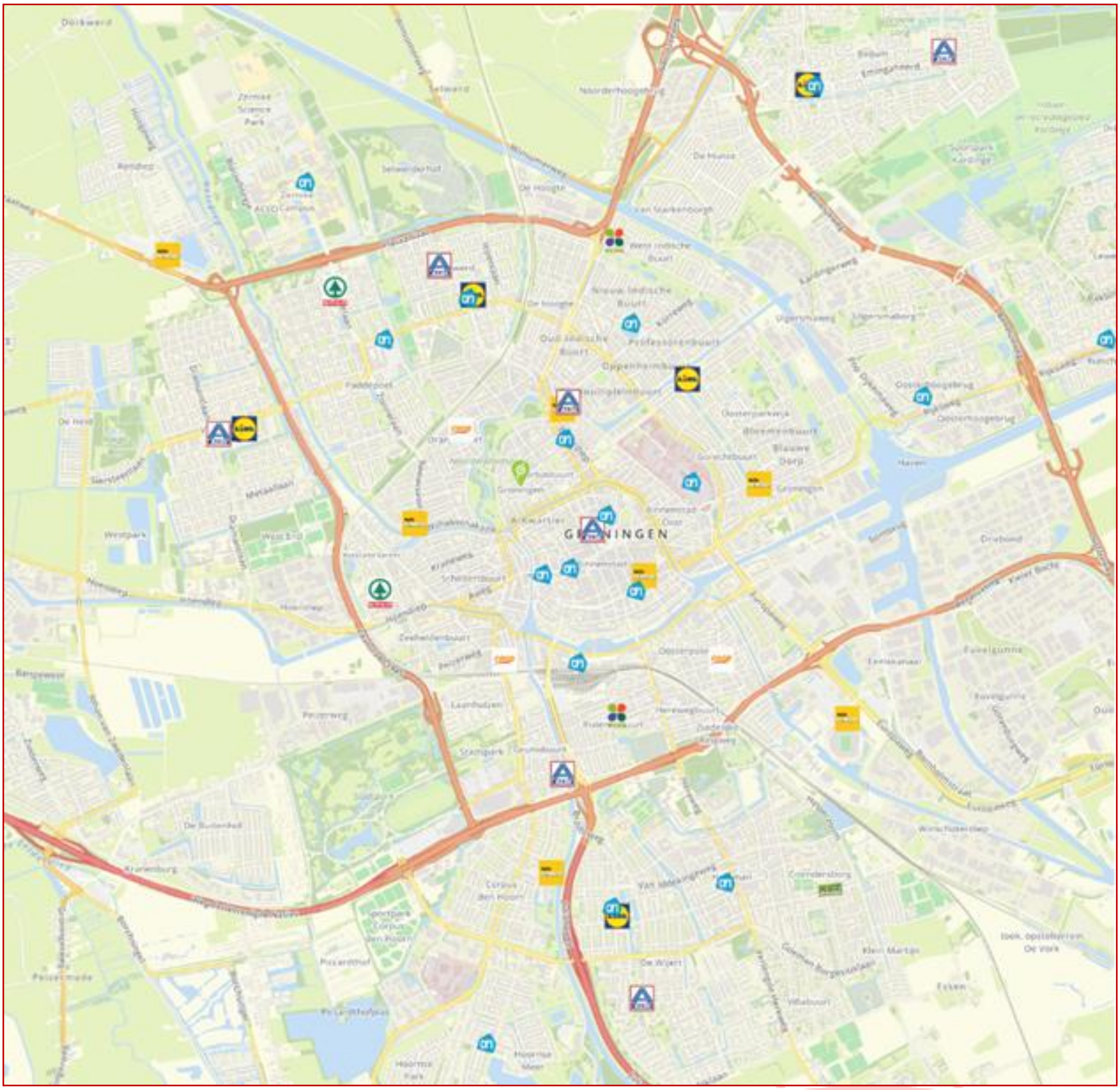
Expenditure categories (1 000 euro)	Scenario 3: Converted FTE's Y	Average expenditures Y	Total expenditures Y	Converted FTE's S	Average expenditures S	Total expenditures S	Converted FTE's M	Average expenditures M	Total expenditures M	Total expenditures YSM
Foods and non alcohol	601,7	€ 2,76	€ 1.662,20	601,7	€ 4,42	€ 2.657,51	996,6	€ 4,56	€ 4.544,50	**€ 8.864,20**
Alcohol and tobacco	601,7	€ 0,94	€ 564,09	601,7	€ 1,05	€ 631,79	996,6	€ 1,03	€ 1.026,50	**€ 2.222,38**
Clothes and shoes	601,7	€ 1,24	€ 744,60	601,7	€ 2,05	€ 1.233,49	996,6	€ 2,06	€ 2.053,00	**€ 4.031,08**
Housing, water and energy	601,7	€ 9,24	€ 5.558,20	601,7	€ 11,42	€ 6.869,41	996,6	€ 11,44	€ 11.401,10	**€ 23.828,72**
Upholstery and household appliances	601,7	€ 1,26	€ 759,65	601,7	€ 2,17	€ 1.303,68	996,6	€ 2,18	€ 2.172,59	**€ 4.235,92**
Healthcare	601,7	€ 0,34	€ 203,07	601,7	€ 0,50	€ 300,85	996,6	€ 0,50	€ 498,30	**€ 1.002,22**
Transportation	601,7	€ 3,35	€ 2.015,70	601,7	€ 5,73	€ 3.449,75	996,6	€ 5,70	€ 5.680,62	**€ 11.146,06**
Communication	601,7	€ 0,96	€ 579,14	601,7	€ 1,30	€ 782,21	996,6	€ 1,30	€ 1.295,58	**€ 2.656,93**
Recreation and culture	601,7	€ 2,49	€ 1.496,73	601,7	€ 3,88	€ 2.336,60	996,6	€ 3,97	€ 3.956,50	**€ 7.789,83**
Education	601,7	€ 0,51	€ 308,37	601,7	€ 0,55	€ 330,94	996,6	€ 0,80	€ 797,28	**€ 1.436,59**
Restaurants and hotels	601,7	€ 1,71	€ 1.030,41	601,7	€ 2,55	€ 1.534,34	996,6	€ 2,44	€ 2.431,70	**€ 4.996,45**
Diverse goods and services	601,7	€ 1,90	€ 1.143,23	601,7	€ 3,30	€ 1.985,61	996,6	€ 3,27	€ 3.258,88	**€ 6.387,72**
Consumption related taxes	601,7	€ 0,43	€ 255,72	601,7	€ 0,77	€ 461,30	996,6	€ 0,75	€ 747,45	**€ 1.464,48**
Charity	601,7	€ 0,10	€ 60,17	601,7	€ 0,12	€ 70,20	996,6	€ 0,15	€ 149,49	**€ 279,86**
Total expenditures	**601,7**	**€ 27,15**	**€ 16.336,16**	**601,7**	**€ 39,78**	**€ 23.937,63**	**996,6**	**€ 40,10**	**€ 39.963,66**	**€ 80.237,45**

(Own work, based on Statistics Netherlands, 2015)

The above tables show a significant difference in estimated total expenditures per scenario. The reasoning for these differences can be traced by evaluating the contrast between expenditures by household groups earlier referred to. Referring back to local multiplier effects, these models simulate the elements concerning increasing spendable income among different households. Firms that sell relatively large amounts of goods at the regional market of Groningen, are considered to benefit the most and ensure the rising demand for labor, continuing the multiplier effect. The supermarket sector fits within this profile, selling goods belonging to expenditure categories Foods and non alcohol, Alcohol and tobacco, Upholstery and household appliances. Supermarkets are used to discuss the further elements of the local multiplier framework that are set into motion.

Next step is to estimate where new workers as result of the job creation are most likely going to live, and thus where their expenditures are made. The new data centre is located in the Eemsdelta region, one of the in the introduction discussed shrinking regions in the province of Groningen. A negative spiral of (spatial) developments emerged as a result of abandoned houses that cause diminishing values of real estate and disappearing facilities and services that cause decreasing liveability applies for this region (Venhorst and Haartsen, 2009). This, together with the well-known phenomena regarding urbanization (Derksen, 2014), supports the assumption that a relatively large number of workers will locate in the city of Groningen. The next element of the local multiplier framework, the increased expenditures by households on the local market, is therefore applied on the supermarket sector in Groningen. To visualize this on a micro level, all locations of supermarkets are included in figure 7. These locations will benefit indirectly of the job creation and subsequently, these are the locations where a rising demand for labor will occur that keeps the multiplier effect in motion.

Figure 7: Supermarkets in Groningen



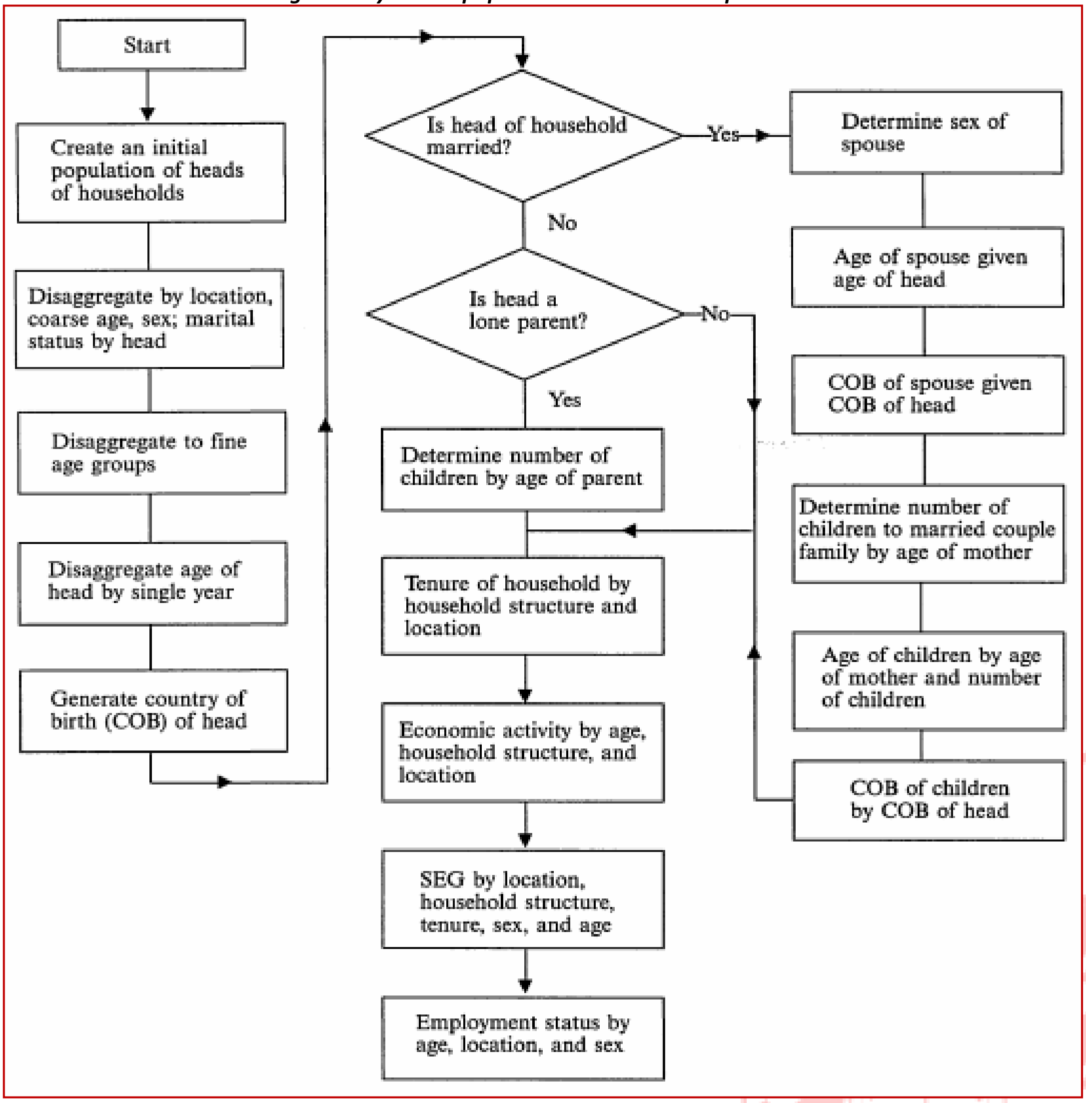
(Spotzi, 2018)

4.3 Blueprint spatial microsimulation model

As already been discussed several times, is the implementation of a complete and professional microsimulation model including multiplier effects beyond the scope of this project. Nevertheless, based on the conducted theory research and carried out analysis in previous paragraphs a blueprint for the purpose of future explorations is proposed. Setting up a spatial microsimulation model is done by (1) collecting a micro data set (or constructing when it is not available), (2) creating a micro-level population by obtaining numerical results derived from random sampling (Monte Carlo Method), (3) implementing different 'what-if' scenarios and (4) adjusting the basic micro data set by dynamically modelling it (Ballas et al., 2005).

When generating a micro data set based on aggregate statistics, the re-weighting by actual micro data will significantly higher its solidity (Ballas et al., 2006). The used data on household expenditures in paragraph 4.2 is derived from a large-scale national survey, while actually data on household expenditures at regional or even better municipal level is desired. A solution to this can be found in one of the several techniques that can process this data into household estimates for the region of Groningen or the municipalities it includes. Therefore, a large amount of external data concerning both individual and household variables needs to be collected and processed. Figure 8 contains a visualization of this synthetic population reconstruction process. In future research an approach comparable to the one Williamson, Birkin and Rees (1998) present in their research can be used to accomplish step 1 and 2 of the spatial microsimulation modelling process.

Figure 8: Synthetic population reconstruction process



(Williamson, Birkin and Rees, 1998)

When steps 1 and 2 have been performed, the data set is ready to be 'manipulated' into different scenarios. Within the scope of this research on the regional economic effects of the capital injection in Eemshaven, it appears that its most relevant and interesting to sketch these scenarios on the basis of contrasting distributions of labor. The carried out analyses in this research are based on three potential distributions of labor containing three groups of workers: Young professionals, Starters and Multiple-person households. Based on household characteristics estimates were made on future expenditures. In actual spatial microsimulation models more extensive approaches are used were households are assigned (census and non-census) attributes. This involves dozens of attributes that give a reflection on a households composition up to their social class. This enables the researcher to sketch very detailed different scenarios including not negligible their geographic consequences. For reference a list of attributes used in research by Ballas et al. (2006) can be found in Appendix 2.

Step 4 implies the adjusting of the micro dataset by dynamically modelling it. To get a first idea of which municipalities will benefit the most of the capital injection in Eemshaven it must be mapped where the workers actually live. The way in which in this research the FTE's are distributed over the province of Groningen (estimations based on theories) is too abstract for a professional spatial microsimulation model. To determine the impact on the socio-economic landscape of this major job gain, detailed information on the data centre's workforce is required. A distribution equal to that of Ballas et al. (2006) is suggested: Professionals, Managerial and Technical, Skilled non manual, Skilled manual, Partly skilled and Unskilled. Thereafter, incomes can be assigned to these groups and together with the earlier mentioned geographical distribution of FTE's across the different municipalities an estimate can be made of the regional increase in earnings. When the Synthetic population reconstruction process shown in figure 8 is followed, now insight is provided on the step 'Economic activity by age, household structure, and location'.

With these steps, the earlier discussed theories on local multiplier effects were put into practice. The Keynesian multiplier effect is a well-known and solid method to use in research like this. Still, there are even better theories to apply within the scope of a spatial microsimulation model approach. In contrast to the Keynesian methods with its industrial perspectives, there are methods that go beyond the regional level and take socio-economic variables such as household income and expenditures into account (Ballas et al., 2006). The disaggregated input-output models of Batey and Madden (1983, 1999, 2001) do contain these demographic and socio-economic components.

5. Conclusion and discussion

5.1 Conclusion

The aim of this research is to give insight in how a spatial microsimulation model could be carried out that investigates the regional economic effects of the capital injection by Google in Eemshaven. Answer is given to the central research question: ***What are the economic effects of the capital injection by Google for the region of Groningen and how can therefore a spatial microsimulation model be designed?*** The direct and indirect effects are investigated separately.

Literature research distinguished several direct effects of the capital injection by Google in Eemshaven that affect the region of Groningen. It can be stated that with this capital injection Groningen's chances on attracting (foreign) investors have been significantly improved. Four main motives underlie this statement. First, by adding wealth through raising wages and living standards in the region of Groningen, Google makes it more attractive for other firms to enter and serve the local market. Thereafter, when the local economy of Groningen grows and the local suppliers are in a position to benefit from economies of scale, firms can lower their input costs and make the region more attractive to other companies that use the same production factors. Next, with the facilitation of knowledge spillovers and the raising of the workers productivity, Google sends a signal to companies abroad that are considering relocation. From a strategic point of view a favourable regulatory framework can help investors with the improvement of their existing products and development of new products (Dunning, 1998), spillovers (Markusen, 1995; Fosfuri et al., 2001; Malchow- Møller et al., 2013; Görg and Strobl, 2005; Görg, 2007). Additional benefit is the effort that Google takes in promoting responsible and efficient energy usage (Shebabi et al., 2016). Probably the most important direct effect that also forms the basis of longer term indirect effects is the annually job creation with a size of approximately 2,200 FTE's (Copenhagen Economics, 2018; Heijdra and Ligthart, 1997; Moretti, 2010; Delfmann and Koster, 2014).

The indirect economic effects of the job creation for the region of Groningen are analysed by the development of a simplified model based on a spatial microsimulation modelling approach (Ballas et al., 2006; Birkin and Rees, 1998). Based on the Statistics Netherlands Budget Research (2015), three scenarios of different labor distributions were modelled containing the household profiles Young professionals, Starters and Multiple-person households. Table 2 gives insight in the economic effects of the job creation in different scenarios (Heijdra and Ligthart, 1997; Moretti, 2010; Delfmann and Koster, 2014). Additionally, it is shown at a micro level where extra expenditures can be expected.

Based on the conducted theory research and carried out analysis, a blueprint for the purpose of future explorations is proposed. When generating a micro data set based on aggregate statistics, the re-weighting by actual micro data will significantly higher its solidity (Ballas et al., 2006). Essential aspect is to process more general data into household estimates for the region of Groningen or the municipalities it includes. External data concerning both individual and household variables needs to be collected and processed (Williamson et al., 1998). In actual spatial microsimulation models more extensive approaches are required in which households are assigned (census and non-census) attributes (Ballas et al., 2006). This enables the researcher to sketch very detailed different scenarios including not negligible their geographic consequences. To determine the impact on the socio-economic socio-economic landscape of this major job gain, detailed information on the data centre's workforce is required. With this new information the analysis on where expenditures will land performed in this research can be re-executed in a complete way. In contrast to the Keynesian methods with its industrial perspectives, there are methods that go beyond the regional level and take socio-economic variables such as household income and expenditures into account (Ballas et al., 2006). The disaggregated input-output models of Batey and Madden (1983, 1999, 2001) are more suitable due to their demographic and socio-economic components.

5.2 Discussion

One of the uncertainties in this research is the fact that the province of Groningen is assigned to as the region affected by the capital injection. In contrast to the clear boundaries of the province and its municipalities, the consequences of the capital injection do not stop or begin at certain borders under all circumstances. It is quite possible that some areas outside the province of Groningen are positively affected more than some of its own municipalities. Furthermore, in discussing the direct effects of the capital injection, the Copenhagen Economics reports (2015 and 2018) were used to structure the answering of this sub research question. Despite the fact that the topics discussed in this report were all substantiated with (academic) literature and theories, it cannot be stated with complete certainty that all relevant direct effects have been considered. Next, the different scenarios within the modelling of the economic effects were based on the researcher's own interpretations. The creative approaches to some of the research questions reduces the chance that other researchers would copy this research design. However, at the same time these approaches can have an inspiring effect for future research on this or any other study on major capital injections. Due to the experimenting approaches in this research, it is self-evident that the outcomes of the analyses should not be seen as very accurate or accepted as the truth.

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Appendices

Appendix 1

The dataset of consumption patterns that is used concerns the Statistics Netherlands Budget Research (2015). Based on the selected household characteristics the dataset places expenditures of Young professionals, Starters and Multiple-person households in fifteen different categories. These group-specific expenditure patterns are included in the tables below.

Household characteristics Young professionals

Expenditure categories (1 000 euro)	Single men, under retirement age	Single women, under retirement age	Pair without children, under retirement age	Household size: 1 person	Age: <25 years	Age: 25 to 35 years	Homeownership: rental property	Income limit: no low income	Average expenditures
Total expenditures	22,1	21,5	39,8	22,3	21,4	29,6	24,3	36,2	**27,15**
Foods and non alcohol	2,1	2	4	2,2	2	2,9	2,9	4	**2,76**
Alcohol and tobacco	1,1	0,7	1,3	0,9	0,6	0,8	1	1,1	**0,94**
Clothes and shoes	0,7	1,1	1,8	0,9	1	1,6	1,1	1,7	**1,24**
Housing, water and energy	8,5	8,3	11,6	8,9	7,2	9,6	8,6	11,2	**9,24**
Upholstery and household appliances	0,8	0,9	2,2	1	0,6	1,5	1,1	2	**1,26**
Healthcare	0,2	0,3	0,6	0,3	0,2	0,3	0,3	0,5	**0,34**
Transportation	2,7	2	6,4	2,1	2,4	3,9	2,4	4,9	**3,35**
Communication	0,8	0,8	1,2	0,8	0,8	1,1	1	1,2	**0,96**
Recreation and culture	1,9	1,9	4,1	1,9	2	2,4	2,1	3,6	**2,49**
Education	0,3	0,4	0,3	0,2	1,7	0,4	0,4	0,4	**0,51**
Restaurants and hotels	1,5	1,2	2,6	1,2	1,6	2,1	1,3	2,2	**1,71**
Diverse goods and services	1,3	1,5	2,9	1,5	0,9	2,4	1,8	2,9	**1,90**
Consumption related taxes	0,3	0,2	0,8	0,3	0,2	0,5	0,4	0,7	**0,43**
Charity	0,1	0,1	0,1	0,1	0	0,1	0,1	0,2	**0,10**

(Own work, based on Statistics Netherlands, 2015)

Household characteristics Starters

Expenditure categories (1 000 euro)	Pair, all children <18	Pair, without children, under retirement age	Household size: 2 persons	Household size: 3 persons	Household size: 4 or more persons	Main breadwinner: 25 to 35 years	Average expenditures
Total expenditures	44,3	39,8	37,2	40,8	47	29,6	**39,78**
Foods and non alcohol	5,3	4	4	4,7	5,6	2,9	**4,42**
Alcohol and tobacco	0,9	1,3	1,2	1,1	1	0,8	**1,05**
Clothes and shoes	2,6	1,8	1,6	2	2,7	1,6	**2,05**
Housing, water and energy	12	11,6	11,5	11,5	12,3	9,6	**11,42**
Upholstery and household appliances	2,4	2,2	2,1	2,2	2,6	1,5	**2,17**
Healthcare	0,5	0,6	0,6	0,5	0,5	0,3	**0,50**
Transportation	6,4	6,4	5,1	5,9	6,7	3,9	**5,73**
Communication	1,4	1,2	1,2	1,4	1,5	1,1	**1,30**
Recreation and culture	4,4	4,1	3,7	3,8	4,9	2,4	**3,88**
Education	0,5	0,3	0,3	0,8	1	0,4	**0,55**
Restaurants and hotels	2,8	2,6	2,3	2,4	3,1	2,1	**2,55**
Diverse goods and services	4,2	2,9	2,7	3,5	4,1	2,4	**3,30**
Consumption related taxes	0,9	0,8	0,7	0,8	0,9	0,5	**0,77**
Charity	0,1	0,1	0,2	0,1	0,1	0,1	**0,12**

(Own work, based on Statistics Netherlands, 2015)

Household characteristics Multiple person households

Expenditure categories (1 000 euro)	Multiple-person households	Multiple person households, additional	Household size: 3 persons	Household size: 4 persons	Household size: 5 or more persons	Main breadwinner: 25 to 35 years	Main breadwinner: 35 to 45 years	Main breadwinner: 45 to 55 years	Main breadwinner: 55 to 65 years	Home ownership: own property	Average expenditures
Total expenditures	40,8	38,7	40,8	47	48,6	29,6	36,2	40,8	37	41,5	**40,10**
Foods and non alcohol	4,7	4,4	4,7	5,6	6,1	2,9	4,1	4,7	4	4,4	**4,56**
Alcohol and tobacco	1,1	1,1	1,1	1	0,8	0,8	0,9	1,1	1,3	1,1	**1,03**
Clothes and shoes	2	1,7	2	2,7	3	1,6	2	2,1	1,5	2	**2,06**
Housing, water and energy	11,8	10,8	11,5	12,3	12,6	9,6	10,8	11,4	11,3	12,3	**11,44**
Upholstery and household appliances	2,3	2,3	2,2	2,6	2,6	1,5	1,9	2,1	2	2,3	**2,18**
Healthcare	0,6	0,5	0,5	0,5	0,5	0,3	0,4	0,5	0,6	0,6	**0,50**
Transportation	5,7	5,5	5,9	6,7	7,2	3,9	4,9	5,9	5,3	6	**5,70**
Communication	1,3	1,2	1,4	1,5	1,5	1,1	1,2	1,3	1,2	1,3	**1,30**
Recreation and culture	4,1	3,7	3,8	4,9	4,9	2,4	3,5	4,3	3,8	4,3	**3,97**
Education	0,6	1,7	0,8	1	1,3	0,4	0,4	0,9	0,4	0,5	**0,80**
Restaurants and hotels	2,5	2,3	2,4	3,1	2,5	2,1	2,3	2,5	2,1	2,6	**2,44**
Diverse goods and services	3,3	2,8	3,5	4,1	4,2	2,4	3,2	3,1	2,8	3,3	**3,27**
Consumption related taxes	0,8	0,6	0,8	0,9	1	0,5	0,7	0,7	0,7	0,8	**0,75**
Charity	0,2	0,2	0,1	0,1	0,2	0,1	0,1	0,1	0,2	0,2	**0,15**

(Own work, based on Statistics Netherlands, 2015)

Appendix 2

Based on household characteristics estimates were made on future expenditures. In actual spatial microsimulation models more extensive approaches are used were households are assigned (census and non-census) attributes. This involves dozens of attributes that give a reflection on a households composition up to their social class. This enables the researcher to sketch very detailed different scenarios including not negligible their geographic consequences. For reference a list of attributes used in research by Ballas et al. (2006) is shown below.

Name	Label	Name	Label
Location	Place of residence (ED level)	Dhdecpos	Economic position of household head
Bath	Availability of bath/shower	Dhdage	Age of household head
Cenheat	Availability of central heating	Dhdsex	Sex of household head
Insidewc	Availability of inside WC	Dhdclass	Social class of household head
Cars	No. of cars	Qsubgrp	Subject group of highest qualification
Hhsptype	Household space type	Indusdiv	Industry (SIC divisions)
Hhspindw	No. of household spaces in dwelling	Occmajor	Occupation: SOC major groups
Roomsnum	No. of rooms in household space	Occsubmj	Occupation: SOC sub-major groups
Tenure	Tenure of household space	Occminor	Occupation: SOC minor groups
Persinhh	No. of persons in household	Hhdcomp	Household composition type
Age	Age	Hdeptype	Household dependant type
Cobirth	Country of birth	Dfhage	Age of head of family
Econprim	Economic position (primary)	Dfresid	No. of residents in family
Econsec	Economic position (secondary)	Dfdepch	No. of dependent children in family
Empstat	Employment status	Dfolddc	Age oldest dependent child in family
Ethgroup	Ethnic group	Dfyngdc	Age youngest dependent child in family
Famnum	Family number	Dfadult	No. of adults resident in family
Famtype	Family type	Dfchild	No. of under-16s resident in family
Hours	Hours worked weekly	Dfpensr	No. of pensioners resident in family
Industry	Industry	Dfltill	No. of persons with ltill resident in family
LTILL	Limiting long-term illness	Dfemp	No. of persons in employment resident family
Mstatus	Marital status	Dfecact	No. of economically active residents in family
Migorgn	Migrant—area of former usual residence	Dfunemp	No. of unemployed residents in family
Occpatn	Occupation	Dfretire	No. of retired residents in family
Qualnum	No. of higher educational qualifications	Dfpsick	No. of permanently sick residents in family
Qualevel	Level of highest qualification	Dfinact	No. of econom. inactive residents in family
Residsta	Resident status	Dfother	No. of residents other inactive in family
Sex	Sex	Dfstuds	No. of students in family enumerated at term-time address
Soclass	Social class (based on occupation)	Dfdeps	No. of dependants resident in family
Segroup	Socio-economic group	Dfolddep	Age of oldest resident dependant in family
Tranwork	Mode of transport to work	Dfyngdep	Age of youngest resident dependant in family
Dhresid	No. of residents in household	Dfhecpos	Economic position of head of family
Dhdepch	No. of dependent children in household	Dfhsex	Sex of head of family
Dholddc	Age of oldest dependent child in household	Dfhclass	Social class of head of family
Dhyngdc	Age of youngest dependent child in household	Dhstuds	No. of students enumerated at term-time address in household
Dhadult	No. of adults in household	Dhdeps	No. of dependants in household
Dhchild	No. of under-16s in household	Dholddep	Age of oldest resident dependant in household
Dhpensr	No. of pensioners in household	Dhyngdep	Age of youngest dependant in hhold
Dhltill	No. of LTILL (Limiting Long-Term Illness) persons in household	Dallstud	All-student household

Dhemp	No. of persons in employment in household	Dallpens	All-pensioner household
Dhecact	No. of persons economically active in household	Dalladlt	All-adult household
Dhunemp	No. of unemployed persons in household	EarnedIncome	Earned income (annual)
Dhretire	No. of retired persons in household	Tax	Income tax paid
Dhpsick	No. of perm. sick persons in household	RetirementPension	Retirement pension (per week)
Dhinact	No. of econ. inactive persons in household	WFTC	Working Families Tax Credit (per week)
Dhother	No. of persons other inactive in household	ChildBenefit	Amount of child benefit (per week)

Additional non-census *SimLeeds* attributes
Rent and mortgage, loan and hire purchase details
Local authority service charges
Allowances/rebates
Difficulties with rent/mortgage payments
Household composition
Consumer durables, cars, telephones, food
Heating/fuel types, costs, payment methods
Non-monetary poverty indicators
Crime
Employment status
Not working/seeking work
Self-employed
Sector private/public
Standard Industrial Classification/Standard Occupational Classification/ISCO (International Standard Classification of Occupations)
Nature of business/duties
Workplace/size of firm
Travelling time
Means of travel
Length of tenure
Hours worked/overtime
Union membership
Prospects/training/ambitions
Superannuation/pensions
Attitudes to work/incentives
Wages/salary/deductions
Childcare provisions
Job search activity
Career opportunities
Bonuses
Performance-related pay
Income from interest/dividends
Savings and investments
Income from benefits