THE UNIVERSITY OF HULL

Estimation of a Regional Income Multiplier Using Primary Data: Economic Impact Assessment of a Major Investment on a Local Economy

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by

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Dedication

This thesis is dedicated to my brother, Phil. I could not have done this without you, bro. Thanks for picking me up, and for supporting me every step of the way. You are the best.

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I would like to thank the University of Hull and the Green Port Growth Programme for generously sponsoring my PhD studies, I am most grateful to have been afforded this opportunity. Thank you to Siemens Gamesa for allowing me to use the Blade Factory as a case study, and to the employees for participating in the research. I hope the findings from the study are interesting and useful, and that the lessons serve as a good base for future impact assessment work.

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Abstract

Over the last century, there has been great interest in the formulation and estimation of income multipliers at regional and sub-regional level to guide the decisions of planners and policy makers. However, the literature expressly highlights a lack of practical guidance for undertaking such assessments which has led to frequent 'recycling' of data, in lieu of more appropriate alternatives. Findings from such studies are therefore often accompanied with notes of caution, on the grounds that further work is required to improve the estimation of coefficients.

This research, therefore, seeks to contribute to the construction of more appropriate data sets and their use to measure economic impacts by way of a Keynesian Multiplier model. For this purpose, it uses the recent Siemens Gamesa and Associated British Ports investment in a blade manufacturing facility in Hull as a case study. There is a particular intention to advance data collection practices, and subsequently highlight the way in which primary data can be used to estimate more robust and granular multiplier values, together with suggestions for further practitioner insight.

In addition to providing a new and comprehensive dataset of current saving and spending propensities for the Humber sub-region, the research goes on to estimate first round and subsequent round multiplier values and reveals the extent of variation in first round by various sub-groups within the Siemens Gamesa sample. This is done using regression analysis to estimate marginal propensities to import from outside the sub-region and is supported by a scenario and sensitivity analysis to assist user judgement.

Finally, as a standalone contribution to the main investigation, the new primary dataset is used to contribute to the discussion on returns to education using the Mincerian earnings function and is also used to assess the determinants of homeownership in the Humber.

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Chapter 1 – Introduction

Chapter 1 sets out the context and motivation, together with the aims and intentions of this study, and specifies the research questions that were used to guide the investigation. The chapter closes with an overview of the thesis design and structure.

1.1 Context and Motivation

Over the last century, there has been great interest in the formulation and estimation of income multipliers at regional and sub-regional level to guide the decisions of planners and policy makers, as part of Economic Impact Assessments (EIAs). Tyrrell and Johnston (2001:94) note that "regional planners and policy makers often rely on the results of economic impact analysis to assess economic consequences". In this regard, national and international news sources frequently use the multiplier concept to promote the business case for investment decisions using statements such as: 'for every £1 spent, the country will receive *x* in benefits' (BBC News, 2019(a)). Coppedge (2011:1) states that when one asks about the extent of impact or benefit arising from a development or investment "the answer lies in the multiplier, which indicates the total impact on income or business activity that results from this initial investment". Taken together, this suggests that the results from multiplier assessments are clearly important and are used as the foundation from which further economic decisions are taken. They must, therefore, be as precise and reliable as possible, else their use might not simply be limited, it may in fact lead to sub-optimal consequences.

In spite of this, the literature expressly highlights a lack of practical guidance for undertaking EIAs – in particular regarding the collection of primary data – which has led to frequent 'recycling' of coefficient estimates, in lieu of more appropriate datasets. Findings from studies are therefore often accompanied with notes of caution, on the grounds that further work is required to improve estimation of coefficients. Further,

owing to the lack of primary and supplementary data, practitioners are limited in their ability to explore more widely the characteristics of first round multipliers, which may be informative in the likely absence of data for the second and subsequent multiplier rounds. Use of primary data offers the additional possibility of conducting a sensitivity analysis, which may provide practitioners with further insight.

Given this context, this research is motivated by a clear need for better primary datasets in support of EIAs and the ability to study local multipliers. It seeks to contribute to the construction of a more appropriate dataset to allow for more precise multiplier estimation and the possibility to address further regional issues.

To do this, the recent Siemens Gamesa and Associated British Ports (ABP) investment of £310m in a wind turbine blade manufacturing facility in Hull is used as a case study. This investment has been considered one of the most significant in recent history of the region and it presents a unique opportunity for assessment. A more detailed discussion of the case study is given at the start of **Chapter 2**.

Following the collection of primary data using a bespoke questionnaire, a simple Keynesian model is built, and a number of local disposable income multipliers are estimated and studied.

1.2 Aims and Intentions of Research

This research seeks, in the first instance, to contribute to the development of a more suitable dataset for the estimation of regional multipliers. It sets out the methods that were trialled to collect the necessary data, including the lessons that were learned from the various pilot rounds.

Having collected the data, the intention is to derive a simple Keynesian Multiplier model that is suitable for the data that is collected. Various multipliers can then be estimated to address the research questions, outlined below.

Upon estimating the regional disposable income multipliers, the data can be further interrogated to provide additional practitioner guidance. Collection of supplementary socio-economic data, such as educational attainment, salary, age and current place of residence (of the newly employed workers at the Blade Factory) will help to develop a profile of additional factors that may be informative in the estimation and/or explanation of multiplier estimates – in the first round. Further, the use of such primary data enables the first round multiplier estimate to be studied by various sub-groups, such that it is possible to determine which groups of individuals – from the newly employed workforce – are likely to contribute the most to regional economic impact, as a result of their individual propensities, as well as their other socio-economic characteristics.

Ultimately, the primary intention is to provide researchers and industry practitioners with seemingly sought after methodological and particularly data collection guidance (BIS, 2009a) to assist future economic impact estimation efforts arising from regional investments. An additional intention is to assist users of the method to optimise the additional socio-economic data that is collected as part of the estimation, allowing additional policy decisions to be supported by evidence.

1.3 Research Questions

The research questions that were used to guide this study are disaggregated into two categories: the use of primary data for EIAs and case study-specific, as follows:

- **The Use of Primary Data for EIAs:**
    i. Can the various leakage parameters of a Keynesian multiplier model be captured in a more accurate way – as opposed to using evidence collected in historic studies? Can ***marginal*** values be estimated, rather than average?
    ii. Is there value in separating the model into 'first round of spending' and second and subsequent rounds of spending'?

iii. Can supplementary socio-economic data be used to reveal anything further about the regional multiplier in the first round, and be used in support of its estimation?

iv. Does the use of primary data significantly change the final multiplier estimate, relative to the use of secondary data?

- **Case study-specific**:

v. For every £1 of the Siemens Gamesa and ABP investment, what will be the impact on disposable income – in the first round, and in subsequent rounds - for the Humber region during the Operation and Maintenance (O&M) phase of the Blade Factory?

vi. How does the estimated first round multiplier differ by Local Authority within the Humber?

vii. How does the estimated first round multiplier differ by various socio-economic sub-groups present in the data set?

viii. Can anything further be identified using the newly constructed dataset? For example, can a contribution to the literature on Mincerian earnings be made with specific reference to the Siemens Gamesa workforce?

1.4 Structure and Design of Thesis

Having set out the rationale and research questions underpinning this study, this final section of **Chapter 1** details the design and structure of the balance of the thesis.

Chapter 2 offers background and context to the research, by introducing the case study upon which the study has been developed – the aforementioned investment made by Siemens Gamesa and ABP in a wind turbine blade manufacturing facility in Hull, UK – followed by a geographical, demographic and socio-economic overview of the study region, with a view to informing readers who may not be familiar with the Humber area and its current landscape. This was also conducted with a view to assisting in the formation of high level hypotheses about the relative size of the first round multiplier.

The geographical overview is particularly important, because it reveals the extent and proximity of alternative spending centres for residents of the Humber. This may prove to be an additional explanatory factor for the first round multiplier estimates, since it may have a significant impact on an individual's propensity to spend locally, or non-locally.

Chapter 3 reviews the literature that has guided this study and brought to light areas of the existing body of knowledge that require further development, assisting in the placement of this research. The chapter opens with an overview of the EIA concept, including the limited guidance and the associated challenges. It progresses into an overview of different types of 'multiplier' approaches, which then leads into a discussion around the specific challenges of Keynesian multipliers and identifies alternative methods that might be more commonly used in impact analysis today.

Having settled on a multiplier estimation technique using the literature set out in Chapter 3, the purpose of **Chapter 4** is to detail the methods of primary data collection that were adopted to gather the required information to estimate the multiplier, and to address the supplementary research question.

Chapter 5 subsequently provides a detailed review of the data that was collected, using tabulations and descriptive statistics. This was important in providing an idea of how representative the sample data is, and in the formulation of first round multiplier predictions – based on various spending and saving propensities.

Chapter 6 details the regional disposable income multiplier estimation for the first round of spending, and for second and subsequent rounds. It provides a derivation of the multiplier model and sets out the method that was used to estimate marginal propensities and includes a scenario analysis using alternative coefficient estimates. A sensitivity analysis is also provided for the various estimates, via use of upper and lower bounds estimates.

Chapter 7 sets out the supplementary findings that were estimated using the wider data collected via the questionnaire. In particular it contributes to the discussion on Mincerian earnings using Siemens Gamesa employee wages and educational experience, and it looks at current housing tenure propensities, with a view to providing local planners and policy makers with an up to date overview of current preferences.

Chapter 8 concludes the study by reviewing the findings in the context of the research questions proposed in Chapter 1 and suggestions for further development of the research are given.

Chapter 2 – Background and Context

Chapter 2 introduces the Siemens Gamesa and Associated British Ports (ABP) case study, upon which this research has been developed, and therefore an understanding of which is integral. Following a review of the case study in **Section 2.1**, the geographical[1] and socio-economic background to the study region – the Humber – is given in **Section 2.2** and **Section 2.3**, respectively, with a view to contextualising the research. Secondary data is used to provide an overview of the region, the findings of which can later be used to inform predictions about possible multiplier estimates. Such multiplier estimates will be generated using primary data collected at the individual level from questionnaires (see **Chapter 4**). However, prior knowledge of the socio-economic context in which the individuals reside may be informative in developing hypotheses about individual saving, spending and import propensities, and thus the multiplier estimates. It may also be relevant from the perspective of determining how closely aligned the primary data sample is to the wider population of the Humber.

2.1 The Siemens Gamesa and Associated British Ports Investment

On 25th March 2014, Siemens (hereafter Siemens Gamesa[2]) announced its decision to invest £160m in the development of an offshore wind turbine production facility, on Hull's Alexandra Dock – a 58 hectare (143 acre approximately) site located on the estate of the Port of Hull (Humber LEP, 2016), on England's East coast (see geographical overview of the Humber region in **Section 2.2**). Siemens Gamesa's chosen investment partner, ABP – the site owner – invested a further £150m in the project, to support the redevelopment of the port site, and the new production facilities. The combined

[1] Reference to a number of Humber sub-regions will be made throughout the case study overview, however, for the sake of fluidity, details of their location within the UK will be provided in the following section (**Section 2.2**), together with further detail.

[2] In April 2017, Siemens Wind Power and Gamesa completed the merger of their two wind power businesses; the company is now referred to as Siemens Gamesa.

investment of £310m was expected to create up to 1,000 jobs directly (at Siemens Gamesa), with many more additional jobs to be created and safeguarded during construction of the facility, and indirectly throughout the supply chain. Siemens PLC (2018) stated that "The investment will provide a huge boost to the UK's offshore wind industry and the Humber region". In line with the economic competencies report, commissioned by Hull Citybuild, and delivered by IBM-Plant Location International (2006), the investment would build on the Humber's strong positioning in Ports and Logistics and in Renewable Energy – two of the areas in which the region was found to have potential for development.

Initially, Siemens Gamesa intended to operate across two sites (see Geographic Context in Section 2.2):

- Alexandra Dock (Hull): a nacelle[3] pre-assembly, project construction and logistics and distribution facility;
- Paull: (East Riding of Yorkshire): a blade manufacturing facility.

However, owing to a number of problems discovered at the Paull site, it was decided in January 2015 that the rotor blade manufacturing plant would be located at Alexandra Dock, and that the nacelle manufacturing facility would be moved to Cuxhaven, Germany, where Siemens Gamesa already had an established supply chain for their construction. The change in plans would allow for an increase in production of rotor blades, from 450 per year, to 600 per year. Further, while the manufacturing of nacelles was expected to generate a larger number of jobs than blades throughout the supply chain, the manufacture of blades was expected to secure more *direct* jobs, and the change was therefore perceived as beneficial for the region (GIA, 2017).

[3] Sharpley (2015) in Windpower Engineering & Development (2019) describes a nacelle as, "the part of a wind turbine that houses the components that transform the wind's kinetic energy into mechanical energy to turn a generator that produces electricity".

Construction of the Blade Factory[4] came to an end, ahead of schedule, in December 2016, marking the start of the O&M phase of the Blade Factory. For a detailed timeline of the Siemens Gamesa and ABP investment, including the political timeline that led to the decision, see **Appendix 1**.

2.1.1 The Involvement of Green Port Hull

One of the entities responsible for securing, and subsequently supporting, the Blade Factory investment, was Green Port Hull (GPH).[5] GPH is a collaboration between Hull City Council and East Riding Council, together with ABP and additional partner organisations, whose 'vision' is to establish Hull and East Riding of Yorkshire as a "world class centre for renewable energy", with a view to "creating wealth and employment for the region" (Green Port Hull, 2019). Having secured funding of £25.7m through the Regional Growth Fund (GIA, 2017) to deliver its vision, GPH has been able to provide support and opportunities to local companies and individuals across the renewable energy sector, via a number of 'strands', including:

- Skills and Employment;
- Business Support;
- Business Grants;
- Research, Development and Innovation;
- Inward Investment;
- Site Assembly.

[4] Hereafter, Siemens Gamesa's facility on Alexandra Dock will be referred to as the 'Blade Factory', since this is how it is known among employees of Siemens Gamesa and was therefore how it was referred to throughout the questionnaire.

[5] For additional context: the Blade Factory development on Alexandra Dock is also known as 'the Green Port Hull', so called because of its contribution towards delivering green energy, from the Port of Hull; it is not, however, the location of the Green Port Hull collaboration, rather, the two simply happen to share the same name, since one is the 'centrepiece' of the other.

GPH was particularly instrumental in the training, upskilling and hiring efforts that were necessary to equip the Blade Factory, through its Skills and Employment strand. Further detail on the role of GPH in the development of the Blade Factory and the subsequent O&M phase can be found in the timeline featured in Appendix 1.

In order to assess its performance against objectives, GPH commissioned the Logistics Institute at the University of Hull to carry out a socio-economic and environmental impact assessment of its activities[6]. Given the significance of the Blade Factory in achieving GPH's vision, one of the objectives of the study was to assess the impact of Siemens Gamesa and ABP's investment, specifically. Clearly, the findings arising from the research that took place in support of this thesis will contribute towards achieving that particular objective of the impact assessment and may therefore be used as necessary.

Having already referred to a number of the sub-regions contained within the Humber, it is important that they are now geographically contextualised, within the UK, and within the context of the wider Yorkshire and the Humber region. Centre for Cities (2009) states that an understanding of economic geography is central to performance analysis; therefore, the following section sets out the geographical positioning of the various regions and sub-regions, with a view to later explaining the socio-economic findings that characterise the study region of this research.

2.2 Geographic Context

The following overview uses Nomenclature of Territorial Units for Statistics (NUTS) and Local Administrative Unit (LAU) classifications to deliver an overview of the Humber.

Yorkshire and the Humber is one of 12 NUTS 1 regions of the UK (ONS, 2019b). **Figure 2.1** highlights (in red) the location of Yorkshire and the Humber in the context of the UK.

[6] Known as the Green Port Impact Assessment ('GIA'); further detail on the project can be found at: www.gia.hull.ac.uk

It is situated on the east coast, facing towards continental Europe and is bordered to the north by the North East region, and to the south by East Midlands.

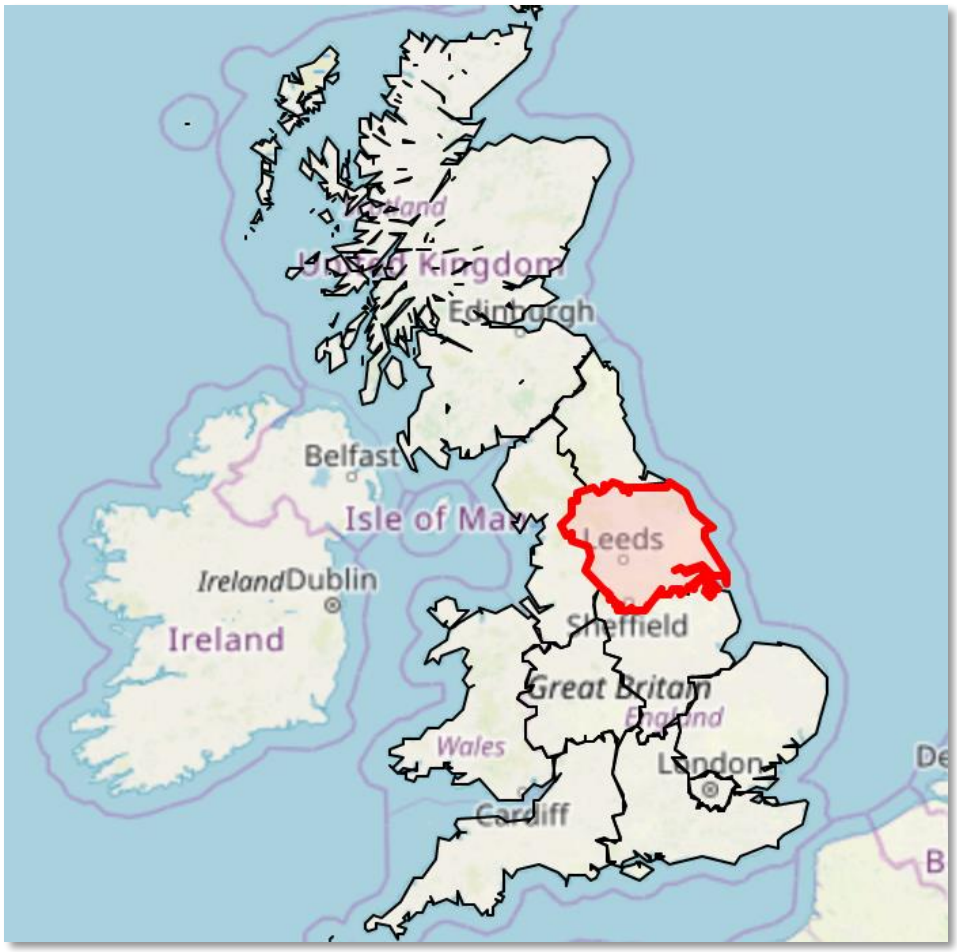

Figure 2.1: Map of Yorkshire and the Humber – UK Context

Source: Nomis, 2019a

Yorkshire and the Humber comprises four NUTS 2 areas (shown in **Figure 2.2**), namely:

- East Yorkshire[7] and Northern Lincolnshire ('the Humber');
- North Yorkshire;
- South Yorkshire;
- West Yorkshire.

[7] 'East Yorkshire' in this context, is not to be confused with 'East Riding of Yorkshire', one of the four Local Authority areas that is contained within the 'East Yorkshire and Northern Lincolnshire' sub-region.

The first sub-region on the list above and shown in pink on the righthand side of Figure 2.2, is commonly known as the Humber – the study area of this research. It consists of the following four LAU1 areas:

- Kingston upon Hull (Hull);
- East Riding of Yorkshire;
- North Lincolnshire;
- North East Lincolnshire.

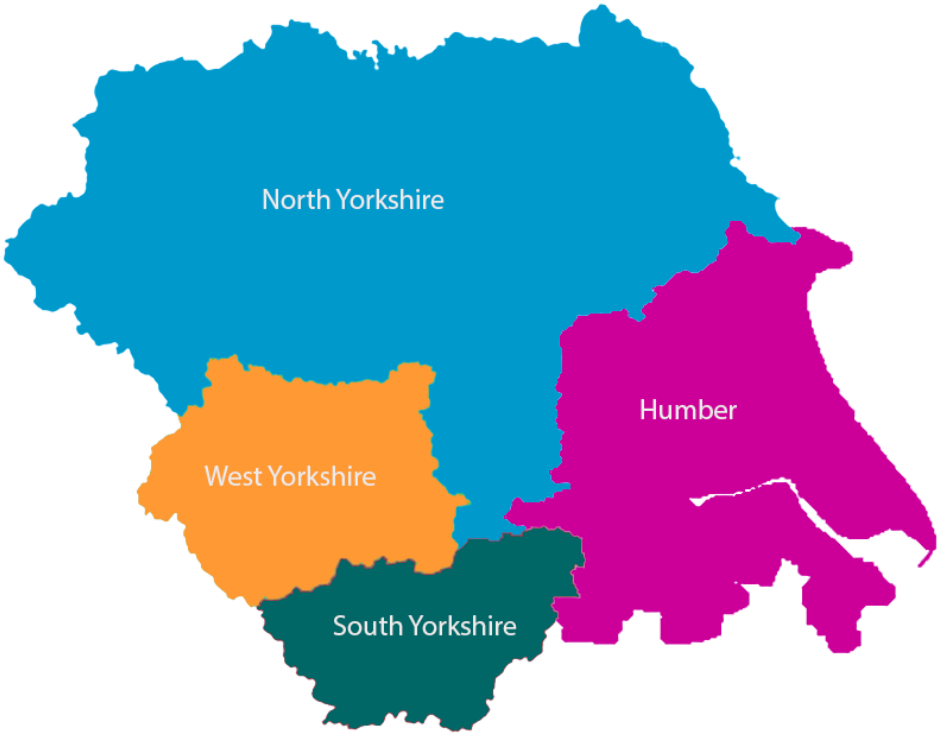

Figure 2.2: Map of The Humber - in Yorkshire and the Humber context

Source: Careers Yorkshire and the Humber, 2018

It is not unusual for the latter two local authorities to be grouped together for statistical purposes (together they are classified as a NUTS 3 region: North and North East Lincolnshire).

Figure 2.3 (overleaf) sets out the locations of the four LAUs within the Humber region; Hull and East Riding of Yorkshire are both on the north bank of the Humber estuary, and North and North East Lincolnshire are situated on the south bank.

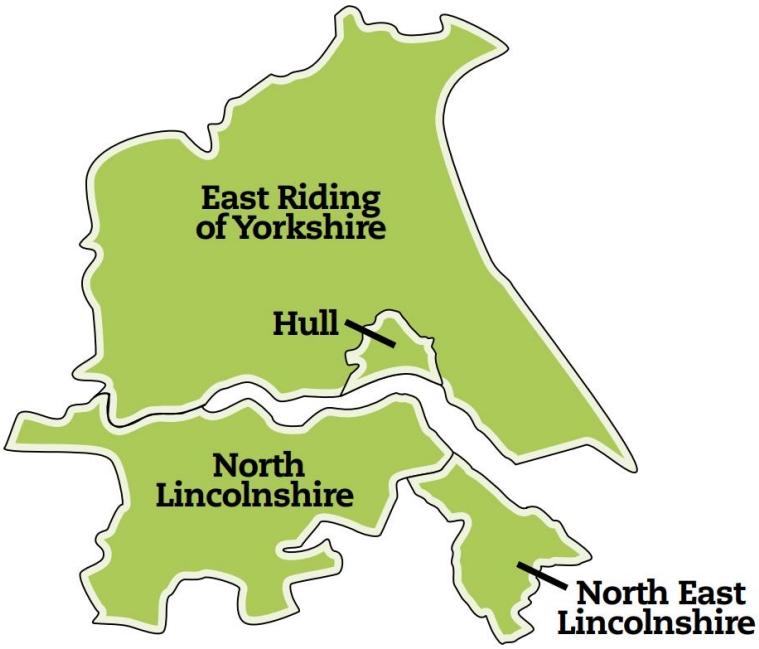

Figure 2.3: Map of Local Authorities – The Humber context

Source: Centre for Cities, 2009

Throughout this research, the focus is on the Humber sub-region, and the local authorities contained within it. As noted in **Section 2.1**, the Blade Factory is located in the City of Kingston upon Hull – usually referred to as Hull – and Siemens Gamesa made a commitment to hiring its Blade Factory employees from 'the local area' (Green Port Hull, 2016). At the start of O&M, approximately 97% of employees were located within 30 miles of Hull city centre; the majority of the 30-mile radius is covered by the Humber sub-region, and little beyond. This is important to note when considering implications for the multiplier. A review of the literature will reveal that the value of the multiplier is reduced when a large number of 'leakages' exist. In other words, when part of the cash injection (in this case, employee wage) exits the system or is unavailable for re-circulating through the rounds of spending (through a decision to save, for example), the extent of local proliferation will be less. A major leakage is clearly the decision to spend wage directly outside the region, in neighbouring areas. If a large majority of employees reside 'locally', it might be reasonable to hypothesise that at least some of their wage is spent

locally, thus contributing to a larger multiplier; if employees tended to reside non-locally, the multiplier might be smaller, since there will be a propensity to spend wage in the region of residence.

Further to this, some predictions can be made about the relative size of the first round multiplier for residents of each Local Authority, based on their respective economic geographies, extent of industrialisation and level of self-containment.

It can be seen that Hull is tightly bounded and has been referred to as "very much an isolated city, at some distance from the nearest fully-functioning labour market" (Centre for Cities, 2009:12). Larkin (1983:54) famously noted the remoteness of Hull by stating that it is, "far away from everywhere else. On the way to nowhere". In addition to this, the city has been found to suffer from poor transport links (Centre for Cities, 2009), further reducing the opportunity for non-local expenditure by residents of the city. As a result, and holding all other leakages constant, one might expect the Humber multiplier for residents of Hull to be relatively large, if in fact their wage *is* typically spent within the region – either in the city of Hull or the neighbouring local authorities of the Humber. It might also be argued that consumption preferences of Hull residents are sufficiently met by local amenities. Hull offers a number of large shopping centres, restaurants, hotels and leisure facilities, and is receiving ongoing investment in development initiatives, including the title of UK City of Culture 2017 and recent approval for a £130m regeneration of the city centre – which will add to the number of shops and facilities for residents (BBC News, 2019(b)). In light of this, it is not necessarily straightforward to determine if the geographic location and incomplete transport links would be responsible for the size of the Humber multiplier among Hull residents, or if it is simply that consumption preferences are adequately met by the amenities of the city. Regardless, the result is the same, and the expectation of a large multiplier (relative to the other LAUs) would not be unreasonable. This hypothesis is true for both the first round multiplier, and

the subsequent rounds multiplier, because employees of the blade factory (responsible for the first round multiplier) and likely to be subjected to the same conditions as all other residents, whose propensities come into play in the second and subsequent rounds.

By contrast, East Riding of Yorkshire, the rural Local Authority which surrounds Hull on the north of the Humber, is far less industrialised and less densely populated with approximately 136 people per square kilometre (Hull: 3,593 people per km^2), according to Humber Economic Partnership (2010). Centre for Cities (2009) notes that East Riding of Yorkshire has only two towns of particular significance, Beverley and Bridlington[8], and while the city of Hull might be a spending destination for residents of East Riding of Yorkshire, so too are the neighbouring towns and cities located in the North Yorkshire region of Yorkshire and the Humber, including York and Harrogate, and for residents on the far west border of East Riding of Yorkshire, the regions within West Yorkshire, such as Leeds and Wakefield might also offer spending opportunities. In view of the large number of possible non-Humber alternatives, it may be reasonable to assume that residents of East Riding of Yorkshire might have a smaller multiplier than residents of Hull (holding all other potential leakages constant), since their potential for wage-leakage into other districts may be higher.

Per the geography of East Riding of Yorkshire, the region of North and North East Lincolnshire is far less tightly bounded than Hull, and similar opportunities for out-of-region spending exist. Residents on the western border of North Lincolnshire, in particular, might choose to make shopping trips to the neighbouring sub-region of South Yorkshire (to the west of the Humber) to cities such as Sheffield or Doncaster. Those on the southern border of North and North East Lincolnshire might utilise the amenities of Lincolnshire and the East Midlands region (to the south of the Humber), consisting of

[8] In 2019, it might be reasonable to include Goole, among the towns of significance in the East Riding of Yorkshire.

Nottingham and Derby, should their consumption preferences not be met locally. However, in contrast to East Riding of Yorkshire, the southern-Humber local authorities have been found to display high levels of self-containment (Coburn, 2014), (Centre for Cities, 2009) suggesting that, in line with Hull (possibly) there may not be demand for out-of-region shopping trips. However, despite the geographical inclusion of North and North East Lincolnshire in the 30-mile radius of the Blade Factory, it appears that – per the self-containment exhibited by both southern LAUs of the Humber – there is little interaction with Hull (as illustrated by the limited traffic flows across the Humber Bridge into the city) and in 2014, it was found that approximately 86% of North East Lincolnshire's working population hold positions of employment within the region (Coburn, 2014). This suggests that the proportion of Blade Factory workers residing in North and North East Lincolnshire might be substantially lower than the northern LAUs share of the Humber. Therefore, a small sample size of residents may pose challenges for drawing inferences about the cause of their multiplier estimates.

By locating the study area, the Humber, and its local authorities, in the context of the wider Yorkshire and the Humber region (and the UK), it has been possible to develop high-level predictions about the relative size of the Humber multiplier for residents of each Local Authority, by observing proximity to, and estimating demand for, alternative, non-local expenditure centres. These predictions will be returned to in the context of the research questions (Chapter 6 and Chapter 7), one of which was to assess the extent of variation among multipliers by Local Authority.

Attention now turns to a socio-economic and demographic overview of the Humber in **Section 2.3**, with a view to developing further predictions and providing additional context to the study region.

2.3 Socio-economic Context

Tassey (2003:13) states that an important step that ought to be carried out "early in the impact assessment process", is the review of current background or economic context, with a view to "effective subsequent development of hypothesized economic impacts". Therefore, the material that follows provides an overview of the current demographic, economic and social landscape of the Humber region.

For the purpose of the overview, the Humber region is disaggregated into its LAU 1 regions: Kingston upon Hull (Hull), East Riding of Yorkshire, and North and North East Lincolnshire[9]. Well-established demographic and socio-economic metrics are used to assess the region's performance, beginning with an outline of the latest indicator data in **Section 2.3.1**, followed by a more detailed overview of selected indicators, such as, Gross Value Added – including a breakdown by Standard Industrial Classification (SIC) – employment, unemployment and weekly pay, and educational attainment.

The following sub-section provides a high-level review of key performance indicators in 2018, after which a more detailed review of the aforementioned metrics will be given.

2.3.1 Demographic and Socio-economic Overview

Table 2.1 (overleaf) sets out key performance indicators for the NUTS 3 regions that make up the Humber, together with Great Britain averages and/or equivalents, as a point of reference.

[9] Per the Geographical Overview in **Section 2.2**, North and North East Lincolnshire can be further disaggregated into Local Administrative Units – North Lincolnshire and North East Lincolnshire, however, in line with the design of the questionnaire, it is not necessary for this analysis to extend beyond NUTS3.

Indicator	Kingston upon Hull	East Riding of Yorkshire	North and North East Lincolnshire	Great Britain
Economic activity rate (%)	78.2	79.8	76.7	78.5
Employment (%)	73.0	77.1	71.7	75.1
Unemployment (%)	6.5	3.4	6.6	4.3
Claimant count (%) (April 2019)	4.7	2.0	3.8	2.7
Median weekly pay by residence (£)	460.1	552.1	514.9[10]	571.1
NVQ4 (%)	24.1	33.4	23.1	39.3
No qualifications (%)	11.4	9.3	10.4	7.8
Population (2017)	260,700	338,100	331,100	64,169,400

Table 2.1: Socio-economic snapshot (2018 - unless otherwise stated)

Source: Nomis, 2019b

It can be seen that the rate of economic activity (defined as the proportion of all people who are economically active) is broadly consistent across all LAUs, and in line with the Great Britain average of 78.5%. So too is the rate of employment, with Hull and North and North East Lincolnshire falling just short of the Great Britain average of 75.1%, at 73.0% and 71.7% respectively, but East Riding of Yorkshire slightly exceeding it at 77.1%. The rate of unemployment (among those aged 16-64), however, is more variable. In 2018, East Riding of Yorkshire had an unemployment rate of 3.4%, below the Great Britain reference case of 4.3%, however, both Hull and North and North East Lincolnshire had rates of 6.5% and 6.6%, respectively, some way above the Great Britain average. In line with this is the claimant count data which reveals that as at April 2019, approximately 2% of East Riding of Yorkshire's population claim benefits (with the principal reason of being unemployed), a little below the Great Britain average of 2.7%. However, both Hull and North and North East Lincolnshire have claimant count levels above the reference

[10] Average of North Lincolnshire and North East Lincolnshire taken, since figures are reported at disaggregated level for weekly pay in 2018; North Lincolnshire: £532.7 and North East Lincolnshire: £497.0.

point at 4.7% and 3.8% respectively. According to Centre for Cities (2019) eight of the top 10 UK cities with the highest claimant count rates (as at November 2018) are located in the north of England and Scotland; this includes Hull, which had a claimant count of 3.7% at the time of the Centre for Cities (2019) report, and that figure has steadily risen over the last couple of years; in fact, the number has not been as high as it currently is[11], since early 2015 (March 2015: 4.8%). However, this is in line with the broader UK picture, where an overall increase in claimant count has also been experienced in recent years.

Employees residing in Hull and North and North East Lincolnshire appear to earn less per week at £460.1 and £514.9 respectively, than those residing in the East Riding of Yorkshire who earn £552.1 per week, all of which are below the Great Britain median of £571.1 per week[12]. This might reflect the qualification profile of the individuals residing in each LAU and will be explored as part of the Mincerian earnings investigation in Chapter 7. As shown in Table 2.1, the proportion of individuals (aged between 16 and 64) with a higher level of qualification, as measured by NVQ Level 4 and above, is lowest in Hull and North and North East Lincolnshire at 24.1% and 23.1% respectively, both well below the Great Britain average of 39.3%. Again, Hull was highlighted as falling among the bottom 10 UK cities for the lowest percentage of individuals with high qualifications (also measured using NVQ4 and above) in the Centre for Cities (2019) report. Similarly, the number of individuals in Hull and North and North East Lincolnshire with no formal qualifications is above the Great Britain average (7.8%) at 11.4% and 10.4%. Of particular interest, and perhaps concern, is the change in

[11] At the time of writing – May 2019.

[12] Earnings by workplace (as opposed to place of residence) is likely to show a considerably different picture, however. Employees working in Kingston upon Hull are likely to earn more than individuals working in the East Riding of Yorkshire, given the industrialised nature of Kingston upon Hull, relative to the East Riding, as explored in the geographical overview. Hull has been cited as an 'employment centre' for areas of the East Riding, such as Beverley (The Work Foundation, 2010), and hence there is much commuting across the Hull/East Riding boundary.

educational attainment over the last couple of years across all Humber LAUs, which is reviewed in detail in **Section 2.3.4**, page 28. One of the possible socio-economic classifications by which the first round multiplier can be disaggregated in this research is educational attainment. It is well-established that a higher level of educational attainment is associated with higher paid employment (and thus the potential to contribute to overall output), however, the extent of *local* benefit, arising from such education and employment characteristics is less clear. The regional multiplier value ought to assist in capturing the extent of local benefit arising from various levels of educational attainment. The following sub-sections continue to explore the variables that featured in the indicator overview table. They also introduce an additional metric, Gross Value Added (GVA), which, according to Atkins *et al.* (2013), is a good measure of regional economic performance.

2.3.2 Gross Value Added (GVA)

The ONS (2019a) defines Gross Value Added (GVA) as "the value generated by any unit engaged in the production of goods and services"; said another way, it is "the value of an industry's outputs less the value of intermediate inputs used in the production process" (ONS, 2018). As a component of Gross Domestic Product (GDP)[13] – a measure of the "size and health of a country's economy", GVA is a good indicator of the regional equivalent. Despite the technical issues associated with the estimation of GVA (Ramudhin *et al.*, 2016), it is a widely used indicator of economic performance at the regional level, making its inclusion in this overview necessary, and perhaps a useful way to begin the socio-economic outline.

[13] GVA + taxes on products – subsidies on products = GDP at market prices (ONS, 2018).

Figure 2.4 and **Figure 2.5** set out real GVA and year-on-year growth in real GVA, respectively, for the time period 2006/2007 – 2017[14]. It can be seen that over the time period, real GVA has fluctuated across all Humber LAUs, and while the UK saw a dip in 2009 (likely owing to the financial crisis), real GVA thereafter appears to have risen consistently. Among the Humber LAUs, it seems that both East Riding, and North and North East Lincolnshire have seen overall growth in real GVA since 2006, with Hull recording lower levels of real GVA in 2017, as compared with 2006.

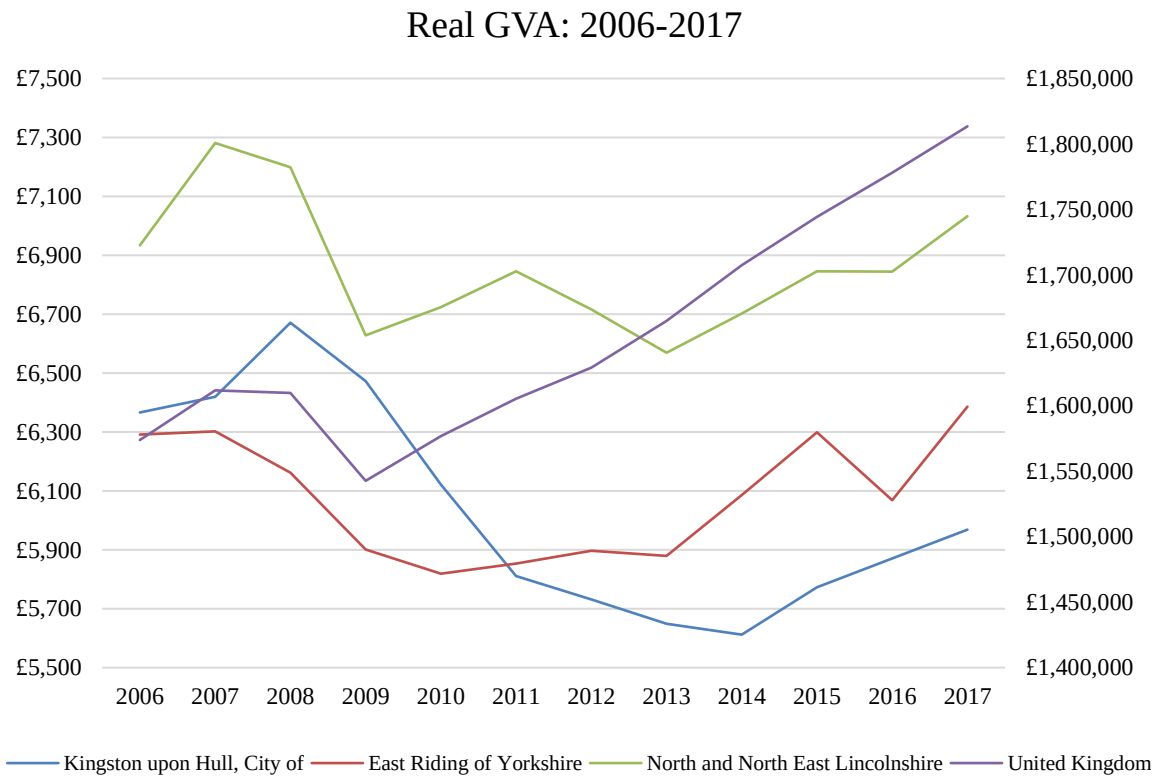

Figure 2.4: Real GVA - 2006-2017

Source: Nomis, 2019b

Encouragingly, however, Hull has seen higher and more consistent levels of real GVA growth since 2014 than its neighbouring local authorities, in line with the wider UK average.

[14] The time period was selected with a view to capturing the most recent 10-years' worth of data; 2017 is the latest available at the time of writing.

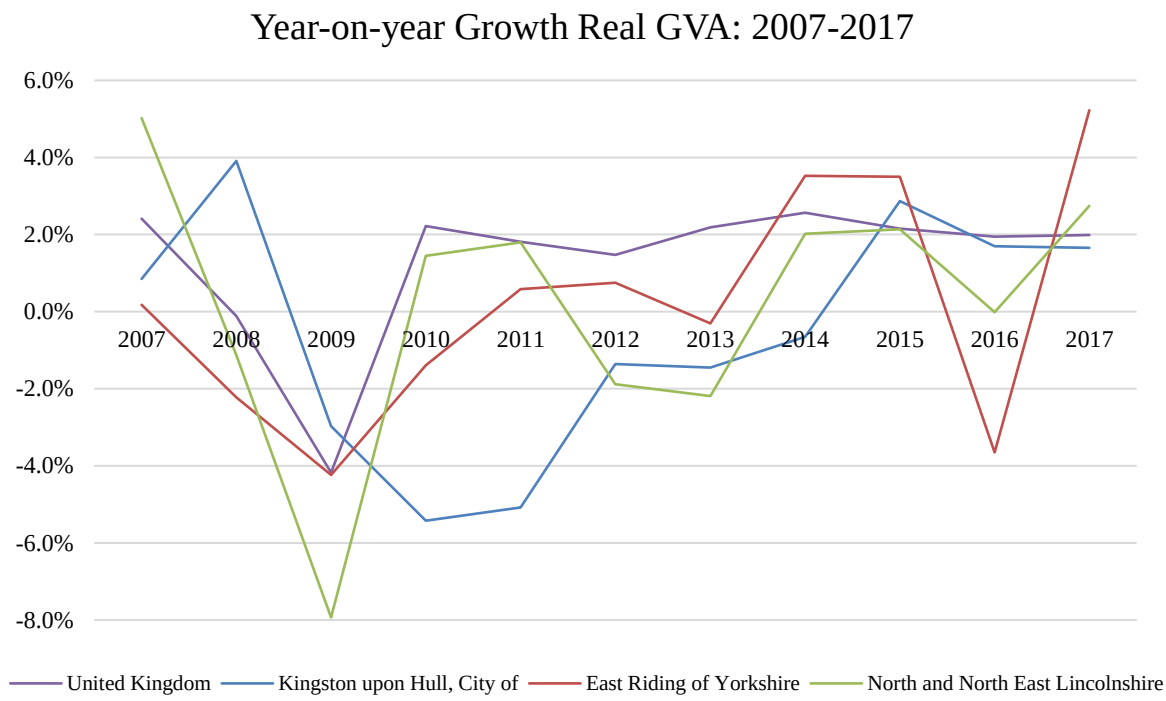

Figure 2.5: Year-on-year growth in Real GVA - 2007-2017

Source: Nomis, 2019b

The pattern of growth among Humber LAUs appeared to be broadly consistent with real GVA growth across the UK prior to the financial crisis. After 2009, however, the relationship between Hull's growth in real GVA, and that of the wider UK appears to be inverse. This was true until 2015; since then growth in real GVA in the UK and in Hull has converged.

From the perspective of the size of the regional multiplier – and the development of a hypothesis – the *performance* of the Humber against the UK average is not necessarily a relevant indicator – it has more use as a context-setting metric, and it might offer an indication of the likelihood of further investment in the region.

Figure 2.6 shows the split of GVA by industry in 2017 for the three Humber LAUs. It reveals that the Manufacturing sector[15] accounts for the largest proportion of GVA in Hull, at 26.5%, and similarly in North and North East Lincolnshire (27.8%). Manufacturing is the second largest industry sector in East Riding (19.6%) after the Distribution sector, which accounts for less than 1% more at 20.5%.

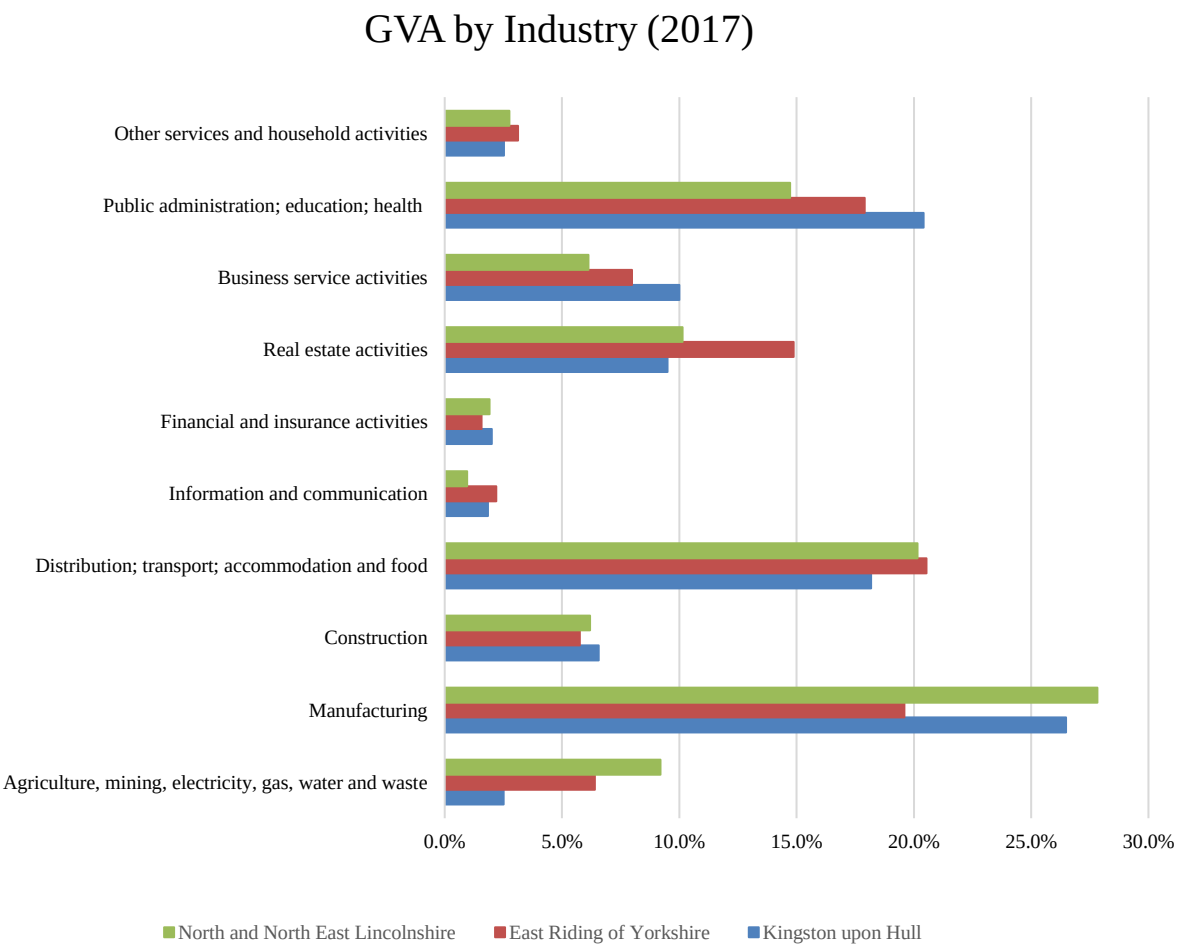

Figure 2.6: GVA by Industry (2017)

Source: Nomis, 2019b

[15] Though it should be noted that the Manufacturing sector is a more aggregated sector than the others.

Figure 2.7 shows the year-on-year change in proportion of GVA accounted for by the Manufacturing sector between 2006 and 2017, in the Humber LAUs. Hull and East Riding of Yorkshire appear to follow largely the same pattern of sector growth, and both continue to see an upward trend through 2017. The contribution of the Manufacturing sector in North and North East Lincolnshire appears to have been a little more volatile, with a number of fluctuations over the time period; however, in line with the neighbouring northern LAUs, the contribution of the sector to overall GVA appears to be growing through 2017.

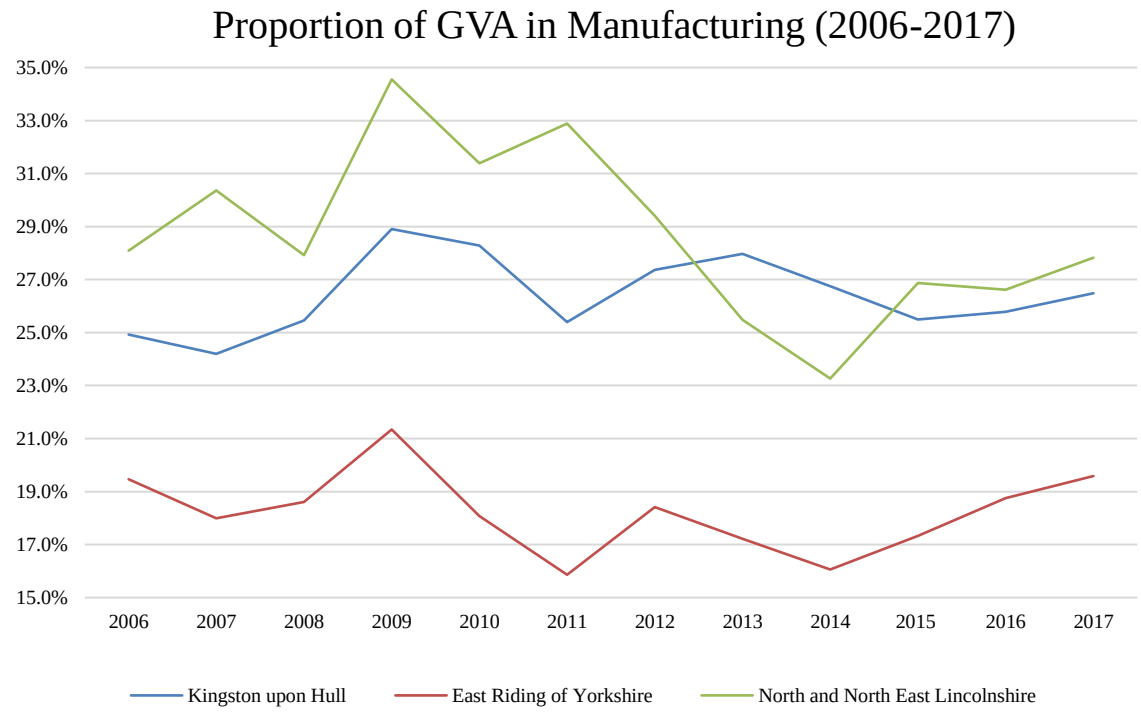

Figure 2.7: % GVA in Manufacturing (2006-2017)

Source: Nomis, 2019b

It is important to note the disaggregation of GVA by sector, not least because it provides support and explanation for Siemens Gamesa and ABP's investment in a manufacturing facility, but it also serves as a reminder that, while the first round multiplier estimates, derived in this research, pertain specifically to a manufacturing workforce – and not to ***all*** regional investments – it is not unlikely, given the dominance of the Manufacturing

sector, that investments in the Humber regions are likely to be classified among the Manufacturing sector.

The GVA overview sought to provide an indication of the Humber's regional performance, relative to the UK average. It also provided the basis for a number of high-level inferences to later be drawn, about the possible size of the regional multiplier.

The following section reviews labour market indicators, with the same intention: to provide regional context and to enable high level inferences about the regional multiplier to be considered.

2.3.3 Labour Market

Figure 2.8 and **Figure 2.9** set out the rates of unemployment and employment[16], respectively, across the three Humber LAUs and the Great Britain reference case.

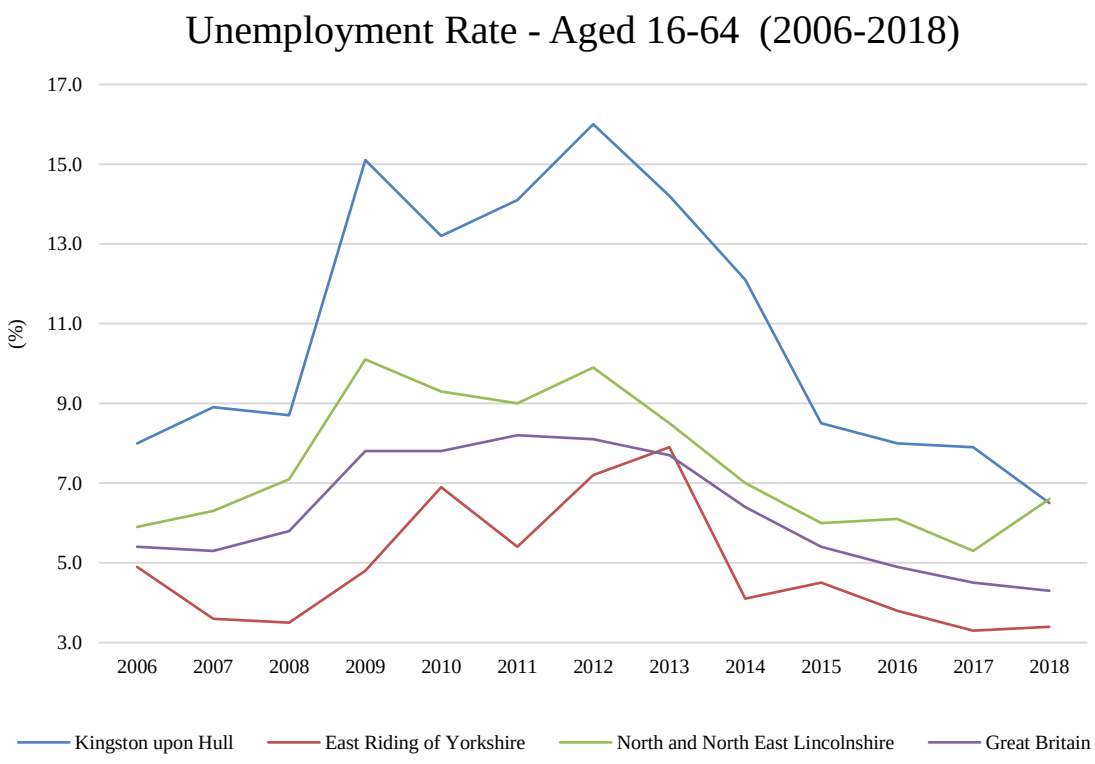

Figure 2.8: Unemployment Rate - aged 16-64 (2006-2018)

Source: Nomis, 2019b

[16] The number of unemployed people, as a proportion of the economically active population, where the economically active population is defined as the total number of individuals who are either in employment or unemployed (Nomis, 2019b).

Largely, the three local authorities tend to follow a similar pattern to the Great Britain average for both unemployment and employment. However, it can be seen that the Great Britain curve, for both unemployment and employment, is far smoother than those belonging to the LAUs, in which a larger number of fluctuations can be seen, in all three instances. By some margin, the rate of unemployment in the Hull has been considerably higher than in East Riding and North and North East Lincolnshire – especially between 2008 and 2015. In 2018, however, the rate of unemployment in North and North East Lincolnshire overtook that of Hull by 0.1% and appears to be exhibiting an upward trend, with an increase in unemployment from 5.3% in 2017, to 6.6% in 2018. By contrast, unemployment in Hull, and more widely in Great Britain, appears to be declining.

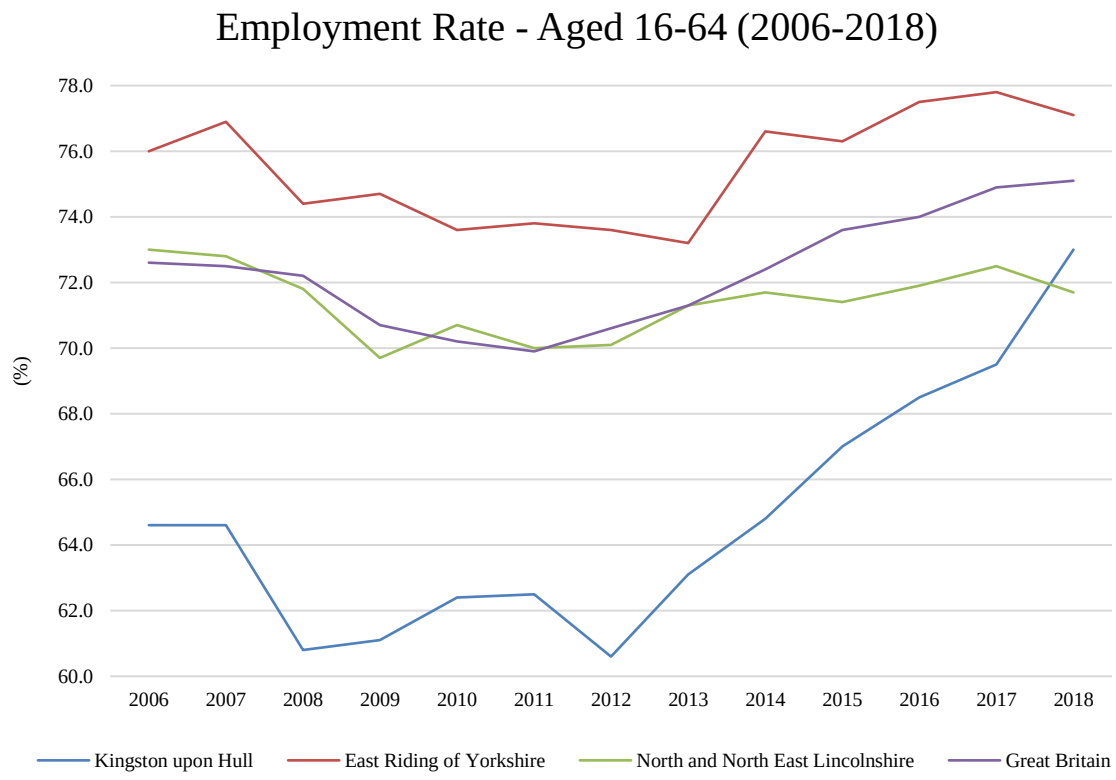

Figure 2.9: Employment Rate - aged 16-64 (2006-2018)

Source: Nomis, 2019b

In line with the observations noted in the GVA overview, the increase in unemployment and corresponding decline in employment, experienced across the Humber local

authorities and more widely in the UK over the period 2008 to 2013, can be attributed to the global financial crisis, which appeared to impact Hull most severely, with a peak unemployment rate of 16% by 2012, and an employment rate of 60.6%. Since then, however, the rate of employment in Hull has increased consistently, and somewhat rapidly into 2018 which saw an employment rate of 73%, bringing it in line with the Great Britain average of 75.1%.

Between 2015 and 2017, the total number of employee jobs in Hull increased from 119,000 to 125,000, of which jobs in the Manufacturing sector accounted for 16.8% in 2017. Since jobs created at the Blade Factory are classified as part of the Manufacturing sector (possibly until a Renewable Energy sector is established), it is likely that Siemens Gamesa (and its associated supply chain) are responsible, in part, for the increase in Manufacturing sector jobs over the last 3-years.

One of the possible classifications, by which the first round multiplier can be disaggregated, is previous employment status, to determine if being previously unemployed (or employed) makes a significant difference to consumption preferences (and ultimately system leakages), that might resultantly impact the multiplier. Similarly, the industry classification of previous employment, and the reason for changing jobs, can be explored, and their respective impacts on the multiplier can be determined. Since data cannot be collected for every individual in the Humber – which would be necessary for second and subsequent round multiplier estimation – understanding how the characteristics of individuals in the first round (Siemens Gamesa employees) impact the first round multiplier, might serve to inform second and subsequent round estimates. By way of example, if individuals in the first round are revealed to be self-employed, and there is a large proportion of self-employed individuals across the Humber more broadly, a view can be taken as to how the propensities of all other Humber residents might be estimated, in line with the *known* propensities of similar individuals in the first round.

An opportunity for further research exists via an investigation into the extent of displacement that may result, following an investment in a new workforce. While the research in this thesis is able to capture previous employment status and industry, it is not intended to explore whether the previous positions of employment have been re-filled by new workers. In order for additionality (defined by English Partnerships, (2008:1) as "the extent to which something happens as a result of an intervention that would not have occurred in the absence of the intervention") to exist – and subsequently, a multiplier – the assumption must be that all previous positions of employment have been re-filled by new workers, and that the Blade Factory roles are 'additional' – rather than leaving previously filled positions of employment now vacant. This is not necessarily an unrealistic assumption, given the existence of organisations such as Green Port Hull, which seek to assist local firms in identifying workers who may be able to fill (or who can be trained and/or upskilled in order to fill) newly vacant jobs that may be available as a result of the Blade Factory. As evidenced by the increase in the number of employee jobs since the Blade Factory hiring phase, it would seem, that GPH has been successful in this regard, and that the Blade Factory roles are indeed 'additional' – else the number of employee jobs would not increase.

The following section reviews the current qualification profile, using NVQ4 as a measure of educational attainment.

2.3.4 Educational Attainment

The link between educational attainment and local competitiveness is reasonably well established, and that the fastest growing economies are typically associated with higher skills level (Getor, Cox & Jensen, 2018). Johnes (1993:2) notes that "Since education and training might be expected to increase an individual's productivity in the workplace, it should also serve to raise her expected stream of future wage income". Further to this, Stevens and Weale (2004:1) state that "If people with education earn more than those

without, should not the same be true of countries?", suggesting that the output of a region or nation is, in part determined by the educational attainment of its population. In light of this, it is important to establish and present the qualification profile of the Humber, with a view to understanding regional earning potential and productivity, together with inferences about how it may relate to the multiplier. Further, a review of the wider region and country enables parallels to be drawn with questionnaire sample, providing support for inferences made about the respondents using in this research.

Figure 2.10 presents the proportion of individuals with a 'higher' level of educational attainment, measured using NVQ level 4 equivalent and above[17]. As previously, data is shown for each of the Humber Local Authorities, and for Great Britain as a point of comparison.

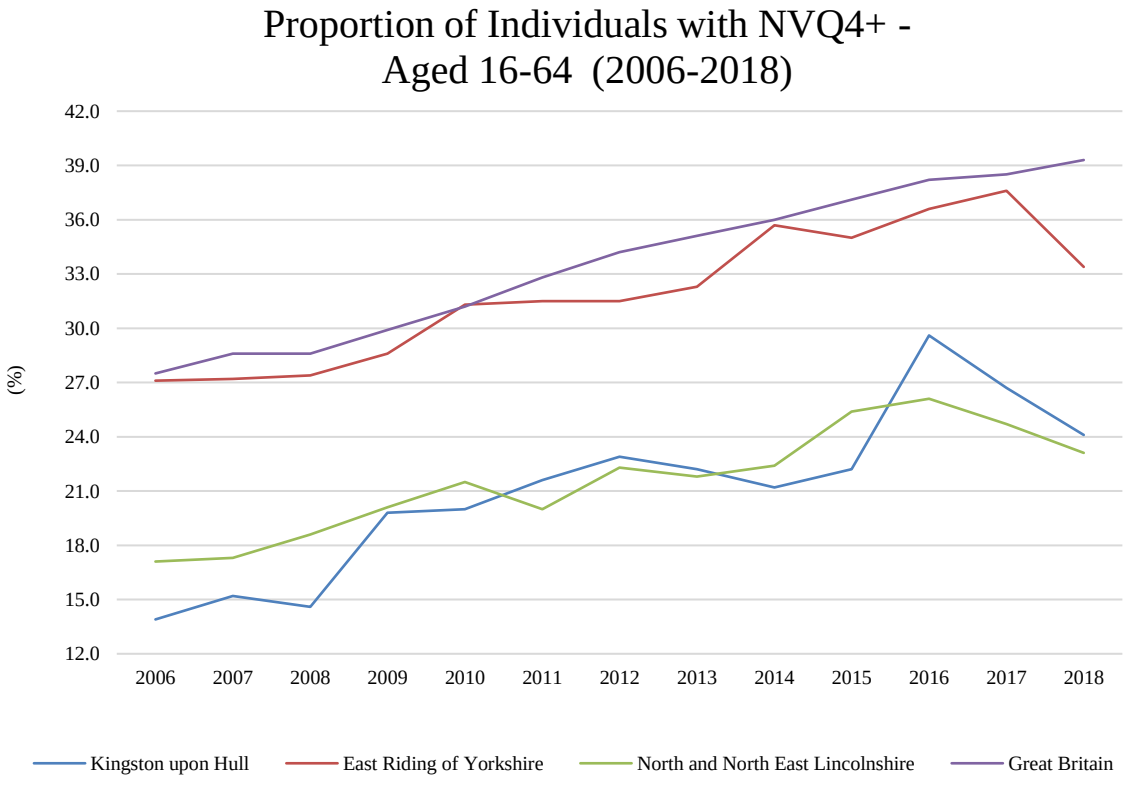

Figure 2.10: % with NVQ4+ - aged 16-64 (2006-2018)

Source: Nomis, 2019b

[17] NVQ 4 equivalent and above is inclusive of Higher National Diploma (HND), degree and higher degree level qualifications.

It can be seen that Kingston upon Hull and North and North East Lincolnshire are the two regions (of those featured) with the smallest proportion of individuals holding a higher level of education attainment. North and North East Lincolnshire appears to have experienced less volatility in the change of proportion of individuals holding an NVQ 4 equivalent, however, Kingston upon Hull has seen the largest increase in individuals holding the higher level of education attainment in the given time period, at approximately 77%.

Of some possible concern is the recent (2017-2018) downward trend in the proportion of individuals holding the higher qualification level across all three of the Humber Local Authorities – particularly if it reflects an absolute drop in numbers. This is inverse to the upward trend that can be seen more widely in Great Britain which, over the given time period, has not seen a decline in the proportion of individuals holding an NVQ 4 equivalent qualification. This observation might suggest that the Humber region could experience lower levels of economic growth and a lower earning potential than the rest of Great Britain.

The relationship between the multiplier and educational attainment has not been established at this point in the research – or more widely in the literature, for reasons previously discussed. However, one might be able to hypothesise that, if educational attainment is a sufficient proxy for the multiplier – or a determinant of it, perhaps it could be said that individuals from the East Riding tend to have multiplier estimates that are more closely aligned to estimates of individuals across the rest of Great Britain. This inference is made on the basis that the proportion of East Riding residents with the higher level of educational attainment appears to be quite closely aligned to that of the rest of Great Britain – relative to the other two Humber Local Authorities, at least.

Figure 2.11 sets out the proportion of individuals with no formal qualifications. Perhaps unsurprisingly, Kingston upon Hull can be seen as having the highest proportion of

individuals with no qualifications. The proportion of individuals with no qualifications in North and North East Lincolnshire is much more closely aligned with the Great Britain average (and the East Riding), suggesting that, while residents may not have the higher level of educational attainment (as measured by NVQ level 4 in Figure 2.10), perhaps they hold NVQ levels 1-3, rather than none at all, and hence the findings in Figure 2.11. It can also be seen that the proportion of individuals with no formal qualifications appears to be increasing in all regions (though only between the time period of 2017-2018), including the wider Great Britain – although the increase in Great Britain is far smaller than in the Humber Local Authorities.[18]

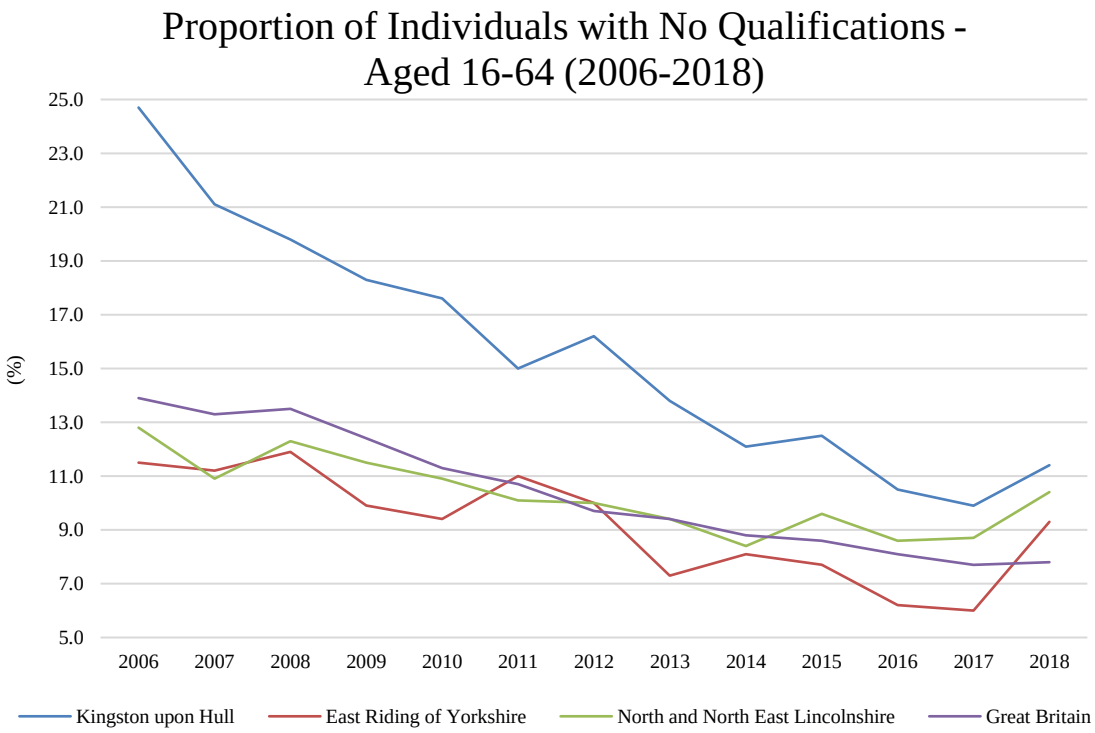

Figure 2.11: % with no qualifications (NVQ) - aged 16-64 (2006-2018)

Source: Nomis, 2019b

In line with Johnes (1993) and Steven and Weales (2004), Figure 2.11 – in conjunction with **Figure 2.4** – reveals that when educational attainment is at its lowest – as indicated

[18] It should be noted that the data used for this analysis is based on the Annual Population Survey, which samples approximately 0.5% of the population. Therefore, this sort of drilling down to sub-regional geographical levels might lead to noisy results and the findings here should be treated as such.

by having a high proportion of residents with no formal qualifications – so too is nominal GVA for each region (Figure 2.4), suggesting that the theory of the relationship between educational attainment and economic growth holds true for the Humber sub-region, for the given time period.

2.4 Summary and Discussion

Chapter 2 has introduced the Siemens Gamesa case study and has presented a series of socio-economic performance indicators for the Humber sub-region, together with Great Britain and the UK as points of reference. It can be seen that, in general, Kingston upon Hull – the location of Siemens Gamesa's Blade Factory – and North and North East Lincolnshire tend to perform below the Great Britain average. While the East Riding can be seen as outperforming Great Britain in some parameters, there still appears to be a gap between the performance of the overall Humber sub-region and the wider Great Britain.

The extent to which determinants of the first round multiplier can be deduced from the indicators discussed throughout Chapter 2 is yet to be explored. However, the literature review presented in the following chapter will reveal which parameters are required in the estimation of a multiplier. It is already understood that individuals with a high propensity to 'leak' their wage out of the region will contribute less to the aggregate multiplier, than those whose wage is retained within the region. Based on the findings from this secondary data overview, some high-level inferences can be proposed at this stage. For example, individuals with higher educational attainment are likely to have somewhat different saving propensities to those with a lower educational attainment. Perhaps individuals with a higher educational attainment also have a higher propensity to save their wage – something that would be considered a 'leakage' from the system (on the basis that it is not available for re-circulating through the rounds of spending). If so, it could be deduced that individuals residing in East Riding of Yorkshire might have a lower first round multiplier than individuals residing in Kingston upon Hull, where

educational attainment appears to be lower. Further, it was established from the geographical overview that individuals from the East Riding might also have a high propensity to spend their wage outside the East Riding, which, compared to the city of Hull, offers less in the way of retail facilities and local transport options, presenting residents with a potential need to own a personal vehicle, and thus the opportunity to leave the East Riding for the purpose of shopping trips. If true, the resultant multiplier for residents of the East Riding is likely to be quite a bit lower than that of residents in Kingston upon Hull. This inference will be investigated further throughout the research – particularly once determinants of the multiplier are explored in Chapter 3's literature review.

Chapter 3 – Literature Review

Having specified the research questions in **Chapter 1** and set out the socio-economic and geographical background and context in **Chapter 2**, the purpose of **Chapter 3** is to review the theoretical and empirical literature that has guided this research. In particular, this review has highlighted the areas that require further development, which has assisted in the placement and contextualisation of the original contribution arising from this study.

As previously stated, the fundamental aim of this research is to provide an update on existing Economic Impact Assessment (EIA) methods used by practitioners at the regional level. Therefore, the literature review opens in **Section 3.1** with an outline of the concept of EIAs, including their importance and usefulness in policymaking and regional planning. Section 3.1 also assesses the extent of existing practical guidance on how EIAs ought to be conducted, the areas that require further work and the challenges that practitioners seemingly face as a result of limited guidance. In this context, a selection of industry-focused, applied literature is reviewed, as well as academically-grounded, theoretical literature, in order to provide a complete picture of the current EIA landscape.

Through Section 3.1, it is established that one of the most widely accepted methods of EIA is the 'multiplier', and therefore, **Section 3.2** reviews the various forms of the multiplier method, specifically noting Leontief Input-Output models, as well as Economic Base models and the Keynesian multiplier model, with a view to defending the use of a Keynesian-founded method, per the research questions. The Keynesian multiplier overview offers a standard derivation of the model and highlights a number of empirical studies. This particular piece of the literature review is especially important in providing a number of case study comparators, from which to draw contrasts with the estimates generated through this research. The coefficient estimates identified in these studies can be used as part of a scenario analysis in the multiplier estimation (Chapter 6).

Section 3.2 closes with a summary of the literature, and an outline of the required data elements that will be necessary to estimate the multiplier. This outline provides a framework for the data collection that will be discussed in Chapter 4.

Chapter 3 closes with a summary of findings in **Section 3.3** noting the important data collection requirements that are then discussed in Chapter 4.

3.1 Economic Impact Assessments

The following sub-sections offer, firstly, a definition of EIAs and an explanation of why they are conducted and why they are important for industry. Secondly, they review the existing practical guidance, including examples of the various approaches, in an attempt to highlight the issues that surround current methods and the resulting estimates. The section concludes with a summary of key lessons arising from the review, which include: the prevalence and suitability of the multiplier as a method of economic impact assessment and the implications of insufficient data for estimation.

3.1.1 Purpose and Importance

Weisbrod and Simmonds (2011) state that 'Economic Impact' refers to any changes in the flow of money in the economy of a region and note that they are commonly measured in terms of income, jobs or output. An Economic Impact Assessment (EIA), therefore, is an evaluation of such changes, arising from an investment, or intervention. Economic appraisals of this nature are, according to BIS (2009a), 'crucial' to understanding net impacts, in order to test and calibrate assumptions. This could be with a view to leveraging public sector support, and/or in support of corporate social responsibility (the BIS, 2009a reference was made with respect to Government intervention specifically, but it appears to be applicable to private sector investments, or, indeed hybrids of both). Weisbrod and Weisbrod (1997) state that there is often an interest in assessing such local or regional economic impacts, resulting from a project, programme or policy, but that economic

impacts are easily misrepresented. Similarly, Wainman *et al.* (2010b:1) states that "The need to deliver value for money, when delivering an intervention or investment (IOI) has created demand from regional and sub-regional decision makers for a consistent and robust method of determining the economic impact of an IOI". Pleeter (1980) notes that owing to increased demand for economic impact statements by government, there has been a 'fairly dramatic' increase in modelling efforts, resulting in an infinite variety of models. Wainman *et al.* (2010a, 2010b) state that, consequently, the number and simplicity of methods has resulted in estimates that are often inconsistent and not directly comparable – presenting an issue for decision makers. Raabová (2014:1) identifies the same issue in more recent literature and suggests that, while economic impact studies are a common tool "it is not usually obvious how the study results were calculated, what methodology was used and what the numbers reflect." Raabová (2014) goes on to state that projects cannot, therefore, be compared and their readers – which she notes are often policy-makers – look on the results 'suspiciously', as they are unable to believe them, or understand them.

Wainman *et al.* (2010a:5) defines an IOI as "An activity which has the potential to impact on the economy of a locality over a finite period" and offers examples such as: investments directly into a business site, with the aim of creating or safeguarding jobs, and the creation of office space for business. On this basis, the investment by Siemens Gamesa and ABP into the Blade Factory, can clearly be considered as an IOI, likely to impact not only the immediate locality of Kingston upon Hull, but more broadly, the Humber region. Given the statements made in BIS (2009a) regarding the importance of measuring such IOI – a sentiment echoed in the English Partnerships (2008)'s Additionality Guide and in HM Treasury (2003)'s The Green Book – clearly a comprehensive assessment of the Siemens Gamesa investment is important, not simply with the intention of providing a statement about the case study in isolation, but also with

a view to developing a robust method that is seemingly missing from the existing body of literature.

The following section provides an overview of some of the established approaches to EIA, together with the drawbacks and challenges posed.

3.1.2 Current Guidance

Having established a definition for EIA, and discussed their increasing importance, attention now turns to an overview of the approaches that are proposed in the guidance literature.

According to Weisbrod and Wesibrod (1997) a number of metrics can be used to measure *direct* economic impacts, including: total additional employment, aggregate personal income, value added, business output and property values. These are in line with the methods discussed in Wainman *et al.* (2010a), where particular attention is given to estimation in terms of GVA, and studies from Inner City Solutions, PriceWaterhouseCoopers and Regeneris Consulting are cited as using GVA estimation approaches. Wainman *et al.* (2010a) explain that evaluations often take net employment gain and multiply it by the mean GVA per filled job for the region, or by an assumed salary, to generate a GVA estimate for the impact or investment. Wainman *et al.* (2010a) go on to state that such methods are simplistic and are not without limitations, owing to the need for assumptions. Despite this, Wainman *et al.* (2010) also note that "Direct measures are the simplest of the impacts to measure and understand", and, in fact, it is the indirect and induced impacts which are more challenging to estimate and comprehend, yet indirect and induced impacts have the "potential to be significant and extend far beyond the boundaries of the IOI". This echoes Weisbrod and Weisbrod (1997), who note that indirect and induced impacts "make the overall economic impacts substantially larger than direct impacts alone", suggesting that their estimation is particularly important. Wainman *et al.* (2010a:17) state that "difficulties in collecting data [in support of indirect

and induced impact estimation] cannot negate their importance when determining the impact of an IOI".

It light of this, it seems attention must be given to the improvement of indirect and induced economic impact methods, which are, in fact, the impacts under consideration in this research.

Weisbrod and Weisbrod (1997) state that indirect and induced impacts are often referred to as multiplier effects. HM Treasury (2003:54)'s The Green Book states that multipliers "measure the further economic activity, (whether output or jobs), resulting from the creation of additional local economic activity". BIS (2009a) and English Partnerships (2008) identify two types of multiplier:

- Supply linkage multipliers: associated with purchases made by firms along the supply chain, as a result of the IOI;
- Income multipliers: associated with local expenditure by those who earn additional income, as a result of the IOI.

Clearly, in the context of the research questions proposed in this study, income multipliers are of particular interest, however, the estimation techniques for all elements of additionality are important to consider.

English Partnerships (2008) provides a number of suggestions for the estimation of multiplier effects, including:

- Surveys of businesses and employees: stating that bespoke investigation, using methods such as surveys, is ranked as the 'best' in terms of good practice for evaluations;
- Previous research/evaluations: stating that data derived through a review of previous evaluations is ranked as 'good', so long as differences in policy, location and economy are recognized, together with IOI specific assumptions;
- Economic models;

- Input-output tables.

While the latter three approaches to estimation might be readily adopted, the first (and 'best') suggestion – collection of data through surveys – appears to be challenging in practice. BIS (2009b:34) reports the findings that arose from research into the improvement of additionality assessments and states that "there is little practical guidance on what questions to ask and how the data that comes back from surveys should be manipulated". It goes on to recommend the standardisation of additionality questions and analysis, stating that such an offering "would be of enormous value to the evaluation community", and that it would lead to improved quality and usage of additionality data.

A further recommendation arising from the BIS (2009b) report is the collection of additional explanatory variable data, to enable additionality to be disaggregated by key parameters, presenting the opportunity for statistical modelling.

Elsewhere in the literature, further challenges have been noted, regarding the use of regional multipliers. Harris (1997:57) highlights the issue of data availability to populate multiplier models and suggests that use of previous empirical studies (per the second approach, given by English Partnerships, 2008) may lead to inaccuracy of "varying degrees". Data availability continued to be problematic, some 13 years later, according to Wainman *et al.* (2010), who note that despite some improvements in IOI methods, "there continue to be challenges in obtaining data, whether through primary research or secondary data". Perhaps most concerning of all are the more recent findings from Kumar and Hussain (2014:363)'s comparison of EIA methods (applied to the tourism industry), which states that many of the commonly used multiplier models are "seriously inadequate", owing to extremely unrealistic assumptions and incomplete representation, thus generating misleading results.

It appears that, while some high-level suggestions for multiplier effect estimation have been proposed by the likes of English Partnerships (2008), the range of methods adopted

in practice – and certainly the models underpinning them – continues to be vast and inconsistent, highlighting a lack of guidance (Wainman *et al.* 2010a, 2010b). Therefore, it is imperative that this research extends the discussion to include a robust contribution to the existing approaches discussed in this overview – particularly from a data collection perspective.

For separate consideration is a suggestion made by Florman, *et al.* (2016:1) who propose that there is an increasing "call to measure economic and social impact holistically". They suggest that evidence exists to support integration of environmental, social and governance issues into financial analysis. In other words, in addition to the primary economic impacts (direct, indirect and/or induced), that results from an IOI, there might be secondary benefits that come about through the impact on society. In their working paper, Florman, *et al.* (2016) set out a selection of approaches for measuring social impact (which they see as inclusive of economic), one of which is the Balanced Scorecard (BSC) approach – also cited as an alternative approach to impact assessment in Wainmann *et al.* (2010b). It is acknowledged that, while the BSC is traditionally a "management and evaluation tool for system performance" (Wainman *et al.* (2010b:77), it could also be hybridised and used with different focus areas for the purpose of impact assessment. Wainman *et al*. (2010b:78) states that "it would allow the identification of strategic drivers at the National and Regional level and allow identification of indicators to evaluate potential IOIs contribution to these strategic aims."

3.1.3 Summary

The review of EIAs has revealed that, while high level practitioner guidance *does* exist to support the conduct of EIAs, the variety of methods, misleading simplicity, and the lack of data collection guidance has led to confusion among, and challenges for, practitioners who carry out the assessments, and for decision makers who are responsible for utilising the results to inform investment choices. Further, results and statements arising from the

various approaches are then widely reported across numerous platforms, and yet the foundation upon which they are built is, at best, unclear, resulting in the possibility of 'genuinely dangerous' consequences if used improperly (Hunter, 1988). It might also be noted that the most recent of the practical guidance cited throughout this section is almost 10 years old (at the time of writing) – and much more of the guidance is closer to 20 years old – which emphasises the lack of recent work in the field and highlights the need for further research.

It appears that, while economic impacts can be expressed in a variety of forms, the review in this sub-section suggests that many of them appear to be underpinned by the multiplier concept (Crompton *et al.*, 2001). The following section, therefore, reviews the various forms of the multiplier.

3.2 Multiplier Methods

Having determined the suitability of the multiplier method as an approach to measure indirect and induced economic impacts, a number of the well-established variations of the multiplier are discussed in this section.

The intention of the research is to use the well-established, and long serving Keynesian Multiplier, per the research questions set out in Chapter 1. However, a number of different types of multiplier must be acknowledged and discussed in this section, in order to defend the use of the Keynesian multiplier – as well as to consider the relative merits of alternative approaches, for future investigations.

Notwithstanding the recent contributions of Gorodnichenko *et al.* (2019) – which finds relevance in 'Keynesian-type' models at firm and individual worker level – together with frameworks including structural Vector Autoregressive (VAR) models, and others such as Dynamic Stochastic General Equilibrium (DSGE) models, quasi and randomised experiments, event studies and discontinuity designs, Section 3.2 specifically looks at Input-Output (I-O) modelling, Economic Base and Local Multiplier 3 (LM3) models,

before turning attention to the Keynesian model, where a number of historic studies are considered. These are particularly important in informing the scenarios analysis that occurs later in Chapter 6.

3.2.1 Input-Output Models

According to McNicoll (1981:80), "it is generally acknowledged that input-output, provides the most accurate estimate of an industry multiplier". However, he continues to note that alternative models have been found to provide estimates that are sufficiently close to those derived using input-output models. Leontief's Input-Output (I-O) model "uses a matrix format or system of linear equations to represent a nation's economy" (Obikwere and Ebiefung, 2014:1). The models show how the outputs of one industry become inputs to another, ultimately providing a sense of how dependent each industry is on the next in the economy for which the I-O model has been constructed. When used appropriately, it is suggested that I-O models can be 'powerful' tools for assessing the economy-wide impacts of an economic stimulus (Bess and Ambargis, 2011). An overview, therefore, of how the matrices (the Leontief inverse matrix) lead to multipliers – including the necessary assumptions (Leontief production functions) and data requirements (transaction matrices) – is important, to ascertain how this approach would be used for this type of impact analysis. A number of relevant studies are also reviewed in this context in terms of assessing applicability for the case study at hand.

Bhattarai (2006) sets out a detailed method of how one might attempt to construct and I-O table, specifically for the Humber economy. This explanation, together with Bhattarai (2014) can be summarised in the following way. Assume an economy with n sectors:

$$X_1 = a_{1,1}X_1 + a_{1,2}X_2 + .. + .. + a_{1,n}X_n + F_1$$

$$X_2 = a_{2,1}X_1 + a_{2,2}X_2 + .. + .. + a_{2,n}X_n + F_2$$

$$\dots \dots \dots \dots$$

$$X_n = a_{n,1}X_1 + a_{n,2}X_2 + .. + .. + a_{n,n}X_n + F_n$$

Where X_i is gross output of sector i, the intermediate inputs are linked by a technology coefficient such as, $a_{i,j} = \frac{X_{i,j}}{X_j}$, where $a_{i,j}$ shows how much of sector i's commodity is required to produce one unit of sector j's commodity, with $X_{i,j}$ representing the intermediate input from sector i to sector j.

Demand for primary factors, such as labour and capital can be written as:

$$L_0 = l_1X_1 + l_2X_2 + .. + .. + l_nX_n$$

$$K_0 = k_1X_1 + k_2X_2 + .. + .. + k_nX_n$$

Solving the above system yields gross output for each sector, X_1 to X_n, in terms of the final demand and technology coefficient matrix:

$$\begin{bmatrix} X_1 \\ X_2 \\ . \\ X_n \end{bmatrix} = \begin{bmatrix} 1 - a_{11} & -a_{12} & . & -a_{1n} \\ -a_{22} & 1 - a_{22} & . & -a_{2n} \\ . & . & . & . \\ -a_{n1} & -a_{n2} & . & 1 - a_{nn} \end{bmatrix}^{-1} = \begin{bmatrix} F_1 \\ F_2 \\ . \\ F_n \end{bmatrix}$$

This can also be expressed as:

$$X = (I - A)^{-1}F$$

Where:

X and F are n x 1 vectors of output and final demand, respectively

I is the identity matrix of n x n

A is the n x n matrix of the Leontief technology coefficients.

Calculation of the above Leontief inverse matrix results in sectoral input-output multipliers. As stated in Myles, 1998:11, "This may then be used to establish the overall changes in sectoral outputs results from changes in final demand."

In order to populate and estimate the model, a number of assumptions must be made, and a number of data points are required to estimate sector composition. Bhattarai (2006) states that such data includes: total employment and output (and sectoral composition of each); costs of production of firms; patterns of expenditure of households; investment

structure of firms, net exports from the rest of the world, and government spending. In the case of Bhattarai (2006) an assumption is made that the production, technology and preferences of economic agents in the Hull do not vary significantly from those in the national economy, and therefore data is borrowed from the UK I-O model to populate the regional attempt.

The first study of interest is Farag and Komendantova (2014)'s assessment of the impacts arising from a renewable energy project in Egypt (in which an I-O model is used in conjunction with a Social Accounting Matrix [SAM]). This is cited as particularly interesting in the context of the Siemens Gamesa case study in the Humber, not least because of the similarity of investment type – in support of the renewables sector, but also because of the intention of the investment, which was to stimulate socioeconomic growth in an economy that had previously suffered from high levels of unemployment – not dissimilarly to the Humber, as evidenced by the socioeconomic review in **Chapter 2**.

A second study is that of Fletcher (1989), who cites I-O models as being the most widely quoted type of multiplier, and seemingly the most comprehensive. Fletcher (1989) used an I-O model to assess the impact of tourism, and notes that, while it might be a comprehensive form of multiplier assessment, I-O models tend to be built on assumptions that do not reflect reality; he states that, to bring the model closer to reality would be expensive in terms of cost and time, although it would probably be required for a country-wide assessment.

Additional studies include that of Ambargis *et al.* (2014), which attempts to use a regional I-O model to show the impact of a university on a local region, in terms of output for restaurants, housing and retail trade, among other things. Results suggest that student spending had the biggest impact on restaurants with an output multiplier of 2.01, despite real spending on books and supplies actually being larger, since these were purchased outside the region and therefore must be considered as a 'leakage' – a particularly

important point to note, with respect to increasing evidence of direct spending outside the region by individuals, in recent times.

Reviewing the formation underpinning the model, and the above selection of studies has brought to light a particularly important finding: the I-O model appears to be most commonly and appropriately used at the **national** level, although clearly its use is possible at a regional level as illustrated by Ambargis *et al.* (2014). Where attempts have been made to use an I-O model at a regional level, such as that of Bhattarai (2006) in his effort to construct and use an I-O table to assess the impact of tax policies on consumer welfare, researchers have been forced to use a combination of national level data (e.g. for demand-side coefficients), in conjunction with regional data (e.g. for GDP, employment etc.), resulting in findings that the researchers themselves suggest ought to be viewed with caution, owing to the inconsistent use of data. Further, McNicoll (1981) states that the data requirements for I-O are much higher than for other methods, such as Keynesian multipliers. However, McNicoll (1981) goes on to assess the results of studies that were conducted using different multiplier methods, in a bid to determine closeness of results. He found that, in general, Keynesian multiplier estimates were smaller than I-O, but the overall ranges were still quite similar. He states that Economic Base multipliers, however, were not comparable to I-O results, making that form of the multiplier less attractive. Despite this, the Economic Base model is reviewed in the following section, together with the New Economic Foundation's Local Multiplier 3 (LM3) variations, for completeness, and with a view to considering ways in which elements of the methods could be adopted in this study.

3.2.2 Economic Base and Local Multiplier 3

Another multiplier framework to consider is the Economic Base model which is built on the assumption that goods are either sold locally or they are exported to other regions (Thulin, 2014). In his work on local multiplier and economic base analysis, Thulin

(2014:2) explains that economic base analysis is typically used to "predict overall growth effects due to exogenous shocks to the local economy." This approach was also used by Atkins et al. (2013) together with a location quotient to assess which industries of the Humber economy could be deemed as holding a comparative advantage, and therefore form part of the exporting (basic) sector. The results indicated that the sector with the largest comparative advantage was the manufacturing sector, which is in keeping with the economic overview given in **Chapter 2.**

A lesser known model – though seemingly gaining more coverage in recent literature (Michell and Lemon, 2019) – is the LM3 model developed by the New Economic Foundation (NEF) and so-called because it captures only the first three rounds of spending. Entwistle (2014) suggests is where the majority of activity takes place. This is supported by Meter and Goldenberg (2015) who state that the first three cycles account for ~90% of economic impact. As set out in Cox (2016), the LM3 is calculated by totalling the first three rounds of spending, and then dividing by the first round. Sacks (2002) illustrates this using an example from a community project in Cumbria, as follows:

Round 1 (income generated by the project): £50,000

Round 2 (the spending of the project): £30,000

Round 3 (spending by the staff and suppliers): £13,375

Total: £93,375

When substituted into the LM3 model:

$$\frac{Total\ income\ generated\ by\ the\ project\ for\ the\ local\ economy}{Initial\ income\ generated\ by\ the\ project} = \frac{£93{,}375}{£50{,}000} = 1.87$$

This reveals that for every £1 of investment, an additional £0.87 is generated for the local economy.

The LM3 approach has been used to investigate the impact of other events on local economies, including the Tiree renewable energy project (a 900kW wind turbine) which generated a multiplier of approximately 1.3 during the Construction Phase.

According to Entwistle *et al.* (2014) the LM3 tool is the only approach that is suitable for measuring impact below Local Authority level – for example, measuring at the Kingston upon Hull level, rather than Humber sub-region. In view of this, together with its simplistic structure (Meter and Goldenberg, 2015), LM3 is unlikely to be a suitable framework in the context of this research, which aims to capture more than just the first three rounds of spending, which would be achieved through use of either an I-O and/or Keynesian Multiplier. A detailed review of the Keynesian method is given in the following section.

3.2.3 The Keynesian Multiplier

Having reviewed some of the well-established alternative multiplier frameworks, attention now turns to the Keynesian multiplier model, which, according to the literature, can reasonably be thought of as the most well-suited framework for the case study on which this research is being developed. The following sub-sections review the theoretical foundations underpinning the Keynesian multiplier, the derivation of the standard multiplier specification from the regional income model, and an overview of empirical studies that used Keynesian multipliers.

3.2.3.1 Theoretical Foundations

As noted in Keynes (1936), the concept of the multiplier was first introduced into economic theory by Kahn (1931) who focused on multipliers of employment. Keynes (1936) offered an addition to the concept with a focus on multipliers of investment and income; the income multiplier (specifically a regional, disposable income multiplier) is used as the foundation for the specification in this research.

Archer (1976) notes that there is much disagreement and confusion among economists when it comes to the concept of regional multipliers, despite the relatively simple theory underpinning the concept, which is that: a cash injection will cause an increase in income, employment and/or output by some multiple of the initial injection (Brownrigg, 1971). Ashcroft and Swales (1982)[19] in Nairn and Swales (1987:32) provide a visual illustration of that process as follows:

$$X_o \rightarrow Emp_0 \rightarrow Y_0 \rightarrow Q_0 \rightarrow D_0 \qquad \text{First Round}$$

$$X_1 \rightarrow Emp_1 \rightarrow Y_1 \rightarrow Q_1 \rightarrow D_1 \qquad \text{Second Round}$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

$$X_n \rightarrow Emp_n \rightarrow Y_n \rightarrow Q_n \rightarrow D_n \qquad n^{\text{th}} \text{ Round}$$

In this way, the cash injection (X) can be seen to generate employment (Emp), income (Y), expenditure (Q) and disposable income (D) in the first, second and subsequent rounds (denoted by subscript *0* through to *n*)[20]. This notion for a change in income (cash injection/investment) is illustrated in the simple form given in equation (3.1) and is largely accepted as a good starting point by the main contributors on this topic;

$$\Delta Y = k_r J \qquad (3.1)$$

where:

ΔY is the change in income;

k_r is the multiplier and

J is the value of the cash injection (the multiplicand).

However, as noted in McNicoll (1981), variants of the Keynesian multiplier, with differing compositions of k_r and J, have been derived by a number of authors and appear to be conditional on the type of investment and the complexity of the assessment.

[19] Some denotation altered from Ashcroft and Swales (1982) to avoid similarity with coefficients used in later derivations.

[20] The circular flow can also be stated as: $X_0 \rightarrow Y_0 \rightarrow D_0 \rightarrow Q_1$ and then $Q_1 \rightarrow Y_1 \rightarrow D_1 \rightarrow Q_2$, in which, expenditure can be seen to cause production, production causes income, and income generates expenditure.

Brownrigg and Greig (1975) is cited as an example of this, in the disaggregation of a tourism multiplier, with a view to assessing its size, relative to other industries.

To understand the necessary modifications that have been made in the literature, it is important to consider the derivation of a 'simple' multiplier, which is set out in the following section. Following this, a selection of well referenced studies – among the academic literature and the grey literature – are reviewed.

3.2.3.2 Derivation

Archer (1976:72), though not the earliest contributor, provides a useful illustration of a simple income multiplier derivation. The derivation starts with a regional income model[21]:

$$Y = C + I + G - T_i + X - M \qquad (3.2)$$

where:

Y is regional income;

C is consumption expenditure by resident population of region H;

I is investment;

G is government spending;

T_i is indirect taxes;

X is regional exports;

M is regional imports;

To develop this explanation further, the following notation is also employed:

B is government benefits (e.g. unemployment benefit) which vary inversely with Y;

T_d is direct taxes, plus National Insurance contributions;

c_j is the proportion of C which is spent outside the region;

[21] It is perhaps worth noting that Archer's model assumes that none of the taxation leakage re-enters the system. In reality, it is quite likely that taxation will be redistributed as C, I, or G at some point, and will, therefore be representing value added to the region. This will be re-visited in Chapter 6 when the model adopted by this research is derived and compared.

The following relationships are then proposed:[22]

$$C = \bar{C} + c(Y - T_d + B) - c_j(Y - T_d + B) \quad (3.3)$$

$$I = \bar{I} \quad (3.4)$$

$$G = \bar{G} \quad (3.5)$$

$$T_i = t_i \mathrm{C} \quad (3.6)$$

$$X = \bar{X} \quad (3.7)$$

$$M = \bar{M} + mY \quad (3.8)$$

$$B = -bY \quad (3.9)$$

$$T_d = \overline{T_d} + t_d \mathrm{Y} \quad (3.10)$$

Archer (1976) continues the derivation by substituting equations (3.3) to (3.10), above, into the original model (3.2) together with an injection of spending, ΔE, leading to:

$$\Delta Y = c\ \Delta\ (Y - t_d Y + bY) - c_j\ \Delta\ (Y - t_d Y - bY) - t_i c\ \Delta\ (Y - t_d Y - bY) - m\ \Delta\ Y + \Delta E \quad (3.11)$$

In this way, E can be thought of as embedding all the autonomous expenditure components. That is, $E = \bar{C} + \bar{I} + \bar{G} + \bar{X} - \bar{M} - \left(c - c_j - t_i c\right)\overline{T_d}$

Given this:

$$\frac{\Delta Y}{\Delta E} = \frac{1}{1-\left(c - c_j - t_i c\right)(1 - t_d - b) + m} \quad (3.12)$$

Where, $\frac{\Delta Y}{\Delta E} = k$, and is referred to by Archer (1976) as the 'instantaneous multiplier', which he states is one that does not consider the effect of either additional flows of exports (induced by a rise in income elsewhere) or additional investment that might also be taking place in the study region, as a result of increased output. In the case of the Humber region, (or more specifically, Kingston Upon Hull, one of the four local authorities of the Humber – see **Chapter 2**) an example of this might be the UK City of Culture investment, the

[22] Original Archer (1970) article does not provide definitions for all coefficients, notably $\bar{C}$ and c.

opening year of which took place at the time when Siemens Gamesa's Blade Factory was being constructed. Despite the lack of consideration for such elements (and undoubtedly many others) Archer (1976) suggests that allowance for them would add less than "1/2p" – half a penny – per £1.

Finally, Archer (1976) goes on to suggest that, while at national level it is not unrealistic to assume that the whole of the initial round of expenditure remains in the system, the same cannot be said at regional level, as (in the case of tourism at least) much of the initial round will leak out almost immediately. As such, Archer argues for the use of an additional parameter, ***L***, as follows:

$$\frac{\Delta Y}{\Delta E} = \frac{1-L}{1-(c-c_j-t_i c)(1-t_d-b)+m} \tag{3.15}$$

where ***L*** represents the amount of direct first round leakage.

3.2.3.3 Application and Evolution of Keynesian Multiplier Specifications

Having reviewed the derivation of a simple multiplier, the purpose of this sub-section is to consider a number of empirical studies that have used varying forms of the Keynesian multiplier specification. This is done with a view to:

- Determining which pieces of primary data are necessary to collect, how to collect them (according to the practices detailed in the studies) and how to use the subsequent data to in the estimation of coefficient values;
- Determining which pieces of data cannot be collected using secondary means, and therefore establishing appropriate estimation techniques in lieu;
- Determining which coefficients ought to be captured in the model used in this research, allowing a specification to be derived;
- Determining coefficient values used in previous studies. This is important for a scenario analysis and for drawing comparisons between the estimates generated

across the various studies, and those generated in this research. While substantial consideration will need to be given to the vastly different time periods in which the studies are conducted (as well as the varying types of investment and geographical regions), having a selection of estimates for each parameter, and for the resultant multiplier, will be important as something of a baseline, from which observations – if not comparisons – can be drawn, with the estimates generated by this research.

Recalling the research questions, given in **Chapter 1**, it can be seen that the first three bullet points from the above list are aimed at addressing the primary data research questions, and the fourth assists in addressing the case study-specific research questions. A review of the evolution of Keynesian multiplier specifications, and their application across a variety of impact assessments studies, serves as an attempt to mirror Andrew (1953)'s efforts to "take stock" (Karlsson *et al.*, 2015:216) of current Economic Base models, an exercise which was regarded by the likes of Karlsson *et al.* (2015:216) as a welcome contribution, for the purpose of "helping to bring together and clarify the sometimes untidy pieces of the model". As with the theory of the Economic Base model (and others), there exists a great many variations in the Keynesian multiplier specification, with numerous modifications that have arisen over time – to bring the model in line with current economic conditions, among other reasons – and it is beneficial to review the current landscape of models, as Andrews (1953) did. According to Karlsson *et al.* (2015), such an effort is not only beneficial in gaining an understanding of the concept at hand, but it also serves to highlight future challenges for the theory, which can then be addressed in later research.

Key contributors to the development of the original Keynesian multiplier include: Steele (1969); Greig (1971); Archer (1976); McGuire (1983) and Glasson *et al.* (1988) who frequently refer to one another, with more recent contributors including Kim and Kim

(1998) and Myles (1998). More recent literature tends to concern itself with application of established models, or hybridisations of them, for example in Safiih *et al.* (2016) which uses a simple multiplier specification, together with bootstrapping in an attempt to generate more robust coefficient estimates.

Since the late 1990s, there appears to be something of a halt in the development of the formulation, in favour of reverting either to the use of software packages that are built upon seemingly basic specifications, and are not without their own substantial problems, or the use of alternative approaches to impact estimation, such as Input-Output, or Economic Base, despite their widely reported limitations at regional and sub-regional level. The lack of further development could be explained by the seemingly impossible challenge of obtaining suitable data. Bozdaglar (2016) states that a major shortcoming of the Keynesian multiplier is use of aggregated data – which appears to be the usual approach – noting it is simply 'inadequate'. However, as stated in Leistritz (1994:308), "Obtaining reliable information on these topics can be a major task"; he goes on to say that such collection efforts would require extensive consultation with project officials, among other things. In the presence of aggregated secondary datasets, only minor modifications can be made to the basic formulation, and certainly no useful assistance can be provided to aid user judgements, for example, through a sensitivity analysis. Despite this, 'multiplier' investigations continue to take place and, according to the EIA literature reviewed in **Section 3.1**, there is great interest in the numbers generated from them.

3.2.3.3.1 Steele (1969) and the Importance of the Import Coefficient

In Steele (1969), which examines the difference between various regional, disposable income multipliers across Great Britain (using data predominantly from 1961, 1963 and

1964[23]), the model's specification begins in the same way as all Kahn-founded multipliers, with a statement about the two main types of leakages: savings and imports, given, simply as:

$$K = \frac{1}{s+m} \tag{3.16}$$

where:

K is the multiplier;

s is marginal propensity to save;

m is marginal propensity to import.

Steele (1969:268) notes, "Without any leakages, *C* would be unity and the multiplier infinity"; regardless of any other leakages that might be identified, these two leakages are undisputed across the literature.

It can be seen that Steele's model is a simplified version of Archer (1976)'s later contribution, where a broader number of leakages are considered.

Like Archer (1976), however, Steele (1969) opts to examine only the 'standardized' multiplier, and chooses not to disaggregate the rounds of spending, though Steele recognises that such an option is possible with large expenditures.

Steele (1969) notes that assumptions do not have to be made about direct taxes and savings, rather secondary estimates are available, with the difference between personal income and expenditure being used as an estimate of savings and direct taxation. However, the import content of personal consumption is unknown, and an assumption is made that the propensity to import out of personal consumption is the same as the propensity to import out of total regional final demand. Therefore, to estimate personal propensity to import, it was deemed 'not unreasonable' to take the ratio of total imports to final demand as an indicator.

[23] Data sources varied by parameter.

Several flaws in the specification were acknowledged, however Steele (1969:274) says, "whatever the shortcomings of the data, until better is produced, these had to be used". The following values were derived for the coefficients of the model:

Great Britain:

- Average savings: 0.14
- Marginal savings 0.18
- Average propensity to import: 0.62
- Marginal propensity to consume: 0.82

Yorkshire and Humberside[24]:

- Average savings: 0.17
- Marginal savings 0.22
- Average propensity to import: 0.74.
- Marginal propensity to consume: 0.78

Though probably not suitable as a point of direct comparison, given the substantive difference in time period, these estimates may prove interesting to show the socio-economic change over time. It is already striking to observe that the propensity to save, both average and marginal, in Yorkshire and Humberside is the highest, together with West Midlands, of all the regions studied in Steele (1969). This is perhaps not in line with the expectation of the region in 2017/18 (the time period in which data was collected for this research), however, the responses from the questionnaire will provide further clarity in that regard (see **Chapter 5**). Closer to expectation, perhaps, is the import to final demand ratio at 74% - the largest import value of the 10 regions included in the study. It is not surprising to observe that all of the regions, with the exception of Scotland, report import values of 59% or higher, reflecting the significant and logical propensity to import

[24] This region was highlighted for potential comparative purposes, given the scope geography of this research (the Humber).

goods and services nationally and internationally, for sale domestically. Scotland reports a particularly low import estimate of between 32% and 41%, possibly reflecting the self-contained nature of the region in the study time period. Consequently, Scotland derived 'extraordinarily high' multiplier estimates, and Yorkshire and the Humber, by contrast, was found to have the lowest multiplier of the 10 regions, reflecting the significance of the import coefficient as a determinant of the multiplier. Steele (1969:282) comments on the relative importance of the three determinants (savings, tax and imports), stating that, "the first two account for about 25 per cent and the last for just over 50 per cent. Imports are therefore as important as all savings and taxation in determining the regional multiplier" and yet, the import coefficient is the one around which the greatest number of assumptions is made, in lieu, certainly of primary data, but also of some secondary data. Steele comments on the crude nature of the calculations and also notes the use of average, not marginal, for the import coefficient, despite the possible preference for marginal in even earlier literature.

Early lessons arising from Steele (1969)'s review highlight the importance of the import coefficient and the struggle to obtain an estimate for it. It also presents the original coefficients of importance and puts forward methods to obtain values using secondary data. While individual multipliers for each region can be estimated, no further disaggregations can be attempted, given the nature of the data used.

3.2.3.3.2 Greig (1971) and Allowance for Rounds of Spending

Greig (1971) continues the evolution, making early reference to Steele (1969), by applying the disposable income multiplier concept to assess the impact of a pulp and paper mill on a sub-region in the Scottish Highlands in 1969. Data were collected in the same way as Steele (1969), using a variety of secondary sources, across a number of time periods spanning 1965-1969. Greig (1971) opts to separate the rounds of spending and uses average rather than marginal propensities in the first round – even in the case of

previously unemployed workers, since that group is seemingly unimportant in the context of his study. Greig (1971) notes that separation of the rounds is especially important for this case study owing to a majority immigrant workforce, and he anticipates that leakages in the first round are likely to be large, owing to the geographical size of the region. He goes on to specify clearly that the multiplicand in use for the study is personal income of the direct employees, rather than capital expenditure arising from the investment in study. The same approach was adopted for the case study used in this research: the multiplicand (investment injection) was restricted only to the wage bill of direct Siemens Gamesa employees (for the O&M phase, and indeed, indirect employees for the Construction phase).[25]

Unlike in Steele (1969), great attention is paid to the first-round multiplier, owing largely to the immigrant workforce, in this case. Greig (1971) notes that such an influx of workers would cause an increase in regional income and wider employment simply by there being an increased population, which would result in increased employment in education, health and Local Authority services – elements that are not captured in the standardised multiplier. An influx of new workers is quite unlikely to hold true for the Siemens Gamesa case study: it was Siemens Gamesa's intention to hire workers from within a 30-mile radius of the site and therefore the expectation was for a very small in-migrant population of workers. However, this does not mean that separation of the rounds is unnecessary. There are various reasons why the first round of a local multiplier should be separated from the second and subsequent rounds, perhaps most obviously because the spending of individuals involved in the first round cannot be assumed to be identical to individuals operating in subsequent rounds. While the various public sector additionality components

[25] This research focuses, specifically, on derivation of the multiplier component, rather than the multiplicand, for the obvious reason that no single model can realistically be developed to represent all possible investments or interventions given by the multiplicand.

of Greig (1971)'s first round model might not be necessary to include in the Siemens Gamesa model, separation of rounds should still be considered, to allow for the expectation of different spending propensities.

Greig (1971) uses a 'conventional' multiplier for the subsequent rounds model – similar to Steele (1969)'s – adopting marginal propensities, rather than average, though in practice, average appears to be used, as it was in Steele (1969), certainly for the import coefficient.

The import coefficient, in both rounds, appears to be referring to ***regional*** import propensity, rather than ***individual*** propensity to remit from other regions; the suggested approach to estimating its value is through use of the former Family Expenditure Survey, and by applying a 'local value added' (LVA) estimate to each category, to determine a proportion of imports for each, and thus a weighted import average.

For saving and tax propensities, Greig (1971) estimates a breakdown of workforce by age and gender, and applies national averages for National Insurance, pension rates and income tax rates. He notes that the estimates cannot be considered precise, but, as recognised in Steele (1969), also identifies that neither are especially sensitive to change, unlike the import coefficient, which is of greater significance – further supporting the justification for an improvement in estimation methods. Greig (1971) introduces a coefficient to capture the decline in transfer payments, u, relevant only to those who were previously unemployed. In the upper case, it was assumed that this coefficient didn't apply at all; in the lower case, the assumption was made that as much as 50% of the workforce were previously unemployed and a value of 0.10 was applied.

Greig (1971) generates the following coefficient values:

- Average propensity to import: 0.71;
- Average propensity to save: 0.06;
- Marginal propensity to save: 0.10;

- Average tax rate: 0.18 (tax: 0.12 and pension rate of 0.06);
- Marginal tax rate: 0.20.

No clear instruction is given as to the difference in approach adopted in the estimation of marginal and average in the relevant cases.

3.2.3.3.3 Archer (1976) and Different Types of Import Leakage

As a result of 'disagreement amongst economists' regarding the meaning and concept of the regional multiplier, Archer (1976) focuses specifically on the derivation of a 'simple income formulation' and then applies the concept to a tourism case study using 1970 data, for the county of Anglesey in Wales.

Archer (1976) arrives at a specification (3.12) using the derivation given earlier in Section 3.2.8.2 the summary of which is given below, as:

$$k = \frac{1}{1-(c-c_j-t_i c)(1-t_d-b)+m} \tag{3.17}$$

Archer (1976:72) states that, unlike in previous models – including Steele (1969) and Greig (1971) – import leakages have been included in ***two*** places in the model: the first, "when consumers spend part of their money outside the region" – denoted by c_j; the second, "when the industrial, commercial and services sectors of the regional economy purchase goods and services outside the region". Archer (1976) does not explicitly provide methods to obtain estimates for each coefficient, instead 'hypothetical, but not unrealistic' values are provided to illustrate the workings of the model, all of which appear to be in line with those estimated by Steele (1969) and Greig (1971). These are:

- Consumption: 0.9 – presumably implying that a 'saving' coefficient would have a value of approximately 0.1, though 'savings' is not mentioned at all in the paper, perhaps somewhat peculiarly;
- Proportion of c which is spent outside the region: 0.3;
- Indirect taxes: 0.16;

- Direct tax and National Insurance contributions etc. 0.20;
- Government benefits: 0.20;
- Regional imports: 0.7.

No guidance on the use of marginal or average is provided, though, using the previous two reviews as evidence, it seems that the choice may ultimately be down to data availability and, in any case, the primary intention of Archer (1976) was to derive a basic formulation.

3.2.3.3.4 McGuire (1983) and Individual-level Import Coefficients in the First Round

McGuire (1983)'s approach most closely resembles Greig (1971), and both papers use a region of Scotland as the case study, making the results arguably more comparable, though the data sources in McGuire (1983) are more recent (1981, predominantly). Per Greig (1971), McGuire (1983) splits the rounds of spending, whereby the first round makes allowances for the creation of additional jobs in the public sector. The difference however, is the inclusion of an individual-level import coefficient in the initial round; recalling the Greig (1971) specification, it can be seen that: $v = (1 - s - t)(1 - m)$; where: s, t and m are, respectively, the average propensities to save, tax and import. In addition, McGuire (1983) suggests the inclusion of $\overline{m}$ as the proportion of employee's expenditure remitted outside the region. The formulation of the subsequent round multiplier is identical to that proposed in Greig (1971).

McGuire (1983) notes that the inclusion of this additional coefficient ($\overline{m}$) is highly significant, especially at the sub-regional level, evidenced by its value of 24%, obtained via a survey of the workforce – albeit with a 'disappointingly low' response rate of only 1.5%. Values for the other coefficients are not given in the paper, but the resultant multiplier estimates appear to be in line with those from similar studies, including those of Greig (1971). Interestingly, McGuire (1983) concludes by discussing the separation of

rounds of spending and notes that, while it was important for the study at hand (since a substantial number of employees are assumed to be either immigrants or potential migrants) in actual fact, “disaggregation of the multiplier into the first and subsequent rounds is however primarily an analytical convenience” (p.272), suggesting that perhaps the need for separation is less important – in particular where the workforce is not anticipated to be predominantly in-migrant. Despite this, an argument certainly exists to consider a scenario in which the rounds are separated, and different propensities are used for agents in the first round – Siemens Gamesa employees. Consistent with the aforementioned contributors, McGuire (1983) comments on the paucity of data for regional models, but stresses that data constraints should not dictate the choice of methodology for a study. McGuire (1983) also highlights a finding that may hold true for the Siemens Gamesa case study: it is noted that the localities under study (Dounreay in Caithness, and Torness in the Lothian region) do not have a specialised capital goods sector to support the construction and O&M demands of the site, therefore, impacts associated with such projects will arise largely from employees’ expenditure, making a Keynesian regional multiplier a particularly suitable method of assessing the impact.

3.2.3.3.5 Glasson et al. (1988) and Disaggregation of the Multiplier by Employment Type

Glasson *et al.* (1988) initially offer a basic multiplier formation, rather similar to the basic formulation of Steele. However, they suggest that it might be useful to apply modified versions of the basic multiplier, according to the type of ‘income injection’, which they separate out into six categories, as follows:

- Earnings of in-migrant workers who moved to the area **with** family;
- Earnings of in-migrants who moved **without** family;
- Earnings of workers who did not move to the area at all, rather commute in for work;

- Earnings of those who are local workers (the most similar category to the individuals surveyed in this research);
- Power station expenditure on local supplies of goods and services, and on local subcontracts;
- Induced investment.

The notion of using different models for different investment injections is an interesting one. However, the multiplier process looks at the aggregate of ***all*** individuals through all the rounds of spending and therefore caution must be applied when separating out the different types of employees, beyond the first round. There is certainly an argument to consider differences in first round propensities, with a view to seeing which groups of, using Glasson *et al.* (1988)'s example, employees might contribute the most in the first round.

Glasson *et al.* (1988) share their estimated coefficient values as follows:

- Average and marginal saving: 0.1 (with consumption estimated at 0.9)
- Average and marginal taxation: 0.3
- Average decline in transfer payments: 0.4
- Average and marginal imports: 0.7.

Clearly, despite a preference for marginal propensities, the values for average and marginal are the same in all cases. McGuire (1983) argues that any loss in estimation through use of 'average' rather than marginal is considered to be 'light', and perhaps, therefore, this approach should not be seen as unsuitable – and especially in the context of the Siemens Gamesa case study, which uses predominantly primary data, and therefore ought to make up for any potential reduction in estimation accuracy.

3.2.3.3.6 Summary of the Review of the Evolution and Key Lessons

A review of the various regional income multipliers, presented in the sub-sections above, has brought to light a number of important considerations. Specifically, it provided detail

on which coefficients are necessary to include in a regional disposable income model, and how previous researchers have sought to collect or estimate them in their respective models. Another learning arising from the review pertains to the separation of spending rounds, where contributors' perspectives tend to vary. Finally, there is mixed evidence on the use of an individual import coefficient. While some contributors make allowance for remittance of wage outside the region, most tend only to look at the *regional* propensity to import; that is, the proportion of goods and services that have been imported from other regions, for sale and consumption within the scope region.

In this research, the important multiplier elements are clear, and include:

- Propensity to save;
- Propensity to import;
- Proportion of income leaked through taxation.

The way in which each coefficient will feature in the model will be determined through full derivation of a model, per Archer (1976), starting with the regional income model. This is carried out in **Chapter 6**. In terms of coefficient estimation, very little guidance is provided about the collection of data, leaving much room for the development of methods in this research. **Chapter 4** sets out the primary data collection methods that were adopted to gather the data necessary to estimate the above parameters.

A further consideration arising from the review is the varied use of average and marginal propensities. While a multiplier clearly calls for marginal propensities – since it is the *next* unit of income that is of interest – it seems that contributors are unable to estimate marginal values, and therefore defer to the more readily identifiable *average* values. This research will be able to estimate marginal values through collection of primary data, by regressing average leakage values (such as savings), against income, to yield the marginal propensity. Further detail on specific estimation techniques are provided in **Chapter 6** where the model and multiplier results are presented.

Regarding the separation of spending rounds: the view taken in this study is that an explicit separation is necessary, on the basis that it cannot be assumed that individuals in the first round operate with the same propensities as the whole population – which are considered in the subsequent rounds. A 'special case' scenario *can* be developed in which propensities are considered to be the same, however this would not generally sit alongside a model with separated rounds.

An additional benefit is posed by separating the rounds of spending: the possibility to estimate first round multipliers for various sub-groups identified within the Siemens Gamesa employee population, with a view to determining which sub-groups contribute the most to the first round multiplier. This might prove useful as part of the estimation of coefficients used in the subsequent rounds. By way of example, if the wider population – whose propensities are important for subsequent rounds – tends to be in line with a particular sub-group identified in the first round, coefficient values could be adjusted to mirror those used in the first round (for the sub-group in question). **Chapter 6** considers these various scenarios, and estimation of the model, in more detail.

Finally, in terms of the all-important import coefficient. This model is concerned with **individual** propensity to import; that is, the proportion of income that is spent outside the region. Much of the literature reviewed in this chapter is concerned with the **regional** propensity to import; that is, the proportion of goods and services that are purchased outside the region, for sale and consumption within the region. Therefore, use of the coefficient estimates as options for scenario analysis is limited, because the regional propensity to import is almost certainly going to be significantly higher than individual propensity to import. Alternative values of individual import propensity will need to be estimated through alternative means in the multiplier model analysis chapter (Chapter 6).

3.3 Summary

The purpose of Chapter 3 was to set out the relevant literature on the topic of Economic Impact Assessments, with a view to determining why they are relevant and how they are broadly conducted. A number of alternative frameworks were considered, and a multiplier approach was deemed the most well suited for the case at hand. Within the 'multiplier' category of methodologies, the Keynesian Multiplier was settled on as the most suitable framework under which this research should be carried out, notwithstanding the flaws identified in the critical review, and in the knowledge that alternative methods exist, with arguably similar merit for consideration in future impact assessment exercises. Following the selection of a Keynesian-founded approach, a number of empirical studies were reviewed with a view to determining which parameters should be considered in a model for this study, and subsequently which pieces of data should be collected. This will form the basis of the discussion in the following chapter, which sets out how the data was collected for the elements required in the model, and for the supplementary analysis. It should be noted that the primary data collation exercise represents a significant portion of the overall contribution of this research. Collection of primary data allows for estimation of marginal, rather than average, propensities; it allows for examination of sub-group marginal propensities in the first round; and it provides an opportunity for sensitivity analysis. Collection of up to date information of this type also enables supplementary analysis on the topic of Mincerian earnings to extend the discussion on the impact of Siemens Gamesa in Hull.

Chapter 4 – Data Collection

Having identified the critical components that are necessary to estimate the regional disposable income multiplier, the purpose of Chapter 4 is to detail the methods that were used to gather the primary data. **Chapter 5** will go on to review the subsequent data, and **Chapter 6** will present the multiplier model, and the results from its estimation.

In support primary data collection, Potschin-Young *et al.* (2018:428) states that conceptual frameworks can be used to, "simplify thinking, structure work, clarify issues and provide a common reference point". Therefore, **Figure 4.1**, overleaf, sets out a conceptual illustration of the various regional leakages and retentions, which will later be reflected by the parameters of the model detailed in **Chapter 6**. The framework might be seen as especially useful for practitioners, with mixed disciplinary backgrounds, who require a straightforward overview of the multiplier process.

Figure 4.1 sets out the process of expenditure, from the initial investment made by Siemens Gamesa and ABP, through the first and subsequent rounds of wage spending (which run to infinity). It shows that the first round of spending begins when wages to Siemens Gamesa employees are paid. This wage can be disaggregated in a number of ways. Unquestionably, some proportion is lost to taxation and National Insurance. Some of the wage might be saved. What is left is assumed to be spent, of which some will be done so non-locally – i.e. outside the region, and the rest will be spent locally. This 'local consumption' will generate another round of spending – the second round – which takes into account the rest of the Humber population, and their respective saving and spending propensities.

The majority of primary data collection will be done in support of populating the first round multiplier model, that is, the propensities of the Siemens Gamesa workforce. Estimates for the whole population propensities which are necessary to populate the

model for the second and subsequent rounds will be generated using secondary data, details of which are given in the multiplier model chapter, **Chapter 6**.

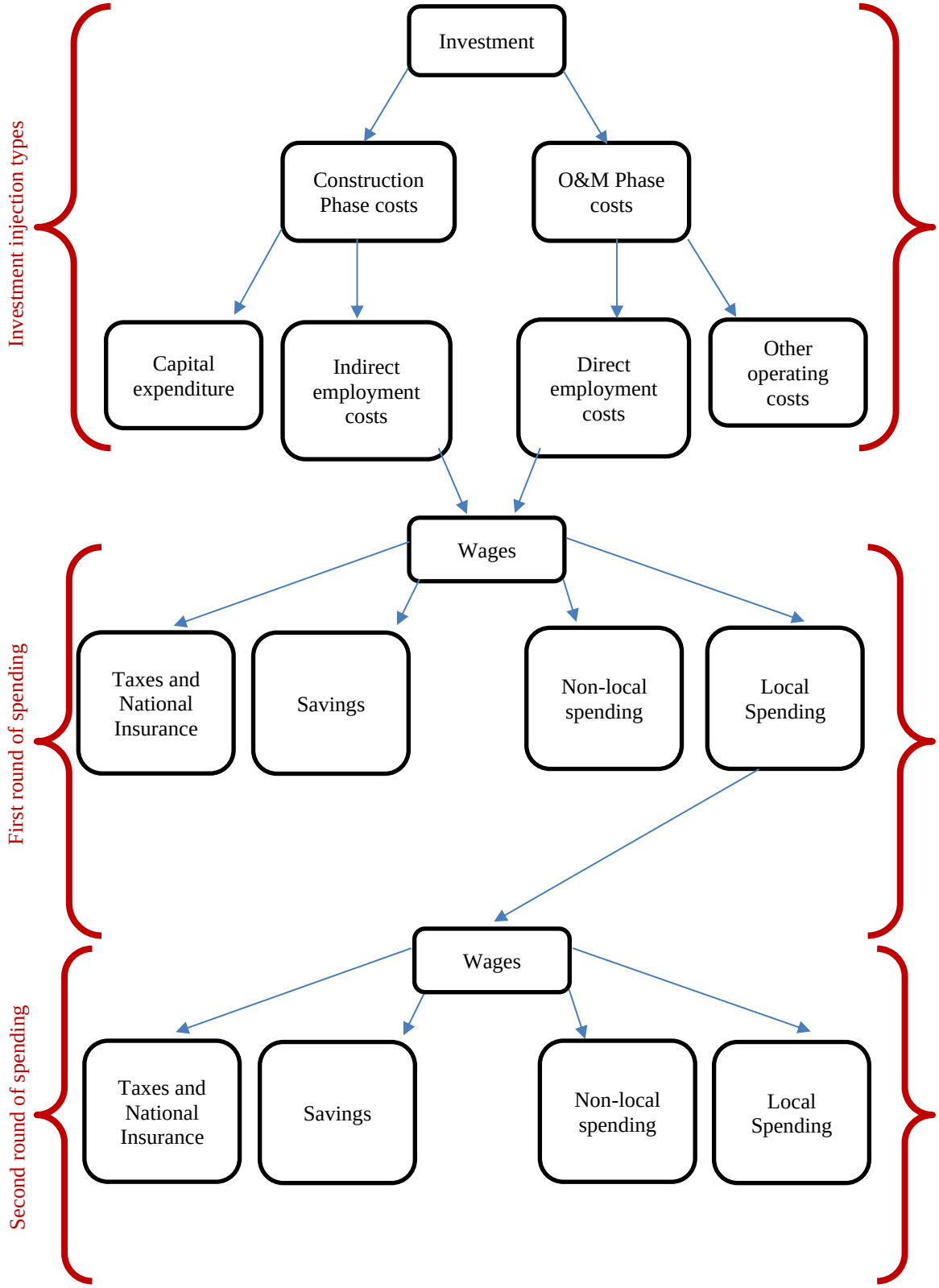

Figure 4.1: Conceptual Illustration of Multiplier Process

According to Figure 4.1, data regarding taxation, saving and local and non-local spending of the Siemens Gamesa workforce are required to populate the first round multiplier. In addition to those elements, a number of additional pieces of primary data will be required such as salary, to estimate marginal propensities. Further socio-economic data must also be collected, to allow sub-group multipliers to be estimated for the first round, and to enable the supplementary research.

The following section, therefore, reviews a number of accepted methods of primary data collection that were considered for use in obtaining the data required by the first round multiplier model. Despite ultimately adopting a questionnaire approach – the preferred method in Economic Impact Assessment literature – it was important to review the relative merits of alternative data collection methods for this purpose, to enable suggestions about the way in which a multi-method approach could be used in extracting further information in future impact assessments – in line with Hox and Boeije (2005) – who suggest that, in order to collect data, social scientists typically use a number of different strategies.

4.1 Primary Data Collection Methods

According to Hox and Boeije (2005:593) primary data offers a number of benefits over secondary data; not least because "on every occasion that primary data are collected, new data are added to the existing store of social knowledge" – which is then available for use by the wider research community. Further, and more specifically in the context of this research, "The most important advantage of collecting one's own data is that the operationalization of the theoretical constructs, the research designed, and data collection strategy can be tailored to the research question, which ensures the study is coherent and that the information collected indeed helps to resolve the problem" (Hox and Boeije, 2005:594). Hox and Boeije (2005) go on to state the limitations of secondary data, including issues pertaining to: identification of useful sources, retrieval of the required

data and evaluation of how well the data meet the quality requirements of the research and methodological criteria. They summarise by saying that, despite faster, and possibly lower cost access to secondary data, "the disadvantage is that the data were originally collected for a different purpose and therefore may not be optimal for the research problem under consideration" (p. 594). Indeed, this has been observed in the literature that has been used to inform this research, with coefficient estimates commonly borrowed from previous studies, that may not bear significance, together with the challenges posed by an inability to disaggregate the data and thus perform further useful analysis, such as construction of a confidence interval. Further, the granularity of the data required by the coefficients of the model appear to be unavailable at the sub-regional level in focus.

The following overview of approaches begins with the method that was ultimately selected, the questionnaire approach. The only evidence of primary data collection among the key contributors reviewed in the literature is by McGuire (1983:266) who attempted a survey approach (using a questionnaire), which yielded a, "disappointingly low" response rate, covering only 1.5% of the total workforce. Other researchers also state the benefits of questionnaires approaches for parameter estimation, but specific guidance on their design remains uncovered. The section also reviews the definition and benefits of alternative approaches that could have been adopted, and might have a place in future impact assessments, in addition to a questionnaire approach.

4.1.1 Questionnaire

Mathers *et al.* (2009) explain the difference between 'questionnaires' and 'surveys' by stating that a survey is a *way* of conducting research, rather than a method of collecting data; a questionnaire is an example of the latter, as are tests, interviews, focus groups and accounts, all of which will be reviewed in this section. According to Teddlie *et al.* (2003) a questionnaire can be thought of as a 'major method' of data collection and is a self-constructed instrument that sets out a series of questions to be completed by research

participants. Walliman (2005) explains that questionnaires enable researchers to organise their questions and receive replies without having to talk to every respondent – which may not be suitable in all types of research, where face-to-face interactions with respondents might reveal supplementary (or critical) information, necessary to address the research questions. In this research, which sought to capture as much of the ~1,000 employee population as possible, the potential benefit that might have ensued from face-to-face interactions was far outweighed by the colossal volume of time that it would have taken to do so. Further, Rowley (2014) notes that questionnaires are typically the data collection instrument of choice where the purpose is to collect data from a large number of people, suggesting between 100 and 1,000. Being able to collect data from a relatively large number of individuals has the potential benefit of generating findings that are more generalisable, thus assisting to reduce issues of external validity. In addition to allowing for the collection of a large *sample*, Hox and Boeije (2005) suggest that structured questionnaires are an important primary data collection tool because they also allow for the collection of data on a large number of *variables*. Czaja and Blair (1996) say that pairing this data with advanced analytic methods is one of the principal means of social investigation. Droff and Paloyo (2015:384) state that survey methods are a "recommended way to estimate the basic parameters of RMMs [Regional Multiplier Models]" and note that the estimation of parameters without the use of survey methods is very difficult and that incorrect values will result in the wrong multiplier. Further, data collected through questionnaires also has the potential benefit of being anonymous, which Walliman (2005) suggests might encourage participants to provide a true answer, even to sensitive questions.

However, Rowley (2014:308) warns that given their prevalence, "it is easy to assume that questionnaires are easy to design and use; this is not the case – a lot of effort goes into creating a good questionnaire that collects the data that answers your research questions".

This proved to be true when designing the questionnaire that was used in this research, if, for no other reason, than the lack of a precedent in the literature, making the use of pilot studies particularly important. Rowley (2014:311) also notes that questionnaires are particularly well suited to quantitative research, such as this, and in cases where the research is focused on drawing predictive and analytical conclusions, that is, where the purpose is to, "understand any relationships between variables"; Rowley (2014:308) goes on to say that with a sufficiently large data set, one is able to, "look for patterns, using techniques like correlation, regression or χ^2 tests to investigate the relationship between two variables". Therefore, a questionnaire approach was deemed to be an appropriate method for the collection of the data required in this research. **Section 4.2** reviews, in further detail, the specific questionnaire process that was adopted in this research.

4.1.2 Interviews

According to Walliman (2005), interviews can be structured, semi-structured or open. They are situations wherein the researcher (interviewer) establishes a rapport with the research participant (the interviewee) and asks a series of questions (Teddlie *et al.* 2003). While the boundary between questionnaires and interviews is 'fuzzy' (Rowley, 2014:310) – since they are both, "question answering research instruments", interviews might be of more use when eliciting qualitative data, since the possibility of 'probing' is an option, which is not the case when using a questionnaire. Rowley (2014) suggests that unstructured interviews are on one end of a metaphorical spectrum, and questionnaires (especially those made up of predominantly closed questions) are on the other end of the spectrum, wherein very specific questions can be posed, and the results used in empirical analysis. Walliman (2005:285) suggests that, "for very precise answers to very precise questions, used for quantitative and statistical analysis, a tightly structured interview is required, with closed questions formulated in a method similar to a questionnaire". It has already been said that the data required by the various parameters of the model can most

readily be obtained via closed questions and therefore, either a structured interview approach, or a questionnaire approach are probably sufficient. Given that a questionnaire approach has been deemed a particularly 'economic' method of data collection (Walliman, 2005), it was decided that use of a questionnaire method would be sufficient for the critical parameters, because the potential benefits arising from an interview would not become apparent – for the critical coefficients, at least. Said another way, if the data for the key components can just as easily be collected through the more economic questionnaire approach, it is surely sensible to employ that instrument, rather than the more timely and costly interview approach, which has the added complexity of set up, scheduling and anonymity challenges, that are less prevalent with a questionnaire method. However, if the findings arising from this research are deemed particularly valuable, the use of an interview method might be useful in future studies, to supplement the data collected through a questionnaire. Examples of the specific questions which might be suitably asked under an interview situation rather than, or in addition to, a questionnaire will be given in **Section 4.2** which presents a detailed review of the questionnaire that was ultimately adopted in this research.

4.1.3 Tests

Tests, or standardised scales, can be thought of as a version of structured interviews, or self-completed questionnaires (Walliman, 2005). The difference, however, is that tests generally seek to measure ability or aptitudes, allowing comparisons to be made across the test subjects. Examples include IQ or intelligence tests (Walliman, 2005). Since this research is not seeking to measure 'performance' of research participants (Teddlie *et al.*, 2003), application of tests as a data collection method in this context is not relevant. However, the process of developing a test can usefully be applied to other data collection instruments, such as questionnaires. Walliman (2005:286) explains that one way to prevent oversimplification of responses (in the context of tests) is by asking, "many

questions about the same topic, from a variety of different angles. This form of triangulation helps to build up a more complete picture of complex issues." The concept of addressing the same question from multiple perspectives was adopted when designing the questionnaire in this research; not only did it enable a more complete picture of the 'leakage' in question, but it also helped to validate some of the responses through provision of supplementary information.

4.1.4 Focus Groups

Breen (2006:466) suggests that the difference between an interview and a focus group is that the latter is, "more appropriate for the generation of new ideas formed within a social context". Clearly, the concept of a focus group does not lend itself to the collection of specific, quantitative data on a large scale and was not, therefore, considered as a suitable tool to elicit data required by the parameters of the model. However, a focus group might be a useful tool to gain an 'in-depth understanding' (Nyumba *et al.,* 2017) post-impact assessment, rather than as *part* of the impact assessment measurement process. By way of an example, it might be of interest to the organisation or individual or company who commissioned the impact assessment to understand how the local multiplier could be increased, and what they can do in support of that. It has already been revealed that one reason for carrying out impact assessments of this nature is to assist local planners in deciding which investments are associated with the greatest local return, and how they can optimise the investment to ensure a regional benefit. Some of that information can be obtained through a questionnaire: for example, disaggregating the first round multiplier by various individual characteristics will reveal the cohorts of individuals who tend to contribute the most to the first round multiplier, as a result of their various spending and saving propensities, but it will not reveal what could be done to influence those propensities, in a way that would yield a larger multiplier. For example, if the individuals have a high marginal propensity to spend wage non-locally (in other words: they tend to

spend their wage outside the region, rather than within it), the regional multiplier will be smaller than if they remit their spend locally and it might be of interest to regional planners to explore the ways in which local spending could be promoted and increased, which would, in turn, result in a larger multiplier. Such information, which is largely qualitative, could be extracted in a focus group setting, rather than through use of a questionnaire, because probing may be important and questions are unlikely be to 'fixed', as they are in a questionnaire – they may evolve and develop based on the answers given to previous questions (Walliman, 2005). Therefore, the focus group method could be considered as post-impact assessment data collection method, to be carried out with specific research objectives that arise from the impact assessment. Of course, the weaknesses of focus groups must then be considered and controlled for, specifically the issues of small, unrepresentative samples that may lead to issues of external validity (Teddlie *et al.* 2003).

4.1.5 Accounts

Accounts are typically a method to collect qualitative data, such as people's feelings or actions; they can also be personal records of experiences or conversations (Walliman, 2005). There might, therefore, be a place for the use of accounts in the context of this research, or similar, wherein participants could document their saving and spending habits, in a bid to provide more accurate estimates to the enquiring questions posted in the questionnaire. However, one must be realistic about the demands on the research participant's time, and the likelihood of receiving unauthentic accounts if the demand on time proves to be too great, thus rendering the method unsuitable – especially when a large volume of data is being sought.

The previous statement brings this section to perhaps the most important consideration regarding the eventual selection of the most suitable data collection methods; that is the need to consider which approach is, in the first instance, the most realistic, given the

constraints of any research project – or impact assessment. Even under a circumstance such as this, in which organisational and stakeholder support has been granted (see **Section 4.2.1**), numerous constraints inevitably exist that limit the possibility to carry out more than one method. That is not to say, however, that elements of each approach cannot be collectively woven into the selected method, such as a questionnaire, which will now be explored fully in **Section 4.2**.

4.2 Questionnaire Approach

Having reviewed alternative methods of data collection that were each considered as potential instruments through which the required data for the model could be obtained, **Section 4.2** now sets out the process that was undertaken to design and distribute the questionnaire, including the measures that were taken to mitigate issues of validity and accuracy.

Micek (2011:176) states that, "All things considered, reliable methods for analyzing the multiplier effects are a rarity" and notes that the limited number of studies dealing with the impact of economic activities on local milieux can be attributed to the absence of generally available statistical data, and the issues involved in trying to obtain it. However, he suggests that some issues might be overcome through use of questionnaire research. He refers to the work of Lynch (2000) which reported a comparison of results provided by RIMS II (Regional Input-Output Multiplier System) and those based on calculations using data derived from questionnaire research which finds that RIMS II models overstate the multiplier effects by between 5% and 10%[26] – providing further justification for the use of a questionnaire. He does, however, indicate the challenges associated with questionnaire research, specifically stating that, "Without the support of local

[26] Details of Lynch (2000)'s study or methodology are not provided, and, in any case, refer specifically to I-O models, as opposed to Keynesian Multiplier Models, which is the chosen framework of this research – given the suitability at the regional and sub-regional level.

stakeholders, conducting this type of research is very difficult" (p.180) and, in addition, notes that the process can be very laborious and requires the cooperation of many economic entities in the given area. Even with cooperation, he notes that, "it is practically impossible to obtain information from all companies" (p.188) – a useful word of caution, also echoed in Droff and Paloyo (2015:383) who state: "a survey is sometimes highly complicated to set up or impossible to realize".

Presenting that set of experiences serves as a reminder that:

- Avoiding the use of primary data for impact assessments is a risk, because suitable secondary data to satisfy the coefficients of the model does not exist; where attempts have been made to use secondary data, it appears estimates are upwardly biased by as much as 10%;
- Reliable methods to collect primary data appear to be scarce: thus, counting on the literature for guidance as to how the questionnaire should be designed would be fruitless;
- When the decision is taken to use a questionnaire, the process is not straightforward; stakeholder participation is critical and even if it is granted, the set-up process is challenging, and capturing all the required information is rarely possible.

In summary, primary data *needs* to be collected, however guidance on its collection is non-existent; only cautions about the associated challenges are freely discussed. Therefore, the methods to design, distribute, and eventually analyse, the questionnaire are entirely tailored to this particular impact assessment and the needs of the model that will be derived in **Chapter 6**. The methods adopted were based on generic questionnaire guidance in the literature and on the company-specific suggestions given by Siemens Gamesa. Future impact assessments should look to build on the methods proposed in this research and tailor them as required, in lieu of a standard method.

4.2.1 A Note About Participation from Siemens Gamesa and Research Ethics

In order to carry out the data collection (and this research more widely), Siemens Gamesa and local partner organisation, Green Port Hull (GPH) – the channel through which Siemens Gamesa conducted much of the Blade Factory hiring (see **Chapter 2**) – committed to providing support in a number of ways. In the first instance, Siemens Gamesa approved the research to be undertaken, using the Blade Factory investment as the case study and through use of the Blade Factory employees. Siemens Gamesa connected the researcher to a number of point individuals at Siemens Gamesa, who would be on hand to provide support in the design and distribution of the questionnaire and could later provide assistance in validating the results for representativeness. The point individuals would also be available to respond to questions about the Blade Factory investment and its employees. Without such support, conducting the research within the parameters of the methodology discussed in this chapter might not have been possible. Siemens Gamesa provided the following statement regarding their support and participation in the GIA[27] – the parent project in which this research topic was encompassed: "Research topics such as the GIA can provide an important indicator for how large scale projects are progressing against the goals, objectives and expectations of the project. This type of research can then be used to review any potential further stages of development; thus the GIA can help and inform decision makers moving forward with the project" – Shane Nicholson, Head of Quality Management at Siemens Gamesa[28].

[27] As noted in **Chapter 2** the Green Port Impact Assessment ('GIA') project was conducted by the Logistics Institute at the University of Hull; the author of this thesis participated in the project as a Research Analyst, concerned with economic impact – including the impact of the Siemens Gamesa Blade Factory, by way of this PhD.

[28] Shane Nicholson was a member of the GIA Steering Group Committee, representing Siemens Gamesa, at the time of this research; Shane was responsible for selecting point individuals to carry out the questionnaire distribution and collection within Siemens Gamesa and was able to provide confirmation of the representativeness of data collected through the questionnaires. Shane provided the quote on 3rd April 2019.

From a research and procedural ethics perspective, three principal integrity frameworks were utilised; these were the Singapore Statement, Hull University Business School (HUBS)'s Ethical Procedures and the Code of Practice for Research checklist, suggested by UKRIO (2009). Prior to undertaking the research, Ethical approval was sought, and subsequently granted, on 15th December 2016 by the Hull University Business School Research Ethics Committee; a copy of the approval letter can be viewed in **Appendix 2**.

4.2.2 Questionnaire Design

The process of designing the questionnaire was particularly time consuming and involved numerous revisions to be sure that it complied with both the standard questionnaire guidance set out in the literature, as well as the more specific requirements given by Siemens Gamesa – which played an important role in both the design and particularly the distribution of the questionnaire.

In the first instance, Walliman (2005:283) states that one must, "establish exactly which variables you wish to gather data about, and how these variables can be assessed. This will enable you to list the questions you need to ask (and those that you do not!) and to formulate the questions precisely in order to elicit the responses that are required". According to **Figure 4.1**, the following pieces of data must be collected – at a minimum:

- Propensity to save;
- Propensity to consume locally/non-locally;
- Tax rate/National Insurance rate.

Clearly, many further pieces of data would also be important and useful to obtain, such as salary, however, without the above elements, the model could not be estimated.

It was deemed likely that individuals would be able to provide an indication of saving and spending propensities, together with income taxation. However, it was thought that asking individuals about National Insurance might be problematic since it is not a widely discussed component of one's wage, in the way that income taxation is, and estimations

might therefore be inaccurate – though this is something that could be tested in future studies. Therefore, the National Insurance coefficient would be estimated using secondary data, details of which are given in **Chapter 6**.

In addition to asking for those critical pieces of data, every iteration of the questionnaire also included a number of introductory questions, as well as supplementary questions to gather additional information that could be used for further analysis. Three versions of the questionnaire were trialled in various pre-tests and pilot scenarios, before a final version was decided upon. Both Blair *et al.* (2014) and Walliman (2005:283) note the importance of pre-tests and pilots in the design of a questionnaire, since they enable, "problems of comprehension or other sources of confusion" (Walliman, 2005:283) to be identified and corrected for in the final version. This was especially important in the context of this research, where little prior guidance existed. The following three sub-sections review each of the pilot attempts and present the lessons that were taken from each of them and channelled into the final version which is discussed in **Section 4.2.2.4**.

4.2.2.1 Pilot 1: Blade Factory Employees Pre-Operation and Maintenance

The first version of the questionnaire was used as part of an MSc. dissertation in July 2016, the topic of which was also impact assessment and used the same (albeit restricted) cohort of employees[29]. The intention in that research was simply to estimate a multiplier using a standard specification, therefore a total of only 10 questions was asked. The first and second questions sought to determine start dates and details relating to training periods (with a view to determining if the individual would be able to accurately answer questions pertaining to the allocation of their new wage, if in fact, they had not been earning it for very long); the third and fourth questions sought to determine which

[29] The MSc. thesis was conducted while the Blade Factory was being built and during the employee onboarding process. Therefore, a restricted number of the (now) ~1,000 employee workforce had been hired, but nonetheless, the premise was similar and the same data elements were required.

company division and organisational levels the individuals were classified under (with a view to establishing how representative the sample was); the fifth and sixth questions asked about qualifications and training; the seventh and eighth asked about current residence using the first part of a postcode and whether or not the individual had relocated to undertake the position; and finally, the ninth and tenth questions asked about the proportion of monthly saving and local spending. The question of income taxation was not asked, instead a default value was used for the whole sample, estimated using secondary data. Clearly the two critical questions, in terms of data for the model, were the last two, and in that first iteration of the questionnaire, the following wording and bandings were used:

What proportion of your monthly take home salary do you typically save, if anything? Please select the most suitable range:					
☐	0 – 5%	☐	6% - 10%	☐	11% - 20%
☐	21% - 30%	☐	31% - 40%	☐	41% +

Table 4.1: Pilot One - Question to collect Average Saving Data

What proportion of your disposable monthly income (after mortgage/rental payments) is spent in the Humber region as opposed to elsewhere?					
☐	0 – 20%	☐	21% - 30%	☐	31% - 40%
☐	41% - 50%	☐	51% - 60%	☐	61% +

Table 4.2: Pilot One - Question to collect Average Local Spending Data

The responses to those two questions, and the eight questions that preceded them, indicated no lack of understanding or reluctance to answer and it was decided that the next iteration would include a more granular breakdown of response categories for both saving and spending questions. It was also decided that the question wording would be made more explicit, to comply with Walliman (2005:283)'s suggestion that, "the language must be unmistakably clear and unambiguous and make no inappropriate assumptions". For example, it could be argued that simply using the term 'Humber' without explicitly defining the region, was making the assumption that all participants know the boundaries of the Humber, or the regions within it.

The same logic, regarding explicit wording, was applied to all questions in the next iteration, and any additional closed questions with multiple response categories were further granularised.

4.2.2.2 Pilot 2: University of Hull Campus Construction Site Employees

The second version of the questionnaire was trialed with two employees at a construction site on the University of Hull campus in January 2017. Since the first version of the questionnaire had been intended for use in a different research project (albeit one with a common interest), a more detailed and bespoke questionnaire designed with *this* project in mind was required, and would need pre-testing on, "people of a similar type to that of the intended sample" (Walliman 2005:282). The opportunity to pilot the questionnaire with the employees on campus was useful for a number of reasons. Firstly, it enabled a clear sense of how the request might be received, something that would otherwise be unknown since the distribution of the final questionnaire, to the Siemens Gamesa Blade Factory employees would be handled by Siemens Gamesa (see **Section 4.2.3**). Gaining an understanding of how the request was received by participants was important and it enabled an initial hypothesis to be made about the potential response rate. Secondly, it provided an opportunity for the additional questions and more granular response categories to be trialed with a new group of different participants.

The questionnaire asked the same questions as previously (though some of the introductory questions were not applicable to a non-Siemens Gamesa workforce, such as start date and company position), and it asked further questions about previous employment, with a view to capturing the extent of previous unemployment or inactivity, as well as a measure of displacement and in an attempt to determine which industries the new employees tended to move from. A question about income taxation was introduced and four response categories were given (0%, 20%, 40% and 45%); a salary range was not requested. It also asked about tenure of current residence (rent, own or other) and

about the mode of travel to work; knowledge of the former, in particular, would help to build a profile of the individual which might prove interesting as part of further analysis. For example, it would allow for an investigation into how the first round multiplier differs according to property tenure preferences. Finally, it asked respondents to disaggregate their proportion of local spending by Humber Local Authority, and by their top three goods and/or services providers. The latter questions about local spending were asked with a view to gaining a deeper understanding about local spending propensities. The various supplementary questions might also serve as verifier and validity questions, for example, if a respondent stated that 100% of his or her local spending was done in Kingston upon Hull, but one of his or her top three spending locations was listed as a provider in East Riding, the proportion of local spending attributed to Kingston upon Hull could be adjusted accordingly.

The responses from the individuals who completed the questionnaire (a site manager and a construction operative) suggested that the additional questions and granularity of response categories were not problematic. The more explicit question wording and response categories that were included to elicit saving and local spending data are given in **Table 4.3** and **4.4.** There was no suggestion that the questions were intrusive and there appeared to be no reluctance in participating in the research.

The final difference between this version and the first pilot was the introductory message at the start of the questionnaire; the first version did not include researcher contact details, however, the second iteration included a contact email address and telephone number, as well as an additional assurance that the project was being completed within the University of Hull's Research Ethics policy.

Approximately, what proportion of your monthly take home salary (after deductions, including tax and pension contributions) do you typically save, if anything? Please select the most suitable range.							
☐	0%	☐	1% - 5%	☐	6% - 10%	☐	11% - 15%
☐	16% - 20%	☐	21% - 25%	☐	26% - 30%	☐	31% - 35%
☐	36% - 40%	☐	41% - 45%	☐	46% - 50%	☐	51% +

Table 4.3: Pilot Two - Question to collect Average Saving Data

Approximately, what proportion of your disposable monthly income (income after mortgage/rental payments) do you typically spend in **Hull, East Riding, North Lincolnshire** and/or **North East Lincolnshire** as opposed to elsewhere or online?							
☐	0% - 10%	☐	11% - 20%	☐	21% - 30%	☐	31% - 40%
☐	41% - 50%	☐	51% - 60%	☐	61% - 70%	☐	71% - 80%
☐	81% - 90%	☐	91% - 100%				

Table 4.4: Pilot Two - Question to collect Average Local Spending Data

4.2.2.3 Pilot 3: Siemens Gamesa Blade Factory Construction Phase Employees

The third pilot opportunity presented itself during the Siemens Gamesa Blade Factory Construction Phase in October 2017, for which a standalone impact assessment was attempted. Owing to insufficient data and coverage of an unknown proportion, it was decided that the findings would not be robust enough to estimate a representative multiplier value using primary data for the Construction Phase. While a complete impact assessment was not carried out for the Construction Phase, the collection of primary data was attempted with the Tier 1 and 2 contractors of Siemens Gamesa's Blade Factory affording the opportunity for the revised questionnaire to be tested for a third time on an additional cohort of individuals.

The third iteration did not differ substantially from the second; the response categories to the question regarding educational attainment were expanded in line with those suggested in the ONS Labour Force Survey, taking the total number of possible educational classifications from 11 in the second iteration, to 16 in the third iteration. The structure

of the questionnaire remained largely the same. However, the document was slightly re-formatted, per the guidance of Boynton and Greenhalgh (2004) who discuss the importance of questionnaire layout, noting that researchers tend not to devote time to the physical layout, in favour of perfecting the content of the questions, despite empirical research suggesting that format and layout have a significant impact on questionnaire participation rates. The response categories for taxation, saving and local spending data remained the same as in the second iteration.

The responses continued to indicate a willingness to attempt most questions and certainly all questions that were aimed at eliciting the critical taxation, saving and local spending data. However, the disaggregation of spending appeared to cause confusion among some respondents, for example, where the questionnaire asked for the name and location of the top three retailers and/or service providers: some individuals summed their top three spending destinations to 100%, implying that those spending destinations are the *only* three spending destinations. Other participants provided the names of the top three spending destinations, but no locations or proportions, and some participants did not attempt to tackle the question at all. Certainly, that question appeared to yield the most varied selection of responses, some of which inadvertently provided additional information about local spending and others that rendered the attempt at further disaggregation impossible. Importantly, however, all respondents provided an answer to the taxation, saving and local spending questions, which are critical for estimating coefficients of the model. In light of this, the next, and final, iteration of the questionnaire altered the wording of the local spending disaggregation questions, with a view to making the requirement more straightforward. It was anticipated that the question might still yield a variety of responses, but it was considered sufficiently important to be included, nonetheless. It was decided that even if the question could not be used in estimating a

coefficient or as part of the further analysis, the additional data might be useful in a way that could not be known at the time of administering the questionnaire.

A further lesson arising from the third iteration was regarding the property tenure question which had previously included three response options: own, rent and other. However, in the third pre-test, some individuals selected the 'other' category and specified 'live with parents/live at home' which was then included as a separate response option in the fourth and final iteration of the questionnaire.

Each iteration of the questionnaire, tested in the three pilots described above, assisted in informing the 'final' questionnaire, which was distributed to the new employees of the Siemens Gamesa Blade Factory. The next section, therefore, sets out the final modifications that were made, as a result of the pilots, and reviews how the literature was consulted again, to support the construction of the final questionnaire.

4.2.2.4 The Final Questionnaire

As discussed in **Section 4.2.1** Siemens Gamesa was instrumental in the design of the final questionnaire, the details of which will be reviewed chronologically in this section.

Perhaps the most noticeable difference between the pilot questionnaires and the final questionnaire is the layout and structure. Not only did the final version include the company logos of Siemens Gamesa and ABP (the two investors) – to serve as an indication to respondents that the research was being conducted in collaboration with both Siemens Gamesa and ABP – but a clear categorisation and logical order of questions was imposed, following the guidance of Blair *et al.* (2014:223), who note the importance of grouping questions into distinct sections and who state that one ought to add, "internal logic and smooth progression, or flow, through the questionnaire". They stress that, "It is also useful for the respondent to sense the flow, or natural progression, of the instrument".

Therefore, the final questionnaire was grouped into four categories:

- Employment (10 questions);

- Saving and Spending (4 questions);
- About You (9 questions);
- Education and Training (2 questions).

A further change that was made throughout was regarding the naming of Siemens Gamesa, which had previously been referred to as 'Siemens'[30] since the pilots were conducted prior to the merger with Gamesa. The reference throughout the final questionnaire was given as 'Siemens/Siemens Gamesa', at the request of Siemens Gamesa, which noted that some individuals would know the company as Siemens, and others as Siemens Gamesa, therefore inclusion of both names was necessary.

The **Employment** section began by asking in which phase of the Blade Factory project the respondent was involved in: 'Construction' phase or 'Operation and Maintenance' (O&M) phase. Blair *et al.* (2014) states that the first question ought to have a number of characteristics, including: relevance to the central topic, it ought to be easy to answer – and applicable to respondents and it ought to adopt a closed format. The question was of great relevance, because the impact assessment under investigation is for the O&M phase only, not the 'Construction' phase (which was attempted separately, as detailed previously), therefore any responses that indicated 'Construction' phase would be subject to a further validity check, posed in the second question, which asked about contract or involvement start date. Knowledge of the start date would conclusively reveal which phase the respondent was involved in, and whether the questionnaire ought to be included in the sample. It was anticipated that ***all*** responses would be for the O&M phase, since they were distributed during the O&M phase and to employees working at the Blade Factory on the development on the blades, rather than the development of the factory. However, it could be that the questionnaire was completed in error by a Construction

[30] Formally, 'Siemens Wind Power', but more commonly referred to as 'Siemens'.

phase employee, who may have been on site at the time of questionnaire distribution. Several additional checks were imposed throughout the questionnaire and will be highlighted in sequence. The question was also deemed answerable by all respondents and was presented successfully in a closed format, with only two response options. The third question asked which contract type best described the employment of the individual. It used the same categories as the third pilot, with the exception of 'shift worker', which was removed on the basis that all individuals are likely to be 'shift workers', and that the category did not adequately describe a Siemens Gamesa contract type. The fourth question was markedly different to the previous equivalent, which sought to ascertain job title. Previously, the question had been left open, allowing respondents to provide a job title, or role, in their own words. Of course, in the third iteration, at least, leaving the question open was the only option because the intended audience of the questionnaire was the construction phase workforce, the employees of which would come from various organisations and would therefore have various job titles and roles that could not be pre-determined and categorised. In the final iteration, Siemens Gamesa provided a comprehensive list of job categories and suggested categorisations, given in **Table 4.5**, from which respondents could select their relevant category. Siemens Gamesa stated that all employees would be able to recognise their job title from the categories given and that each category contained enough sub-categories to ensure that no individuals could be revealed by grouping the job titles in this way.

What is your job title at the Siemens Gamesa Blade Factory?	
☐	**Engineering Team** (Engineering Manager – Process & Industrial; Lead Process Industrial Engineer; Process and Industrial Engineer)
☐	**Intern, graduate or apprentice** (Engineering Intern; Finance Intern; HR Intern; Planning and Purchasing Intern; Quality Intern)
☐	**Production Team** (Crane Operative; Group Lead; LEAN specialist; Lifting Coach; Maintenance Technician; Production Operative; Senior LEAN specialist; Slinger/Signaller; Team Lead; Warehouse Operative)
☐	**Quality Team** (QA Document Controller; QA Methods Engineer; Quality Assurance Operative; Quality Assurance Support Technician; Quality Coach; Quality Controller; Quality Manager in Projects [QMiP]; Quality Operations Manager; Quality Surveyor; Quality Systems Manager)
☐	**Senior Leadership Team: SLT** (Commercial Head of Hull Plant; Head of Engineering & Innovation; Head of OOSM; Head of Operational Excellence; Head of Quality Management; Maintenance Manager; Operations Manager; Plant Director [Blades, Hull]; Production Manager)
☐	**Support Functions** (Environment, Health & Safety Coordinator; Finance Manager; Financial Controller – Blade Factory; IT Support Coordinator; Management Accountant; Personal Assistant; Planner; Prisma Administrator; Purchasing Manager; Supply Manager; Team Coordinator; Technical Coordinator; Training & Competency Coordinator; Training Administrator; Training and Competency Manager
☐	Other, please specify

Table 4.5: The Final Questionnaire – Question to collect Siemens Gamesa Job Title Category

The fifth question had not been included in any of the previous questionnaire iterations and asked respondents to select the salary bracket that applied to them. Siemens Gamesa provided approximate salary bracket guidance which enabled categories to be formed; the classifications are given in **Table 4.6**.

Which of the following salary brackets applies to you?							
☐	Less than £10,000	☐	£10,000-£14,999	☐	£15,000-£19,999	☐	£20,000-£24,999
☐	£25,000-£29,999	☐	£30,000-£34,999	☐	£35,000-£39,999	☐	£40,000-£44,999
☐	£45,000-£49,999	☐	£50,000-£54,999	☐	£55,000-£59,999	☐	£60,000-£64,999
☐	£65,000-£69,999	☐	£70,000-£79,999	☐	£80,000-£89,999	☐	£90,000-£99,999
☐	£100,000 and over						

Table 4.6: The Final Questionnaire – Question to collect Salary Category

Salary data might be considered superfluous in direct estimation of the multiplier (hence the lack of inclusion in the pilot questionnaires). However, it would be extremely valuable

in estimating *marginal* values, marking a significant contribution to the existing literature and empirical studies, where, in practice, *average* propensities tend to be used. Further, it can also be considered as one of several pieces of supplementary data that would be critical for the Mincerian earnings research.

It has already been said that limited evidence of primary data collection efforts for model parameters exists in the literature, therefore, even less evidence of the collection of supplementary socio-economic data, done in conjunction with data for multiplier estimation exists in the literature. Such data is important to collect in conjunction with multiplier data, not only from the perspective of supporting it, but also, from a somewhat novel perspective, it might reveal suitable proxy variables that can be used in future investigations, where the critical data may be challenging to obtain. Further, collection of supplementary data, in this case, enables an up to date view of the socio-economic landscape of the Humber to be drawn, from which a comparison of distributions can be made with the secondary data overview presented in Chapter 2, which will reveal the extent to which the sample is representative of the wider Humber, and therefore how likely it is that the results from this impact assessment might hold true for the region. For this reason, salary data was requested, with an additional view to disaggregating the first round multiplier by salary cohort.

It has been suggested that requesting salary data early on in a questionnaire can adversely impact response rate. However, it was considered important to ask the question in the context of 'employment' section, which was deemed the most appropriate section to open the questionnaire with. In order to maximise the likelihood of yielding a response, the question was asked halfway through the section (question five of ten), and in a bid to minimize intrusion, salary classifications were banded into the categories listed in Table 4.6. It was important to provide equal salary bandings for reasons of consistency and later analysis. At the time of developing the questionnaire, there was little indication of how

many individuals might participate, and into which salary classifications they might fall. **Chapter 5** will reveal to what extent the chosen classifications were suitable, and whether a future study might benefit from alternative classifications, such as narrower ranges. Siemens Gamesa sanity checked the questionnaire with this sort of potential issue in mind and approved the groupings for use in the final version.

The sixth question asked respondents to select the tax bracket that applies to them, using the same four categories as the third iteration.

The remaining four questions of the Employment section asked about previous employment; starting with the previous employment situation, for which there were six options, given in **Table 4.7** (the same six that were used in the third pilot); an open question which asked for the name of the previous employer (if applicable); another open question which asked for the job title at the previous employer and a final open question which asked for the reasons for taking the role at Siemens Gamesa.

Prior to the start of your contract on the Siemens Gamesa Blade Factory project, which of the following applied to you?			
☐	I was in employment with Siemens/Siemens Gamesa and working on another contract/project	☐	I was in employment with a different organisation
☐	I was unemployed	☐	I was in education
☐	I was self-employed	☐	Other, please specify

Table 4.7: The Final Questionnaire – Question to collect Previous Employment Situation

The final questions in the Employment section were included, inter alia, with a view to capturing displacement, and to identify if a trend existed between reasons for moving jobs. Such supplementary information might serve as useful insight to policy makers and regional planners about the motivations for employment among a cohort of this type.

The second section of the questionnaire comprised four questions to elicit **Saving and Spending** data. The first question asked what proportion of monthly take home salary is typically saved, using the wording and classifications given in **Table 4.8**. Previously, the categorisations stopped at 51%, offering a maximum category of '51+', (**Table 4.3**) however, it was decided that the additional categories, between 51% and 100%, ought to be included in the final questionnaire. The only exception to this was the maximum category which spanned beyond the 5% increments offered in all other categories, by providing an option of 91%-100%. It was hypothesised that selection of that category would be minimal, and therefore it was unlikely that accuracy would be lost by including a wider range. It was important for the categories to be kept reasonably narrow (in all other cases), because the midpoint of each range would be taken as the savings estimate and used in the multiplier model. It was decided that the ranges could not reasonably be narrowed any further because it would be unlikely that respondents could be more precise in their estimation. Despite a hypothesis that many respondents might opt to select a lower saving category (given evidence in secondary data), offering more granular categories at the lower end might inadvertently encourage respondents to select a lower category, and therefore it was deemed more appropriate to keep the increments consistent.

Approximately, what proportion of your monthly take home salary (after deductions, including tax and pension contributions) do you typically SAVE, if anything? Please select the most suitable range.							
☐	0%	☐	1% - 5%	☐	6% - 10%	☐	11% - 15%
☐	16% - 20%	☐	21% - 25%	☐	26% - 30%	☐	31% - 35%
☐	36% - 40%	☐	41% - 45%	☐	46% - 50%	☐	51% - 55%
☐	56% - 60%	☐	61% - 65%	☐	66% - 70%	☐	71% - 75%
☐	76% - 80%	☐	81% - 85%	☐	85% - 90%	☐	91% – 100%

Table 4.8: The Final Questionnaire - Question to collect Average Saving Data

A future study might like to attempt an open-ended approach to this question, such that adoption of mid-points is not required. However, in addition to the possibility that a specific value might not readily be known (and therefore a response might not be given at all), it could be considered intrusive to request a specific value (which might also result in no response at all). A classification offers a certain amount of privacy that an open-ended question does not. Further, it was considered possible that a variety of responses might be returned to this question had it been left open-ended; for example, a monetary value might have been provided, rather than a percentage, which would have required interpretation and thus a loss in accuracy.

The second question in the Saving and Spending section asked respondents what proportion of their disposable monthly income they spend locally. The classifications, given in **Table 4.9**, were the same as those used in the previous iteration (shown above in **Table 4.4**), however, the wording is subtly different and more explicit. Data collected from this question was used, together with the taxation and saving data.

Approximately, what proportion of your disposable monthly income (income after mortgage/rental payments), including bonus payments, do you typically SPEND in the HUMBER REGION (Hull, East Riding, North Lincolnshire and/or North East Lincolnshire) as opposed to elsewhere or online?							
☐	0% - 10%	☐	11% - 20%	☐	21% - 30%	☐	31% - 40%
☐	41% - 50%	☐	51% - 60%	☐	61% - 70%	☐	71% - 80%
☐	81% - 90%	☐	91% - 100%				

Table 4.9: The Final Questionnaire - Question to collect Average Saving Data

The third and fourth questions ask respondents to disaggregate their Humber spending by Local Authority, and then to provide an indication of their top three spending locations – both the name of retailer and/or service provider, and its location within the Humber. Inclusion of these questions would provide an indication of which industries might be most impacted by the additional wage and would also provide regional planners and

policy makers with an up to date breakdown of disposable income, which could be further disaggregated by socio-economic characteristics, such as age and qualification level.

By this point in the questionnaire, all of the data required by the model (taxation, saving and local spending) should have been obtained, and the balance of questions in the third and fourth sections were designed to elicit entirely supplementary information for use in further analysis and scrutinisation of the multiplier.

The third section of the questionnaire, entitled '**About You**', sought to collect a range of demographic data for the purpose of further analysis. It began by asking for the respondent's gender, which was left as an open-ended question on the recommendation of Human Rights Campaign (2016) literature and the work of Bauer *et al.* (2017), which suggest that the question can be left open-ended, allowing people to 'self-identify'. Since the question was not important from the perspective of the model, nor critical from a first-round disaggregation perspective – rather it was included to ensure a mix of all genders was captured, thus ensuring that the findings were representative of the wider population – it would not matter particularly if respondents chose not to provide their gender, and left the question unanswered.

The second question asked for the respondent's nationality, and was, again, left open-ended, to ensure inclusivity.

The third question asked for the respondent's age, using the categories given in **Table 4.10**. Inclusion of this question would enable a profile of saving and spending propensities, by age, to be revealed, and therefore a disaggregation of the first round multiplier, too.

Which of the following age categories applies to you?							
☐	16-17	☐	18-20	☐	21-24	☐	25-29
☐	30-34	☐	35-39	☐	40-44	☐	45-49
☐	50-54	☐	55-59	☐	60-64	☐	65 and over

Table 4.10: The Final Questionnaire - Question to collect Age Data

The fourth question asked about current residence, specifically requesting the first part of the respondent's postcode, with a view to assessing the first round multiplier by region. It would also enable a comparison of saving, and local spending propensities to be made between regions within the Humber, and to regions outside the Humber, allowing hypotheses to be made in future impact assessments.

The fifth question asked about current property tenure – as previously – using the same classifications as the third questionnaire iteration, given in **Table 4.11**.

Do you rent or own the property where you are currently living?			
☐	Rent	☐	Own (including mortgage)
☐	Live with parents	☐	Other (please specify)

Table 4.11: The Final Questionnaire - Question to collect Current Property Tenure

The sixth, seventh and eighth questions probed further into the current residence situation of the respondent by asking if they had moved to the region specifically to undertake the role with Siemens Gamesa, if it was intended to be a permanent move and where had they moved from. The questions were asked with a view to determining the extent of regional displacement, that is, to what extent would other regions suffer as a result of the Siemens Gamesa Blade Factory investment. It was anticipated, however, that the majority of the respondents would be 'local' to the Humber region, in light of Siemens Gamesa's well publicised commitment to hiring from within a 30-mile radius of the Blade Factory (Worldwind Technology, 2016).

The final question of the 'About You' section asked which mode of transport the respondent typically takes to work.

The fourth (and final) section of the questionnaire posed two questions regarding **Education and Training**. The first was a closed question which asked respondents to select their highest level of educational attainment, as shown in **Table 4.12.** The

categories would later be grouped into a smaller number of classifications for the purpose of further analysis. The final question asked if the respondents had received any training as part of their contract with Siemens Gamesa.

Which of the following levels of education have you obtained? Please tick ALL that apply and provide details as required in the space provided.							
☐	School Leavers Certificate	☐	Other work-related or professional qualification (please specify)	☐	GCSE/Vocational GCSE or equivalent (please specify)	☐	O-levels or equivalent
☐	International Baccalaureate	☐	AS-level/Vocational AS-level or equivalent	☐	A-level/Vocational A-level or equivalent	☐	Higher qualification below degree level (please specify)
☐	Degree level qualification, or higher	☐	NVQ Level 1	☐	NVQ Level 2	☐	NVQ Level 3
☐	NVQ Level 4	☐	NVQ Level 5	☐	Don't know	☐	Other (please specify)

Table 4.12: The Final Questionnaire - Question to collect Education Data

Once drafted, the questionnaire was reviewed in accordance with the literature to confirm that the final structure complied with the general guidance suggested by key contributors. From a formatting perspective, Blair *et al.* (2014) suggest that the questionnaire ought to be less than eight pages and they suggest that a different typeface ought to be used for questions, response categories and section headings. It was also suggested that use of open-ended questions be minimised, since their responses tend to be ambiguous, causing serious problems in coding and analysing. The final draft fell across six A4 pages and a different typeface was used, as suggested by Blair *et al.* (2014) for section headings and questions. Of the 25 questions, 11 were open-ended and 14 were closed. All of the questions requiring critical data for use in the model were asked using closed questions; only the supplementary information was asked for using open-ended questions. The final questionnaire[31] was sent to Siemens Gamesa for a final review and quality check before

[31] The full questionnaire can be viewed in **Appendix 3**. A further, summarised, overview of the questionnaire structure will be provided, again, for reference, as part of the Multiplier Estimation and Data

distribution, the details of which are given in **Section 4.3.3**. The full questionnaire can be found in **Appendix 3**.

4.2.3 Questionnaire Distribution

As detailed in **Section 4.2.1** Siemens Gamesa coordinated the distribution of the questionnaires. Once the final draft was approved and printed, 800 copies were given to Siemens Gamesa, at its request, for distribution among the Blade Factory employees. The questionnaires were distributed via each Group Lead, across the four daily work shifts to ensure that every employee had an opportunity to participate. The remaining questionnaires were distributed in the canteen, the office and the support areas. Once completed, each employee was asked to return the questionnaire to the dedicated collection boxes, which were periodically emptied by the Siemens Gamesa point-person for collection by the researcher. In addition to distribution via each Group Lead, Siemens Gamesa also issued an excerpt in the company newsletter, alerting its employees to the questionnaire and the importance of completing it. The full excerpt can be seen in **Appendix 4**.

Data collection took place between 12th December 2017 and 6th February 2018, after which time Siemens Gamesa closed the activity, stating that it believed a reasonable end point had been reached.

In essence, something of a simple stratified sampling approach was adopted, though the representation of each group would not be known until the questionnaires were reviewed during the data analysis phase (**Chapter 6**). Walliman (2005:277) states that, "Simple stratified sampling should be used when cases in the population fall into distinctly different categories (strata)" – as was the case for the Siemens Gamesa workforce, which

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Analysis Chapter (Chapter 6), which opens with a review of the questionnaire responses, broken down by category.

is stratified per **Table 4.5**. While the theory dictates that, ideally, simple randomised sampling is achieved when an equally proportioned randomised sample is obtained from each stratum (to ensure that each stratum is equally represented) in practice, ensuring such representation might not be so readily achieved, although the approach did appear to adhere to the preference for randomisation. The point-person supporting this research within Siemens Gamesa, was made aware of the importance of equal representation and therefore sought to ensure that as many individuals as possible from each stratum completed the questionnaire, so that equal representation could be achieved once all responses were collected and returned for analysis. Rowley (2014:319) supports this pragmatic approach by stating that, "notwithstanding the importance of a systematic approach to sampling, many studies depend on non-probability samples, often purposive, convenience or snowball samples, as a result of the difficulties associated with creating sufficiently comprehensive sampling frames. Most researchers agree that some data is better than no data, but it is still important to know the extent to which your sample is aligned with its population." Therefore, it would be important to know the breakdown of headcount by job category in the wider Blade Factory workforce (the total population) to be sure that the sample of completed questionnaires was suitably in line, and representative. This is reviewed in the results presented in **Chapter 5**.

4.2.4 Issues of Validity

As explained in Roe and Just (2009:1266), "In the realm of empirical research, investigators are first and foremost concerned with the validity of their results". They state that, "Validity within empirical economics is generally concerned with whether a particular conclusion or inference represents a good approximation to the true conclusion or inference". In other words, do the results arising from a piece of research represent the true picture? While Roe and Just (2009) conclude by stating that no single approach universally solves the issues of validity, it was deemed important throughout this research

that measures were taken where possible to reduce the potential for invalidity, particularly internal and external validity – though the range of possible invalidities is extensive (Cohen *et al.*, 2007) – by using the well-documented list of threats posed by Cohen and Manion (1994) in Walliman (2005) as a guide.

4.2.4.1 Internal Validity

Mark and Reichardt (2001) state that internal validity refers to the accuracy of inferences about whether one variable causes another; Walliman (2005:294) says that the, "quality of data gained from true experimental design should genuinely reflect the influence of the controlled variables". Such quality and assurance regarding the inferences drawn about the relationship between variables can be determined and controlled through use of sophisticated research design. Two of the threats that stood out as potential dangers, from the list presented in Cohen and Manion (1994), were the issue of:

1. History: the occurrence of a potentially interfering event that takes place during the research
2. Instrumentation: differences, shortcomings or changes in the way the data was measured or collected.

The former was a concern because data collection took place, predominantly, during the month of December, which, for many individuals, might be associated with Christmas – an event that could be considered an interference and could result in distorted estimation of 'typical' saving and spending propensities. However, per the remarks made by Rowley (2014), regarding the nature of data collection in practice, it happened that the December time frame was the most suitable opportunity for data collection from the point of view of organisational stakeholders – whose participation, as already expressed by Micek (2011), is critical – giving little choice, therefore about alternative data collection windows. Moreover, it was suggested that collection of saving and spending data could be equally challenging throughout the year, for example, during the months of June to

September, during which many employees might choose to take annual summer leave, and may therefore alter their typical saving and spending propensities to accommodate holidays. Therefore, collection of the data during the December window was deemed equally problematic – or not so – as any other time of year, and the threat of invalidity arising as a result should be relatively minimal – or at least equal to other times during the year.

With respect to the latter concern of instrumentation, the risk presented itself as a result of potential inconsistencies in the delivery of the questionnaire from the Group Leads to the respondents, in terms of its purpose and how it ought to be completed. To mitigate this, clear and concise instructions were given at the start of the questionnaire – and were therefore readable by all respondents. Additionally, the excerpt that was included in the newsletter stated the purpose of the questionnaire and the research, in a further bid to make clear the rationale behind the questionnaire, such that any instructions given by the Group Leads would be supplementary only, rather than fundamental to the understanding of respondents, thus lowering the risk of invalidity arising from instrumentation.

4.2.4.2 External Validity

Walliman (2005:432) defines external validity as, "the extent of legitimate generalizability of the results of an experiment". It is important that the results are not only seen to have a high degree of internal validity, but that they are also representative of the wider population that they are representing. Cohen *et al.* (2007) presents a list of measures that can be taken to minimise the risk of possible invalidity, including the suggestion to tailor data collection instruments to suit the respondents – a measure that was taken as part of the Siemens Gamesa quality control check, in which language was altered to bring it in line with comprehensible terminology for the workforce. Additional measures, which may assist in reducing reactivity rates, include building on motivation of the respondents. This was attempted by highlighting the importance and excitement

surrounding the new Blade Factory in the Siemens Gamesa newsletter excerpt that was circulated among employees. The excerpt was intended to serve not only as a channel to inform employees about the questionnaire – in a bid to encourage participation – but also as a means of generating interest and excitement in the research, to, hopefully, encourage participants to provide true responses, rather than false ones, a risk that, accordingly to Walliman (2005), can occur as subjects learn of ways to manipulate the results during experiments.

4.2.5 Input and Preparation of Questionnaire Data

The data collection exercise came to a close on 6th February 2018, when the completed questionnaires were returned for the analysis phase to begin. Before preliminary or further analysis could take place, the responses from the questionnaires needed to be digitised, enabling them to be prepared, coded and cleaned, so that they would be in a suitable form for interrogation. As Boynton (2004) notes, this part of the process is where much of the workload took place. Excel was recommended by Rowley (2014) as suitable office software for the preparation of data collected in print questionnaires, since it offers a range of functions, such as sorting and filtering, from which the prepared data could then be exported into "specialist research data analysis software", such as SPSS or STATA for further interrogation.

Rowley (2014) sets out a number of steps that were used as a guide to prepare the questionnaire responses for further analysis. In the first instance, the questionnaires were checked for completion; any questionnaires that lacked the critical data required by the model were discarded, leaving only those that contained enough data to estimate the three critical components of: saving, local spending and taxation. A further round of elimination would take place during the imputation process. The next step was to enter the data from each questionnaire into the pre-prepared Excel file – which was set up, per the guidance of Rowley (2014), during the data collection window – numbering each

questionnaire in turn, for reference later, as necessary. Initially, the responses to each question were entered exactly as they were written on the completed questionnaire, so that only the worksheet would be necessary to refer to throughout the analysis, rather than the hard copy questionnaires. This also helped to increase anonymity, by removing the original questionnaire from any further part of the process, thus eliminating potential respondent identification clues, such as handwriting. From that, a coded and refined workbook was created, in which a more concise summary of each question and response was given. Once all data was entered in the complete (master) document, and later the refined version, Rowley (2014)'s 'familiarization process' began, in which the data was scrutinised for missing elements, errors and issues. To assist this, shorthand notes written against each observation during initial data entry into the Master Document, were utilised. Arising from that process, a third version of the data was created, containing only the elements that would be used as possible variables for the analysis, based on the quality of responses that had been received. **Chapter 5** sets out the results of the data input process and details the variable groupings that were identified and coded for use in further analysis. Examples of this include the reduced classifications that were created for variables to represent educational attainment, using the data collected from the final section of the questionnaire. The clean, coded dataset was then ready for preliminary analysis.

4.3 Summary

The purpose of **Chapter 4** was to set out the method and rationale that was adopted to collect the primary data necessary to derive the multiplier model, and to address the supplementary research questions. A considerable body of work took place to gather the data, with very little guidance from the literature. While not all questions, answer classifications, or phraseologies would not necessarily transpire to be optimum, this effort represents something of a first attempt at gathering primary data for the purpose of

multiplier analysis. This is scarcely evident in the literature and will allow for more robust and representative estimation and further analysis.

The following chapter presents the data that were collected from the questionnaire in a series of tabulations and cross tabulations. Some preliminary descriptive analysis is carried out, and high level hypothesis regarding relative size of the first round multiplier are offered.

Chapter 5 – The Data

The purpose of this chapter is to review the data that were collected from the Operation and Maintenance (O&M) phase questionnaires, described in Chapter 4. Setting out the data in this way is important for a number of reasons:

- It provides an opportunity to assess the data collection process, in terms of response rate and perception of questions; through this, alternations to the questionnaire can be determined and suggestions can be made for future impact assessments;
- It provides an opportunity to observe how representative the sample is the wider Siemens Gamesa population, and the population of the Humber. While data from the questionnaires can only be used directly in support of estimating the first round multiplier, if the data transpire to be somewhat representative of the wider Humber population, it *could* be used in the estimation of subsequent round coefficients;
- Relationships and trends between variables can be determined, which might lead to predictions about the first round multiplier and to hypotheses in response to the supplementary research questions.

Section 5.1 reviews the data collection process, recalling why the collection of primary data was necessary and how the questionnaire was received by recipients. **Section 5.2** presents the data that were collected and provides an initial descriptive analysis. A summary of the data is given in **Section 5.3** in anticipation of the results that are presented in **Chapter 6**.

5.1 Data Collection Process

5.1.1 The Importance of Primary Data

As discussed in **Chapter 3** and **Chapter 4**, a primary data collection exercise was necessary to obtain the information required to undertake estimation of a robust regional

income Keynesian multiplier and to conduct further associated analysis. The literature reveals that existing methods – which typically use secondary data – are not only insufficient for generating meaningful multiplier estimates, but they are also inadequate for use in further analysis, the lessons from which might be of particular interest and importance in supporting policy suggestions that arise from estimating regional multipliers. The ability to drill down further into the multiplier's determinants and the determinants of its components, in particular the propensity to consume locally and to save, might provide additional assistance to policymakers in their quest to better understand relationships in regional economies. Empirical support for inferences between socio-economic characteristics – such as age and educational attainment – and the multiplier, at the *individual* level, appears thus far absent from the literature, making this research particularly novel and interesting. Further, as already noted, collection of primary data enables a sensitivity analysis to be conducted, and collection of *supplementary* primary data enables estimation of *marginal* values to be estimated – as opposed to the frequently used *average* values in the literature. While the lack of primary data poses an issue in terms of equivalent values in the literature (from the point of view of comparators in a scenario analysis), the results arising from this study can be used as something of a benchmark for impact assessments going forward.

5.1.2 Overview of Questionnaire Structure

Table 5.1 sets out a summary of the questions that were asked in the questionnaire that was issued to the new employees at Siemens Gamesa. A full discussion of the rationale underpinning each question, and the overall structure of the questionnaire, is given in **Chapter 4**, **Section 4.2.2.4**. However, a brief summary is given following the table, to serve as an in-context reminder.

Section of questionnaire	Summary of question asked	Intended use in data analysis
1. Employment	Phase of Blade Factory Project (Construction or O&M)	• Validity question
	Start date of contract with Siemens Gamesa (open)	• Validity question
	Contract of employment type (closed)	• Potential sub-group for first round multiplier Sample representation question
	Job title at Siemens Gamesa (open)	• Potential sub-group for first round multiplier
	Salary bracket (closed)	• Multiplier – to estimate marginal propensities • Potential sub-group for first round multiplier • Supplementary analysis
	Income tax bracket (closed)	• Multiplier estimation
	Previous employment situation (closed)	• Potential sub-group for first round multiplier
	Name of previous employer (open)	• To investigate displacement
	Job title at previous employer (open)	• To investigate displacement
	Reason for moving to Siemens Gamesa (open)	• Qualitative support
2. Saving and spending	Monthly saving (% - closed)	• Multiplier estimation
	Local (Humber) spending (% - closed)	• Multiplier estimation
	Local spending split by Humber LA (% - open)	• Qualitative support
	Names, location and proportion of spending at top three spending destinations (open)	• Qualitative support
3. About you	Gender (open)	• Potential sub-group for first round multiplier
	Nationality (open)	• Potential sub-group for first round multiplier
	Age range (closed categories)	• Potential sub-group for first round multiplier
	Current residence (postcode)	• Potential sub-group for first round multiplier
	Current property tenure (closed categories)	• Potential sub-group for first round multiplier • Supplementary analysis
	Relocation to take up Siemens Gamesa role (Yes/No)	• Qualitative support
	Permanent/Temporary relocation (closed)	• Qualitative support
	Prior location before relocation (open)	• Qualitative support
	Mode of travel to work (closed)	• Qualitative support and validity
4. Education and training	Level of education/qualification attainment (closed)	• Potential sub-group for first round multiplier
	Training at Siemens Gamesa (open)	• Qualitative support

Table 5.1: Summary of questionnaire data and associated variables

As shown in **Table 5.1**, the questionnaire was split into four sections to assist the respondent in answering. This was done in line with the guidance of Blair *et al.* (2014) who note that there ought to be a clear logic to the order of the questions, and that it might be best to start with 'easy' questions that the respondent can readily answer, as opposed to those questions that might require additional thought or estimation.

With this in mind, the first section of the questionnaire sought to collect information pertaining to the individual's current and previous **employment**, including the start date at Siemens Gamesa, their job role and salary bracket. The second section of the questionnaire asked about the **saving and spending** propensities of the respondents. These two pieces of information would be critical to estimation of the multiplier; any questionnaires without responses to either or both of these questions were rejected. The third section posed **demographic** questions, including, age and nationality. These questions would provide interesting sub-cohorts by which first round multiplier estimates could be generated, using alternative marginal import propensities. The final section of the questionnaire asked about current level of **educational** attainment and any training that is underway, or anticipated to take place, as part of the role at Siemens Gamesa.

The following sub-section reviews the data input and preparation process that was necessary in order to begin the analysis. It highlights the questions that were commonly misinterpreted and the approach that was taken to account and correct for such issues. It also explains the method and rationale behind particular variable groupings, which had not been possible to anticipate before receiving all completed questionnaires and inputting the data into one database.

5.1.3 Input and Preparation Process

The self-fill questionnaire survey of Siemens Gamesa employees had the potential to generate a large evidence base to support the analysis. Siemens Gamesa requested 800 paper copies of the questionnaire which were to be distributed among the 905 new

employees at the Blade Factory during the months of December 2017 and January 2018.[32] Distribution of the questionnaires would be carried out in accordance with the process outlined in Chapter 4.

A total of 194 questionnaires were completed and returned for use in this research, thus yielding a response rate of 21.4% (or 24.3% of the reachable population, based on 800 questionnaires). However, only 189 questionnaires were suitable for use in the multiplier estimation and further analysis – five were rejected on the basis that they contained incomplete saving and/or spending data, which are critical components of the multiplier formulation. Therefore, the final sample size of 189 observations covered 20.8% of the total population, or 23.6% of the reachable population. Rowley (2014:317) states that one ought to aim for completion of 100 questionnaires, as a rule-of-thumb, however "collecting more than 100 questionnaires is likely to make your research more robust and offer opportunities for generating a wider range of insights", supporting the assumption that 189 completed and useable questionnaires is, especially in light of previous data collection experiences detailed in the literature, a successful response number. Despite this, it must be noted that there are limitations to obtaining only 189 responses. While on aggregate a sample of this size might provide useful information, drilling down into the sample could result in rather small sub-groups, and therefore caution must be exercised in using the results from further disaggregations of the sample. This is likely to be particularly problematic when further sub-grouping is necessary, for example, by educational attainment. Reducing the sample into as many classifications as provided by the questionnaire (approximately 16) will inevitably result in groups that contain only a handful of responses. Therefore, broader classifications might be necessary, even though

[32] While it was possible that all 905 employees might have been reached and might have been willing to participate by completing a questionnaire, it is not unreasonable to assume that such an outcome was considered to be an unlikely event, and hence Siemens Gamesa requested only 800 copies of the questionnaire.

such an action might be perceived as unnecessarily disregarding data. This will be noted in-context where necessary.

Once collected, each questionnaire was numbered, to ensure it could be referred back to, and the responses to each question were inputted into an Excel workbook.

The questions that appeared to pose the greatest challenge were those that requested a disaggregation of local spending, by Humber Local Authority and by the top three spending destinations. For the latter (spending destinations), many responses were incomplete or left blank. However, the responses given to the former (split by Local Authority) actually provided an opportunity to generate a more accurate estimate for overall local spending. Recall, in the question that asked for a local spending estimate, closed category options were provided in ranges of 10%, and it was intended that the midpoint would be selected for use in the model. The question that followed asked: what proportion **OF** that amount is spent in each Local Authority of the Humber, with the intention that the number would be treated as 100%, and the split by Local Authority would sum, therefore, to 100%. However, in approximately a third of responses, the split by Local Authority summed to a number contained within the 10% range that was selected in the previous answer, providing an opportunity to reject the midpoint of the range, in favour of – presumably – a more accurate overall local spending estimate. Therefore, while the responses to the disaggregation question did not provide support in the way they were intended, they actually offered arguably a more important benefit by revealing more about overall local spending – a notoriously challenging component of the model to estimate.

Chapter 4 noted a concern regarding the placement of the salary question which was requested in the first section of the questionnaire. It has been said that asking for such data somewhat early on in a survey might adversely impact response rate. While it cannot be known if any individuals opted against completing the questionnaire as a result of the

placement of this question, what *can* be known is the proportion of individuals who opted not to complete the question. Approximately 1% of respondents left this question blank; the salary of those individuals could be estimated using their job title and contract type. Despite this, future studies might like to request salary data at a later point in the survey if this lack of response is deemed unacceptably high.

The following section looks at the data that were collected from the questionnaires.

5.2 Review of the Data

Having inputted the data into Excel, a number of tabulations and cross-tabulations were generated with a view to gaining an understanding of response coverage. Presenting the data in this way also enables patterns and trends to be highlighted for further analysis and might also inform predictions.

The review is structured in the same way as the questionnaire, beginning with **employment** section, moving onto **saving and spending**, then to **individual demographics** and finally to training and **educational attainment**.

5.2.1 Employment

Tables 5.2 provides the breakdown of headcount by contract type for the surveyed workforce (n = 189). It can be seen that approximately 92% of employees in the sample have full time contracts with Siemens Gamesa, of both a permanent (the majority) and temporary nature. Stock and Watson (2014:529) state that "the population studied and the population of interest must be sufficiently similar to justify generalizing the experimental results". Therefore, it is important to provide context to the various surveyed sample breakdowns by drawing comparisons with the wider Siemens Gamesa population, the Humber region, and the UK picture. While this is not possible in all cases – for example, the overall saving and spending propensities of the wider Siemens population cannot be known – it *is* possible in some cases and these are indicated in the tables. According to 2017 ONS data, approximately 66.8% of employees in the Humber had full-time jobs,

and in the UK approximately 67.5% of employee jobs are classed as full-time. This suggests that the proportion of full-time employee jobs at Siemens Gamesa somewhat over-represents the regional and national picture, and therefore, inferences made about the workforce might not necessarily be representative of the wider context, but rather, for a population that bears similarity to this – a predominately full-time workforce.

Contract Type	% of Sample (*n* = 189)
Permanent, full-time	88.4%
Temporary, full-time	3.7%
Permanent, part-time	3.2%
Other, including: Interns, fixed-term and self-employed[33]	4.8%

Table 5.2: Employee breakdown by Contract Type

Table 5.3 presents the employee breakdown by job title. It can be seen that the majority of the workforce form the Production Team and the balance make up the Senior Leadership Team, Engineering Team and Intern population. Based on the proportions provided by Siemens Gamesa (indicated in the table), it would appear that the breakdown in Table 5.3 is reasonably representative of the wider workforce population – although it could be argued that the Quality Team and Support Functions are somewhat overrepresented by a factor of around two.

Job Title	% of Total Population[34]	% of Sample (*n* = 189)
Production Team	88%	77.8%
Quality Team	6%	11.6%
Support Functions	3%	7.4%
Other, including Senior Leadership Team and Interns[35]	3%	3.2%

Table 5.3: Employee breakdown by Job Title

[33] Breakdown includes one observation of 'No Response'.
[34] Data provided by Siemens Gamesa in November 2017.
[35] Breakdown includes one observation of 'No Response'.

Such ‘overrepresentation’ is not dissimilar to the geographical boosters used in the likes of the British Household Panel Survey (BHPS) and might, therefore, be seen as similarly useful. Cross-tabulations featuring contract type or job title may not be suitable at this time, given the proportions presented in Table 5.2 and Table 5.3. Any observations made about the individuals who do not form part of the permanent, full-time contract banding, and similarly the Production Team banding, would be done on the basis of a relatively small sample, and may not therefore be conclusive. This is an example of the limitations posed by having a sample of only 189 observations. However, this should not be considered problematic in the context of these variables, because neither are necessarily critical to the analysis at hand.

Table 5.4 sets out the sample breakdown into four salary brackets that were generated out of the 17 salary ranges offered in the questionnaire. The two ranges with the largest proportion of total headcount are £25,000 to £29,999 and £20,000 to £24,000 (contained within the first range shown in Table 5.4) with a combined total of 80% of the workforce.

Salary Range	% of Sample (*n* = 189)
Under £25,000	36.5%
£25,000 to £30,000	47.1%
£30,000 to £45,000	12.2%
Over £45,000	4.2%

Table 5.4: Employee breakdown by Salary Range

The breakdowns provided in Table 5.4 indicate that the salary classifications offered in the questionnaire were arguably insufficient at capturing the proportion of individuals who fall into income groups below £30,000. In order to better distinguish between individuals below this threshold, small increments would be required or better still, an open-ended question, with no classifications at all, allowing individuals to specify an

income value. As previously discussed, the lack of categorisation might have deterred some individuals from responding at all (hence the use of a closed question). However, this has resulted in almost 80% of the sample falling into just two categories, and subsequently an inability to meaningfully distinguish between them. This lesson will be reviewed again in **Chapter 8** where recommendations for future studies are proposed. Ideally, Siemens Gamesa would have provided a split of total population for the salary variable. This would have been useful in order to ascertain representativeness and could subsequently help to explain any over or under representation of other variables, such as saving, which will be used directly in the first round multiplier model for the Siemens Gamesa workforce. However, attempting to obtain such information could be considered intrusive and was therefore not requested, nor would Siemens Gamesa be obliged to provide it. A future study might, however, be able to obtain such information.

The average salary among Production Team workers is £25,867 (estimated using the midpoint of each salary range) and the average salary across all 189 observations is £27,804. On that basis, it follows that the most common tax rate among employees is the basic rate of 20%, paid by 95% of employees. The average salary for the sample is a little higher than both the average for the Humber region, which in 2017 was approximately £23,467[36] and Great Britain, which was approximately £26,496 in 2017[37].

Cross-tabulations of salary and educational attainment reveal that, of the individuals in the upper two salary categories shown in Table 5.4, approximately 55% are classified as being part of the higher qualification band; approximately 3% fall into the lower qualification band. Of those earning upwards of £45,000, albeit a small proportion of the sample, 75% have 'higher' educational attainment, and no individuals form part of the lower educational attainment banding.

[36] Estimated on the basis of £488.9 weekly pay, for 48 weeks per year (Nomis, 2019c).
[37] Estimated on the basis of £552 weekly pay, for 48 weeks per year (Nomis, 2019c).

While there does not appear to be a particularly strong correlation between salary and age – according to the correlation coefficients: $r = 0.237$ and $r_s = 0.2684$ (Prob > | t | = 0.0002) – the average age of individuals in the Under £25,000 salary cohort is 31.9; the average age of individuals in the £25,000 - £30,000 salary cohort is 35.5; the average age of individuals in the £30,000-£45,000 salary cohort is 35.7 and the average age in the highest salary cohort is 41.5 – revealing, in the simplest form, that salary tends to increase with age, as implied by the positive correlation coefficients. However, in order for the relatively weak correlation coefficients to be examined, further interrogation will need to take place through additional cross-tabulations and statistical testing. This will help to determine, at a more granular level, the extent of the relationship between age and salary. **Table 5.5 (overleaf)** sets out the breakdown by previous employment situation of the 189 observations, and the industry of their previous employers.[38]

[38] Industry classifications were determined using the company search tool on Companies House website.

Previous Employment Situation	% of Sample (*n* = 189)
Employment, different organisation	82.5%
Self-employed	8.5%
Unemployed	3.7%
Education	2.1%
Other, including: Siemens/Siemens Gamesa, different contract/ project	3.2%
Previous Employer Industry	**% of Sample (*n* = 189)**
Manufacturing	42.9%
Of which: Caravan	6.9% of total headcount (Caravan accounts 16.0 % of Manufacturing sector)
Construction	12.2%
Wholesale and retail trade; repair of motor vehicles and motorcycles	6.9%
Self-employed	4.8%
Human health and social work activities	3.7%
Public administration and defence; compulsory social security	3.7%
Transportation and storage	2.6%
Professional, scientific and technical activities	2.6%
Education	2.1%
Administrative and support service activities	1.6%
Accommodation and food service activities	1.6%
Mining and Quarrying	1.1%
Electricity, gas, steam and air conditioning supply	1.1%
Water supply, sewerage, waste management and remediation activities	1.1%
Information and communication	0.5%
Agriculture, Forestry and Fishing	0.5%
n/a[39]	5.8%
Unemployed	3.2%
No response/Other	2.1%

Table 5.5: Employee breakdown by Previous Employment Situation and Industry

[39] Cohort includes those previously inactive or in education.

It can be seen that the majority of individuals were in employment, at a different organisation. Of the previous organisations, 42.9% are categorised as being part of the Manufacturing sector, of which approximately 16% are contained within the Caravan sub-sector, specifically.

Prior to the investment, there was concern among local companies that the caravan industry – a major employer in the Humber region (and an obvious source of suitably skilled labour) – may suffer as a result of the Blade Factory Project, with Siemens Gamesa stating that its workforce would comprise individuals with a skillset developed locally through previous employment in sectors such as caravan manufacturing (The Guardian, 2016). According to these results, the expectation was reasonably well founded, with the Caravan sub-sector constituting the third[40] largest previous employer industry of the sample. Further, 38.5% of the individuals previously employed in the caravan sector appear to come from one company, which might, therefore, have suffered more than others, as a result of the Blade Factory. This result may have been considered inevitable, if only a small number of caravan manufacturers exist locally. However, approximately six different caravan companies were stated as previous employers by questionnaire respondents, and KCOM Colour Pages (2019) specifies an additional 14 caravan manufacturers, suggesting that a not insignificant number of caravan manufacturers are based in the local area.

While Siemens Gamesa's investment in the area might not have been in support of the caravan sector in the first instance, it could be suggested that the investment might bring about unforeseen wider economic benefits to the region. These may ultimately have a positive impact on the caravan sector, as a result of an improvement in the profile of the sub-region overall. If the Humber is to be considered a destination for investment as a

[40] Jointly with 'Wholesale and retail trade; repair of motor vehicles and motorcycles'.

result of the Blade Factory, an influx of new individuals might be encouraged to enter the region and may choose to seek employment in the caravan sector. In this regard, scope exists to further investigate the wider economic benefits that have arisen as a result of Siemens Gamesa's investment. Of course, some time will need to elapse first, in order for particular benefits to be captured.

Having established that nearly 80% of the sample form part of the Production Team at the Blade Factory (**Table 5.3**), the dominant previous industries of Manufacturing and Construction, accounting jointly for over half the total at 55%, is perhaps unsurprising. Of greater interest, from a regional policy perspective, might be the reasons for these workers taking the roles at Siemens Gamesa, set out in **Table 5.6** (overleaf).

Of the individuals previously working in the Caravan sub-sector of the Manufacturing industry, 30% cited 'Job security' or 'Job stability' as the reason for taking the job at Siemens Gamesa, with a further 30% citing 'Job opportunities' or 'Opportunities'. This could be owing to the notoriously cyclical nature of the sector – a well acknowledged fact among major caravan manufacturers who seek to hire on a short-term basis to meet seasonal demand. Alternatively, it could be owing to continued concern following the recent economic downturn, which is reported to have caused approximately 1,500 job losses in the caravan industry in 2008 (BBC, 2012). Further evidence suggests that the caravan industry in Hull, specifically, has suffered considerably since the start of the recession with approximately 20% of workers losing their jobs, and many more facing the same possibility as manufacturers 'scale back workforces' in line with an anticipated decrease in demand (Yorkshire Post, 2008). It is not surprising, therefore, that the results arising from this question suggest that job uncertainty is a particularly prominent motivator for the move to Siemens Gamesa, with only 7.6% citing 'Money' as a primary reason for taking the new role – despite concerns that the industry might lose workers to Siemens Gamesa because of its ability to offer more attractive remuneration benefits.

When assessing the reasons for taking the job, given by those previously engaged in the Manufacturing and Construction sectors more widely, it seems that job stability, security and opportunities are equally important as they are to those previously engaged in the Caravan sub-sector, with 25% of those previously employed in the Manufacturing sector (excluding the Caravan subset), citing job stability, security and opportunities as the primary reason for taking the job at Siemens Gamesa, and 35% citing the same among those previously employed in the Construction sector.

Primary reason for taking the job at Siemens Gamesa	% of Sample (*n* = 189)
Future/job prospects/career progression	14.8%
Change/new challenge/something different	9.5%
Job opportunity	8.5%
Job security	8.5%
Lifestyle	6.9%
Money	6.9%
Company specific	5.8%
Opportunities	5.8%
No response	5.3%
Redundancy/liquidation/voluntary exit	3.7%
Job stability	3.2%
Sector specific	2.7%
Pension/package	2.1%
Contract end	1.1%
Self-development	1.1%
Working conditions/patterns	1.1%
Financial stability	0.5%
Private sector employment	0.5%
n/a[41]	11.6%
Other	0.5%

Table 5.6: Employee breakdown by Primary Reason for Job Change

[41] Cohort includes those previously inactive or in education.

If the suggestion arising from these results is that individuals working in the Manufacturing and Construction sectors, within the Humber region, are motivated to take jobs that come with guarantees of stability, security and prospects, more so than financial gain or self-development opportunities, there could be some merit in local government devising schemes that enable local Manufacturing and Construction companies to hire on a permanent basis, rather than short term – since that type of contract appears to be increasingly unattractive to the available workforce. Providing assistance to companies might enable them to offer long-term, or permanent, employment which might, in turn, encourage applicants to consider them as potential employers, and they may be satisfied in taking a role in a smaller, local company, as opposed to at a larger firm, which may previously have been the only option for those seeking secure employment. From the company's perspective, having permanent employees, as opposed to only fixed term, might mean that additional work can be tendered for, where it might not previously have been possible, owing to a reduced or absent workforce.

Further disaggregation by salary reveals that individuals earning salaries of £35,000 and over tended to be less concerned about job security (with zero citing it as the primary reason for taking the job), or even about 'Future/job prospects/career prospects' (with ~11% citing that as the primary reason – two questionnaire respondents). The most commonly cited primary reason pertains to 'Change/new challenge/something different' – cited by over 22% of individuals – suggesting that the incentive is centred on the specifics of the new role, rather than the contract of employment.

The survey suggests that those earning 'higher' salaries appear to be motivated by the prospect of continued challenge, change and self-development. Assuming they are successful in achieving such self-development, their earning power will continue to increase, while those earning 'lower' salaries (not that the two classifications are necessarily binary), appear to be concerned predominantly with job security and therefore

might not seek opportunities that encourage challenge or self-development to the same extent as higher earners, thus potentially restricting their earning power.

However, caution must be exercised when using the results from this particular question. Some degree of interpretation was required to interpret the numerous open responses that were provided. Despite this, a large number of categories was still generated, as presented in Table 5.6. As it stands, some of the categories could be perceived as overlapping and the nature of classifying them included some discretion the part of the author. To provide further support to the assertions made in this section, additional and specific research would need to be conducted, and the findings posed here could form the foundation of that.

5.2.2 Saving and Spending

Table 5.7 (below) and **Figure 5.1** (overleaf) set out the split of headcount by saving cohort. The questionnaire provided 20 savings categories starting with 0%, and then increasing in increments of 5%. The 20th category posed a range of 91%-100%, making it the only band to offer a range of 10%. For the purpose of further analysis, the 20 ranges were reduced to the five shown in Table 5.7. The categories were generated with a view to each one containing a similar proportion of the sample.

Saving Range	% of Sample (*n* = 189)
0%	16.4%
1%-5%	27.0%
6%-10%	20.1%
11%-25%	24.3%
Over 25%	12.2%

Table 5.7: Employee breakdown by Saving Range

In the same way that more granular classifications of salary groupings might have led to a greater ability to distinguish between individuals, the same can be said for saving categories. In fact, it could be said that saving data is less sensitive than salary data, and therefore an argument exists to remove any response categories, in favour of an open-ended question, allowing respondents to state an exact proportion. This is something that could be considered for future impact assessments.

The highest savings category to be selected was 66%-70% (Figure 5.1) after which none of the categories were selected, suggesting that the maximum saving out of disposable income is 70%, or, for the purpose of this analysis, 68% where the midpoint of that range was selected.

The most commonly selected saving range was 1%-5%, chosen by 27% of individuals, followed by 6%-10%, selected by 20.1% of individuals. Together with the 0% savings category, the lowest three categories account for 63.5% of the total sample, said another way, 63.5% of the sample save between 0% and 10% per month, and the balance of 36.5% save between 10% and 70%.

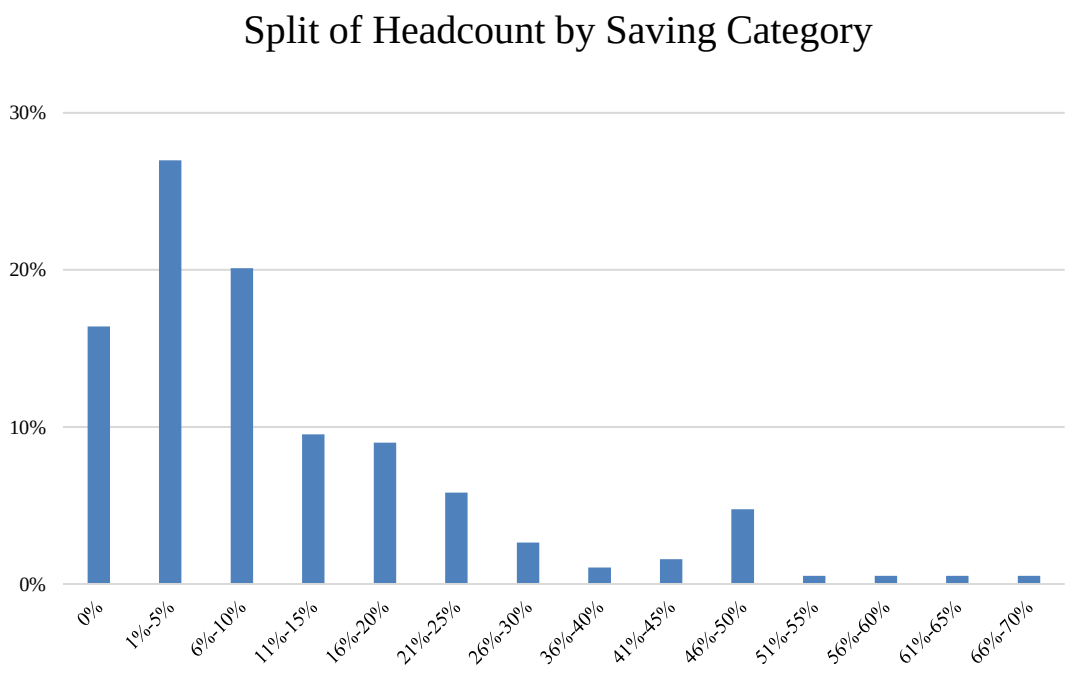

Figure 5.1: Sample breakdown by Saving Range

The average saving across the 189 respondents is 12.1%. The weighted average, estimated by multiplying the midpoint of each saving range by the probability of selecting the range, is 12.0%. Comparisons to other estimates derived in the empirical literature (reviewed in **Chapter 3)** might not be relevant, owing to the difference in time periods and the study regions in question, but, nonetheless, values tended to be in the range of 10% to 17%, suggesting that the average estimates derived from the data collected in this study are in line with previous, albeit historic studies.

If it can be established that individuals with a low propensity to save also possess other common traits, such as a common level of educational attainment, generating a hypothesis based on those other factors alone, in the absence of savings data in future investigations, might be possible. That is, if it can be determined that individuals with a low propensity to save typically have a higher first round multiplier, the characteristics of those with a low propensity to save can be reasonably determined – perhaps they tend to fall into the same educational classification banding, or local spending group – then it may be possible to infer a higher first round multiplier estimate based on *those* characteristics acting as proxies, if savings data is unavailable.

In light of that, and of interest in its own right, is the breakdown of savings by education classification given in **Table 5.8**.

Qualification Category	Mean Saving (% of take home wage)	Std. Dev.
Higher qualification	16.8%	16.9%
Midlevel qualification	10.2%	12.0%
Lower qualification	10.8%	14.3%
Other qualification/No Response	13.3%	12.3%

Table 5.8: Mean Savings by Educational classification

It reveals that those in the higher educational grouping tend to have a higher propensity to save with an average of 16.8%; those in the midlevel and lower educational bandings tend to save 10.2% and 10.8% respectively, both falling below the overall sample average of 12.1%. Of those individuals who state they typically save 0% of their take home salary, approximately 42% fall into the lower educational classification banding, as opposed to only 16.1% who are classified as having a higher educational attainment. Further cross-tabulations involving educational attainment are considered in **Section 5.2.4**.

Additional cross-tabulations involving savings were also performed, including the mean by current residence. As shown in the Individual Demographic overview (**Section 5.1.2.3**, page 193), the majority of individuals reside in Kingston upon Hull and East Riding of Yorkshire (83.5%); the average saving propensities of those individuals is 12.4% and 11.5% respectively, both reasonably in line with the mean for the overall sample. A small proportion (less than 3%) reside outside the Humber and appear to have a higher propensity to save (approximately 30%), however the sample size may not be sufficient to constitute that as a conclusive finding and further investigation is required. Similarly, a small proportion reside in North and North East Lincolnshire (approximately 6%) and appear to have a lower propensity to save at 5.8%, but, again, the sample size is likely insufficient to constitute a conclusive finding and there is scope for further investigation. Of course, propensity to save is just one of the, in this case, four determinants of the multiplier estimation, and it may have no bearing on the other coefficients, such as propensity to spend wage locally[42]; therefore, the other factors must be explored in the same way, for inferences to be drawn and hypotheses to be made.

Table 5.9 and **Figure 5.2** (both overleaf) review the responses to the local spending questions and may provide further evidence to support a first round multiplier hypothesis.

[42] **Section 6.2** explores the relationship between the leakage variables as part of the multiplier estimation process.

Local (Humber) Spending Range	% of Sample (*n* = 189)
0%-10%	4.8%
11%-20%	12.2%
21%-30%	9.5%
31%-40%	6.9%
41%-50%	6.3%
51%-60%	7.9%
61%-70%	9.0%
71%-80%	10.6%
81%-90%	12.7%
91%-100%	20.1%

Table 5.9: Employee breakdown by Local Spending Range

Figure 5.2 shows the distribution of responses to the question that inquired about the proportion of disposable income that is spent locally.

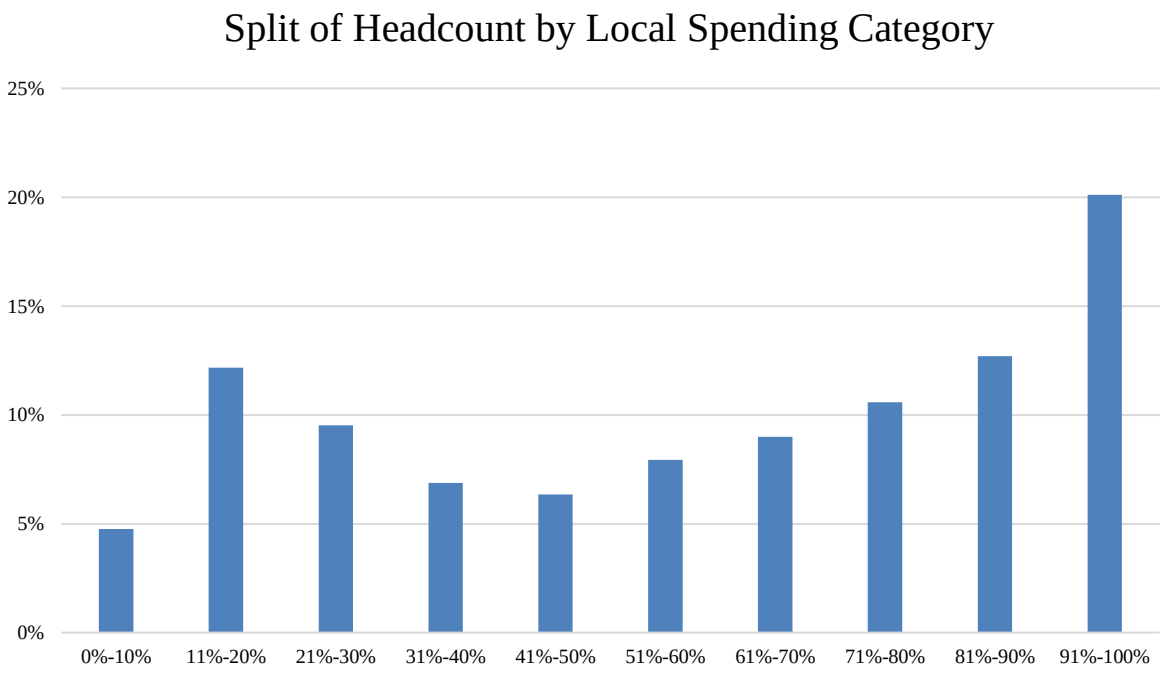

Figure 5.2: Employee breakdown by Local Spending Range

Unlike the distribution of savings, which was somewhat skewed to the right, the distribution of local spending forms something of a U-shape with just over a quarter of the responses (26.5%) falling into the first three categories: local spending of up to 30%. Approximately 43.4% of responses fall into the last three categories: local spending of between 71% and 100%. Clearly, non-local spending is a 'leakage' – possibly the most considerable and import leakage in the model. The larger the proportion of non-local spending, the lower the multiplier, because *that* money is not being re-spent locally, it has exited circulation and is being spent elsewhere. Similarly, the higher the proportion of local spending, the greater the potential for a higher multiplier estimate, owing to the opportunity for wage to be circulated through the rounds of spending locally. Further investigation reveals that of the individuals in the lowest **three** categories of local spending, 20% are either non-Humber residents currently, or they are non-British nationals. Of the lowest **two** categories of local spending, 28.1% are either non-Humber residents or non-British nationals. Their relatively low propensity to spend locally can therefore be explained either because they might choose to spend their wage in the region in which they reside, or it might be that they choose to spend or send the money to their home country, perhaps to friends and family.

The **average** local spend as a proportion of disposable income is approximately 58.8% (weighted average: 58.2%). Given the breakdown of respondents by current residence – which revealed that the majority reside in the Humber – it is perhaps not surprising that over half (60.3%) the total sample appear to spend more than 50% of their disposable income in the Humber region and therefore a cross-tabulation by current residence reveals nothing unexpected. However, of more relevance for the model is the *marginal* propensity to spend locally, or rather, to import, since the model will be composed of leakages. Marginal propensities will be calculated using the salary data, a full discussion of which takes place in Chapter 6.

A tabulation of interest, however, is the breakdown of local spending by educational attainment. This is given in **Table 5.10** and reveals that those in a higher qualification banding claim to remit slightly less of their wage locally, than those in lower educational attainment bands.

Qualification Category	Mean Local Spending (% of take home wage)	Std. Dev.
Higher qualification	49.4%	30.4%
Midlevel qualification	59.0%	28.5%
Lower qualification	66.0%	31.8%
Other qualification/No Response	53.1%	34.1%

Table 5.10: Mean Local Spending by Educational Classification

When used in conjunction with the results in **Table 5.8** (regarding saving propensity by educational attainment), the findings suggest that those in the higher qualification banding are likely to have a lower first round multiplier, because two of the critical multiplier components, saving and local spending are relatively high and low, respectively, which, consistent with theory, will generate a low estimate because both leakages are high. On the same logic, individuals who are classified as having lower education attainment appear to have a higher propensity to spend wage locally, and a lower propensity to save, and can therefore be expected to contribute to a higher multiplier, because the leakages are lower. The extent to which that expectation holds true will be explored in **Chapter 6**.

Table 5.11 sets out the primary spending destinations of the respondents. As previously discussed, the supplementary questions regarding spending preferences were not answered consistently by all recipients. Approximately 21% did not attempt Question 4 of the 'Saving and Spending' section, which sought to determine the names and locations of primary retailers or service providers, and the balance of respondents who did attempt the question, did so with varying levels of details.

Primary Spending Category	% of Sample (*n* = 189)
Supermarket	62.4%
Blank	21.2%
Transport, travel, logistics	3.2%
Bars and Restaurants	7.4%
Retail (on and offline)	3.7%
Other	1.6%
Entertainment	0.5%

Table 5.11: Employee breakdown by Primary Spending Category

Despite the lack of consistency in responses, categorisation of the primary[43] spending destinations was attempted, and perhaps unsurprisingly – and, in the absence of further detail, perhaps uninterestingly – indicated that the majority of respondents tended to select major UK supermarket chains as the primary spending destination. No further detail about the types of purchases was provided, nor was it asked for, and therefore it is not possible to know what exactly was purchased at the supermarkets – and to therefore determine if it was imported to the region or not.

Of possible interest, however, are the characteristics of the individuals who did not select a supermarket as the primary spending destination. Those who stated a bar, restaurant, entertainment provider or an online or offline retailer as the primary spending location appear to have a lower average age than that of the overall sample, at 29.2 (sample mean: 34.6) and approximately 45.5% either rent their current residence or live with parents, as opposed to own. Further, their average local spend is higher than the overall sample average at 70% (sample mean: 58.8%). Given the latter in particular, it might be possible

[43] 'Primary' was determined as being either the first retailer/service provider given out of a possible three, or the retailer/service provider against which the largest proportion of spending was allocated – where provided.

to hypothesise that individuals who selected a bar, restaurant, entertainment provider or an on or offline retailer will have a higher first round multiplier, and not simply because of the higher local spend allocation, but also because the local spend is primarily at an establishment or provider that *could* be independent, for example, a bar or restaurant, as opposed to a major supermarket chain.

5.2.3 Individual Demographics

Per the Final Questionnaire layout, given in **Section 4.2.2.4** (page 86) the first question of the Individual Demographics portion of the questionnaire asked about respondent's gender and was left open, per the guidance cited in the aforementioned section. Approximately 47.1% of respondents did not answer the question; of the 52.9% who responded to the question, approximately 22% stated female, and the balance of just over three quarters, stated male.

Table 5.12 shows the distribution of headcount across the three age classifications, condensed down from 12 categories[44] that were provided in the questionnaire.

The dominant age category of the nine classifications that were selected by respondents was 30-34, with 23.8% of the overall headcount and the average age across the sample is 34.6.

Age Category	% of Sample (*n* = 189)
Age Under 30	33.5%
Age 30-44	46.3%
Age 45 upwards	20.2%

Table 5.12: Employee breakdown by Age Category

[44] A total of 12 age categories was provided in the questionnaire, but only nine categories were selected by respondents.

There appears to be little, if any relationship between age and propensity to spend wage locally, as suggested by the correlation coefficient: r = 0.14 and r_s = 0.14 (Prob > | t | = 0.0598). However, there is something of a relationship between age and saving. Despite the arguably weak association given by the correlation coefficients: r = -0.26 and r_s = -0.22 (Prob > | t | = 0.0019) – which indicates that as age increases, propensity to save declines – the chart in **Figure 5.3** shows something of a U-shaped distribution wherein those in the lower age categories, particularly of age 18 to 20, have a higher propensity to save relative to the rest of the sample, as do those in higher age categories – although the smaller proportion of headcount in those categories might be kept in mind.

This distribution of saving by age is arguably in line with a priori expectations – and fits well with the life-cycle hypothesis. Of those in the lowest two age categories, 18-20 and 21-24, approximately 61% state that they 'live at home' and might, therefore, be saving to move into different accommodation, or have greater disposable income as financial commitments are not the same as those who have households to maintain – and thus save a greater proportion of their wage relative to the wider sample.

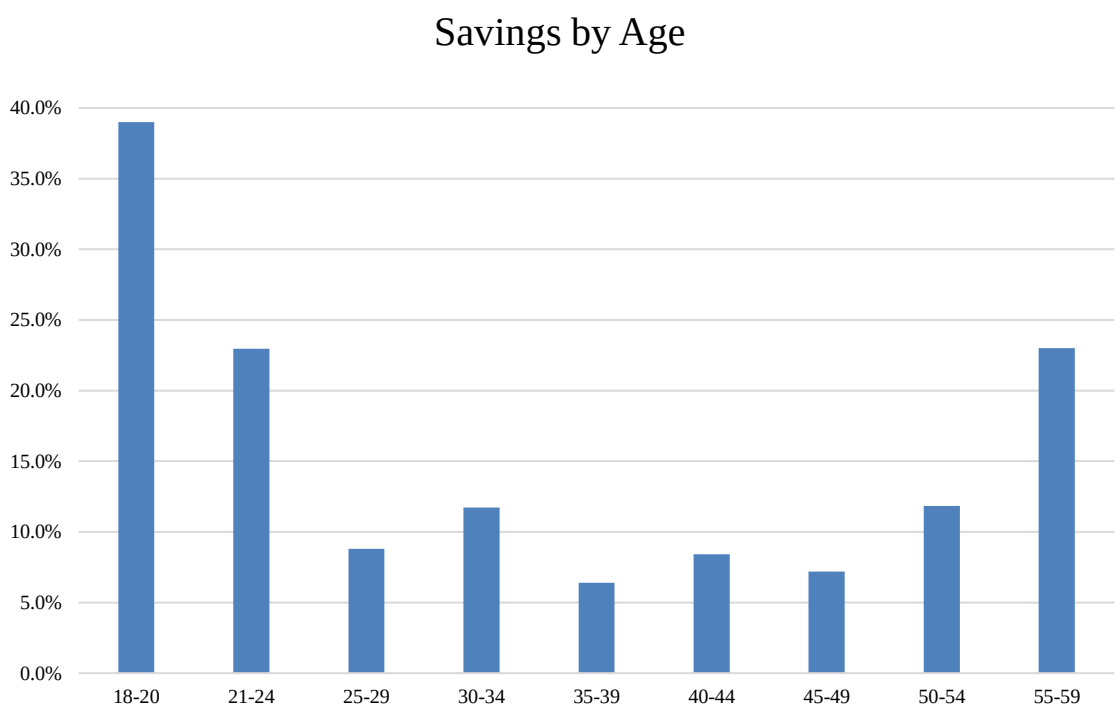

Figure 5.3: Propensity to save by Age Range

Moving through the age categories (breakdown in **Table 5.13**), it can be seen that propensity to save appears to decline, in particular among the 35-39 category, where mean saving is approximately 6.4%. This could suggest that expenses are particularly high between the ages of 25 and 49, when home ownership appears to be more common, with approximately 66% of individuals stating that they own their property, as opposed to alternative property tenures.

Age Category	Mean Salary	Mean Saving (% take home salary)	Mean Local Spending (% take home salary)
18-20	£ 22,499.50	39.0%	49.8%
21-24	£ 24,238.63	23.0%	46.5%
25-29	£ 26,070.93	8.8%	59.1%
30-34	£ 28,777.29	11.7%	60.5%
35-39	£ 27,716.89	6.4%	54.6%
40-44	£ 26,183.71	8.4%	66.7%
45-49	£ 32,291.17	7.2%	67.5%
50-54	£ 31,249.50	11.8%	54.4%
55-59	£ 27,499.50	23.0%	81.5%

Table 5.13: Breakdown of Age (split of headcount), Salary, Saving and Local Spending

Business Insider (2018) supports this notion, stating that the age of 31 was found to be associated with the most financial outgoings, and cited getting married, buying a house and having children as possible explanatory factors. ONS (2019d) data on household expenditure by age (for the UK in 2017 **and** 2018) notes a similar trend, in which individuals aged between 30 and 49 appear to incur the largest weekly expenditure of the reported age categories. It could be that a decline in such costs, together with a higher average salary explains the increased propensity to save among those in the age 50 and upwards categories, where average saving is more than double that of the 25-49 age

cohorts at approximately 13% and average salary is £30,714, as opposed to £28,202 – the average of those in the 25-49 age categories. However, correlation between saving and salary alone is unclear, with a coefficient of r = 0.097 and r_s = 0.1023, suggesting that other factors are more significant in determining the reasons behind propensity to save.

Table 5.14 sets out the split of headcount by current residence of the respondents, together with the average saving and local spending propensities of respondents who reside in each location.

Current Residence	% of Sample (n = 189)[45]	Mean Saving (% take home salary)	Mean Local Spending (% take home salary)
Kingston upon Hull	57.1%	12.5%	60.7%
East Riding of Yorkshire	26.5%	11.5%	56.8%
North and North East Lincolnshire	5.8%	5.8%	58.2%
Non-Humber	2.6%	30.0%	16.6%
Blank	7.9%	10.7%	66.8%

Table 5.14: Breakdown of Current Residence (split of headcount), Saving and Local Spending

As discussed throughout this section, the majority of respondents reside in the Humber region, and specifically in Kingston upon Hull, where the Blade Factory is located. Given the small number of observations in non-Humber locations, there is insufficient evidence to draw strong conclusions about the difference in characteristics between those who live in the Humber, and those who do not. It is possible, however, to draw comparisons between those who live in Kingston upon Hull and those who live in the East Riding. Residents of Kingston upon Hull appear to have a slightly higher propensity to remit wage in the Humber, at 60.7%, compared with the East Riding residents whose propensity is to remit 56.8% in the Humber. As previously mentioned, non-Humber residents have a very

[45] Components may not sum to total due to rounding.

low propensity to spend locally (approximately 16.6%), however, that estimate is based on a small sample size and should be used with caution.

However, residents of Kingston upon Hull appear to have a higher propensity to save, relative to those from the East Riding, though the difference is marginal, and both estimates round to approximately 12%. Based on the local spending propensity, it might be reasonable to hypothesise that the first round multiplier for Kingston upon Hull residents could be slightly higher than that of residents in the East Riding, and that of the overall sample. The extent to which that prediction holds true will be explored in **Chapter 6**.

The difference in salary between the locations was also marginal, with those in Kingston upon Hull earning an average of approximately £27,175 and those in the East Riding of Yorkshire earning slightly more at £28,200. Those from North and North East Lincolnshire appear to earn the least of the Humber Local Authorities at £25,227, but, like the non-Humber residents, that approximation is based on a sample size of less than 6%.

Table 5.15 sets out the breakdown of headcount by property tenure, together with the associated average saving and local spending propensities of the individuals in each group.

Property Tenure	% of Sample (*n* = 189)	Mean Saving (% take home salary)	Mean Local Spending (% take home salary)
Own[46]	60.3%	10.6%	60.4%
Rent	25.4%	10.7%	56.2%
Live with parents	13.8%	21.2%	58.3%
Other	0.5%	23.0%	26.0%

Table 5.15: Breakdown of Property Tenure (split of headcount), Saving and Local Spending

[46] Including those with a mortgage.

Given the earlier tabulations, especially those discussed in the **Section 5.2.2**, there is nothing especially remarkable about the findings presented in the table. Those who live with parents have a higher propensity to save than those who rent or own their properties, and those who own have a slightly lower propensity to save than the overall sample average. Those who own also appear to have a slightly higher propensity to remit wage locally, at 60.4%, compared to the group average of approximately 58.8%, which could reflect the more permanent nature of their residence in Hull. Those who rent have a slightly lower than average propensity to spend wage locally, which might reflect marginally less commitment to the Humber area. Based on this, it is likely that individuals who own their property will have a higher first round multiplier than those who rent or live with parents, because they have smaller leakages, in the form of lower than average saving, and higher than average local spending of wage. This will be explored in greater detail as part of **Chapter 7**'s supplementary investigation which assesses property tenure, for the purpose of regional planners.

5.2.4 Education

The distribution of headcount across the three educational classifications, presented in **Table 5.16**, shows that the largest proportion of individuals (37%) have a midlevel qualification as their highest level of educational attainment, closely followed by those with a lower level of educational attainment (34.4%). Less than a quarter of the sample have a higher level of educational attainment, considered in this research to include NVQ Level 4 and 5 and degree level qualifications or higher.

Qualification Category	% of Sample (n = 189)	Mean Saving (% take home salary)	Mean Local Spending (% take home salary)	Mean Salary
Higher qualification	23.8%	16.8%	49.4%	£32,444
Midlevel qualification	37.0%	10.2%	59.0%	£27,357
Lower qualification	34.4%	10.8%	66.0%	£25,423
Other qualification/No Response	4.8%	13.3%	53.1%	£25,277

Table 5.16: Breakdown of Educational Attainment (split of headcount), Salary, Savings and Local Spending

Those with the higher level of educational attainment also have the highest average salary, the highest propensity to save, and the lowest propensity to spend wage locally. Based on those characteristics, it seems reasonable to continue with the previously suggested hypothesis that those with the higher qualifications will have a lower first round multiplier – and will contribute less to the overall multiplier, because of the high leakages associated with the respondents who fall into that category. Further, of the sub-5% of individuals who pay the higher rate of tax (40%), approximately 60% of them are classified as being part of the higher qualification banding for educational attainment; this is an additional leakage that will reduce the multiplier further.

As qualification banding declines, so too does salary, however, propensity to save is largely the same for those with midlevel and lower level educational attainment. Propensity to spend locally, however, as noted in **Section 5.2.2**, is higher for individuals in the lower qualification banding. That could be as a result of the lower salary, which might restrict spending opportunities outside the Humber, or it could be that the spending preferences of those in the lower qualification banding are met by the opportunities available in the Humber. Individuals with the higher level of educational attainment might not only have the financial means to spend their wage outside the region, but they might also have particular preferences, developed as a result of further education, that mean their demands cannot be met locally, thus forcing remittance non-locally.

5.3 Summary and Hypotheses

The purpose of Chapter 5 was to review the data that were collected from the questionnaires. In the first instance, this would allow for the data collection process to be reviewed – including suggestions for future studies based on the responses of the surveyed individuals. It would also allow for an up to date saving and spending landscape to be presented, featuring variables that are scarcely sought at the same time, thus presenting unique opportunities for analysis. Finally, it would allow for a number of high level

predictions to be drawn about the relative size of the first round multiplier for various sub-groups identified in the sample. Of course, at this stage in the analysis, these predictions are based on *average* propensities, rather than marginal – which will be looked at in the following chapter.

The following sub-sections summaries each of the findings identified in Chapter 5.

5.3.1 The Data Collection Exercise

A total of 189 useable questionnaires were returned by Siemens Gamesa, accounting for almost a quarter of the reachable employee population. Recalling evidence from the literature review, this far outstrips attempts made by the likes of well-referenced McGuire (1983) who achieved workforce coverage of approximately 1.5%. It is also in line with recommendations from Rowley (2014), who suggested that one ought to aim for completion of 100 questionnaires, noting that any more than 100 would likely support more robust research, and opportunity for wider insight. However, a sample of 189 has some limitations. In the first instance, the intention is for the 189 questionnaires to represent the overall Siemens Gamesa workforce, and therefore, the first round of the multiplier. While it might be successful in achieving that, a subsequent intention is for sub-groups to be identified within the sample, such that various marginal propensities can be considered, and ultimately used to indicate which sub-groups might contribute the most towards the first round multiplier. Once the sample of 189 is drilled down into sub-groups, the evidence to support assertions will become weak and therefore conclusions should be accompanied with notes of caution. In light of this, some variable groupings have been generated in a way that appears to disregard data where an opportunity for further sub-grouping might have existed with a larger sample. For example, the classification of educational attainment. While 16 categories were offered in the questionnaire, only four classifications were used for analysis to ensure each group

contained a sufficient number of observations.[47] In addition to limiting sub-group analysis, if the Siemens Gamesa sample is to be used as part of a scenario analysis in which the propensities of the workers are used to represent the wider Humber population, it cannot necessarily be assumed that the preferences of those 189 individuals will sufficiently represent a sub-region composed of approximately 1,000,000 people. This provides further support for the need to separate the rounds of spending and for alternative values to be used in the second and subsequent round analysis. It also suggests that the greatest attention should be paid, in this research, to the first round multiplier, where the most evidence exists to support estimations.

5.3.2 The Humber Landscape

The data indicate that the average salary earned among Siemens Gamesa employees in this sample is approximately 18% higher than the Humber average at £27,804, and 5% higher than the Great Britain average. There appears to be little correlation between salary and age, though there is some suggestion that salary tends to increase with age, in line with theory. There is strong evidence to suggest that salary increases in line with educational attainment, further analysis of which will be done as part of the Mincerian earnings return to education investigation in **Chapter 7**.

With respect to saving, it can be seen that the average propensity to save out of disposable income is approximately 12% among this sample, with more than 60% of the sample stating that they save less than 15%. While comparisons to the wider Humber cannot readily be made through a lack of available data, and comparisons to the literature offer little value, a comparison to the wider UK can be made. The UK saving ratio in Q4 2017 (the time of research) was approximately 5.8% (ONS, 2019e) – considerably lower than

[47] It should also be noted that some of the 16 questionnaire classifications are referring to the same level of educations attainment for which a number of different qualification types exist – such as ‘GCSE’ and ‘O-Level’.

the sample average. However, it is important to state again, that these are *average* propensities. Propensities of interest in this research are the *marginal.* In other words, what is the propensity to save out of the *next* pound of earnings. This will be calculate using salary data, in **Chapter 6**. There is some, unsurprisingly, correlation between the propensity to save and educational attainment, where those with a higher level of attainment appear to have a higher average propensity to save, than those with mid-level or lower educational attainment.

The data revealed that the average local spend among the surveyed employees is approximately 59%, with a significant proportion (43.4%) stating that they spend between 91% and 100% in the Humber region. The collection of such data at a regional, or even national level appears absent, and evidence from the literature review suggest that only data on regional imports (that is – the proportion of goods and services purchased outside the region, for sale inside the region) is such and cannot, therefore, be assumed to be relevant or comparable in this research. As part of the scenario analysis in Chapter 6, plausible alternative values for local spending – or rather, propensity to import from outside the Humber – will need to be estimated for use the second and subsequent round multiplier model. Of possible interest, with respect to the first round multiplier, is the relationship between educational attainment and local spending. It can be seen that those with a higher level of educational attainment appear to have a lower propensity to spend locally. This data point, together with the high propensity to save, suggests that the contribution to the overall multiplier from individuals with a higher level of educational attainment is likely to be low, relative to those in lower educational attainment classifications.

The various saving and spending propensities of other sub-groups, including by location within the Humber, and by property tenure type, will be explored in Chapter 6 and 7.

5.3.3 First Round Multiplier estimation

The review of data in Chapter 5 allows for a number of high level predictions to be drawn regarding the first round multiplier estimates for various sub-groups identified in this sample. While the multiplier process is concerned with the dissipation of investment (in this case, income) through the rounds of spending across all individuals in the local population, the separation of rounds enables some analysis to take place regarding which groups of individuals might contribute the most to the first round multiplier, based on their marginal propensities. While such analysis might only be true for the first round – where the data regarding marginal propensities for sub-groups is available – some further analysis might be possible to determine the extent of similarity between the surveyed population (whose marginal propensities are considered in the first round), and the wider population of all other individuals in the local population. In other words, if the propensities of individuals in the first round can be considered as representative for individuals in subsequent rounds, there is no need to separate the multiplier, and the predictions about the first round multiplier can be extended to the overall multiplier. This is explored further in Chapter 6's scenario analysis.

The following are some high level predictions regarding the likely contribution of various subgroups to the overall multiplier:

- Individuals who are classified among the 'highly qualified' sub-group are likely to contribute less to the first round multiplier, than individuals who are classified among other educational attainment groupings. This is based on their high propensity to import and to save, relative to individuals in other educational attainment categories;
- Individuals in the Under 25 age categories of *this* sample will have smaller first round multipliers because they have a higher than average propensity to save, and a lower

propensity to spend locally, relative to the wider sample;[48] thereafter, the size of the first round multiplier may vary with age, but tends to increase, particularly among those in the over 45 age categories where saving declines and local spending increases;

- Individuals who reside in Kingston upon Hull are likely to contribute more towards a higher first round multiplier than individuals living in the East Riding, because they appear to have a higher propensity spend locally, and a lower propensity to save.

5.4 Conclusion

Among other things, Chapter 5 provided an overview of the data collected from the questionnaires. This data, together with guidance set out in the literature will now be used to estimate the multiplier for the Humber region in Chapter 6.

[48] It should be noted that this prediction will not necessarily apply to all populations of under 25 year olds; in some cases, individuals in relatively young age cohorts might equally have a tendency to focus more on the present than the future (especially if they are not particularly well paid), and therefore might not have a higher than average propensity to save, which would alter the relative size of their multiplier estimate.

Chapter 6 – The Multiplier Models

6.1 Introduction

Following the data overview in Chapter 5, and in light of the literature set out in Chapter 3, it is now possible to estimate the regional disposable income multiplier for the Humber region. Chapter 6 is structured in the following way: **Section 6.2** sets out the derivation of the first round and full multipliers and notes a 'special case' condition in which separation of the rounds is not necessary. **Section 6.3** details the estimation of the first round multiplier, together with a sensitivity analysis, and the methods that were used to determine the coefficients of the model. **Section 6.4** details the estimation of the full multiplier for the Humber region, including the methods that were used to estimate coefficients for the whole population in the locale of interest where they were not available from the questionnaire, the literature, or among secondary data sources. This sections also includes a scenario and sensitivity analysis. Chapter 6 is summarised in **Section 6.5** ahead of the supplementary analysis exercise in Chapter 7.

6.2 Derivation of the Model

Based on the primary data that was collected, the model is derived using a similar set up to Archer (1976) presented in Section 3.2.8.2. Recall the set-up of a simple Keynesian Model of the Humber wherein:

$$I = \bar{I} \tag{6.1}$$

$$G = \bar{G} \tag{6.2}$$

$$X = \bar{X} \tag{6.3}$$

The consumption function is written as:

$$C = c_0 + c_1 Y_D \tag{6.4}$$

Imports are a function of disposable income, written as:

$$M = m_0 + m_1 Y_D \tag{6.5}$$

Equilibrium condition:

$$Y = C + I + G + X - M \tag{6.6}$$

Therefore:

$$Y = C(Y) - M(Y) + I + G + X \tag{6.7}$$

Where:

I is investment

G is government spending

X is exports

C is consumption

c_0 is autonomous consumption

c_1 is marginal propensity to consume

M is imports

m_0 is autonomous imports

m_1 is marginal propensity to import

Y_D is disposable income

Y is income

It is assumed that autonomous imports, m_0, are related to I and G, and $m_1$is related to C. Imports (which depend on disposable income) affect private consumption by household, implying:

$$Y = c_0 + m_0 + (c_1 - m_1)Y(1 - t - NI) + \bar{I} + \bar{G} + \bar{X} \tag{6.8}$$

Expressed another way, the full multiplier can be explicitly written, together with additional leakage parameters, as:

$$Y = \frac{c_0 + m_0 + \bar{I} + X + \bar{G}}{1 - (c_1 - m_1)(1 - t - NI)} \tag{6.9}$$

Where additional leakages are notated as:

t is taxation

NI is National Insurance.

6.2.1 Comparison to the Literature

The model presented in (6.9) follows a similar form to that of Archer (1976) presented in Section 3.2.8.2, equation (3.12) However, are a number of noteworthy differences, particularly with regard to the treatment of imports and taxes, were made based on what was appropriate for the primary data that was collected.

Archer denotes non-local consumers spending as c_j, and also allows for some expenditure on 'non-local' goods (goods that have been imported into the region for sale locally – 'foreign goods') given as m. Both are assumed to be leakages that do not come back into the region. In model (6.9), the fraction of disposable income spent outside the Humber is denoted by m_1. Linking Archer's model to model (6.9), it can be seen that effectively $c_j = m_1$. However, model (6.9) makes no leakage allowance for the consumption of foreign goods, meaning: $m = 0$. This was done on the basis that local consumption of foreign goods cannot constitute a leakage entirely; some portion of the consumption will generate value added to the region in which it is sold, despite it not being produced domestically. The questionnaire sought data on exactly *where* local (Humber) consumption took place, with a view to estimating a value for m, however, insufficient responses were returned, and it was not possible to generate a value added number.

6.2.2 Separation of Rounds

Given the provision of primary data for the Siemens Gamesa workforce, and per the research questions set out in **Chapter 1**, it is possible (and according to the literature, necessary) to estimate a multiplier for the first round – the spending of the Siemens Gamesa workforce – separately from the second and subsequent multiplier rounds.

The difference in multiplier estimates between the rounds of spending depends on the difference in m_1 – the marginal propensity to import out of disposable income[49]. In the first round, the marginal import propensity of the Siemens Gamesa workforce can be estimated from the data collected via the questionnaires and is denoted using:

$$m_1 = m_1^{sg} \tag{6.10}$$

In the second and subsequent rounds, the marginal import propensity of the aggregate Humber economy will be estimated as part of a scenario, and can be denoted using:

$$m_1 = m_1^{*} \tag{6.11}$$

While it is sensible to assume that a difference in import propensities exists between the different rounds of spending, a 'special case' scenario can be estimated where no difference in import propensities exists, in which case:

$$m_1 = m_1^{sg} = m_1^{*} \tag{6.12}$$

Given these notations, the overall multiplier can be calculated by defining k^{sg} as:

$$k^{sg} = (c_1 - m_1^{sg})(1 - t - NI) \tag{6.13}$$

based on the first round import propensity. Said another way, k^{sg} can be interpreted as the marginal consumption expenditure of a Siemens Gamesa employee, generated by each additional unit of income.

Whereas, k^{*}can be interpreted as the marginal consumption expenditure of a representative consumer in the Humber area, and is defined as:

$$k^{*} = (c_1 - m_1^{*})(1 - t - NI) \tag{6.14}$$

[49] It is assumed that c_1, consumption, is a deeper parameter than m_1, imports. Therefore, the value estimated for c_1 in the first round (using the questionnaire data) will be held constant through the subsequent rounds. The value of imports, m_1, will determine the difference in multipliers estimates of each round.

If there is no difference between first and subsequent rounds, a simple multiplier can be derived wherein J represents the total increase in expenditure in the region after n rounds, generated by an additional unit of autonomous spending. That is, J represents the multiplier:

$$J = 1 + k^{sg} + k^{sg\,2} + k^{sg\,3} + \cdots k^{sg\,n} \tag{6.15}$$

$$kJ = k^{sg} + k^{sg\,2} + k^{sg\,3} + \cdots k^{sg\,n} \tag{6.16}$$

$$J - kJ = 1 \tag{6.17}$$

$$J = \frac{1}{1 - k^{sg}} \tag{6.18}$$

However, a difference between rounds ***is*** to be assumed. Therefore, under the assumption that the income injection equals 1, and the total effect of the investment is given by J, each of the elements of the injection and subsequent rounds can be arranged as follows:

$$J = 1 + k^{sg} + k^{sg}k^{*} + k^{sg}(k^{*})^{2} + k^{sg}(k^{*})^{3} + \cdots = 1 + \frac{k^{sg}}{1 - k^{*}} = \frac{1 + (k^{sg} - k^{*})}{1 - k^{*}} \tag{6.19}$$

As noted above, if there is no difference between the import propensities across the rounds, then: $k^{sg} = k^{*}$, and the model reduces to the standard multiplier formula given in (6.18).

6.2.3 Summary of Models

The above derivations can be summarised as follows:

First-round multiplier:

$$1 + k^{sg} = 1 + (c_1 - m_1^{sg})(1 - t - NI) \tag{6.20}$$

Full multiplier[50]:

$$\frac{1+(k^{sg}-k^{*})}{1-k^{*}}=\frac{1+\left(m_1^{*}-m_1^{sg}\right)(1-t-NI)}{1-(c_1-m_1^{*})(1-t-NI)} \tag{6.21}$$

The 'special case' multiplier, in which $m_1^{sg}-m_1^{*}=0$, can be estimated using:

$$\frac{1}{1-(c_1-m_1^{sg})(1-t-NI)} \tag{6.22}$$

The following section uses equation (6.20) to estimate the multiplier for the Siemens Gamesa workforce, that is, the first round multiplier.

6.3 The First Round Multiplier

In order to estimate the first round multiplier, the following pieces of data were required:

- Marginal propensity to consume:
- Marginal propensity to import;
- Taxation;
- National Insurance.

To estimate a consumption value for each observation, it was first necessary to determine a value for National Insurance. Per the rationale set out in **Section 4.2.2**, this value was not sought in the questionnaire, instead, a standard estimate would be used for all individuals, estimated from secondary data. According to the HMRC (2019) data set out in **Table 6.1**, the vast majority of individuals in the Siemens Gamesa sample will be paying a marginal rate of 12% in National Insurance contributions.

[50] Additional leakage parameters can be considered for inclusion in the full multiplier. An example of this might be a coefficient to represent transfer payments. While such a parameter might not be applicable to the Siemens Gamesa workforce (and therefore superfluous in the first round) it *might* have a place in the full multiplier, where the focus is not on the Siemens Gamesa workers, but rather the wider locale of the Humber.

Employee Earnings (£)	National Insurance Contributions (%)
£0 - £ 156 (per week)	0%
£157 - £866 (per week)	12%
Over £866	2%

Table 6.1: National Insurance Contributions 2017/2018

Source: HMRC, 2019

Based on the average salary in the Humber region (discussed in **Section 5.2.1**), the same will be true of the wider Humber population. On this basis, a coefficient estimate of 0.12 (12%) will be used for the first round multiplier, and for the full multiplier.

Having established a National Insurance estimate, and in possession of the marginal rate of taxation from the questionnaire responses[51], net income could then be determined. Following this, a total consumption estimate could also be derived by deducting savings from net income. A simple OLS regression could then be performed using a similar function to the one provided in equation (6.4) together with an error term, as in equation (6.23) below, to determine **marginal** consumption:

$$Consumption_i = \beta_0 + \beta_1 NetSalary + \varepsilon_i \qquad (6.23)$$

Having determined a total consumption value for each observation, the proportion of local consumption could be estimated using the local consumption data provided in the questionnaire (Section 2: Saving and Spending, Question 2). Once a local consumption value was estimated, it could be deducted from total consumption, leaving an import estimate. A similar OLS regression could then be carried out by regressing the import

[51] Based on the responses given in the questionnaire (Section 1: Employment, Question 2), and per the discussion in Chapter 5 (Section 5.2.1), a marginal taxation rate of 20% was used in the multiplier model.

propensity against net salary, per the model in (6.24), providing a value of **marginal** propensity to import.

$$ImportPropensity_i = \beta_0 + \beta_1 NetSalary + \varepsilon_i \quad (6.24)$$

The results of the OLS regressions indicate that the marginal propensity to consume for the whole sample is approximately 0.655. Said another way, for every additional pound of disposable income, Siemens Gamesa employees in this sample are likely to spend approximately 66 pence and save approximately 34 pence. Of the 66 pence, approximately 24 pence is spent outside the Humber – the marginal propensity to import. This implies that approximately 41 pence of every additional pound is spent locally – the marginal propensity to spend within the Humber.

These values, together with a taxation estimate of 20% and a National Insurance estimate of 12%, generate a first round multiplier value for the whole sample of **1.284**. It was possible to estimate a lower and upper bound estimate around this value, by using one standard error of the import value, and applying it in both directions to yield an upper bound multiplier value for the whole sample of **1.338**, and a lower bound value of **1.230**. In other words, for every £1 of Siemens Gamesa's investment in employee wages, an additional 28 pence is created in disposable income, after the first round of spending.

Conceptually, it might be interesting to compare these values to the literature. However, there are a number of obstacles in drawing meaningful comparisons with the empirical studies noted in Chapter 3, namely, the time periods in which they were conducted, and also the lack of marginal estimates. Further, these results have been estimated specifically for the first round, and not all contributors attempted to separate the rounds of spending. Comparing the first round estimates to those of a whole population will not necessarily draw meaningful conclusions.

Notwithstanding the aforementioned limitations of the time period and use of average estimates, it would be more prudent to compare the results from the full multiplier in **Section 6.4** with estimates derived from the literature.

However, it is possible to draw comparisons from within the sample for the first round multiplier estimates. By identifying different population groups within the sample, it is possible to examine which cohorts would contribute the most to the first round multiplier. The results from this sub-group analysis are given in the following section.

6.3.1 First Round Multiplier: Sub-group Analysis

A number of different populations were identified within the Siemens Gamesa sample. The marginal consumption and import propensities for the populations were determined per the method used for the whole sample and were substituted into equation (6.20) to determine multiplier estimates. The results are given in **Table 6.2**.

Sample sub-group	Marginal Propensity to Consume (c_1)	Marginal Propensity to Import (m_1^{sg})	Multiplier Estimate	Lower Bound Multiplier Estimate	Upper Bound Multiplier Estimate
Whole Sample	0.655	0.236	**1.284**	1.230	1.338
'Older' Employees	0.786	0.331	**1.310**	1.148	1.471
'Younger' Employees	0.602	0.207	**1.268**	1.229	1.307
Higher earners	0.468	0.115	**1.240**	1.195	1.285
Lower earners	0.983	0.157	**1.561**	1.442	1.681
Higher qualified	0.600	0.151	**1.305**	1.258	1.353
Lower qualified	0.964	0.000	**1.656**	1.461	1.851
Hull Employees	0.823	0.140	**1.464**	1.360	1.569
East Riding Employees	0.890	0.495	**1.268**	1.112	1.425

Table 6.2: First Round Multiplier Estimates

It can be seen that employees who are above the average age of the sample ('older' employees) have a higher multiplier than those who are below the average age of the

sample (‘younger’ employees). This indicates that that ‘older’ employees will contribute more to the first round multiplier than ‘younger’ employees. Recalling the data overview in Chapter 5, this is not surprising, since individuals who are below the average age threshold appeared to have a higher propensity to save. Said another way, the marginal propensity to leak is higher among ‘younger’ employees than it is among ‘older’ employees. It is possible that ‘younger’ employees are likely to have a greater need to save – perhaps in order to purchase a home – and that their consumption preferences are sufficiently met by local amenities. If these tendencies are suitably reflective of a wider sample, they *could* be used to estimate values for the full multiplier, allowing inferences to be drawn about the size of a regional multiplier based on the age of its population. It can also be noted that the multiplier for the ‘younger’ employees is better identified than for the ‘older’ employees, implying less variation in the marginal propensities among the ‘younger’ employees.

For the reasons discussed in Chapter 5’s overview of the questionnaire responses, disaggregating individuals into sub-groups according to their salary was challenging, because a large majority of the sample tended to fall into just two of the available cohorts. However, asking for more granular salary data might have resulted in no responses at all. Therefore, the inferences drawn from the analysis by salary sub-group should be taken with caution. Individuals earning above the mean[52] salary of the sample (‘higher’ earners) are likely to contribute less to the first round multiplier than individuals who earn below the sample mean (‘lower’ earners). It can be seen that marginal consumption among ‘lower’ earners is significantly higher than for the rest of the cohort. In other words, the propensity to consume out of each addition pound of disposable income is higher among employees who earn below the sample average. Further, the proportion of non-local

[52] The median was also used, and almost identical results were generated.

consumption among the ‘lower’ earners, is lower than among the ‘higher’ earners. Each of these leakages will contribute towards a higher first round multiplier. While these specific propensities might not be representative of a wider population, the secondary data discussed in accordance with the questionnaire salary data in Chapter 5, indicates that Siemens Gamesa employees in this sample tend to earn above the regional average. On this basis, it be might be reasonable for the full multiplier to use leakage propensities that are more closely aligned with the preferences of ‘lower’ earners, than of higher earners. This will be considered in **Section 6.4**’s scenarios analysis when alternative import propensity values are estimated for the full multiplier.

In line with the salary sub-groups, the sample split by qualification indicates that employees who are categorised as lower a higher level of educational attainment will contribute significantly more to the first round multiplier than individuals with a higher level of educational attainment, owing to a higher marginal propensity to consume, and to do so locally.

By employee residence, it can be seen that employees who live in the Local Authority of Hull will contribute more to the first round multiplier, than employees who live in have a in the East Riding, as a result of a lower marginal propensity to import. Employees living in the East Riding, have a higher propensity to import (than those living in Hull), possibly as a result of their proximity to alternative shopping destinations outside the Humber.

The disaggregation of the sample into different populations is not only informative with respect to identifying which groups of individuals will contribute the most towards the first round multiplier, but also in estimating plausible values for coefficients to be used in the full multiplier, in the absence of further primary data about the wider locale of interest. If it can be determined that the wider locale tends to be composed of individuals who possess traits that have been identified among the sub-populations in this analysis, then coefficient estimates can be estimated to reflect the propensities of those individuals.

This is explored in the following section, when the full multiplier is estimated as part of a scenario analysis.

6.4 The Full Multiplier

Following the derivation set out in **Section 6.1**, the full multiplier can be estimated using equation (6.25), wherein:

$$\frac{1 + (k^{sg} - k^{*})}{1 - k^{*}} = \frac{1 + \left(m_1^{*} - m_1^{sg}\right)(1 - t - NI)}{1 - (c_1 - m_1^{*})(1 - t - NI)} \tag{6.25}$$

Clearly, the difference between first and subsequent rounds is defined by the marginal propensity to import. In order to estimate the full multiplier, values for m_1^* – the marginal propensity to import for the wider locale of the Humber – must be identified.

An obvious starting place would be the literature reviewed in Chapter 3. However, much of the literature is referring to a markedly different time period, in which estimates for consumption are unlikely to be representative of 2017/2018. Further, the estimates for import propensity appear to be referring specifically to the imports of the region, that is, the proportion of goods and services that have been imported for sale within the Humber, rather than the non-local spending of residents – which is what this study is considering. With that in mind, the literature is unlikely to offer meaningful insight into plausible values.

An alternative estimation technique might be to consider the composition of the Humber, relative to the Siemens Gamesa sample, and, per the methods used by the contributors in the literature, one might attempt to "slightly modify" (Glasson *et al.*, 1988:260) the estimates of the Siemens Gamesa sample, to reflect the structure of the wider locale. In any case, a number of different values for m_1^* can be estimated and used in the full model as part of a scenario analysis.

6.4.1 Scenario Analysis

It was noted in Chapter 5, and earlier in Chapter 6, that the average salary among individuals in the Humber is approximately 18% lower than the salary earned by Siemens Gamesa employees. Therefore, **Scenario 1** (**Table 6.3**) considers an instance wherein the marginal propensity to import among the wider locale is the same as it was for individuals who were classified as 'lower' earners, in the sub-group analysis. Substituting this import propensity value into the model generate a multiplier of approximately 1.430. This can be interpreted as indicating that for every pound of Siemens Gamesa's investment in employee wage bill, approximately 43 pence is generated through the rounds of spending in the Humber.

Scenario	Marginal Propensity to Import	Full Multiplier Estimate
1: 'Lower' Earners	0.157	1.430
2: 'Lower' Qualified	0.000	1.513
3: Hull Population	0.140	1.437
4. East Riding Population	0.495	1.319
5. Special Case	*0.236*	1.397
6. Simple Average	0.204	1.410
7. Weighted Average	0.203	1.410

Table 6.3: Overall Multiplier Estimates – Sensitivity Analysis

Scenario 2 considers a more extreme situation, wherein the wider Humber follows suit with individuals who are classified among the 'lower' qualified sub-group, and who have an import propensity of zero. That is, individuals in the subsequent rounds of spending choose to spend all disposable income locally and import nothing. Under that assumption, a larger multiplier of 1.513 is generated. While theoretically possible, such an eventuality

can be considered as highly unlikely, and therefore estimation of the aforementioned multiplier should be considered implausible.

Scenario 3 assumes the wider Humber population to adopt a composition that is similar to individuals in the Hull cohort of the Siemens Gamesa sample, with a marginal propensity to import of 0.140. Substituting this value into the full model would yield a multiplier estimate of 1.437, an addition of approximately 44 pence per pound of investment. By contrast, **Scenario 4** assumes the wider population to follow the propensities of individuals residing in the East Riding, who had a higher preference to import. Under this assumption, a lower multiplier value of 1.319 is estimated, owing to a larger leakage through non-local spending.

In reality, the wider locale of the Humber is unlikely to perfectly adopt the propensities of any of the sub-groups identified in the Siemens Gamesa sample. Without further assumption, it is not possible to use the Siemens Gamesa sample to overlay the population of the Humber and determine its composition. Therefore, in the absence of further primary data, something of a 'special case' scenario can be estimated wherein the subsequent round propensities are considered to be the same as the Siemens Gamesa sample, per equation (6.26):

$$m_1 = m_1^{sg} = m_1^* \tag{6.26}$$

In this case (**Scenario 5**), separation of rounds is not necessary, and the estimate is the result of a simple multiplier. It does not, therefore, naturally sit alongside an exercise in which the first round has been separated from the subsequent rounds. However, for the purpose of comparison, it is not unhelpful to report it in this way. It can be seen that, in this case, the multiplier estimate is 1.397, wherein approximately 40 pence is generated in disposable income for every £1 of Siemens Gamesa's investment. While this approach is conceptually awkward, the decision to assume Siemens Gamesa propensities across the whole population can be defended. This is so on the basis that it *is* the latest available

data for the region (albeit, a very small sample of the Humber) and given the dominance of the manufacturing sector in the Humber, it could be reasonably argued that this population of individuals might somewhat reflect the greater Humber.

Two final approaches are given in in **Scenario 6** and **Scenario 7**. Both attempts can be thought of as somewhat crude, however, they both seek to optimise what little primary data is available on this topic. Scenario 6 estimates a simple average using the marginal import propensity of each sub-group identified in the sample (studied in **Table 6.2**), together with the estimate for the whole sample. This simple average generates a marginal import propensity of approximately 0.204, and therefore a multiplier of 1.410. This value is certainly in line with what one might expect having examined the various import propensities of each group in some detail. This approach can be developed by applying sensible weights to each sub-group with a view to reflecting the composition of the Humber. Using the secondary data reviewed in Chapter 2 and 5, was assumed that the wider Humber is composed of marginally fewer 'younger' individuals, fewer 'higher' earning individuals, fewer higher qualified individuals, and marginally fewer residents of Hull. Applying such weights yields an average marginal import propensity of approximately 0.203 – almost exactly the same as the simple average, and thus generating almost exactly the same full multiplier.

6.5 Summary

The purpose of Chapter 6 was to set out the derivation of the multiplier models, based on the literature and the data collected. It was then possible to estimate a first round multiplier based on the Siemens Gamesa sample, and a full multiplier for the wider Humber region. A sensitivity analysis was employed (by way of one standard error) to assist user judgement and a number of scenarios were captured by estimating alternative values for marginal import propensity. The results indicate that the first round multiplier lies in the range **1.230 and 1.338**, and the full multiplier lies in the range **1.391 and 1.513.**

Chapter 7 – Supplementary Findings

The purpose of Chapter 7 is to make further use of the data that was collected in the questionnaires, by contributing to two discussions that might be of particular interest to regional planners and policy makers – the audience for whom much of this research is intended. **Section 7.1** looks at the returns to education, using the Mincerian earnings function, to determine the value that Siemens Gamesa places on education as evidenced by salary. **Section 7.2** looks at the current profile of property tenure in the Humber. It uses the data from the Siemens Gamesa sample to establish relationships between various socio-economic traits and the propensity to own or rent.

7.1 The Mincerian Earnings Function

7.1.1 Introduction

Silles (2006) states that there has been increasing interest in the economic returns to education in recent times. Despite being a well-established topic in the literature, Silles (2006) notes that comparable estimates from the UK are difficult to obtain. Given the data that was collected in the questionnaire, it is possible to contribute to the discussion on returns to education as represented by the Siemens Gamesa sample. Using a Mincerian (1974) approach – a 'cornerstone of empirical economics' according to Heckman, Lochner and Todd (2003) – it is possible to estimate the value of an additional year of education, in terms of employee wage.

As noted in Silles (2006), Mincer (1974)'s human wage model is specified as:

$$\ln y_i = \beta_0 + \beta_1 s_i + \beta_2 x_i + \beta_3 x_i^2 + \varepsilon_i \qquad (7.1)$$

Where:

y is earnings

s is the years of schooling completed

x is age

ε is the error term

i is an index of individuals ($i = 1,2, \dots, n$).

Upon estimating the model, the impact of each additional year of schooling (and of age) is revealed as a percentage of earnings. The model can be estimated separately for men and women, and by various other sub-groups of interest in a population.

In addition to estimating the Mincer function using 'years of schooling', Sillies (2006) also estimates the model using data that replaces years of schooling with five binary variables, represented by National Vocational Qualification (NVQ) levels – the same proxy that was used to examine the regional education profile in Chapter 2, and was collected in the questionnaire. Figure 7.1, borrowed from Silles (2006), sets out a description of what is contained within each NVQ level.

NVQ or equivalent	
Level 5	University or CNAA Higher Degree (eg MSc, PhD)
	University or CNAA First Degree (eg BA. BSc)
	University Diploma
Level 4	Teaching qualifications
	Nursing qualifications
	Other higher qualifications
Level 3	More than 1 GCE at A level
	Scottish Higher Grade Equivalent
	Level 3 vocational qualifications
Level 2	1 GCE at A level
	Scottish standard grades – grades 1-3
	GCE O level – passes or grades A-C
	GCSE grades A-C
	CSE grade 1
	Scottish O grade – passes or grades A-C
	Level 2 vocational qualifications
Level 1	CSE grade 2-5
	Other qualifications
	Level 1 vocational qualifications
Level 0	No qualification

Figure 7.1: Description of NVQ Level Classifications

Silles (2006:394) notes that "Educational qualifications provide more information about an individual's education career than the usual measure of years of schooling".

Mincer (1974) also provides a specification using 'years of experience', defined as current age minus age at completion of schooling – assuming work experience to be continuous and assuming it starts immediately after completion of schooling. In the event that age and experience data are available and separable, the preferred variable for the purpose of the specification is experience, since it provides a better fit to the earnings profile and is most commonly used in the Mincerian wage equation (Psacharopoulos and Patrinos, 2004; Lemieux, 2006). However, in the primary data collected for this research, age and experience are not separable and therefore age is used as a proxy for experience.[53]

The following section sets out the relevant data that were collected. This will reveal which models can be specified in support of estimating the returns to education using the Siemens Gamesa sample.

7.1.2 The Data

Using the data that was collected from the questionnaires (Section 4, Question 1), the qualification data were organised into five binary variables, NVQ Levels 1-5, using the highest level of qualification held by each individual. A summary of the qualification profile of the sample is given in **Table 7.1**.

NVQ Level	Proportion of Sample
Level 1	3.3%
Level 2	33.3%
Level 3	32.3%
Level 4	12.8%
Level 5	18.3%

Table 7.1: Educational Composition of the Siemens Gamesa Sample by NVQ Classification

[53] A model was attempted using a variable for experience; experience variable was estimated by deducting 16 (the minimum age at which individuals may leave school) from current age, and further deducted an estimate for how long it would take to achieve the current level of educational attainment. Results were imprecise likely owing to the amount of assumption necessary to estimate the experience variable.

It can be seen that just under a fifth of the sample hold the highest level of educational attainment (NVQ 5) and the majority hold either NVQ Level 2 or Level 3. A small portion of the sample hold NVQ Level 1, the lowest level of educational attainment.

It is reasonable to say that this sample is not a perfect representation of the wider Humber in 2017, where approximately 13% hold NVQ Level 4 and above and around 35% hold NVQ Level 1 (Nomis, 2020). The sample was weighted to reflect this composition in scenario analysis presented in **Chapter 6**, **Section 6.4.1**.

Recall from Chapter 5 that data was also collected on employee age (Section 3, Question 3). Given the primary intention of this research, data was *not* collected on the age at which individuals completed their highest level of education, nor the age at which they undertook it. Estimation of the length of time that it might have taken to complete the qualification would require substantial assumption and therefore an estimate of the number of years of 'schooling' cannot reasonable be obtained in the data. Further, it is possible that some of the qualifications were taken alongside continuous employment, as is increasingly the case in recent times, and therefore estimating the age at which education was completed might not be possible, or representative, as a measure of work experience. Given this, the most sensible approach is to reformulate regression (7.1) as:

$$\ln y_i = \beta_0 + \beta_1 Edu_i + \beta_2 x_i + \beta_3 x_i^2 + \varepsilon_i \qquad (7.2)$$

Where: Edu is the level of education as represented by NVQ classification.

The model can be re-estimated using sub-group restrictions, such as age, to reveal the impact of an additional NVQ Level of educational attainment on the earnings of the Siemens Gamesa workforce.

OLS regression is used to estimate the model on the basis that any potential endogeneity concerns are small since current wage does not have an impact on past educational choices. It is therefore regraded among Mincerian wage-regression literature to be the preferred method for estimation. Robust standard errors are adopted throughout.

7.1.3 The Returns to Education

Table 7.2 presents the summary statistics for the variables of interest across the whole sample.

Variable	Mean	Std. Dev.
Log of Annual Salary	10.200	0.234
NVQ Level of Education	3.094	1.152
NVQ 1	0.033	0.180
NVQ 2	0.333	0.473
NVQ 3	0.322	0.469
NVQ 4	0.128	0.335
NVQ 5	0.183	0.388
Age	34.641	9.368
Age Squared	1287.287	689.840

Table 7.2: Summary Statistics for Variables of Interest in Returns to Education (Whole Sample)

Table 7.3 sets outs the same summary statistics as those given in Table 7.2, however they are split out by gender. Recalling the evidence presented in Chapter 5, it should be noted that the gender question was answered by approximately 53% of respondents, of which 78% are male and the balance female.

It can be seen that, based on this sample, the average level of educational attainment is generally higher among the female cohort, with fewer holding NVQ levels 1 and 2, and a greater proportion holding NVQ levels 3, 4 and 5. The average age for female respondents is lower than for males and lower than the sample average, at approximately 32 years. The former is very much is in line with secondary time series data for the Humber region, and the wider UK where the proportion of females holding the higher level of NVQ is greater than it is for males. This did not reflect the composition studied in Silles (2006) research (which used UK data between 1985 and 2003) wherein a higher proportion of males generally appeared to have a higher level of education attainment

than females. However, a review of more recent secondary data for the Humber region and for Great Britain suggests that the change in composition began to occur in 2004 (for the Humber) and 2005 (for Great Britain), where the proportion of females holding the higher level of NVQ overtook that of males. This has remained true into 2017, and beyond into the most recent time series data.

Variable	Male		Female	
	Mean	Std. Dev.	Mean	Std. Dev.
Log of Annual Salary	10.229	0.234	10.219	0.234
NVQ Level of Education	3.105	1.152	3.545	1.184
NVQ 1	0.026	0.180	0.045	0.213
NVQ 2	0.342	0.473	0.136	0.351
NVQ 3	0.316	0.469	0.318	0.477
NVQ 4	0.132	0.335	0.227	0.429
NVQ 5	0.184	0.388	0.273	0.456
Age	35.179	9.368	32.295	9.605
Age Squared	1320.569	669.004	1131.068	646.664

Table 7.3: Summary Statistics for Variables of Interest in Returns to Education (By Gender)

Table 7.4 sets out the summary statistics, disaggregated by the local authority in which employees live. It can be seen that employees who reside in Hull have a lower mean annual salary than employees who live in East Riding. In line with this and given the well-established relationship between salary and educational attainment, a greater proportion of employees in Hull appear to hold the lower levels of NVQ (1 and 2), than those in East Riding. A greater proportion of employees from East Riding hold higher NVQ levels (4 and 5) than residents in Hull. The average age of employees from Hull is approximately 34.2, marginally lower than the whole sample average, and the mean age of employees from East Riding is approximately 36.6, a little above the sample average.

Variable	Hull		East Riding	
	Mean	Std. Dev.	Mean	Std. Dev.
Log of Annual Salary	10.184	0.214	10.222	0.215
NVQ Level of Education	2.990	1.202	3.265	1.095
NVQ 1	0.050	0.219	0.020	0.143
NVQ 2	0.380	0.488	0.249	0.434
NVQ 3	0.290	0.456	0.367	0.487
NVQ 4	0.090	0.288	0.184	0.391
NVQ 5	0.190	0.394	0.184	0.391
Age	34.159	9.564	36.60	9.744
Age Squared	1257.456	697.441	1432.616	718.506

Table 7.4: Summary Statistics for Variables of Interest in Returns to Education (By Residence)

Having set out the summary statistics of interest, the Mincerian earnings model (given in equation (7.2)) is estimated. The results are given in **Table 7.5** and indicate that the variable for level of educational attainment (NVQ 1-5) is a statistically significant determinant of salary for the sample, wherein a one-level increase in NVQ is associated with an increase of approximately 6% annual salary. In other words, the returns to education are approximately 6% per level of NVQ for the whole sample.

	Model 7.2
	OLS Estimation
Dependent Variable →	Log of Earnings
Independent Variables ↓	
NVQ Level (Edu)	0.0597438 *(3.71)*
Age (x)	0.0236908 *(1.72)*
Age Squared (x^2)	-0.0002349 *(-1.23)*
Intercept	9.500739 *(39.14))*
Number of observations	179
Prob > F	0.0000
R^2	0.1619

(t-stat given in brackets)

Table 7.5: The Returns to Education - OLS Estimation

The variable for age is statistically significant at the 90% level and indicates that a one unit increase in age is associated with 2.4% increase in annual salary. The age squared variable would suggest that after a particular age, in fact the impact on salary is negative however the variable is not statistically significant and therefore no such conclusion can be drawn. The R^2 suggests that the independent variables used in the model explain approximately 16% of the variation in salary, indicating that many other variables should be considered when looking to explain changes in annual salary for this population.

As in Silles (2006:400), the above estimates assume "that the returns to education are the same for all age groups". This is only the case if all sub-groups – such as age – are perfect substitutes for one another in production. The model can be restricted by some of the sub-groups identified in the sample. Gender, for example, might be an obvious choice by which to restrict the model, however with only 22 observations for the female cohort, any findings would need to be viewed with caution and could not be considered conclusive.[54]

An alternative sub-group by which the model can be restricted is age. This could be done using the three age groups identified in **Chapter 5**. However, doing so would result in particularly small samples, which would likely reveal counterintuitively signed and insignificant results. Individuals in the under 30 age cohort, for example, are unlikely to have had a sufficient opportunity to fully realise the returns to education. Therefore, splitting the sample into just two age groups – individuals under the age of 40, and individuals over the age of 40 – might be a more sensible approach.

In support of this, Model (7.2) is restricted by those two age groups and the results are given in **Table 7.6**.

The results indicate that those in the under 40 age cohort (accounting for approximately 71% of the sample) can expect to see an increase of approximately 4.6% in annual salary

54 A model was estimated using the gender restriction; however, results were determined to be imprecise and are therefore not presented for analysis.

with each additional level of NVQ, and those in in the over 40 age cohort can expect an increase of approximately 11% in annual salary.

The impact of age is unlikely to be statistically significant if the model is restricted into three age groups – since the within-group variation of age is lessened as the sample size is reduced into smaller cohorts. However, when the sample is split into just two age cohorts, it can be seen that age *is* a statistically significant variable in determining salary – as it was for the whole sample, at the 90% level of confidence. For those in the under 40 age group, a unit increase in age is associated with an 8.3% increase in annual salary and for individuals in the over 40 age group, a unit increase in age is associated with a 31.8% increase in age. However, given the substantially different sample sizes – and the limited number of age units considered in the over 40 age group, the results are not directly comparable, and should be taken with caution.

	Model 7.2	
	Under 40 years	**Over 40 years**
	OLS Estimation	
Dependent Variable →	Log of Earnings	Log of Earnings
Independent Variables ↓		
NVQ Level (Edu)	0.0457838 *(2.61)*	0.1110683 *(3.10)*
Age (x)	0.0830097 *(1.97)*	0.3177858 *(2.33)*
Age Squared (x^2)	-0.0012458 *(-1.75)*	-0.0031954 *(-2.25)*
Intercept	8.705713 *(13.78)*	2.095701 *(0.64)*
Number of observations[55]	127	52
Prob > F	0.0053	0.0109
R^2	0.1442	0.2753

(t-stat given in brackets)

Table 7.6: The Returns to Education, by Age Group - OLS Regression

[55] Owing to differing sample sizes, caution should be taken when making direct comparisons between the results.

An additional model (7.3, below) can be estimated to reveal the respective returns of education by each NVQ level. In this case, NVQ levels can be treated as binary variables:

$$\ln y_i = \beta_0 + \beta_1 NVQ1_i + \beta_2 NVQ2_i + \beta_3 NVQ3_i + \beta_4 NVQ4_i + \beta_5 x_i + \beta_6 x_i^2 + \varepsilon_i \quad (7.3)$$

Educational dummies can be interpreted as differentials with respect to a particular reference group. **Table 7.7** presents the results, in which the estimated coefficients can be compared to the group of individuals with the *highest* level of education attainment – NVQ Level 5. This is carried out for the whole sample and for the two age cohorts that were used previously.

	Model 7.3		
	Whole Sample	**Under 40 years**	**Over 40 years**
	OLS Estimation		
Dependent Variable →	Log of Earnings	Log of Earnings	Log of Earnings
Independent Variables ↓			
NVQ 1	-0.1158735 *(-1.83)*	-0.0802315 *(1.20)*	-
NVQ 2	-0.181143 *(-3.31)*	-0.1328073 *(-2.38)*	-0.3404745 *(-2.66)*
NVQ 3	-0.1422509 *(-2.49)*	-0.0847456 *(-1.53)*	-0.3030288 *(-2.22)*
NVQ 4	0.0032571 *(0.03)*	0.0728646 *(0.62)*	-0.1640642 *(-1.03)*
Age (x)	0.0232343 *(1.64)*	0.0859069 *(2.00)*	0.2974628 *(2.18)*
Age Squared (x^2)	-0.0002323 *(-1.17)*	-0.0013076 *(-1.80)*	-0.0029853 *(-2.11)*
Intercept	9.80766 *(38.84)*	8.883674 *(14.43)*	3.175795 *(0.98)*
Number of observations	179	127	52
Prob > F	0.0002	0.0224	0.0468
R^2	0.1829	0.1794	0.2897

(t-stat given in brackets)

Table 7.7: The Returns to Education, Binary NVQ Levels - OLS Regression

The results for the whole sample indicate that individuals with lower levels of educational attainment (NVQ 1 and 2) will earn between 11.6% and 18.1% less than individuals with the highest level of education attainment – the returns to education are lower. The reverse of this, wherein NVQ levels 1–4 represent the baseline, reveals that individuals with NVQ

level 5 earn approximately 13.4% more than individuals with all other levels of educational attainment.

Similar results are presented when the sample is disaggregated into the two age groups. Individuals in the under 40 age cohort, with lower levels of educational attainment, will see lower returns to education than individuals with higher levels of educational attainment – though the educational dummies present varying levels of statistical significance.

In the over 40 age group, individuals with NVQ levels 1-4 can be expected to earn between 16.4% (for those with NVQ 4) and 34.0% (for those with NVQ 2) less than individuals with NVQ 5. Said another way, individuals with NVQ 5 can be expected to earn approximately 28.6% more than individuals with NVQ levels 1-4 (NVQ 5 t-stat: 2.25).

7.1.4 Summary

The findings indicate that for this sample there is evidence of returns to education as measured by the Mincerian function. Across the whole sample, it was found that salary will rise by approximately 6% with each additional level of NVQ, increasing to as much as 11.1% for the over 40 age category. This is in line with Silles (2006) who notes that each additional year of schooling is associated with an increase in salary of between 5.5% and 7% in men, and 6.8% to 8.3% in women.

There appeared to be some statistical significance between salary and age across the whole sample, wherein a unit increase in age is associated with a 2.4% increase in annual salary. In terms of salary, the most gainful increase in qualification level occurs between NVQ level 3 and 4, which is associated with an increase in annual salary of 15.6%. This is line with findings by Dearden (2000) and Bhutoria (2016) where the marginal return to qualifications is approximately 15.3% for NVQ level 4.

A future study would benefit from obtaining further information specifically pertaining to years of schooling and years of work experience. Despite having data on age and level of educational attainment, such variables cannot be used as proxies for the aforementioned because it is possible that study takes place alongside continuous employment. Indeed, employers might choose to support employees in obtaining additional qualifications while at work.

Similarly, further investigation into the *type* of qualification might be necessary to better understand the extent of relevance to the industry at hand. Categorisation of qualifications into NVQ bandings, while common in the literature and a necessity to conduct analysis, does not necessarily reveal the full extent of the circumstance.

However, the purpose of this supplementary analysis was simply to illustrate the additional data mining possibilities that can be undertaken, even if data is not collected specifically for this purpose. The results can be used to continue the discussion on returns to education in the UK, specifically for the manufacturing sector.

The following section sets out an additional use of the data that were collected in the questionnaire, namely a review of the socio-economic characteristics that are associated with different property tenure types across this sample of the Humber population.

7.2 Property Tenure in the Humber

7.2.1 Introduction

In addition to collecting data necessary to estimate the multiplier, a question was asked regarding the property tenure of employees (Section 3, Question 5). This was done with a view to further developing a socio-economic profile of each individual and can now be used to determine if there are any common characteristics that influence a preference for home ownership, rental or otherwise.

Such information might be useful and interesting for local governments who are seeking to understand the housing preferences of individuals who are employed at 'new-to-the-region' organisations. Findings might enable something of a coordination effort among regional planners. By way of example, perhaps an investment is set to attract individuals of a particular educational attainment banding (as an example of a socio-economic characteristic), and that particular group of individuals has a preference for home-ownership (as opposed to rental properties). However, a new development of rental-only properties is being considered for developed locally. It might be in the interest of planners to make recommendations about the location of such a development, in light of the home-ownership preferences of the confirmed investment.

Additionally, an understanding of the factors that determine the decision to purchase or to rent are likely to also be of interest to real estate agents and to rental providers locally. Finally, while there appears to be some literature on the topic of homeownership determinants in the UK (Crib *et al.*, 2018), there is less evidence of econometric studies conducted at the regional level. Regional studies have, however, been undertaken in Europe (Gűris *et al.*, 2011) and reveal interesting relationships with various socio-economic characteristics. This supplementary piece of research demonstrates a *further* use of data that was collected for the multiplier investigation and intends to contribute to the discussion on property ownership at the (less commonly analysed) regional level.

In support of this, the following sections uses a number of specifications, estimated using linear probability modelling. They each consider the impact of various socio-economic characteristics, obtained in the questionnaire, on the propensity to own, rent or otherwise among the Siemens Gamesa population.

7.2.2 The Models

Model (7.4) is a linear probability model (LPM), estimated using robust standard errors. The coefficient values on each independent variable represent the change in probability

of homeownership (Own_i=1), associated with a one unit change in the variable. While there are alternative frameworks that might be better suited to the estimation of homeownership preferences, such as logit and probit, the LPM model allows for clear interpretation of coefficients.

$$Own_i = \beta_0 + \beta_1 NetSalary + \beta_2 Age + \beta_3 NVQLevel + \varepsilon_i \quad (7.4)$$

Variables were chosen in line with characteristics studied in the literature, and in accordance with the data available from the questionnaire. Across the literature, key determinants of interest include: income, age, educational attainment, marital status, household size and race, among others. The questionnaire provided data on income, age and educational attainment and hence their inclusion in the model.

Summary statistics for each of the variables are given in **Table 7.8**.

Variable	Mean	Std. Dev.
Own (1 or 0)	0.6032	0.491
Rent (1 or 0)	0.254	0.436
Net Salary (£)	19010.24	5121.605
Age (years)	34.641	9.368
NVQ Level	3.094	1.152

Table 7.8: Summary Statistics for Homeownership Determinants

The literature does not offer clear guidance on whether there is a preference for net or gross annual income, however the likes of Hood (1999) opts for net income which was the measure chosen for this study.[56]

Table 7.9 (overleaf) reports the results from LPM (7.4), together with the t-stats to indicate statistical significance of the variables. It also reports the results from an

[56] Models were also estimated using gross annual income and generated very similar results to those using net income given in Table 7.9. The decision in future studies is likely to be determined by data constraints.

additional model (7.5) in which the likelihood of renting a property (as opposed to any other tenure type) is considered:

$$Rent_i = \beta_0 + \beta_1 NetSalary + \beta_2 Age + \beta_3 NVQLevel + \varepsilon_i \quad (7.5)$$

	Model 7.4	Model 7.5
	Linear Probability Model	
Dependent Variable →	Own	Rent
Independent Variables ↓		
Salary (£)	0.0000172 *(3.12)*	-0.0000108 *(-2.21)*
Age	0.0261795 *(9.76)*	-0.0079065 *(-2.84)*
NVQ	-0.0170634 *-(0.62)*	-0.0180357 *(-0.58)*
Intercept	-0.5708228 *(-3.97)*	0.7789757 *(5.11)*
Number of observations	179	179
Prob > chi^2	0.0000	0.0014
R^2	0.2946	0.0574

(t-stat given in brackets)

Table 7.9: LPM Regression Results - Likelihood of Property Tenure [Models 7.4 and 7.5]

The results indicate that as salary increases, so too does the probability of homeownership, and the variable for salary is statistically significant. Similarly, the probability of homeownership increases by approximately 2.6% for each additional year of age. The variable for educational attainment is not found to be a statistically significant determinant of homeownership. The results for model (7.5) are in line with these findings. The probability of renting decreases with each additional unit of salary and age, and both variables are found to be statistically significant. Again, the variable for educational attainment is not found to be statistically significant.

As noted at the start of Section 7.22, there are alternative – more suitable – frameworks can be used to assess the determinants of property ownership. For the purpose of robustness, the models reported in Table 7.9 are estimated again using a logit model, and the odds ratios are reported in **Table 7.10**. Marginal effects are reported in **Table 7.11**.

	Model 7.4	Model 7.5
	Logit (Logistic)	
Dependent Variable →	Own	Rent
Independent Variables ↓		
Salary (£)	1.000213 *(3.59)*	.9998641 *(-2.52)*
Age	1.170662 *(5.99)*	.9579457 *(-2.45)*
NVQ	0.8544382 *-(0.86)*	.8983004 *(-0.59)*
Intercept	.0002643 *(-5.88)*	3.986009 *(1.05)*
Number of observations	179	179
Prob > chi^2	0.0000	0.0028
Pseudo R^2	0.2790	0.0657

(t-stat given in brackets)

Table 7.10: Logit Regression Results (Odds Ratios) - Likelihood of Property Tenure

Coefficient	dy/dx	Std. Err.	z
Salary (£)	0.0000344	8.74e-06	3.93
Age	0.025376	0.0025556	9.93
NVQ	-0.0253344	0.0292287	-0.87

(z value given in brackets)

Table 7.11: Marginal Effects

In line with the results reported for the linear probability models, it can be seen that the variable for salary is a statistically significant determinant of homeownership and that an increase in salary is positively associated with the probability of homeownership. This is very much in line with expectation and with the literature. Hood (1999), for example, notes that rising net income can be expected to increase the probability of home ownership directly and indirectly, owing to the likelihood of securing favourable financing and an ability to meet initial homeownership costs. However, the data from this sample reveals that if the model is restricted by higher and lower earners (splitting the sample at the mean) the variable for salary is *not* a statistically significant determinant of homeownership among lower earners. Alternative variables, such as marital status or

household size, might be more relevant variables at explaining the probability of homeownership among that cohort.

Age was hypothesized in the literature to be a highly significant determinant of homeownership on the basis that older individuals will have more work experience and regulated income (Gűris *et al.*, 2011). Indeed, the results indicate that an increase in age is associated with an increased probability of homeownership, and the variable is statistically significant as it was among the literature.

The various probabilities of property ownership for each of the nine age cohorts are illustrated graphically in **Figure 7.2**, together with a 95% confidence interval for the probabilities.

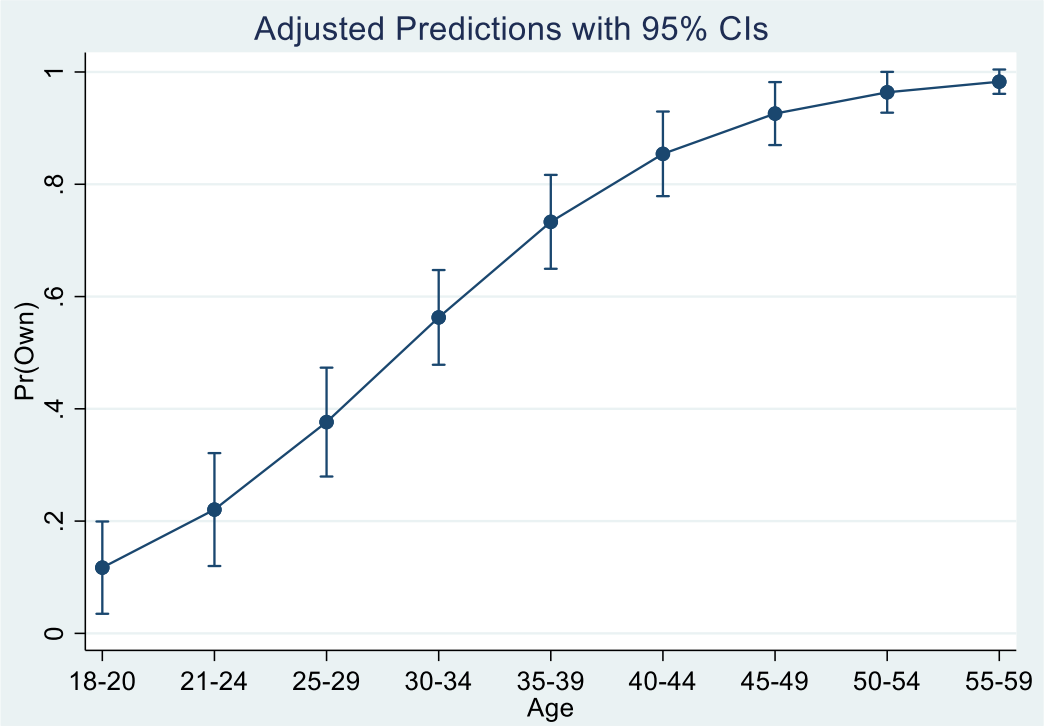

Figure 7.2: Probability of Property Ownership by Age Cohorts

The graph shows that the probability of home ownership increases with age, and the probability of home ownership among individuals in the upper two age categories is between 93%-100% and 96%-100%, respectively. A review of the data for this sample reveals that, in fact, 100% of individuals in the highest age category own their property, however, this particular sample represents ~1% of the overall sample, and cannot,

therefore, necessarily be seen as representative of all individuals that fall into that age cohort in a wider Humber population; it also explains the narrow confidence interval.

The largest confidence interval appears to be for individuals in the 21-24 age cohort, where the probability of property ownership is approximately 22% (confidence interval: 0.12-0.32). This likely reflects the broad mix of potential circumstances of the individuals in that age category. Some may have recently graduated and might be saving to purchase a home, and the employment with Siemens Gamesa might be their first position of employment (approximately 9% of the 21-24 age cohort stated education as their previous employment situation). Others may have graduated some years ago or may not have undertaken a degree (approximately 65% of the 21-24 age cohort state a qualification of below degree level as their highest level of education attainment) therefore affording the opportunity to earn sufficient funds to purchase a home. It could also be reflecting further, unexplored circumstances, such as marital status, number of dependents, the range of which varies significantly among the 21-24 age cohort.

Interestingly, the variable for educational attainment is not found to be a statistically significant determinant of homeownership – or indeed of the propensity to rent (Model (7.5)). The salary and education data collected from this sample suggest that each additional level of NVQ is associated with an increase in gross annual salary of approximately £2,340, and the variable for NVQ level is statistically significant at the 1% level. Given the clear relationship between educational attainment and salary, it might be suggested that an additional level of NVQ would be positively associated with the likelihood of homeownership. Hood (1999) states this expectation and justifies it on the basis that more highly educated individuals are likely to have a greater awareness of the associated saving behaviours that are necessary to secure a house. Similarly, Lauridsen and Skak (2007) state that they expect individuals with ‘final education’ to have an increased probability of homeownership. However, Lauridsen and Skak (2007) found that

having higher educational attainment yielded an 'insignificant and unexplained negative coefficient' on homeownership rate. So too did findings in Gűris *et al.* (2011), where it was revealed that lower levels of education were associated with *greater* probability of homeownership. This was found to be true in rural areas where the stock of jobs does not require high levels of educational attainment, and homes are more readily acquired because there exists a large number of individuals who are employed in such occupations. Gűris *et al.* (2011) go on to state that in the event that higher educational attainment is sought, individuals might relocate to urban areas to seek new employment opportunities in line with the newly acquired qualifications. Such areas might be associated with a smaller and more expensive stock of housing. While that particular example is relating to data from Europe, similar examples exist widely in the UK, most obviously, in the case of London.

7.2.3 Summary

This second regression exercise has revealed that the Humber population (represented by the Siemens Gamesa employee cohort) qualitatively behaves largely in line with economic theory and per the literature. Increasing age and salary are associated with an increasing probability of homeownership, but a decreasing probability of rental tenures. In other words, the older one becomes and the more one earns, the more likely he or she is to own their home, as opposed to rent it. The variable for educational attainment had a negative sign and was not statistically significant, though it had been in some of the literature.

Given the consistency of the results with the literature and with theory, an opportunity exists for further research to be conducted, using more detailed and varied explanatory variables, particularly among sub-groups where the expected variables held less statistically significance in explaining property ownership preferences – such as lower earners.

7.3 Conclusion

The purpose of Chapter 7 was to illustrate the way in which the additional questionnaire data could be used in two supplementary analysis exercises. The first revealed the returns to education among the Siemens Gamesa workforce and sub-groups within it. The second isolated property ownership determinants to reveal to probability of homeownership according to variables identified in the literature and in the questionnaire.

Chapter 8 concludes the research in the context of the questions posed in Chapter 1.

Chapter 8 – Summary of Research and Conclusions

The purpose of Chapter 8 is to summarise the research in the context of the questions that were posed in Chapter 1 and to set out limitations together with suggestions for further research. The chapter closes with a reflection on the research.

8.1 Address of the Research Questions

The research questions were categorised into 'Use of Primary Data for EIAs' and 'Case study-specific', and they will be addressed as such in **Section 8.1.1** and **Section 8.1.2**, respectively. Following the address of each question, **Section 8.1.3** summarises the contribution of primary data to impact assessment.

8.1.1 Use of Primary Data for EIAs

The first part of **Question 1**[57] sought to determine whether coefficients for the model could be estimated using alternative means to those discussed in the well-referenced literature – namely by borrowing from historic studies. Indeed, the questionnaire was responded to by a sufficiently high proportion of the population to develop reasonable parameter estimates – and it was done so using minimal resource. The questionnaire was not without faults, and during analysis of the responses, a number of ways in which the questions could be rephrased or approached were revealed. For example, the categorisation of the variable for salary. While there exists an argument to keep this as a closed question, the categories provided could usefully be made narrower, to enable more meaningful analysis – particularly if a supplementary exercise is carried out during the impact assessment. The same is true for the questions which sought critical data for the model, such as rate of saving and local consumption. Further, since these questions might

[57] **Research Question 1**: Can the various leakage parameters of a Keynesian multiplier model be captured in a more accurate way – as opposed to using evidence collected in historic studies? Can ***marginal*** values be estimated, rather than average?

be perceived as less intrusive, participants might be willing to answer even if categories are not provided, thus removing the need for use of midpoint during the analysis.

The second part of Question 1 asked if *marginal* values could be estimated, as opposed to the commonly used *average* in the literature. The answer is yes. Collection of salary data allows for a simple OLS regression to determine the impact of an additional unit of salary – the marginal. In support of the earlier point, the more granular the data on salary, the more meaningful these estimates can be.

Question 2[58] asked about the value in separating the rounds of spending. There are many reasons why the rounds should differ from one another, in particular, the propensity to leak is likely to be different. Isolating the first round allows the propensities of this sample to be differentiated from the wider Humber, whose propensities – and the impacts of them – are examined in the subsequent rounds. This can usefully be considered in the context of **Question 3**[59] which asked how supplementary socio-economic data about individuals in the sample could be used in the first round multiplier. While the 'full multiplier' considers the aggregate impact of all agents in the economy, it is possible to determine which groups of individuals from this sample contribute more to the first round multiplier. In turn, this might mean it is possible to make inferences about the size of a regional multiplier, based on the socio-economic composition of the region.

The final methodological question, **Question 4**[60], asked to what extent the use of primary data made a difference to the multiplier estimates, relative to the use of secondary data. In the first instance, the use of primary data allowed for estimation of *marginal* values. Secondary data commonly defer to use of *average* propensities, in lieu of marginal values,

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[58] Is there value in separating the model into 'first round of spending' and second and subsequent rounds of spending'?

[59] Can supplementary socio-economic data be used to reveal anything further about the regional multiplier in the first round, and be used in support of its estimation?

[60] Does the use of primary data significantly change the final multiplier estimate, relative to the use of secondary data?

despite acknowledging that it is marginal values that are of interest. Further, estimates in the literature pertaining to import leakages typically refer to leakages at the regional level, that is, regional spending on imported goods and services for sale locally, as opposed to individual spending of disposable income. Therefore, borrowing from the literature for the propensity to import variable would likely mean changing the specification to fit the available data, as opposed to estimating the model of choice. Finally, without primary data, further investigation into the contribution of sub-populations is not possible, and this constitutes something of a novel contribution to the topic of regional multipliers.

8.1.2 Case study-specific Research Questions

Question 5[61] asked arguably the most critical question in the research: what the regional disposable income multiplier in is the first, and subsequent, rounds. The first round multiplier for the whole sample was estimated to be **1.284**, with an upper bound value of 1.338, and a lower bound of 1.230. In other words, for every £1 of Siemens Gamesa's investment in employee wages, an additional 28 pence is created in disposable income, after the first round of spending. A range of scenarios was estimated for the full multiplier, with values ranging from **1.319** to **1.513**. In other words, for every £1 of Siemens Gamesa's investment in employee wages, between 32 and 51 pence is generated in disposable income through the rounds of spending.

Question 6[62] and **Question 7**[63] ask about the contribution of different sub-populations on the first round multiplier. In the case of the former, it can be seen that individuals who live in Hull will contribute more to the multiplier than individuals who live in East Riding owing to a greater marginal propensity to import. For the latter, a number of sub-groups

[61] For every £1 of the Siemens Gamesa and ABP investment, what will be the impact on disposable income – in the first round, and in subsequent rounds - for the Humber region during the Operation and Maintenance (O&M) phase of the Blade Factory?
[62] How does the estimated first round multiplier differ by Local Authority within the Humber?
[63] How does the estimated first round multiplier differ by various socio-economic sub-groups present in the data set?

were identified, including by age, educational attainment and salary banding. It was found that 'older' employees will contribute more to the regional multiplier than 'younger' employees owing to a higher marginal propensity to consume. Similarly, individuals among the 'lower qualified' sub-group – that is, lower levels of NVQ attainment – will contribute more to the multiplier, as a result of having a higher marginal propensity to consume and particularly low marginal propensity to import. By contrast, individuals among the 'higher' earning sub-group were found to contribute less to the multiplier, as a result of a lower marginal propensity to consume. Upper and lower bound multiplier estimates for each sub-group were generated to assist user judgement.

Finally, **Question 8**[64] asked about the supplementary findings that could be generated from the data that was collected in the questionnaire. With regards to returns to education, it was revealed that salary will rise by approximately 6% with each additional level of NVQ, increasing to as much as 11.1% for the over 40 age category. Further data would need to be collected to investigate these findings more thoroughly, however the investigation sought to demonstrate how additional analysis could be carried out using this newly constructed dataset. The second supplementary exercise sought to examine the determinants of home ownership. Per the literature, income and age were found to be positively associated with an increasing probability of homeownership. However, educational attainment is not a statistically significant determinant of homeownership, or the decision to rent. Further research using more granular variables is required to explore alternative variables that might explain the propensity to own, rent or otherwise, particular among sub-groups of the population, such as lower earners where variables such as income are not deemed to be statistically significant.

[64] Can anything further be identified using the newly constructed dataset? For example, can a contribution to the literature on Mincerian earnings be made with specific reference to the Siemens Gamesa workforce?

8.1.3 The Contribution of Primary Data to Impact Assessment

Through addressing the research questions, this study sought to provide evidence on the importance of using primary data for impact assessments and it offered guidance on how to collect such data. The use of primary data not only removes the need for unnecessary approximation of parameters, it also enables estimation of *marginal* values, something that appears uncommon in the literature. Additionally, use of primary data provides an opportunity for the first round to be readily separated from subsequent rounds, an important consideration if propensities are assumed to be different across the rounds. Primary data also enables a sensitivity analysis to be conducted through the provision of upper and lower bound estimates which are valuable in assisting user judgement. Further, collection of supplementary socio-economic primary data allows sub-groups to be identified in the population, and for their contribution to the multiplier to be assessed. In doing so, inferences about the size of the regional multiplier can be determined, based on socio-economic composition of the region.

8.2 Limitations and Suggestions for Future Research

While this research serves as something of an update to the literature, particularly regarding data collection methods, there is clearly further scope for additional research to build on the approaches adopted in this study. Many of these have been discussed in-context throughout the thesis. However, a number of additional limitations and suggestions are considered below.

While use of a survey questionnaire to capture the necessary data proved reasonably successful for this study, adoption of an additional data collection tool – such as an interview approach – would undoubtedly have strengthened the quality of the data that was collected. It would have provided an opportunity to gather additional qualitative data to support the questionnaire, and – had it been adopted as part of the pilot stage – might

have provided greater insight into the understanding of questions by recipients, allowing for further tailoring in a final questionnaire.

A further limitation, inherent in research that require collection of primary data from human participants, is perception of estimates by respondents. While some effort can be made to modify or rebase estimates if sufficient reason exists to do so, it must be assumed that the data collected is a true and accurate reflection of the individual's circumstance. In reality, however, there is likely to be a high margin for misestimation by participants. This gives further rise to the need for sensitivity analysis – readily provided through use of primary data – to provide a range of estimates, rather than simply a point estimate.

An additional consideration is the time period in which the data were collected. As detailed in Chapter 4, data collection took place predominantly during the month of December, which might be associated with unusual spending propensities, owing to the Christmas period. In order to determine the extent of this possible limitation, the same study – preferably with the same participants – would need to be conducted at different points in the year, allowing for a comparison of results. It should be noted, however, that various points throughout the year may be associated with unusual spending patterns – such as the summer period when individuals might be taking holiday – and therefore one must be pragmatic about data collection, and accept the window of time that is most suitable for those participating. In reality, until studies of this nature are considered as 'standard practice', there may not be any scope for researchers to select their preferred data collection window, rather, they ought to accept the option available and be mindful of the limitations that it may pose.

A final limitation to note is the portion of investment that was selected for analysis in this study. Clearly, in order to conduct a robust investigation, only a small piece of the total investment could be captured using the methods discussed in this thesis. In this case, the Siemens Gamesa employee wage bill was treated as the multiplicand – the investment –

in part because gathering data from the employees was considered to be more straightforward than in other areas of the investment. With additional scope and resource, estimations of impact arising from additional elements of the Construction Phase (the build of the Blade Factory) and other areas of the Operation and Maintenance (O&M) Phase could be attempted.

8.3 A Final Word

This research was motivated by a curiosity to learn more about how investments are assessed at a sub-regional level. It came to light that a lack of recent research has resulted in outdated practices, particularly pertaining to collection of primary data, and subsequently misleading results. With investment decisions drawing increasing attention regionally, nationally and internationally, inaccurate results could be detrimental – or at best, unhelpful. This study has revealed that a number of opportunities exist to develop up to date, representative datasets and methods to measure economic impacts, such as investments. Revised data collection methods – accompanied with guidance on how to subsequently use the data – allow for novel estimation techniques, and further data mining possibilities, through the application of simple econometric techniques. Further, the methods and processes detailed throughout this thesis were applied during a live EIA process, following an investment at sub-regional level. The suggestions are therefore based on empirical findings, that were obtained using methods that are underpinned by economic theory.

It transpires that Coppedge (2011) was right – the answer *does* lie in the multiplier – but this study has shown that the multiplier is simply the starting point for much greater interrogation, which can only help to inform planners and practitioners in their quest to make robust investment decisions.

Appendix

Appendix 1: Timeline of Siemens Gamesa and Associated British Ports Investment in the Blade Factory

Adapted from GIA (2017), p. 11-13

Year	Timeline
2005	Associated British Ports (ABP) applies for a parliamentary order to develop Alexandra Dock site for Samskip.
2006	**April 2006:** • ABP Harbour Revision Order (HRO) for Alexandra Dock in Hull granted; • However, owing to financial considerations, Samskip decided to withdraw from the project and not use Alexandra Dock, leaving the dock with consent to develop, but no project. **September 2006:** IBM Plant Locations, commissioned by Hull City Council (HCC), identified four economic competency bases for Hull: ○ Port Logistics; ○ Renewable Energy in particular offshore wind; ○ Pharmaceutical; ○ Development of the City Centre.
2009	• Department of Energy and Climate Change (DECC)'s Offshore Energy Strategic Environmental Assessment concluded up to 33 GW of potential offshore wind capacity in UK waters attracting interest from international players; • Siemens Project Manager was working with DECC and Yorkshire Forward to set up a Siemens manufacturing site in the UK.
2010	***NOTE**: Prior to the 2010 general election, a scheme for UK ports had been developed to allow UK ports to benefit from government infrastructure investment (as is the case for EU ports); however, owing to the election, this was never granted* • ABP applies for the Invitation to Tender (ITT) put out by Siemens; • Site selection narrowed from over 100 sites to four: ○ Hull; ○ Harwich; ○ Felixstowe; and ○ Able Marine Energy Park (AMEP) site in Immingham Initially, AMEP was the preferred site **29 March 2010:** • Gordon Brown and Peter Mandelson signed a Memorandum of Understanding (MOU) with Siemens; • Siemens announced its intention to invest in excess of £80m to develop an offshore wind turbine production facility in the UK. **December 2010:** • Site selection and recommendations were taken to Siemens Steering Committee [in Hamburg] and Hull was selected. The decision was motivated by the following facts: ○ A planning permit was already in place;

	○ ABP, as a partner and owner of the site, was prepared to invest in the development of the necessary infrastructure; ○ Alexandra Dock had one of the longest berths; ○ Steaming time to installation sites is shorter than sites outside of the Humber. • HCC and ABP along with its partners, East Riding of Yorkshire Council (ERYC) and the University of Hull set out to promote the offshore wind industry in the region and launched GPH to oversee and facilitate the establishment of the region as a world class centre for renewable energy.
2011	**20 Jan 2011:** • Siemens and ABP announced the signing of MOU, in which Siemens selected Green Port Hull (GPH)'s site at the Port of Hull as their preferred location; • The intention was to build a wind turbine manufacturing facility for nacelles at Alexandra Dock and a blade assembly plant at the Paull site. **May 2011:** • GPGP bid submitted to Regional Growth Fund (RGF). **July 2011:** • Electricity Market Reform (EMR) White Paper released to attract the £110 billion investment needed to replace the UK's ageing energy infrastructure with a more diverse and low-carbon energy mix; • EMR will facilitate vital investment through the introduction of two new schemes: Contract for Difference (CfD); and Capacity Market. These replace Renewable Obligations. • UK Government also set a target of 11-18GW by 2020 which was lower than DECC's initial 33GW of potential offshore wind capacity in UK waters by 2020. ***NOTE:*** *Some policy concerns around what will happen post-2020. Uncertainty due to market risk and market failure. Energy Bill/CfDs caused delays during which Siemens was not receiving new orders for turbines.* **September 2011:** • Vince Cable (Former Secretary of State for Business, Innovation and Skills) met with HCC; • HCC made an offer to contribute £5m from its capital programme towards infrastructure works associated with the sites that were of wider community/public benefit, including the transformation of the public right of way and listed structures. **Oct 2011:** RGF £25.7m funding awarded to deliver the following strands of activity: ○ Employment and Skills Development; ○ Inward Investment; ○ Site Assembly; ○ Business Support and Advice; ○ Business Investment Grants; ○ Research Development Innovation.
2012	**May 2012:** Outline planning consent granted by HCC for the wind turbine manufacturing facility at Alexandra Dock. **July 2012:** GPGP in place and commenced delivery.
2013	**Jan 2013:** Approval of Energy Bill, i.e. Energy Act 2013 **July 2013:**

	• Siemens internal review ended; Siemens Central Board provided an 'In principle' go ahead; • It was intended to be for the manufacture of both nacelle and blades. **3rd September 2013:** HCC granted planning permission for the development of Alexandra Dock.

2014	**March 2014:**
	• UK Prime Minister David Cameron and Secretary of State for Energy & Climate Change Ed Davey visit ABP's Port of Hull to welcome Siemens investment decision;
	• Siemens announced its decision to invest £160m in wind turbine production and installation facilities in Yorkshire;
	• Its partner, ABP, is to invest a further £150m in the infrastructure development at Alexandra Dock to support Siemens facilities.
	Sept 2014:
	HCC granted planning permission for the new wind turbine production facility at Alexandra Dock, enabling development to commence on the nacelle pre-assembly, project construction and logistics & distribution facilities and offices; details of the proposed rotor blade manufacturing facility were to be submitted later in 2014/15
	Nov 2014:
	• *Change of Plans Announced*
	• Siemens announced that the rotor blade manufacturing plant would be co-located at Alexandra Dock site following a redesign of the development that would create 1,000 direct jobs and that the nacelle manufacturing plant will be moved to Cuxhaven.
	• Reasons:
	  ○ The initial application was for a nacelle plant but supply chain for nacelles is heavily based in Cuxhaven. Blade manufacturing has the potential to create more direct jobs and hence was considered beneficial for Hull;
	  ○ Paull site wasn't ready and needed £20m investment for flood protection, road access and other infrastructure development and another £6m in utilities.
	Nov 2014:
	Construction works on site commenced.

2015	**May 2015:** Sign off of Green Port Hull Impact Assessment (GIA) study by the Logistics Institute, University of Hull.
2016	**1st Dec 2016:** Siemens Blade Manufacturing Factory official launch ahead of schedule.
2017	**January 2nd:** First installation vessels loaded. **January 4th:** First vessels set off from Alexandra dock. **January 23rd:** Deadline for construction of the blade factory.

Appendix 2: Research Ethics Approval Letter

UNIVERSITY OF Hull

Hull University Business School
Research Office
T +44(0)1482 463536
E h.carpenter@hull.ac.uk

Ref: HUBSREC 2016/24

16 December 2016

Dear Fiona

Re: A socio-economic impact assessment of a Major investment in a UK city

Thank you for your research ethics application.

I am pleased to inform you that on behalf of the Business School Research Ethics Committee at the University of Hull, Dr Raymond Swaray has approved your application on Thursday 15th December 2016.

I wish you every success with your research.

Yours sincerely,

David Griffiths
Secretary,
Research Ethics Committee

Hull University Business School
University of Hull
Hull, HU6 7RX
United Kingdom

School reception
+44 (0) 1482 347500

www.hull.ac.uk/hubs

Accredited by Association of MBAs

Appendix 3: Final Questionnaire

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Siemens Gamesa Blade Factory: Operation and Maintenance Phase

Employee Questionnaire

Dear Siemens Gamesa Employee,

Siemens Gamesa is currently undertaking research in partnership with the University of Hull to establish the socio-economic impacts that the Siemens Gamesa and ABP investment in Hull will have on the local economy. In support of this, could you please take a few minutes to complete the questions below?

This questionnaire is being undertaken within the University of Hull's Research Ethics policy. Your responses will be kept **completely confidential,** and it **will not be possible to identify individual** respondents within the aggregated data. Completion of the questionnaire constitutes consent for your responses to be used for the purpose of this research.

Please do not hesitate to contact me, Fiona Cox, at: F.Cox@2015.hull.ac.uk or 01482347535 if you have any queries.

Thank you for your support on this project!

Employment

1. **In which of the following phases of the Siemens Gamesa Blade Factory project have you been involved?**

☐ Construction phase ☐ Operation & Maintenance (O&M) phase

2. **Start date of your contract/involvement with Siemens/Siemens Gamesa Blade Factory project:**

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3. **Which of the following best describes your contract type?**

☐ Permanent, full-time ☐ Permanent, part-time ☐ Temporary, full-time ☐ Temporary, part-time

☐ Fixed term, full-time ☐ Fixed term, part-time ☐ Self-employed, full-time ☐ Self-employed , part-time

☐ Other, please specify

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4. What is your job title at the Siemens Gamesa Blade Factory?

☐ **Engineering Team**
(Engineering Manager – Process & Industrial; Lead Process Industrial Engineer; Process and Industrial Engineer)

☐ **Intern, graduate or apprentice**
(Engineering Intern; Finance Intern; HR Intern; Planning and Purchasing Intern; Quality Intern)

☐ **Production Team**
(Crane Operative; Group Lead; LEAN specialist; Lifting Coach; Maintenance Technician; Production Operative; Senior LEAN specialist; Slinger/Signaller; Team Lead; Warehouse Operative)

☐ **Quality Team**
(QA Document Controller; QA Methods Engineer; Quality Assurance Operative; Quality Assurance Support Technician; Quality Coach; Quality Controller; Quality Manager in Projects [QMiP]; Quality Operations Manager; Quality Surveyor; Quality Systems Manager)

☐ **Senior Leadership Team: SLT**
(Commercial Head of Hull Plant; Head of Engineering & Innovation; Head of OOSM; Head of Operational Excellence; Head of Quality Management; Maintenance Manager; Operations Manager; Plant Director [Blades, Hull]; Production Manager)

☐ **Support Functions**
(Environment, Health & Safety Coordinator; Finance Manager; Financial Controller – Blade Factory; IT Support Coordinator; Management Accountant; Personal Assistant; Planner; Prisma Administrator; Purchasing Manager; Supply Manager; Team Coordinator; Technical Coordinator; Training & Competency Coordinator; Training Administrator; Training and Competency Manager

☐ Other, please specify

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5. Which of the following salary brackets applies to you?

☐ Less than £10,000 ☐ £10,000-£14,999 ☐ £15,000-£19,999 ☐ £20,000-£24,999

☐ £25,000-£29,999 ☐ £30,000-£34,999 ☐ £35,000-£39,999 ☐ £40,000-£44,999

☐ £45,000-£49,999 ☐ £50,000-£54,999 ☐ £55,000-£59,999 ☐ £60,000-£64,999

☐ £65,000-£69,999 ☐ £70,000-£79,999 ☐ £80,000-£89,999 ☐ £90,000-£99,999

☐ £100,000 and over

6. Which of the following income tax bands applies to you?

☐ Personal allowance: 0% ☐ Basic rate: 20% ☐ Higher rate: 40% ☐ Additional rate: 45%

7. **Prior to the start of your contract on the Siemens Gamesa Blade Factory project, which of the following applied to you?**

- ☐ I was in employment with Siemens/Siemens Gamesa and working on another contract/project
- ☐ I was in employment with a different organisation
- ☐ I was unemployed
- ☐ I was in education
- ☐ I was self-employed
- ☐ Other, please specify

---

8. **IF you were in employment with a different organisation, can you please state which organisation you worked for and where you were based?**

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9. **IF you were in employment with a different organisation, can you please state what your job title/role at that organisation was?**

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10. **IF you were in employment with a different organisation, can you please state your reason(s) for moving to Siemens/Siemens Gamesa?**

Saving and Spending

Please answer the following questions with only YOUR wage in mind, rather than for your whole household if that circumstance applies.

1. **Approximately, what proportion of your monthly take home salary (after deductions, including tax and pension contributions) do you typically SAVE, if anything? Please select the most suitable range.**

- ☐ 0%
- ☐ 1% - 5%
- ☐ 6% - 10%
- ☐ 11% - 15%
- ☐ 16% - 20%
- ☐ 21% - 25%
- ☐ 26% - 30%
- ☐ 31% - 35%
- ☐ 36% - 40%
- ☐ 41% - 45%
- ☐ 46% - 50%
- ☐ 51% - 55%
- ☐ 56% - 60%
- ☐ 61% - 65%
- ☐ 66% - 70%
- ☐ 71% - 75%
- ☐ 76% - 80%
- ☐ 81% - 85%
- ☐ 85% - 90%
- ☐ 91% – 100%

2. **Approximately, what proportion of your disposable monthly income (income after mortgage/rental payments), including bonus payments, do you typically SPEND in the HUMBER REGION (Hull, East Riding, North Lincolnshire and/or North East Lincolnshire) as opposed to elsewhere or online?**

☐ 0% - 10% ☐ 11% - 20% ☐ 21% - 30% ☐ 31% - 40%

☐ 41% - 50% ☐ 51% - 60% ☐ 61% - 70% ☐ 71% - 80%

☐ 81% - 90% ☐ 91% - 100%

3. **OF the proportion spent in the HUMBER REGION (Hull, East Riding, North Lincolnshire and/or North East Lincolnshire), what percentage do you estimate you spend in each location?**

Location	Approximate proportion of disposable income spent locally (%)
Hull	
East Riding	
North Lincolnshire and/or North East Lincolnshire	

4. **Please state the NAME and LOCATION of the top three retailers and/or service providers at which you spend your disposable income and the approximate percentage at each; examples might include supermarkets, transport, restaurants, and health services.**

Retailers and/or service providers	Approximate proportion of disposable income spent (%)
1.	
2.	
3.	

About You

1. **What is your gender?**

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2. What is your nationality?

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3. Which of the following age categories applies to you?

☐ 16-17	☐ 18-20	☐ 21-24	☐ 25-29
☐ 30-34	☐ 35-39	☐ 40-44	☐ 45-49
☐ 50-54	☐ 55-59	☐ 60-64	☐ 65 and over

4. **Current residence (First part of postcode):**

---

5. Do you rent or own the property where you are currently living?

☐ Rent	☐ Own (including mortgage)
☐ Live with parents	☐ Other (please specify)

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6. Did you relocate to the region (Hull, East Riding, North Lincolnshire or North East Lincolnshire) in order to take up the role at Siemens/Siemens Gamesa?

☐ Yes ☐ No

If 'NO', please go to Question 7

6i. Is this intended to be a permanent or temporary move?

☐ Permanent ☐ Temporary ☐ Other, please specify

6ii. Where did you move from? (First part of postcode, and also country if outside the UK):

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7. How do you typically travel to work?

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☐ By foot ☐ By car (personal vehicle) ☐ By car (shared vehicle, e.g. car pool)

☐ By car (taxi) ☐ By bus ☐ By train

☐ By bicycle (pedal bike) ☐ By motor bike ☐ Other (please specify)

Education and Training

1. **Which of the following levels of education have you obtained? Please tick ALL that apply and provide details as required in the space provided.**

☐ School Leavers Certificate	☐ Other work-related or professional qualification (please specify)	☐ GCSE/Vocational GCSE or equivalent (please specify)	☐ O-levels or equivalent
☐ International Baccalaureate	☐ AS-level/Vocational AS-level or equivalent	☐ A-level/Vocational A-level or equivalent	☐ Higher qualification below degree level (please specify)
☐ Degree level qualification, or higher	☐ NVQ Level 1	☐ NVQ Level 2	☐ NVQ Level 3
☐ NVQ Level 4	☐ NVQ Level 5	☐ Don't know	☐ Other (please specify)

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2. **Have you, are you or will you be undertaking any training/skills development/graduate scheme/apprenticeship as part of your contract with Siemens/Siemens Gamesa? Please provide full details.**

Thank you again for your participation!

Appendix 4: Excerpt from Siemens Gamesa's Company Newsletter – Featuring Request for Questionnaire Participation

University of Hull Impact Survey

As many of you may be aware, Siemens Gamesa is working with The University of Hull on a study to assess the impact of the new Blade Factory in Hull. As one of the biggest investments ever to be made in the region, it is an important and exciting impact to capture! In order to measure it, the research team will be issuing a short questionnaire for all employees to complete, which asks about your roles and how you're spending your wage, with a view to understanding how the local economy will benefit from the investment. It is clearly stated that ALL responses are absolutely confidential and cannot be traced to any individual. The surveys will be distributed through group leads and handed out to office staff.

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