OXFORD ECONOMICS

Nuneaton & Bedworth Forecast Model (NBFM)

Technical annex

October 2011

A report Nuneaton & Bedworth Borough Council

OXFORD ECONOMICS

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1 Introduction

1.1 Overview

1.1 This report sets out the technical elements of the Nuneaton & Bedworth Forecast Model (NBFM). For each variable, we include details of the data used in the model and the forecast methods.

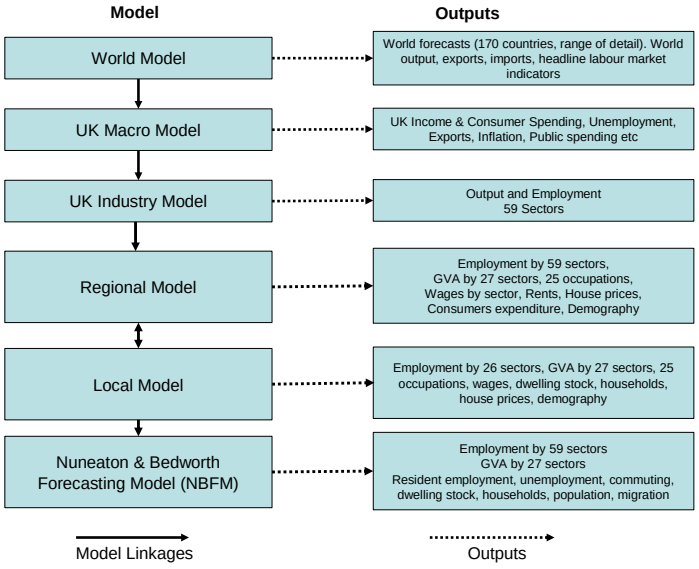
1.2 In addition, we provide insight into the relationships in the model, including details on the linkages between the NBFM and Oxford's wider suite of models.

1.3 We finish with a section which steps through the model and explain in detail how scenario impacts are derived.

1.2 Oxford suite of models

1.4 Oxford Economics has a suite of models which covers every country in the world. Within this a UK macroeconomic model is embedded. This includes global factors such as oil prices, world trade (exports and imports), exchange rates, etc. Consequently, changing world conditions will feed into the forecasts for the UK economy in the UK macro model.

Figure 1.1: Hierarchal structure of Oxford Economics' suite of models



1.5 In tandem with the UK macro model, we have a UK industry model which provides forecasts of output and employment by 59 sectors in the UK economy (these are set later in this section). As such, global factors such as rising oil prices will affect the outlook for industries which depend upon oil for the production of goods. Similarly, sectors which depend on exports

to overseas markets will be influenced by changes in the global economy. For example, demand for imports from the UK economy could be influenced by changes in the exchange rate. Thus, sectors which are forecast to grow based on export potential would perform better or worse depending on the outlook for the UK exchange rate.

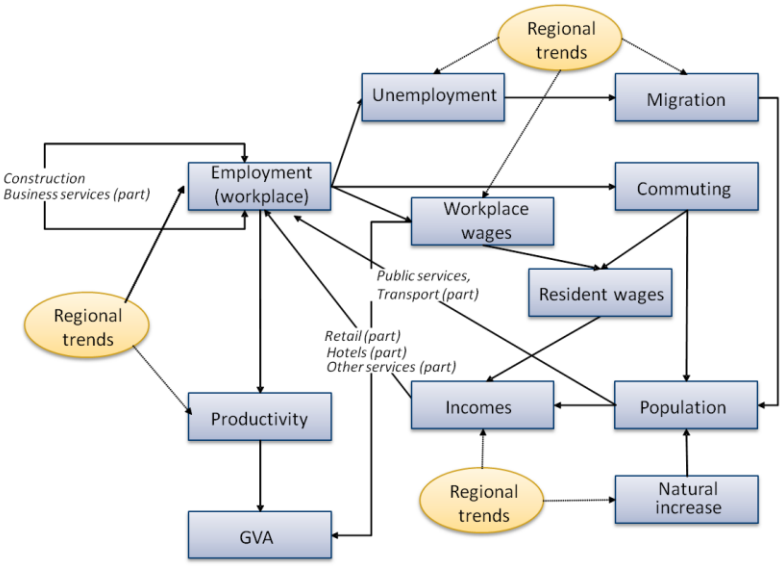
1.6 Both the macro and industry models feed directly into the UK Regional Model. In doing this, events in the global economy, and also UK economic factors (e.g. exchange rates, fiscal tightening, interest rates, etc) will have an impact on regional trends throughout the forecast period.. Similarly, the local model – from which the NBFM model is derived - will be influenced by the same factors.

1.3 An economically driven model

1.7 The models designed by Oxford Economics (and therefore the NBFM) are economically driven models. The key dimensions of the economy – labour market, demography, output and housing – are all interlinked such that a change in one dimension will feed through to the rest of the model.

1.8 This is illustrated in the flow diagram below.

Figure 1.2: Local model linkages



1.9 It is our view that an economically driven model is the best way to estimate the future outlook for the area.

1.10 For example, if employment or productivity changes in one sector, there are implications for all sectors of the economy through indirect (supply chain) and induced impacts. The employment creation will then put downward pressure on unemployment, while encouraging increased

commuting into the economy, and making it a more attractive location for migrants. This would drive up population and housing demand, and thus put more demand on public services.

1.11 This example illustrates the implications of a productivity or employment led scenario (as is the focus of the work Oxford Economics has carried out on behalf of the Council).

1.12 Models can also incorporate non-labour market scenarios and remain economically driven, such as housing developments and skills uplifts. Housing scenarios differ to productivity / employment led scenarios in that they reveal the implications on an economy of a change to the level of housing provision. For example, when running a scenario where housing provision increased by a set amount, it is possible to show how the economy needs to perform to accommodate the increase in population. However, building houses alone will not improve an economy beyond the initial construction impact. If on the off chance that the new housing provision was fully utilised, unemployment would be pushed up and resident employment rates would fall.

1.13 These examples show the benefit of using economic driven models. Such a model will show how the economy needs to perform to maintain employment and unemployment rates as new housing drives up population levels. It allows the user to sequence policy decisions to ensure that the economy creates the jobs required to attract new residents and warrant the provisions of new housing.

1.4 Variable, geographical and time period coverage

1.14 The NBFM is constructed on an annual basis. Historical data for most of the variables has been collected for over 20 years to help estimated the future trends and relationships in the model. Forecasts are provided out to the year 2028.

1.15 The geographies covered in the model are the borough itself, and it also includes comparator data for the West Midlands and UK.

1.16 The data covered in the model is listed below. Broadly, it is separated into 4 broad categories – demography, labour market, economy and housing. These are listed below:

- **Demographic indicators**
    - Population (total and working age)
    - Migration
- **Labour market**
    - Employment (workplace jobs, by 59 sectors)
    - Workplace people in employment (total only)

- Resident people in employment (level and rate)
- Unemployment (claimant – level and rate)
- Net commuting levels

- **Economy**
  - Gross Value Added (2006 prices, by 26 sectors)
  - Productivity (2006 prices, by 26 sectors)
- **Housing**
  - Dwelling stock (total, occupied and vacant)
  - Households (total)
  - Household type
    - One person household
    - Couple and no other adult
    - Couple and one or more adult
    - Lone parent with or without adult
    - Other

1.17 The sectoral coverage in all Oxford models is consistent with the SIC 2003 Standard Industrial Classification (SIC). Our models, in line with published data, produce forecasts of employment and GVA for 26 sectors of the economy (see table below).

Table 1.1: SIC 2003 – 26 sectors

No.	Sector	SIC 03
1	AB: Agriculture	01-05
2	CC: Extraction	10-14
3	DA: Food, Drink & Tobacco	15-16
4	DB: Textiles, Leather & Clothing	17-19
5	DD: Wood & Wood Products	20
6	DE: Pulp, Paper & Printing	21-22
7	DF: Coke, Oil Refining & Nuclear	23
8	DG: Chemicals	24
9	DH: Rubber & Plastic Products	25
10	DI: Other Mineral Products	26
11	DJ: Metals	27-28
12	DK: Machinery & Equipment nec	29
13	DL: Electrical & Optical Equipment	30-33
14	DM: Transport Equipment	34-35
15	DN: Manufacturing nec	36-37
16	EE: Electricity, Gas & Water	40-41
17	FF: Construction	45
18	GG: Distribution	50-52
19	HH: Hotels & Catering	55
20	II: Transport & Communications	60-64
21	JJ: Financial Intermediation	65-67
22	KK: Business Services	70-74
23	LL: Public Admin & Defence	75
24	MM: Education	80
25	NN: Health & Social Work	85
26	OO: Other Personal Services	90-99

Source: Standard Industrial Classification 2003

1.18 Whilst these categories include a detailed coverage of the manufacturing sub-sectors, the coverage of business services is less detailed. The

business services sector has grown substantially in the UK over the past 2 decades and has become increasingly important, particularly in terms of the future growth of the economy.

1.19 Against this backdrop Oxford Economics have produced more detailed sectoral employment estimates for Nuneaton & Bedworth. As a result the NBFM is capable of running more detailed employment growth scenarios. For example business services, financial services, transport & communications and distribution & retail have all been split out into their constituent parts. Consequently the model covers the 59 employment sectors shown in the table below.

Table 1.2: SIC 2003 – 59 sectors

No.	Sector	SIC 03
1	Agriculture	01-05
2	Coal	10
3	Oil	11-12
4	Gas	13-14
5	Food	15.1-15.8
6	Drink	15.9
7	Tobacco	16
8	Textiles Only	17
9	Clothing & Leather	18-19
10	Wood & Wood Products	20
11	Pulp, Paper & Printing	21-22
12	Coke, Oil Refining & Nuclear	23
13	Chemicals	24 excluding 24.4
14	Pharmaceuticals	24.4
15	Rubber & Plastic Products	25
16	Other Mineral Products	26
17	Basic Metals	27
18	Metal Goods	28
19	Machinery & Equipment nec	29
20	Electronics	30, 32
21	Electrical Machinery	31
22	Instruments	33
23	Motor Vehicles	34
24	Aerospace	35.3
25	Other Transport Equipment	35 excluding 35.3
26	Manufacturing nec	36-37
27	Electricity	40.1
28	Gas	40.2
29	Water	41
30	Construction	45
31	Distribution	50-51
32	Retailing	52
33	Hotels & Catering	55
34	Rail Transport	60.1
35	Other Land Transport	60 excluding 60.1
36	Water Transport	61
37	Air Transport	62
38	Other Transport Services	63
39	Communication	64
40	Banking & Finance	65
41	Insurance	66
42	Other Finance	67
43	Real Estate Activities	70
44	Renting of Machinery & Equipment	71
45	Computer & Related Activities	72
46	Research & Development	73
47	Legal & Accounting Services	74.1
48	Architectural & Engineering	74.2
49	Technical Testing	74.3
50	Advertising	74.4
51	Labour Recruitment	74.5
52	Security Services	74.6
53	Industrial Cleaning	74.7
54	Other Business Services Including Call Centres	74.8
55	Public Admin & Defence	75
56	Education	80
57	Health & Social Work	85
58	Waste Services	90
59	Miscellaneous	91-99

Source: Standard Industrial Classification 2003

1.20 Note we do not provide GVA estimates for the detailed 59 sub-sectors. GVA data is not published at this level of detail for local authorities. Indeed, GVA data is not published at all for local authorities as it is not considered robust enough. Rather it is published for NUTS3 geographies which are aggregates of local authorities. For example, Nuneaton & Bedworth is included within the Warwickshire NUTS3 area which includes North Warwickshire, Rugby, Stratford-on-Avon and Warwick (in addition to Nuneaton & Bedworth). Oxford Economics estimate local authority level GVA and this is set out in more detail in section 2.2.14. In doing this, we only provided estimates of GVA to cover the 26 standard SIC sectors, as there is insufficient information available to disaggregate this any further.

1.5 Mapping OE sectors to land use estimates

1.21 The provision of detailed employment sectors is also useful for making land use estimates. As Oxford forecasts are demand based, this enables us to estimate how much office, warehouse, retail, etc space is required to accommodate the additional employment growth in the economy. This is useful for local planners in establishing policy which is achievable, in the context of future jobs growth.

1.22 We have performed a simple mapping exercise which defines these sectors in terms of the various different types of land space.

1.23 The starting point in the mapping exercise was to define the sectors under 7 broad categories (listed below). This allows us to identify where specific components of larger sectors require a different type of land space to the overall sector. For example, the miscellaneous services sector includes a range of sub-sectors including television & radio activities, youth clubs, leisure centres, beauticians, etc. These sectors require different types of land. As such, we have mapped this sector to several types of land space.

1.24 This will make estimating land use groupings more difficult since the amount of land required under each category will ultimately depend on the size of the specific sub-sector. As such, any groupings estimated in this work by Oxford Economics, have been performed in the simplest way and should be treated with caution. We have not considered current land use and supply nor the quality of current provision or indeed infrastructure to support it.

1.25 The 7 categories we have used are:

- Office
- Retail & leisure
- Industry
- Storage & distribution
- Health & education

- Other public services
- Other uses (primary / utilities / misc)

1.26 The table overleaf shows the results of the mapping exercise.

Table 1.3: Oxford Economics employment sectors and land space

Name	SIC03	Land use definitions	Land use summary
Agriculture	01-05	Other - primary, utiliities & misc	Other
Extraction - coal	10	Other - primary, utiliities & misc	Other
Extraction - oil & gas	11-12	Other - primary, utiliities & misc	Other
Extraction - other mining	13-14	Other - primary, utiliities & misc	Other
Food	15.1-15.8	Industry (B1b & c & B2)	B2
Drink	15.9	Industry (B1b & c & B2)	B2
Tobacco	16	Industry (B1b & c & B2)	B2
Textiles	17	Industry (B1b & c & B2)	B2
Leather & Clothing	18-19	Industry (B1b & c & B2)	B2
Wood & Wood Products	20	Industry (B1b & c & B2)	B2
Pulp, Paper & Printing	21-22	Industry (B1b & c & B2) / Other - primary, utilities & misc	B2
Coke, Oil Refining & Nuclear	23	Industry (B1b & c & B2)	B2
Pharmaceuticals	24.4	Industry (B1b & c & B2)	B2
Other Chemicals	24 excl 24.4	Industry (B1b & c & B2)	B2
Rubber & Plastic Products	25	Industry (B1b & c & B2)	B2
Other Mineral Products	26	Industry (B1b & c & B2)	B2
Basic Metals	27	Industry (B1b & c & B2)	B2
Metal Goods	28	Industry (B1b & c & B2)	B2
Machinery & Equipment nec	29	Industry (B1b & c & B2)	B2
Electronics	30.32	Industry (B1b & c & B2)	B1 c
Electrical Machinery	31	Industry (B1b & c & B2)	B1 c
Instruments/Optical Equipment	33	Industry (B1b & c & B2)	B1 c
Motor Vehicles	34	Industry (B1b & c & B2)	B2
Aerospace	35.3	Industry (B1b & c & B2)	B2
Other Transport Equipment	35 excl. 35.3	Industry (B1b & c & B2)	B2
Manufacturing nec	36-37	Industry (B1b & c & B2)	B2
Electricity	40.1	Other - primary, utiliities & misc	B1 a
Gas	40 excl. 40.1	Other - primary, utiliities & misc	B1 a
Water	41	Other - primary, utiliities & misc	Other
Construction	45	Industry (B1b & c & B2) / Other - primary, utilities & misc	B1 a
Distribution	50-51	Industry (B1b & c & B2) / Storage & distribution / Retail	B8
Retailing	52	Retail & leisure	A1, A2
Hotels & Catering	55	Retail & leisure	A3
Rail Transport	60.1	Other - primary, utiliities & misc	B8
Other Land Transport	60 excl. 60.1	Other - primary, utiliities & misc / Storage & distribution	B8
Water Transport	61	Other - primary, utiliities & misc	Other
Air Transport	62	Other - primary, utiliities & misc	Other
Other Transport Services	63	Other - primary, utiliities & misc / Storage & distribution	B8
Communications	64	Other - primary, utiliities & misc / Storage & distribution	B8
Banking & Finance	65	Other - primary, utiliities & misc	A2
Insurance	66	Other - primary, utiliities & misc	A2
Other Finance	67	Other - primary, utiliities & misc	A2
Real Estate Activities	70	Other - primary, utiliities & misc	B1 a
Renting of machinery	71	Other - primary, utiliities & misc	A1
Computer Related Activities	72	Other - primary, utiliities & misc	A1
Research & Development	73	Other - primary, utiliities & misc	B1 a
Legal and Accounting Services	74.1	Offices B1(a)	B1 a
Architectural and Engineering	74.2	Offices B1(a)	B1 a
Technical Testing	74.3	Offices B1(a)	B1 a
Advertising	74.4	Offices B1(a)	B1 a
Labour Recruitment	74.5	All	All
Security Services	74.6	Offices B1(a)	B1 a
Industrial Cleaning	74.7	Offices B1(a)	B1 a
Other business services	74.8	Offices B1(a)	B1 a
Public Administration	75	Offices B1(a) / Other public services	B1 a
Education	80	Health & education	B1 a
Health	85	Health & education	B1 a
Waste services	90	Other - primary, utiliities & misc	B1 a
Miscellaneous	91-99	Offices B1(a) / Other - primary, utiliities & misc / Retail	B1 a, A1

2 Understanding the data and model outputs

2.1 It is important to point out that forecasting is not an exact science. The results that come from Oxford models, or any model for that matter, does not mean that this is exactly what the economy will look like in ten or twenty years time. Rather, forecasting models are best used to assess all of the available information and set out what the possible outcomes are. This is why we produce scenario analysis.

2.2 There are a number of things to remember when using the model, these are set out below.

2.1 Caveats

2.1.1 NBFM forecasts are based on observed past trends only

2.3 Past trends reflect past infrastructure and policy environments. Even where major new investments or policy changes are known and have actually started, they can only affect NBFM forecasts to the extent that they are reflected in the currently available data. If they have not yet impacted on the available data, they will not be reflected in the forecasts.

2.1.2 Data quality

2.4 As with all statistical data, revisions are likely as more information comes to light, so official statistical releases tend to be revised. Data is much more robust at a macro and regional level, however as the level of detail becomes more refined the quality of the data diminishes.

2.5 This is because often local based data is produced via a national survey, and at local authority level the sample sizes are much too small to be reliable. Where we use this type of survey information in our local models (BRES, ABI, LFS, etc) we do our best to smooth out the volatility by using 3 year averages, but this does not completely eliminate the problem.

2.1.3 Local employment data is particularly volatile

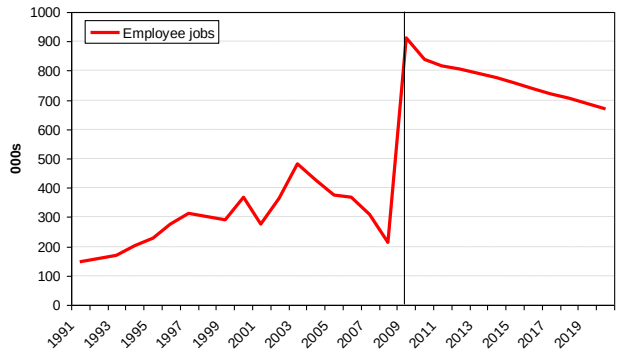
2.6 Oxford Economics' forecasts for employee jobs are primarily based on time series trends. For this we use ABI data (recently replaced by the BRES) which is subject to large revisions, and indeed reporting errors can lead to significant spikes in the time series.

2.7 For example, a survey return for a particular company could be submitted from a head office. In reality this survey return should state the number of employees at the head office only, therefore when the data is published it will only show the number of head office workers, but it happens occasionally that all the employees across the nation are allocated to one

small area based on the information provided. Such a spike in the data will affect the outlook as the overall level of employment could be incorrectly inflated based on the last data point.

2.8 Our approach is to accept the data as true unless we are indicated otherwise. Should any spikes in the series exist and prove to be incorrect, our approach is to correct this in the first year of the forecast, so the raw data can still be referenced but the long term outlook remains realistic.

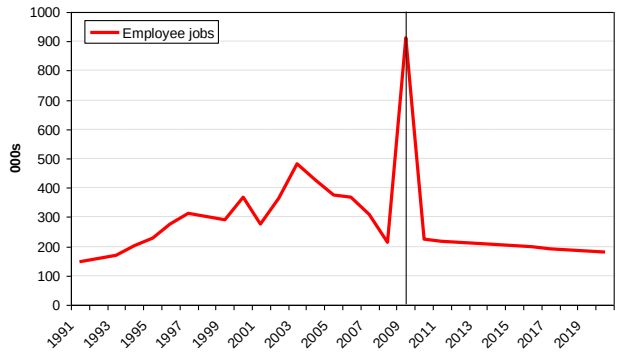
Figure 2.1: Employee jobs with no correction



Source: Oxford Economics, BRES, ABI

2.9 Figure 2.1 shows a forecast where no correction has been made and figure 2.2 shows where we have corrected in the first year of the forecast. Please note that the numbers used in these charts are purely illustrative and do not represent any area or sector.

Figure 2.2: Employee jobs with correction



Source: Oxford Economics, BRES, ABI

2.10 Note: in the NBFM no corrections *have been made to the data in relation to these types of issues.*

2.1.4 The forecasts are unconstrained

2.11 This means that the forecast numbers do not take into account any policy or other constraints that might prevent their actual realisation on the ground. Forecasts of housing, for example, are the outcome of projected changes in population, etc. If in reality planning constraints were to

prevent this demand being satisfied, the associated forecast levels of GVA, employment, population, etc, would be less likely to materialise.

2.1.5 The forecasts are subject to margins of error

2.12 As with all kinds of forecasting, there are margins of error associated with the results which tend to widen over time. Furthermore, the quality and reliability of data decreases at more detailed levels of geography. Under current data-quality conditions, models are most helpful for identifying trends, average growth rates and broad differentials between areas, sectors, etc. Accordingly, users are encouraged to focus on the patterns over time, not figures for individual years.

2.1.6 Reality is more complex than any model

2.13 Several of the modelled relationships are complicated and their treatment in the NBFM is necessarily simplified. In particular, the demand for housing is complex and not all the factors may be fully captured. Questions such as whether migrants' apparent willingness to live at higher densities than the existing population is merely a temporary state and would require much more investigation.

2.1.7 Forecasts shelf-life

2.14 It is difficult to build a model which has a particularly long shelf-life as new data or major economic shocks can significantly alter an outlook. The recent recession is a good example of this whereby most economists failed to predict the depth and length of the global recession. As a result forecasters were constantly downgrading their growth forecasts to reflect each bit of new data and other information as and when it emerged.

2.15 To counter-act this, the model can be refreshed with new data and forecasts from the Oxford suite of models. This is not included under the current assignment but remains an option to the Council going forward.

2.2 Baseline data and forecast methods

2.16 This section steps through each variable in the NBFM. For each, we have provided a brief definition of each indicators, where it has been sourced from and the latest year for which data is available. In addition, we have provided details of the forecasting methodology, and any other areas of estimation where data is unavailable.

2.2.1 Population

2.17 **Description:** The total number of residents living in the area.

2.18 **Data:** Population data is collected from the ONS mid-year population estimates for Nuneaton & Bedworth, the West Midlands and UK. The latest year for which data is available is 2009.

2.19 **Forecast method:** In reality, population changes each year as a result of two factors - migration and natural increase. As such we project these elements separately (details of which are set out below) to forecast total population.

2.20 For example, the total level of population in 2011 will be equal to the 2010 level of population plus the number of people migrating into / out of the area, plus the natural increase arising from births and deaths.

2.2.2 Working age population

2.21 **Description:** The total number of residents living in the area who are of working age.

2.22 At present 'working age' is defined as the total of all females aged 16-59 plus all males aged 16-64, taking into account the current retirement age. Over the future, the retirement age will increase in line with government policy[1]. The working age projections included in the NBFM take into account the planned changes to the retirement age.

2.23 **Data:** Working age population data is collected from the ONS mid-year population estimates for Nuneaton & Bedworth, the West Midlands and the UK. The latest year for which data is available is 2009.

2.24 **Forecast method:** At regional level, working age population is forecast using official projections of natural increase in the working age population (i.e. the number of 15 year olds turning 16, and the number of older people leaving the working age) and Oxford's forecast of net migration of working age people.

2.25 For local areas, we estimate a dependency ratio. This is a calculation of working age people as a proportion of total population and is estimated using the published data over the period 1991-2009. We then take the same ratio using the official (2008 based) population projections, which takes into account the 'aging' of the population. We apply the year-on-year growth rate in the official dependency ratio to the dependency ratio we have calculated using the published historical data. Finally, this ratio is applied to the total population forecast to obtain a forecast of working age population.

[1] Over the years 2010 to 2020, state pension age will increase from 65 years for men and 60 years for women, to 65 years for both sexes. Between 2026 and 2046, state pension age will increase in three stages from 65 to 68 years for both sexes.

2.2.3 Migration

2.26 **Description:** The net flow of people moving into and out of an area, whether this to be to/from other parts of the region, the UK or the world. A negative number signifies a net outflow of people from an area, a positive number a net inflow.

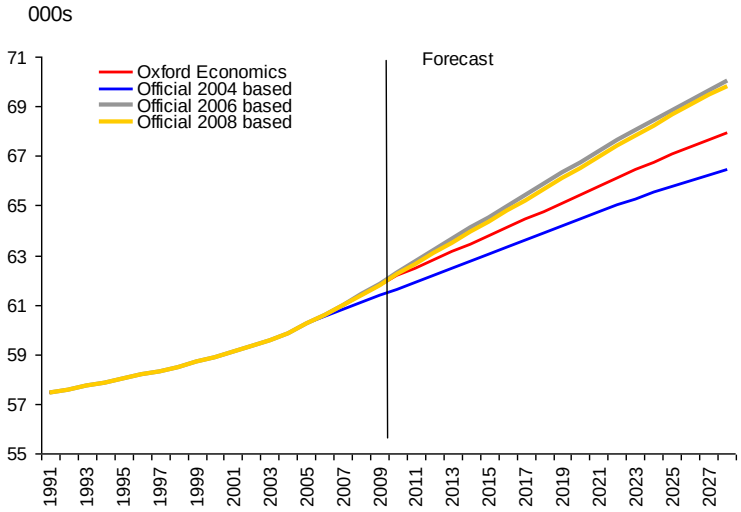
2.27 **Data:** Migration data is collected from the ONS components of change tables, from which the population and natural increase is also derived. The latest year for which data is available is 2009.

Why Oxford migration assumption is lower than official projections

Oxford Economics population projections are produced independently of the ONS official population projections. Official projections are generally produced by trending on the growth in existing data on population by age and making assumptions around migration patterns over time. By comparison, Oxford Economics forecasts are economically driven and take into account the pressures population growth can put on the labour and housing markets. As such, we believe our population forecast to be more realistic.

Comparing the Oxford population projections (which have remained relatively unchanged over the past few years) with the last three official population projections releases is useful to help illustrate this point.

UK population: Oxford vs Official



Source: Oxford Economics, ONS

In 2004, official projections suggested that the UK population would reach 66.4m people by 2028. However this was prior to the large influxes of migrants from Eastern Europe. Consequently there was a large upward revision in the 2006 based projections which estimated that UK population would be closer to 70m people by 2028 and the 2008 based projections were broadly similar.

Oxford estimate of UK population over the future lies somewhat lower than the official projections on account of a lower migration assumption, reasons for this are set out below. The other component which makes up population is natural increase. Given that we don't project birth and death rates separately, we are happy to accept the official natural increase projections.

The official projections estimate that the net flow of migrants (inflows minus outflows) in the long run will be in the region of 180,000 net inflows per annum. However Oxford Economics do not agree with this assumption and expect migration to be closer to 80,000 net inflows per annum. The reasons for this are as follows:

- Migrant inflows into the UK in recent years have been strong, peaking at 263,000 in 2005. This has been as a result of lax migration regulations and greater proportions of people coming from Eastern Europe. The official projections suggest that net migration from Eastern European countries will be zero from 2015 onwards and we concur with this view. However prior to the migrant boom from Eastern Europe, migration levels never reached 100,000 and we believe that a level of 180,000 net inflows per annum would be unsustainable.
- Looking into the official projections in more detail, it appears that 130,000 of the net inflows will come from the New Commonwealth. Again, this has never happened before and we believe that this is unlikely to become a reality.
- In addition, migration has become a politically sensitive topic in recent years, particularly due to the lack of job opportunities following the recession. We expect migration regulation policy to tighten in the coming years and thus making such high levels of migration inflows unlikely.
- Furthermore, the official projections are 2008 based meaning that the latest year of data available at the time of publishing these projections was 2008. However, 2009 data has since been published and was lower than the official estimates. This over-estimation of population in 2009 supports our view that the long run trends are perhaps too strong and a lower assumption feels more likely.

This has clear implications for policy makers, particularly those involved in planning, however it does not seem plausible that such high levels of population growth are viable in the context of the wider economy.

2.28 **Forecast method:** As a result of this lower migration assumption at the UK level, the regional and local level forecasts of migration are also lower than the official estimates.

2.29 Regional migration is projected in the Oxford Economics regional model, in which we forecast net migration of *working age* people into the West Midlands in any given year as a function of:

- Working age net migration into the UK

- Difference in unemployment rates between the West Midlands and the UK
- Ratio of the West Midlands' house prices to those in London
- Ratio of the West Midlands' average wages to those in London

2.30 *Total* net migration into the region in any given year is forecast as the sum of forecast working age migration, plus a *constant* annual figure for other migrants set at its actual 2009 value of 3,100 people.

2.31 Local authority data is projected manually by Oxford Economics. This is based on two factors:

- **Historic trend:** we look at the historic trend and set the forecast at a level which is plausible in the context of what has happened in the area historically. In other words, if migration has never been higher than 1,000 net in-migration, it would be less realistic to expect that migration would be much higher than this in the forecast.
- **Resident employment rates:** these are estimated using the number of residents in employment and working age population. Too many people migrating to an area where there aren't many job opportunities would result in a low resident employment rate. Alternatively too few people migrating into an area would result in a high resident employment rate.

2.32 Consequently, we forecast migration at a level which results in a plausible resident employment rate, but at the same time fits with the historical trend.

2.2.4 Natural increase

2.33 **Description:** Natural increase is the total number of births in an area minus the total number of deaths.

2.34 **Data:** Natural increase data is also collected from the ONS components of change tables, from which the population and migration is also derived. The latest year for which this data is available is 2009.

2.35 **Forecast method:** As Oxford models do not project births and deaths separately, we accept the official estimates of natural increase at national, regional and local level.

2.2.5 Employee jobs

2.36 **Description:** The total number of full time and part time jobs located in the area. It is a workplace measure and therefore includes commuters from outside Nuneaton & Bedworth. Note that this is a measure of workplace jobs, not people. As such, if one person has two part-time jobs, they could be counted twice.

2.37 **Data:** For employee jobs, the data sources vary depending on which geography you require.

2.38 For the UK and regions, more timely data is published by the ONS in its Workforce Jobs (WFJ) series. This series is published on a quarterly basis and thus provides more up-to-date information on the labour market. However, this series is subject to revision as it is by-and-large survey based. This data is available to Q1 2011.

2.39 The latest local authority data is available from the BRES (Business Register Employment Survey). Prior to this data was sourced from the ABI (Annual Business Inquiry) and AES (Annual Employment Survey). Similar to the regional and UK data, local employee jobs data is also collected using surveys and thus subject to revision. The latest year for which this data is available is 2009. However, we can use the quarterly sectoral data for 2010 to provide a robust estimate of 2010 employment.

2.40 **Forecast methods:** Employee jobs data in the Oxford Economics macro and regional models are based on the average of the four quarters in each year.

2.41 The data published in the BRES and ABI are collected in September. To avoid seasonality issues, we apply scaling factors to the local estimates of employee jobs in each sector to remove the seasonality. As such, the employee jobs data in the NBFM indirectly become four quarter averages. Consequently, the data used in the model will not match up exactly with the published data.

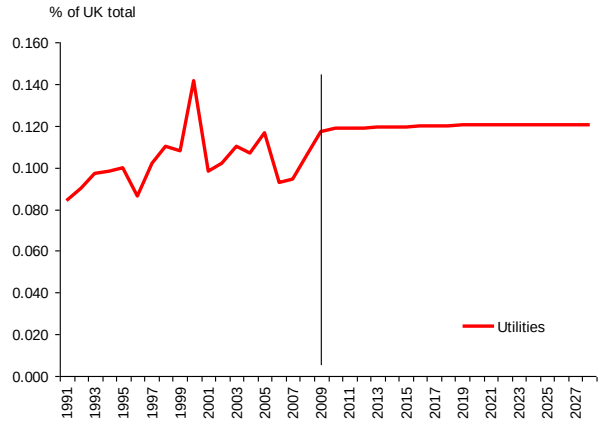
2.42 Employee jobs in each sector at national, regional and local level are all forecast separately. National employee jobs are forecast in the Oxford Economics Industry Model where global factors such as oil prices and exchange rates are taken into account.

2.43 Regional employee jobs forecasts are estimated in the Oxford Economics Regional Model. These are produced based on a combination of shares and location quotients (LQs). A location quotient is a ratio which summarises the concentration of a particular sector in a particular area, relative to the regional average. So an LQ of 0.8 (or 80%) for a given sector and area means that that sector is under-represented in the area. And an LQ of 1.25 (or 125%) means that the sector is overrepresented in the area.

2.44 For sectors which are forecast based on shares, we take the share of UK employment in a particular sector from the historical series. So for example, in 2010 the West Midlands share of total utilities employment in the UK was 11.6%. Taking the trend in this share over the past 20 years, we forecast the future trend in this share. This could be projected to continue to rise, if it has been rising in the historical data as this would suggest that it is a strong growing sector in the area. Or it could be projected to continue to fall, if it has been falling historically suggesting that it is either a less labour intensive sector, or simply dying out within that area. If the historical series is volatile, then we tend to hold it constant at the last value over the forecast period.

2.45 By way of example, the figure below shows the share of UK employment in utilities which is concentrated within the West Midlands. Historically, this series has been relatively volatile. As such, we have forecast this to remain relatively constant over the future.

Figure 2.3: Share of total UK employment in utilities, 1991-2028



Source: Oxford Economics

2.46 We then apply the projected share to the UK total utilities employee jobs outlook out to the year 2028. Therefore, the forecast takes into account any global factors which will affect the utilities sector outlook (e.g. exchange rates, oil prices, commodity prices, etc). Other sectors which are forecast based on shares include agriculture, extraction and the manufacturing sub-sectors.

2.47 Some sectors are forecast regionally using location quotients based on total employment. This means that the future growth in these sectors will react to changes in the wider economy in terms of employment levels. For example, construction employee jobs are forecast based on this method. As overall employment grows, there is an increase in demand for services from the construction sector (to build offices, warehouses, renovations, etc). Consequently construction employee jobs will grow in tandem with overall employment growth. Other sectors which are based on this method include financial and business services.

2.48 Similarly, employee jobs in retail, hotels & restaurants are forecast using location quotients based on consumer spending growth. Therefore, as consumers spend more in the economy there is more demand for employment in these sectors. Areas which have a high LQ may suggest that these areas which are considered 'wealthy'. In other words, the disposable income of residents is high and therefore there is a higher propensity to spend on luxury items or services. Similarly, it might also suggest the presence of a large shopping centre or a high volume of car dealerships. Consequently, in areas where the LQ is high they are more likely to obtain a larger share of the future growth in these sectors in the UK.

2.49 Finally, employee jobs in the public sector are forecast using location quotients based on population growth. Thus, as population grows there is greater demand for the provision of public services.

2.50 Local authority employee jobs levels are a lot simpler in that we estimate sectoral shares of the regional sectoral employee jobs and forecast these based on historical trends. These shares are then applied to the West Midlands sectoral employee jobs forecasts. Therefore, the global factors applied to the UK wide forecasts are indirectly incorporated in the local economy forecasts.

2.51 Only public services are forecast using location quotients at local level. These are based on overall population growth. Therefore, in the same way as the region is projected, areas with higher LQs in public sector will get a higher proportion of the regional jobs growth in these sectors. For example, in an area where there is a hospital, the LQ for the health sector is likely to be high. Therefore, a larger proportion of the growth in health employee jobs is more likely to go to the area where the hospital is located.

Table 2.1: Shares and LQs in Nuneaton & Bedworth by 26 sectors, 2009 and 2028

	2009	2028
Agriculture	0.69	0.88
Extraction	0.42	0.42
Food, drinks & tobacco	0.69	0.69
Textiles	1.30	0.28
Wood products	1.25	2.89
Pulp, paper & printing	0.74	0.74
Coke, oil refining & nuclear fuel	0.00	0.00
Chemicals & man-made fibres	0.64	0.64
Rubber & plastic products	0.37	0.37
Other non-metallic mineral products	0.58	0.58
Metals	1.78	1.78
Machinery & equipment	3.07	4.67
Electrical optical equipment	1.14	1.14
Transport equipment	2.44	2.03
Other manufacturing	0.46	0.46
Electricity, gas & water supply	0.00	0.00
Construction	2.18	2.18
Distribution	2.14	2.25
Hotels	1.38	1.24
Transport & communications	1.95	1.95
Financial services	1.19	1.19
Business services	1.60	1.60
Public admin & defence	0.66	0.66
Education	0.93	0.99
Health	0.63	0.63
Other personal services	1.37	1.30

Source: Oxford Economics, BRES

2.2.6 Self employed jobs

2.52 **Description:** The total number people that are self employed working in the area.

2.53 **Data:** For the UK and regions, the total level of self employed jobs is published by the ONS in its Workforce Jobs (WFJ) series. This series is published on a quarterly basis and thus provides more up-to-date

information on the labour market. The sectoral data is also published quarterly but it is only available for Great Britain. Sectoral data for the regions is not available. Similar to employee jobs, the data is based on survey collections and therefore subject to revisions. The latest date for which data is available is 2011 Q1.

2.54 At local authority level, self employed totals are published within the Annual Population Survey (APS). However, due to sampling errors, the data are volatile, and in cases where moving averages are used to smooth out the volatility, the level of inaccuracy remains a problem. Therefore Oxford Economics estimates self-employment at a sectoral level which is consistent with the GB sectoral data and the regional/local totals.

2.55 **Forecast method:** At GB level, self employment by sector is taken from the ONS Workforce Jobs series and is scaled to a four quarter average of the seasonally adjusted series which is also available from National Statistics. This provides an estimate of self employment by sector for the GB. These data are also a 4 quarter average, and therefore consistent with the employee jobs series discussed earlier. UK self employment is projected in conjunction with the Oxford Economics industry model.

2.56 For regions, we take total self employment from the ONS WFJ series and split into sectors. The sectoral split is based upon both the employee data and an historical series of regional self employment by broad sector. This series has been discontinued but the sectoral proportions are used to aid the construction of our regional sectoral data. These ratios along with the sectoral employee data are used to construct a 'pre-scaled' sectoral series. This is then scaled to be consistent with the GB sectoral data and the regional totals.

2.57 Similar to the employee jobs forecast method, regional self employment is forecast by taking the historical shares of total UK self employment in each sector. These are forecast based on the observed historical trends. So for example, if self employment in West Midlands in construction has been rising historically, we forecast it to continue to grow, and vice versa if there is a falling trend. Finally, these are scaled to add to the UK sectoral self employed totals and therefore take into account any UK or global conditions which might affect the outlook.

2.58 Self employment in the NBFM is estimated by taking the West Midlands ratio of employee jobs to self employment by sector which are forecast in the Oxford Economics Regional Model. We then apply this ratio to the forecasted local area employee jobs by sector. This gives us a ‘pre-scaled’ or ‘first-round’ estimate of self employed jobs.

2.59 To bring in the local dimension, we take the Census estimate of total self employment and apply scaling ratios to this series to ensure that we match up with the Census in 2001. However the Census estimate of self employment is people based. Therefore we apply a final round of scaling which ensures that the local estimates of employment add to the regional

self employed series. Therefore, the self employed estimates in Nuneaton & Bedworth are consistent with the employee jobs series.

2.2.7 HM forces stationed at home

2.60 **Description:** The number of UK regular armed forces stationed in the UK.

2.61 **Data:** Data on HM forces stationed at home is collected from DASA (Defence Analytical Services Agency) at national, regional and local level. Specifically, the data used is published in table TSP10. This is a quarterly series and the latest data is available for 2010 Q1.

2.62 National and regional data is also published within the ONS Workforce Jobs series and is consistent with the DASA data. This is a quarterly series and the latest data is available for 2011 Q1.

2.63 **Forecast method:** HM forces includes army and naval officers stationed at home. However, it is difficult to project when these people will be sent 'on assignment'. As such we do not apply any sophisticated forecast method to this variable. Consequently it is held constant throughout the forecast period at national, regional and local level.

2.2.8 Government supported trainees

2.64 **Description:** The number of employees in government training schemes who have a contract of employment with the government rather than the firm they work for directly.

2.65 **Data:** Data on government supported trainees is only published at national and regional level. This is available from the ONS Workforce Jobs series and is available on a quarterly basis. The latest date for which this is available is 2011 Q1.

2.66 There is no published information for local authority level government supported trainees data.

2.67 **Forecast method:** The national and regional estimates of government supported trainees do not break this down on a sectoral basis. As such, we treat this as a total level only and do not allocate it to any sector.

2.68 For local authorities, we estimate government supported trainees by allocating the regional data across local authorities according to each area's share of total regional employment, i.e. on a pro-rata basis.

2.2.9 Employment (workplace based jobs)

2.69 **Description:** The total number of jobs in the economy. This is estimated as the sum of employee jobs and self employed jobs located in the area for each sector.

2.70 Note that as HM forces and government supported trainees are not allocated to any one sector, total employment is estimated as the sum of the sectors plus forces and government trainees.

2.71 There is no further information required for this variable in relation to data source, time period or forecast method as it is an aggregate of the data already outlined.

2.2.10 Employment (workplace people employed)

2.72 **Description:** The number of people who are employed in an area (irrespective of where they live).

2.73 **Data:** The only data available at national, regional and local authority level for the number of people that are employed comes from the Census in 2001.

2.74 Time series data is estimated by Oxford Economics using full and part time employee jobs data from the BRES, ABI and AES. Self employment is also included in this measure, details of which have already been outlined above. This is similar for HM forces which are sourced from DASA and government supported trainees which have also already been discussed.

2.75 **Forecast method:** In estimating the number of people in employment, we assume that it is possible for one person to have more than one job. This could range from someone having one full time job and a part time job, or it could be one person having 2 or more part time jobs. For example, it could be possible for a person to work during the day as a taxi driver whilst in the evening, they could work as a painter / decorator.

2.76 The starting point in estimating people in employment is to take all full time jobs in an area and add half of the part time jobs (assuming that some people will have multiple jobs). Part time jobs are forecast based on historical trends and full time jobs are estimated as the residual between total employee jobs and part time jobs.

2.77 For self employment, HM forces and government supported trainees we assume that there is a one for one ratio. In other words, every self employed job is taken by one person and so forth.

2.78 We know that in 2001, the Census publishes an estimate of the number of people in working in a particular area. Usually, we apply a ratio which ensures that this series is consistent with the Census in 2001.

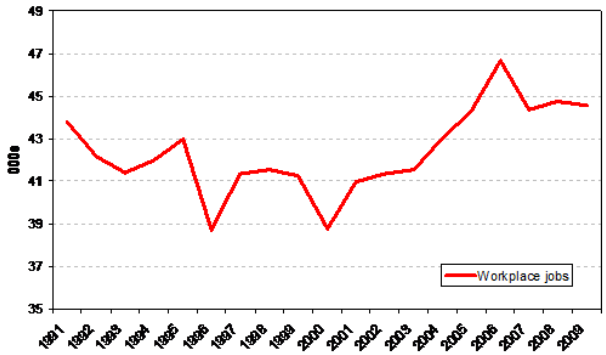
2.79 For Nuneaton & Bedworth however we treat this estimate differently. Analysis by Oxford Economics found that there were more people working than there were jobs in Nuneaton & Bedworth.

2.80 Lets take 2001 as an example. The ABI tells us there were 41,000 jobs in Nuneaton. However the census tells us there are 42,000 people working in the same year. In reality some people will have multiple jobs so we always expect the people figure to be below the jobs figure (which is clearly not the case in Nuneaton).

2.81 The solution is normally to make adjustments to one of the data series (either the jobs series would be uplifted or the people working series would be reduced).

2.82 The figure below shows the job series for Nuneaton over the past two decades. Historically, this series does not suggest any odd patterns in 2001, however the falls in employment level in 1996 and 2000 appear strange and could have been mis-reported to the ABI in these years. Overall, a level of 41,000 jobs seems fitting with the overall trend. It would appear odd that the ABI would have misreported the job numbers consistently over the past.

Figure 2.4: Total employment in Nuneaton & Bedworth, 1991-2009 (000s)



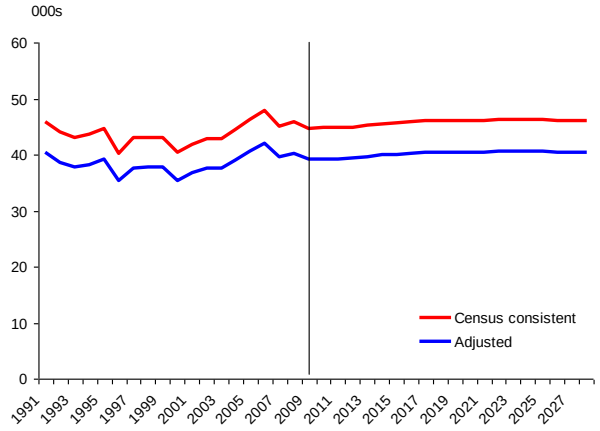
Source: Oxford Economics, BRES, ABI, AES

2.83 Consequently we would therefore adjust the people working data series as it seems too high. It would not be the first time that the Census has mis-reported data.

2.84 In consultation with the Council, it has been agreed that Oxford Economics would adjust the people in employment series to establish a more plausible economic picture.

2.85 To adjust the series we have applied the wider West Midlands ratio of jobs to people to the Nuneaton & Bedworth workplace employed jobs series. In this case 88% of total jobs were taken by people in the West Midlands. The figure below shows the Census consistent and adjusted series for reference.

Figure 2.5: Workplace employment – census consistent and adjusted, in Nuneaton & Bedworth, 1991-2009



Source: Oxford Economics, BRES, ABI, Census

2.2.11 Resident based employment (resident people employed)

2.86 **Description:** The number of people in employment that are resident in an area (irrespective of where they work).

2.87 **Data:** National, regional and local level data is collected from the APS (Annual Population Survey). Resident employment data is also available from the Census which we apply scaling factors to ensure the series is also consistent with the Census. The latest year for which this data is available is 2009.

2.88 **Forecast method:** APS data is survey based and thus subject to volatility. We estimate resident employment by taking a smoothed average of the resident employment rates (estimated as the number of residents in employment divided by the working age population) to reduce the level of volatility. Then we apply the smoothed employment rate to the working age population to obtain the number of residents in employment. This ensures that resident employment is estimated on a consistent basis with the rest of the data included in the model.

2.89 We then apply scaling factors to the series to ensure that it matches up with the Census in 2001. We do this for national, regional and local estimates.

2.90 Resident employment is forecast using commuting ratios from the Census. We have taken the proportion of Nuneaton & Bedworth residents that work in the local borough and outside the region. So for example, 69% of Nuneaton & Bedworth residents work in the local Borough, 9% of the residents commute to Coventry for work, 8% work in North Warwickshire and so forth. This is illustrated in the table below.

2.91 We apply these ratios to the workplace employment change in the areas where Nuneaton & Bedworth residents commute to for work. So for example, an estimated 1,800 jobs were lost in Coventry in 2010. If we

take 9% of these jobs, then we can assume that an estimated 162 resident jobs will be lost for Nuneaton & Bedworth residents.

Table 2.2: Commuting patterns of Nuneaton & Bedworth residents, 2001

	% of N&B residents commute to:	% of N&B workers commute from:
Nuneaton & Bedworth	51%	69%
Coventry	21%	10%
North Warwickshire	4%	5%
Rugby	4%	2%
Warwick	3%	1%
Solihull	2%	1%
Other	16%	12%

Source: Census 2001

2.2.12 Claimant unemployment

2.92 Description**:** The number of people claiming unemployment benefits that are resident in an area.

2.93 **Data:** National, regional and local level data is collected from the Claimant Count series published on Nomis. This series is published on a monthly basis and the latest month for which data is available was for June 2011.

2.94 As the NBFM is an annual model, we take the average of the monthly data for each year as our annual unemployment figure.

2.95 National and regional unemployment data is collected from a seasonally adjusted series. Whereas the local data is unadjusted. Although we take an average of the 12 months of data, this does not fully eliminate the seasonality. Finally we apply scaling factors to this series to ensure that it adds to the regional and national totals. But the scaling applied to ensure the local claimant data matches up with the West Midlands and UK is minimal.

2.96 **Forecast** method**:** Unemployment levels are forecast based on the change in resident jobs and working age population. As new resident jobs can be taken by new migrants into the area, people currently inactive or people moving from other jobs (and creating a 'chain' effect) as well as by the unemployed an assumption is made regarding the proportion of jobs taken by these distinct groups. Similarly when people move to an area for reasons other than employment a proportion are added to the number of unemployed people.

2.2.13 Net commuting

2.97 **Description:** The number of people that travel into and out of the area for the purposes of work.

2.98 **Data:** This data isn't collected from a data source, but is estimated using the workplace and resident employed people data used in the model.

2.99 **Forecast method:** Net commuting is estimated by subtracting the number of resident people in employment in a particular area from the number of workplace people in employment in the area. Note that this is a net figure. As such it does not include any sophisticated detail of the direction of flow. However a negative number suggests that there are more people commuting out of the area, and vice versa for a positive number.

2.2.14 GVA

2.100 **Description:** The total sum of income generated in an area in each year. It is the sum of wages and profits. Raw data is published in nominal terms thus including inflationary pressures. However estimates used in Oxford Models eliminate inflation and are reported in 2006 prices[2].

2.101 **Data:** The data used to estimate GVA comes from the ONS. For the UK, up-to-date estimates of GDP are published in quarterly National Accounts bulletins. However, this includes the total level of GDP which differs slightly to GVA for definitional reasons, but the growth rates will be similar.

2.102 Annual GVA data is published in the annual National Accounts publication (the Blue Book). This provides annual data of GVA totals for 2009, and sectoral information for 2008.

2.103 Similarly, Regional Accounts provides total GVA for each region for 2009 and sectoral information for 2008.

2.104 Local authority GVA data is not published anywhere due to the lack of reliable data. The lowest level of geographical detail that is published is NUTS3 level data which is also published in Regional Accounts. NUTS3 areas are aggregates of local authorities, and are therefore used in the estimation of local authority level GVA. Details on how this is done are set out below. NUTS 3 data is available by broad sector up until 2008 only.

2.105 **Forecast method:** Although UK and regional GVA data is only available until 2009 (for totals only), we know a little more about the overall UK economic growth up until the first quarter of 2011. Using this, and recent labour market data, we are able to make robust estimates of the pattern in GVA growth across regions and local areas in 2010, and to a lesser extent 2011 (given that we only have the first quarter of 2011 for UK GDP).

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[2] Where currency based series are used, they can often be quoted in current prices or constant prices. Current price data series includes increases in inflation. Constant price series takes account of movements in inflation by reporting the value in a chosen base year. In other words any GVA value presented in our reports or models are done so using 2006 prices. This is consistent with the base year used in UK National Accounts data published by the ONS.

2.106 As already mentioned, local authority data is not published as the data is considered too unreliable. As such, we estimate GVA by sector for the local authority using the data available to us. We do this by taking historical and projected regional productivity by sector (i.e. the amount of output per job) and multiply it by the local authority employment levels by sector. This gives us a first round estimate of GVA.

2.107 Given that GVA is the sum of profits and wages, and we know the wage levels from the ASHE (Annual Survey of Profits and Wages), we make an adjustment to account for the relative wage level. Therefore, in areas where wages are higher, we can uplift the GVA estimate accordingly. In the same way, where wages are lower, GVA estimates will be scaled down accordingly. These relative wages are held constant over the forecast period.

2.108 A further step in the GVA methodology is to apply an adjustment factor which ensures that the final estimates match the published data for NUTS3 areas. This adjustment factor is held constant over the forecast period. This system ensures that the final estimates of GVA for local authorities will match up with the published NUTS3 data in 2006 only (since GVA is reported in real 2006 prices).

2.109 Finally we apply scaling factors to the entire series which ensures that local authority GVA adds to the regional series. Therefore this is consistent with regional and national patterns of growth.

2.2.15 Dwelling stock

2.110 **Description:** The total number of dwellings located in an area.

2.111 Dwellings are defined as residential units including houses, flats, mobile homes, etc and includes both single households and several households sharing some facilities (e.g. care homes would be counted as one under this definition).

2.112 **Data:** UK and West Midlands data is collected from DCLG published tables. Local authority data for dwelling stock (occupied and vacant) is collected from the HSSA (Housing Strategy Statistical Appendix) which is based upon information supplied by local authority bodies. The latest year for which data is available is 2010.

2.113 **Forecast method:** Note that the flow diagram and associated discussion of housing flows under the scenario on page 40 also outlines the model linkages and forecasting methodology for housing the NBFM.

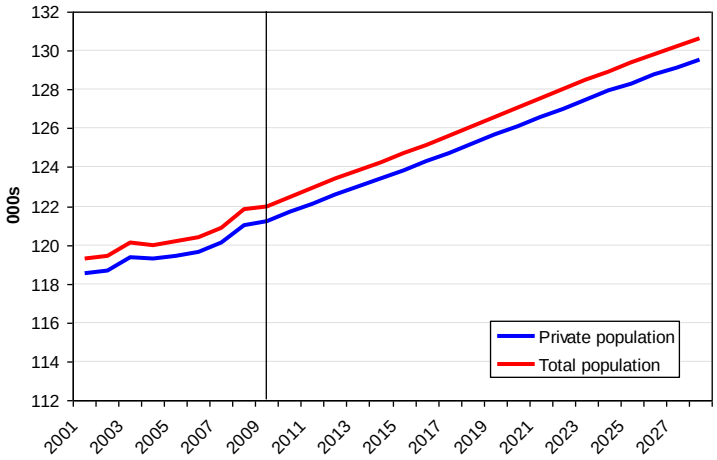
2.114 The breakdown of detail in the HSSA includes total dwelling stock with the number of vacant dwellings published separately. By subtracting vacant dwellings from total stock we have estimated occupied dwelling stock in the Borough. As second homes and holiday accommodation are not published separately, this method implicitly means that these dwellings are included in the count of occupied dwelling stock.

2.115 Dwelling stock in the Oxford Economics models is demand based. That is to say the increase in the number of dwellings in Nuneaton & Bedworth is based on the demand from the additional population either due to natural increase or to more people moving into the borough.

2.116 Occupied dwelling stock is forecast using projected ratios of the number of people per dwelling. We project these ratios using official household projections from the ONS and DCLG, and the Oxford estimate of population which is lower than the official population projections.

2.117 Note that we exclude people living in communal establishments or institutions such as retirement homes, prisons, army installations, etc as these tend to have higher occupancy rates and are counted as one dwelling according to official definitions. We refer to this measure of population as private population and it is estimated using official data from DCLG (the figure below shows the difference between the series).

Figure 2.6: Total and private population in Nuneaton & Bedworth, 2001-2028



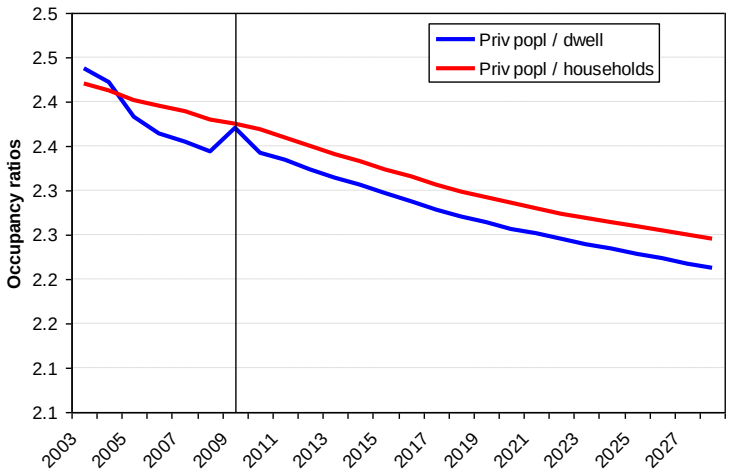
Source: Oxford Economics, ONS, DCLG

2.118 There are a number of steps taken in forecasting occupied dwelling stock:

- Firstly, we estimate the number of people per occupied dwelling using the published dwelling stock data from HSSA and Oxford's estimate of private population over the period 2002-2010.
- Then we take the official household and population projections to estimate the number of people per household out to 2028. We take the growth rate in this series (the % change year-on-year) and apply it to our estimate of people per occupied dwelling (as outlined above) to obtain a projected ratio of people per dwelling out to 2028.
- The final step is to apply this projected ratio to the Oxford estimate of private population to obtain an estimate of dwelling stock over the period 2011-28.

2.119 The chart below shows a comparison of the Oxford projected ratio of people per occupied dwelling, and the official ratio of people per household using the official government projections.

Figure 2.7: Occupancy ratios of private population divided by Oxford dwellings and household projections in Nuneaton & Bedworth, 2003-2028

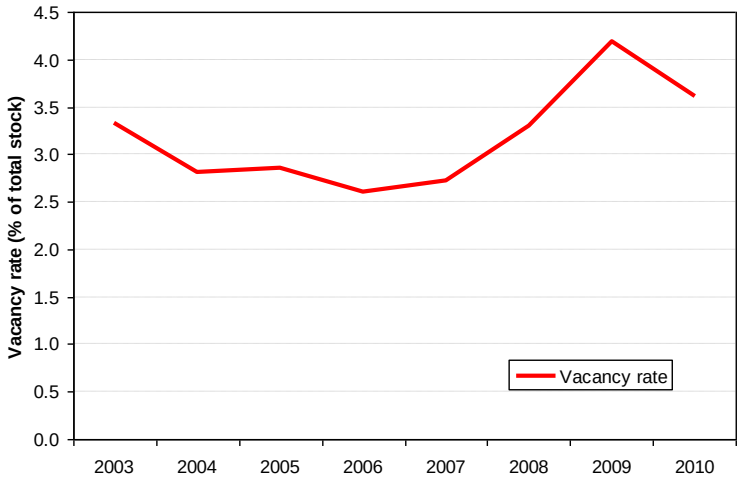


Source: Oxford Economics, ONS, DCLG

2.120 In 2009, there was a step up in the number of people per occupied dwelling. This was due to a fall in the number of vacant dwellings in 2009 (as illustrated in the chart below), and given that occupied dwellings is estimated as the difference between total and vacant stock, there is an increase in the number of occupied dwellings in that year.

2.121 Over the past few years in Nuneaton & Bedworth, there has been around 1% more dwellings than households, suggesting that there is a higher proportion of second homes which make up part of the occupied dwelling stock. Note that second homes include holiday homes, homes in use which aren't considered as the principal residence (e.g. for people who work in an area during the week but return home at the weekend, or a temporary arrangement for a household in the middle of moving to a new home), and homes retained by employers for visiting staff. Since some dwellings are in multiple occupation (e.g. care homes, army installations, etc), the actual proportion of second homes will be higher than 1%, but without sufficient data it is difficult to estimate this ratio. As such, in our projections we assume the ratio of second homes remains at 1% of occupied stock.

Figure 2.8: Vacant dwellings in Nuneaton & Bedworth, 2002-2010



Source: DCLG

2.122 To project vacant dwellings, we have estimated a vacancy rate which is calculated as a percent of total dwelling stock. This has remained relatively constant over the past 8 years with the exception of the pick up in 2008. The average vacancy rate (estimated as the ratio of vacant dwellings to occupied dwellings) over the past 8 years suggests that 3.2% of total dwelling stock was vacant and we have held this constant over the forecast to estimate the number of vacant dwellings. Note that this does not mean that the number of vacant dwellings will remain flat - it will continue to rise in response to the change in total stock.

2.2.16 Households

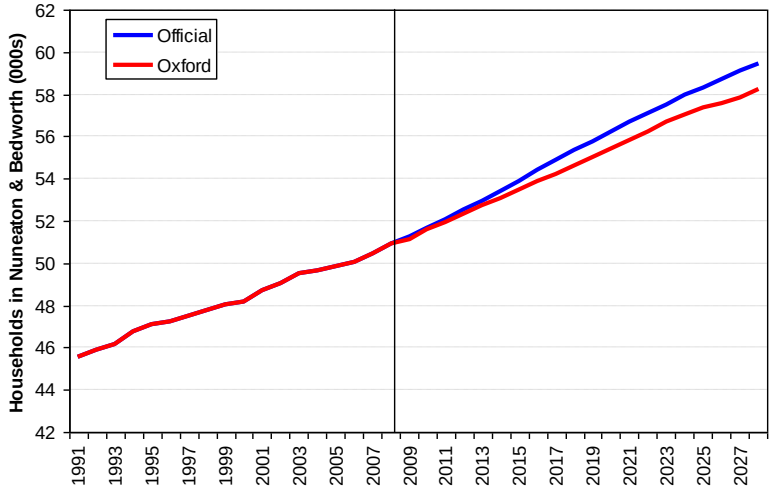
2.123 **Description:** The total number of households located in an area.

2.124 Households are defined as residential units where economic production, consumption, child-rearing, etc is carried out.

2.125 **Data:** National, regional and local households are collected from DCLG, with data available to 2008.

2.126 **Forecast method:** We have used a ratio of official private population to the official households numbers in Nuneaton & Bedworth to project households in the NBFM. This is shown in figure 2.6 above in the dwelling stock section. We have applied this ratio to the Oxford Economics forecast of private population - which is lower than the official estimates - to estimate household numbers over the future on a consistent basis with the wider NBFM.

Figure 2.9: Comparison of official and Oxford household projections, 2002-2028



Source: Oxford Economics, ONS, DCLG

2.127 For household numbers by type of household - one person households, couple and no other adult, couple and one or more adult, etc - we have assumed that the proportions in the official households projections will be the same in our forecast and have applied these shares to our total households estimates. Note that the number of households will differ from the official projections because the OE population forecasts for the district are not the same as the official population forecasts. This is summarised in table 2.3 below.

Table 2.3: Households by type in Nuneaton & Bedworth

	Baseline (000s)	
	2010	**2028**
One person housholds	16.1	21.0
Couple and no other adult	24.4	25.8
Couple and one or more adult	5.0	3.2
Lone parent with or without adult	4.1	5.9
Other	2.0	2.0
Total	**51.6**	**57.8**

Source: Oxford Economics, DCLG

3 An overview of the NBFM framework

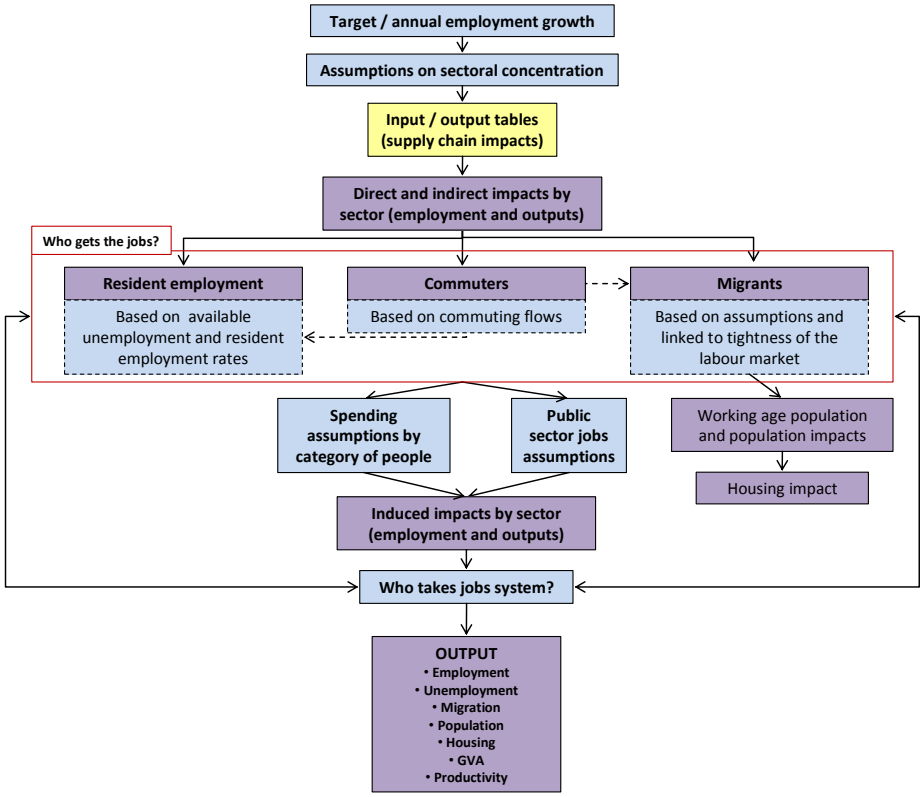
3.1 This section provides an understanding of how the NBFM has been developed to simulate scenario analysis. A high level conceptual model of the framework is introduced before discussing the key components in detail.

3.1 Performing scenario analysis

3.2 The starting point for scenario analysis in the NBFM is to take the baseline forecasts and build upon these to estimate the impact of a specific scenario.

3.3 The diagram below sets out the NBFM framework which has been used to estimate the scenario impacts. A more detailed explanation of the mechanics of the model in estimating scenario results is provided below.

Figure 3.1: NBFM framework



3.1.1 Input-output framework

3.4 The model contains an input-output framework. The data used is taken from UK input-output tables published by the ONS and contains details of which sectors purchase goods and services from other sectors. Specifically we take the domestic use tables which measures where

purchases are made within the UK economy, thus excluding imports and exports. Using this, we are able to quantify the magnitude of spending by a particular sector on goods and services from other sectors within the economy.

3.1.2 Direct, indirect and induced effects

3.5 The model is primarily driven by changes in jobs levels. At present, employment growth is forecast to grow at 0.3% per annum under the baseline over the period 2013-28. The model is designed to compute the impacts of an uplift / downgrade to the baseline growth rate by measuring the amount of **direct** additional jobs required to achieve the new target rate of growth. In doing so, the model also estimates the resulting indirect and induced jobs (explained below), which combined with the direct jobs provides the new rate of employment growth.

3.6 When additional direct jobs are created in an area, there will be 'knock-on' impacts generated elsewhere through supply chain spending. These are the additional jobs created as a result of the increased demand from the sector where the direct jobs have been added. We refer to these 'knock-on' impacts as **indirect** effects.

3.7 In addition to this, further jobs are created through **induced** effects. This third round of employment impacts arise when those employed in the new direct and indirect jobs spend their income in the economy (i.e. where the additional wages generated as a result of the extra jobs will be spent elsewhere in the economy). So for example, there could be an additional 200 jobs created at a manufacturing plant in Nuneaton & Bedworth. A proportion of these workers may buy lunch at a local restaurant nearby, therefore there is capacity for additional jobs in restaurants. In addition, people will spend more money on groceries at the local supermarket, creating additional demand, over and above that in the baseline outlook.

3.8 The exact steps of estimating indirect and induced impacts are discussed in detail below.

3.1.3 Sector selection

3.9 Once the additional direct jobs have been estimated and inputted into the model, the sectors in which the jobs will be concentrated must be selected.

3.10 The selection of sectors ultimately depends on the objective of the Council. It could be possible to produce a 'manufacturing renaissance' scenario. Or it could be possible to produce an export led scenario whereby tradable services sectors are expected to enjoy faster growth.

3.11 In the work produced by Oxford Economics on behalf of the Council, a range of sectors were selected based on local specialisms and national growth opportunities. These have been agreed with the Council and are engineered to assist in achieving diversification of the local economy,

whilst also attracting people with varying skill levels and thus uplifting the skills profile of the Borough (the main report provides a detailed discussion of the sectoral assumptions underpinning the two scenarios).

3.1.4 Quantifying the indirect impacts

3.12 The direct jobs are converted to GVA using baseline productivity estimates. For example, the distribution & retail sector in Nuneaton & Bedworth created on average £23,300 of GVA per job in 2009. If an additional 100 jobs are generated in retail, then this would mean that there would be £2.33mn (in 2006 prices) of additional GVA generated. Input-output tables use measures of output, therefore it is necessary to convert the GVA to output using ratios taken from input-output tables.

3.13 This additional direct output will be run through the input-output framework in the model to estimate the amount of indirect output which will be generated as a result of supply chain effects elsewhere in the economy. This, in turn, is translated back into GVA then jobs to allow the rest of the analysis to be conducted.

3.1.5 Where the supply chain jobs will be created

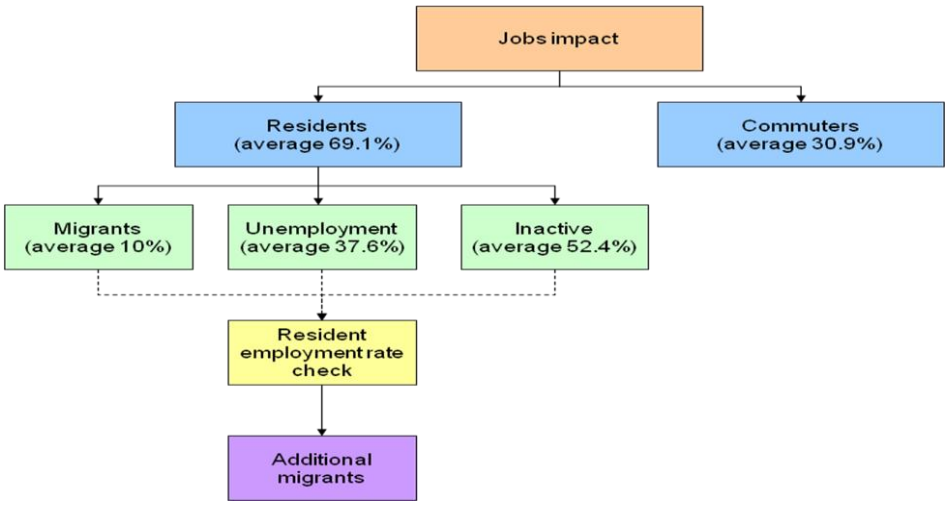
3.14 The way in which the supply chain works means that not all of the additional jobs created will be generated locally. Indeed, a proportion of the jobs will be generated in the wider West Midlands and UK economy.

3.15 The model estimates these allocations using location quotients. Typically, the majority of indirect jobs tend to be located in close proximity to the area to allow for the distribution of goods and services. As such, where the local economy has a higher concentration of employment in a particular sector then we assume a larger proportion of the supply chain inputs can be sourced locally. By contrast, where there is a relatively small concentration of a particular sector, then it is likely that the supply chain will be sourced from further afield, and therefore proportion of indirect jobs created in the local economy falls.

3.1.6 Who takes the jobs?

3.16 The next step in the analysis is to estimate who takes the jobs within the local Borough. The flow diagram below shows a conceptual overview of this process within the model.

Figure 3.2: Who takes the jobs



3.17 Broadly, the additional jobs are taken by either residents living in Nuneaton & Bedworth or commuters from outside the area.

3.18 To start with, we assign a proportion of the additional jobs to residents. We do so by applying the proportion of Nuneaton & Bedworth residents that have a workplace based job within the Borough. According to the 2001 Census 69.1% of the total number of people that work in Nuneaton & Bedworth were local residents. Unfortunately the Census does not provide a sectoral breakdown. In reality this ratio will differ across sectors, in addition it will have also changed over time. To take account of this Oxford Economics have made some small sectoral adjustments. Distribution, Hotels and Other personal services have been adjusted up to 89.1% to reflect the likelihood that more local residents will take these sorts of lower paid jobs (i.e. it is less likely that people will commute into the borough take up a relatively lower paid job). The second set of sectors that have been adjusted are business services and the public sectors, which have been uplifted to 79.1%, assuming that residents are likely to have enjoyed the bulk of recent growth in the sectors. If we apply these ratios to the 2001 employment data, we will arrive at a higher number of residents employed in the borough than the Census would suggest (i.e. the sectoral uplifts assign more of the 2001 jobs to residents). As such we use the 2001 Census employment data as a control total and scale our resident employment estimates to it. In doing so we essentially scale down our sectoral resident employment figures to match the Census total. The ratio of the number of residents taking Nuneaton & Bedworth jobs therefore changes accordingly and the sectors that were not previously adjusted, experience a lower resident employment ratio than the 69.1% average (note the even those sectors that had been adjusted up, are subsequently scaled down). Table 3.1 shows the proportion of workplace based jobs taken by residents in each sector.

Table 3.1: Proportion of jobs taken by residents by sector

	% of residents by sector
Agriculture	61%
Extraction	61%
Food, drinks & tobacco	61%
Textiles	61%
Wood products	61%
Pulp, paper & printing	61%
Coke, oil refining & nuclear fuel	0%
Chemicals & man-made fibres	61%
Rubber & plastic products	61%
Other non-metallic mineral products	61%
Metals	61%
Machinery & equipment	61%
Electrical optical equipment	61%
Transport equipment	61%
Other manufacturing	61%
Electricity, gas & water supply	61%
Construction	61%
Distribution	78%
Hotels	78%
Transport & communications	61%
Financial services	61%
Business services	69%
Public admin & defence	69%
Education	69%
Health	69%
Other personal services	78%

Source: Oxford Economics, Census

3.19 The remainder of the jobs are taken by commuters from outside the area. This is treated as a residual in the model (i.e. it is the difference between total jobs and the number of jobs taken up by residents). Commuters take, on average, 38.4% of the additional jobs created in the scenario.

3.20 The next step in estimating who takes the jobs is to calculate what proportion of the resident jobs will come from the unemployed, the inactive or from additional migrants moving into the area.

3.21 We apply sectoral assumptions of the proportion of those that are likely to come from the unemployed. This ranges from 10% to 50%, and the individual sector proportions are shown in table 3.2 below. On average 37.6% of the additional resident jobs created in the scenario are taken by the unemployed (see figure 3.2).

Table 3.2: Proportion of likelihood to come from unemployment

	% liklehood to come from unemployment
Agriculture	40%
Extraction	40%
Food, drinks & tobacco	40%
Textiles	40%
Wood products	40%
Pulp, paper & printing	40%
Coke, oil refining & nuclear fuel	40%
Chemicals & man-made fibres	40%
Rubber & plastic products	40%
Other non-metallic mineral products	40%
Metals	40%
Machinery & equipment	40%
Electrical optical equipment	40%
Transport equipment	40%
Other manufacturing	40%
Electricity, gas & water supply	40%
Construction	50%
Distribution	50%
Hotels	50%
Transport & communications	40%
Financial services	10%
Business services	30%
Public admin & defence	20%
Education	20%
Health	20%
Other personal services	50%

Source: Oxford Economics

3.22 Similarly, for migrants we have applied sectoral assumptions of what proportion of additional jobs will be taken by migrants. In most sectors we assume 10% of additional resident jobs are taken by migrants. For some sectors we assume that the jobs will be sourced locally or by commuters and therefore do not allocate any proportion to this sector for migrant jobs.

3.23 The reason for this is that some sectors require workers with specific skillsets. For example, in the health sector workers are required to have health based qualifications (doctors, nurses, physiotherapists, etc). If the local Borough does not have residents with these qualifications then the labour will come from elsewhere. Similarly, some sectors are more generalised and don't require specific skills. This could include retail workers where the labour could be sourced locally due to the non-specific skills requirements. The proportions applied in this study are illustrated in table 3.3 below. On average 10% of the additional resident jobs created in the scenario are taken by migrants (see figure 3.2).

Table 3.3: Proportion of jobs taken by migrants by sector

	% of jobs taken by migrants
Agriculture	10%
Extraction	0%
Food, drinks & tobacco	10%
Textiles	10%
Wood products	10%
Pulp, paper & printing	10%
Coke, oil refining & nuclear fuel	10%
Chemicals & man-made fibres	10%
Rubber & plastic products	10%
Other non-metallic mineral products	10%
Metals	10%
Machinery & equipment	10%
Electrical optical equipment	10%
Transport equipment	10%
Other manufacturing	10%
Electricity, gas & water supply	0%
Construction	10%
Distribution	0%
Hotels	0%
Transport & communications	0%
Financial services	0%
Business services	10%
Public admin & defence	0%
Education	10%
Health	10%
Other personal services	0%

Source: Oxford Economics

3.24 We have assumed that the remainder of the jobs will be taken by people currently classified as economically inactive. On average, 52.4% of the additional resident jobs created in the scenario are taken by the inactive.

3.25 Finally, there is a mechanism integrated into the model which checks that the results of the scenario do not become implausible. There are two things which the model 'checks':

1. Checks if the labour market is becoming too tight with unemployment falling to unrealistic lows and the resident employment rate being pushed to unrealistic highs. For example, even if an economy is booming, there will always be a pool of unemployed workers containing individuals that are not suitable or work ready or those between jobs. The mechanism ensures that the rate of unemployment in the local economy does not fall below historic low levels. Likewise it prevents the resident employment rate rising above realistic highs.; and

2. That the number of jobs being filled by the inactive is not unrealistic. This is done by checking that the resident employment rate does not become too high. The resident employment rate is calculated as the number of residents in employment as a proportion of the working age. Historically the resident employment rate rarely exceeds 85% in any local authority. Therefore we use this as the basis of this checking exercise. We have built in a mechanism which says that once the resident employment rate begins to reach a level which is close to 85% we start to bring in additional migrants. This results in higher working age population which therefore slows the growth in the resident employment rate.

3.1.7 Induced people effects

3.26 The additional migration generated as a result of the indirect jobs will push up the level of population. This will drive up demand for public services and therefore will lead to an increase in the number of public sector jobs located within the Borough. This is estimated by applying baseline ratios of public sector jobs to the number of people in the local Borough. For example in 2009, there were 14 public administration & defence jobs for every 1,000 people. We apply this ratio to the number of additional people in the scenario to estimate how many additional public administration jobs will be required. We follow the same processes for the education and health sectors.

3.27 In addition, the extra population will have implications for housing in the Borough. As housing forecasts in the NBFM are demand based, additional housing will be required to accommodate the increase in population. A more detailed explanation of how these impacts are measured is provided below.

3.1.8 Induced spending effects

3.28 As already discussed, there will be additional income generated in Nuneaton & Bedworth for local residents, commuters and migrants as a result of the direct and indirect employment. This income is most likely to be spent in the retail, hotels & restaurants and other personal services sectors of the local economy.

3.29 In estimating induced employment we have started by calculating the number of jobs typically found in these sectors of the economy per £1m of consumer expenditure.

3.30 We then take separately, the additional income generated under the scenario for residents, migrants and commuters. For each group of workers we apply assumptions on what is likely to be spent in the local economy.

3.31 For residents, we take the resident wage forecast from the baseline projections. We apply this wage to the additional jobs taken by residents to obtain an estimate of the total additional income generated amongst residents. To estimate the net effect of the additional income we need to take account of the counterfactual position (i.e. what would have happened had there not been the additional job creation under the scenarios). Without the jobs, these residents would have been in receipt of unemployment benefits which they would have spent locally. The impact of the scenario is therefore to estimate the additional income over and above the level of benefits. We therefore subtract approximately £5,000 off of the additional resident jobs annual income. This is then converted to consumer expenditure using the baseline ratio of income to spending. Finally, the additional consumer expenditure generated as a result of additional employment is applied to the 'induced' ratios mentioned above to obtain an estimate of the additional jobs created.

3.32 For migrants, we take the resident wages again from the baseline and apply this to the additional migrants coming to the area to take the jobs. We make an additional assumption that of the total income generated in a year for each migrant a fixed amount (£2,000) will be sent home or spent abroad. This amount is subtracted from the total additional income for every migrant job. Again this final income is converted to consumer spending and translated to jobs using the ratios of jobs to spending in the 'induced' sectors.

3.33 For commuters, we take the workplace based wages from the baseline model and apply this to the additional commuters coming to the area to take the jobs. In addition, we have assumed that commuters will only spend 10% of their income in their place of work. By applying the ratio of income to spending, we have a final estimate of the amount of money spent by workers locally. This is then translated into jobs using the same method as for residents and migrants.

3.34 These jobs generated as a result of the additional people and spending will feed back into the model. The model will then estimate who takes the additional induced jobs (i.e. unemployed, migrants or commuters), and will go through these steps until equilibrium is found and every job is allocated.

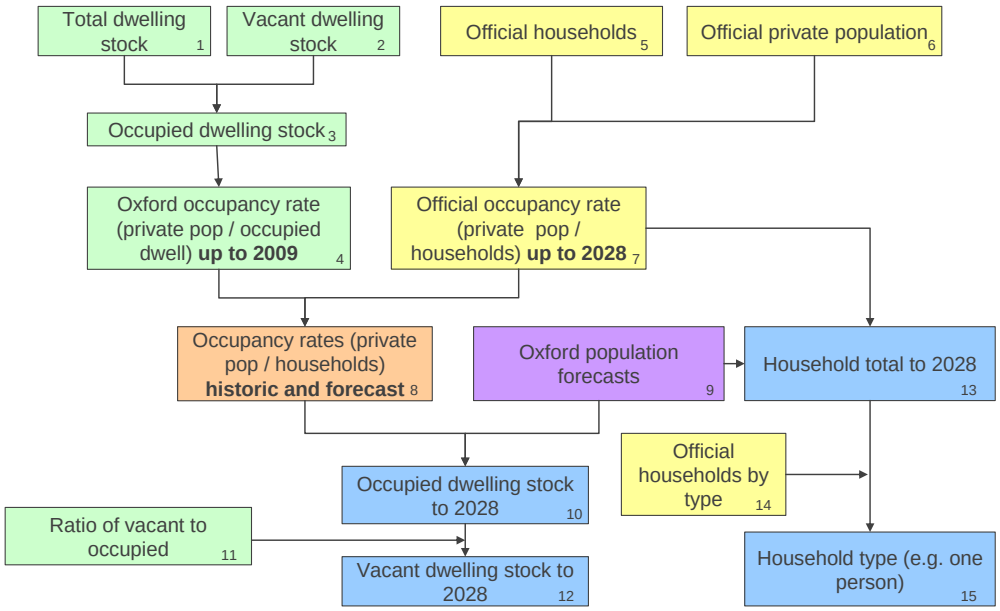
3.35 Finally, the model will convert the additional jobs to GVA by applying the baseline productivity in each sector.

3.2 Housing flows under the scenario

3.36 Embedded within the model is a housing module which provides the estimated impacts of a scenario on the housing market. As already mentioned, housing data in the NBFM is demand driven. In other words, the number of additional housing generated over the forecast period is based upon the level of demand from the projected population increase.

3.37 Here we set out the steps in the model where housing is estimated. This is illustrated in the figure below and the explanation will follow the linkages in the flow diagram.

Figure 3.3: Housing flows



3.38 The colour coding in the above diagram is as follows:

- **Green boxes** represent published historical data and calculations derived from this
- **Yellow boxes** represent 2008 based official projections published by DCLG and the ONS for households and population
- **Blue boxes** represent outputs of the analysis
- **Peach boxes** represent assumptions derived from the available data
- **Purple boxes** represent existing Oxford forecasts where the methodology has been outlined previously and are used as external influences on housing projections

3.39 There are two things that drive demand for housing in the NBFM:

1. Private population
2. Occupancy ratios (dwellings and households based)

3.40 We start by taking the dwelling stock data which is published in the HSSA by DCLG. This provides data for the total number of dwellings and vacant dwellings (boxes 1 and 2 in the flow diagram). From these we can derive the number of occupied dwellings (box 3) as the difference between these indicators.

3.41 Then we estimate the 'private population' of the area. This is equal to the total population minus the number of people living in institutions. These can be nursing homes, student halls, army installations where the number of occupants tends to be higher. It is wiser to remove this from the total population as institutions are generally counted as one dwelling in the official definition of dwellings.

3.42 There is published data on the institutional population available from DCLG up until 2008, and projections are available up to 2028. To estimate the institutional population we take the proportion of people that are aged 85 or over in Nuneaton & Bedworth according to the 2008 based official projections of the population. It is worth noting that the institutional population includes people living in care homes, army installations, student halls, etc. In the absence of better data, we have assumed that the majority of the institutional population is accounted for by those living in care homes and therefore we estimate the institutional population based on people aged 85 and over. In addition, the impact of this on the labour market will be minimal as people living in care homes and army installation are less likely to take up the extra jobs. This leaves a small proportion of students of which only a limited number will take up part time employment while studying. We then apply this ratio to the Oxford estimate of total population which is lower than the official projections. This gives us an estimate of the population that are aged 85 or over that is consistent with the Oxford population forecast. In doing this, we have assumed that there is a higher propensity of 85 year olds and older that tend to live in institutions. This does not account for other types of institutions but it is worth noting that there are no universities or large army installations in the area.

3.43 We then calculate the ratio of institutional population as a proportion of the over 85s in Nuneaton & Bedworth (both measures taken from the official projections). This ratio is applied to the Oxford estimate of people aged 85 and over to obtain an estimate of institutional population. Finally we subtract this measure of institutional population from the total number of people in the Oxford model to have a series of private population.

3.44 The next step in the methodology is to take this estimate of private population and divide by the number of occupied dwellings from the published data. It is better to use occupied dwellings as the projections are based on the number of additional people in the area, and vacant dwellings would not correspond with population change. This gives an estimate of the occupancy ratio of the number of people per occupied dwelling (box 4) up until 2009.

3.45 Then we need to forecast this occupancy ratio out until 2028. To do this we take the official household and private populations projections (boxes 5 and 6), and calculated an occupancy ratio of the number of people per household (box 7). Then we take the year on year growth rate in this series and apply it to the occupancy ratios of people per occupied dwelling (box 4) from 2009 onwards. This provides a projected ratio of people per occupied dwelling throughout the forecast period (box 8).

3.46 This projected ratio (box 8) is then applied to the Oxford private population forecast (box 9) to estimate the number of occupied dwellings (box 10) over the future required to accommodate the additional population.

3.47 For vacant stock, we estimate a ratio of vacant dwellings to occupied dwellings (box 11) using the historical data. Over history, this ratio has been relatively constant at around 3.2%. As such, we have held this value constant over the forecast period and applied it to the occupied stock to estimate vacant stock (box 12).

3.48 Household projections (box 13) are established using the official occupancy ratio of people to households (box 9) and applying this to the Oxford projection of private population (box 9).

3.49 Households by type (box 15) are defined by the following categories:

- One person household
- Couple and no other adult
- Couple and one or more adult
- Lone parent with or without adult
- Other

3.50 These are estimated by applying the proportions of households by each type taken from the official projections (box 14) and applying these to the Oxford estimate of total households (box 13).

3.51 Note that the reason why household and dwelling stock growth over the forecast is lower than the official projections is due to a lower population outlook. As housing provision is demand based in the model, we expect there to be fewer houses required over the future.

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