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Greater Manchester Forecasting Model

**Technical note:
Model description and data
sources**

2009

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1: Introduction

The Greater Manchester Forecast Model (GMFM) was developed by Oxford Economics as part of the Research, Foresight and Intelligence (RFI) project. The aim was to develop a model capable of bringing together the housing and economic projections under one roof. Since its inception the model has undergone continuous development work, most notably in 2006 as part of the 'Making Housing Count' work. The developments have refined the model capabilities and a roadmap of future development is planned to continually increase coverage and refine accuracy.

This report is intended to provide relatively technical information on the coverage, methodology and data sources for the model. The latest forecasts produced with the model are reported separately.

The model should be viewed as one piece of evidence in making policy decisions and tracking economic, demographic and housing change. As with all models it is subject to margins of error which increase as the level of geographical detail becomes smaller. In addition the model relies heavily upon published data which, unfortunately, is becoming less and less reliable with ABI data in particular coming under server criticism at local sectoral level. It is however better to base decisions upon imperfect information than no information at all.

Models, though predominantly quantitative, also require a degree of local knowledge and past experience, or more generally forecasting art, to make plausible long term projections. To this end the Oxford model has been developed by a team of senior staff (Graham Gudgin, Alan Wilson, Neil Gibson and Kerry Houston (nee Hazley)) who have a long history in model building and forecasting at both local and regional levels. The team has remained unchanged throughout the five year history of the project and have built up considerable local knowledge. In addition the forecast team are grateful to the support and comments provided by both the Steering Group and local representatives of each council.

Model history

A number of published forecasts have emanated from the GMFM. These can be summarised as follows:

- October 2005 - First year model release
- June 2006 - Second year model release ('Spring 2006 update')
- September 2007- Final third year forecast results
- December 2008- Final fourth year forecast results
- November 2009- Final fifth year forecast results

In addition, a number of alternative scenarios have been produced with the model, and work to enhance features of the model relevant to housing market analysis as part of the Making Housing Count project led to an additional version of the model being released early in 2007.

The key reports associated with the development of the model and forecasts are as follows:

- Revised Economic Analysis and Forecast Report – September 2005
- Modelling demographics and housing in Manchester and Salford - September 2005
- WS4: Model Development and Feasibility Report – March 2007

- Greater Manchester Forecast Model, 2007 update – final version November 2007
- Greater Manchester Forecast Model: Technical note – final version November 2007
- Greater Manchester Forecast Model, 2008 update – final version December 2008
- Greater Manchester Forecast Model, 2009 update – final version November 2009
- Greater Manchester Forecast Model: Technical note – final version November 2009

The intention is for future annual updates to the model.

Report structure

This report does not provide a write up of the forecast results, these can be found in Greater Manchester Forecast Model Report, rather it is designed to provide a methodological description of how the model works and the data sources used. It can be seen as a compendium or reference guide to support the published results. It will be updated as new data becomes available and any methodological developments are made. The rest of this report is structured as follows:

- **Chapter 2: Description of the Model** – This chapter summarises the GMFM model coverage with respect to geography time periods and its linkages to other Oxford economic models.
- **Chapter 3: Model Overview** – This chapter summarises the structure of the GMFM model, the linkages and relationships and summarises the development work carried out under the Making Housing Count project.
- **Chapter 4: Data Used** – This chapter summarises each of the variables in the model, the exact description and latest data used. It also sets out any manipulation of the data which is carried out prior to entering into the GMFM model. This section can be used to reference any of the published data.

2: Description of the model

This chapter provides an overview of the Greater Manchester Forecasting Model (GMFM) and summaries its coverage and links to other models in the Oxford suite. It also contains a list of the variables contained in the model. The forecast methods and data sources are described in the subsequent chapters.

Structure of the Economic Model

The Greater Manchester Forecasting Model was developed as part of the Research, Foresight and Intelligence (RFI) Consortium. The role of the model within RFI was to:

- Demonstrate the key ways in which the economies of Manchester, Salford and surrounding areas are interlinked and linked to the wider UK and international economies
- Quantify the links between economic change and population change at local authority level in Greater Manchester
- Produce forecasts of economic and population change consistent with existing projections for the UK and international economies
- Develop the capacity to contribute to simulations of alternative futures including policy-on and policy-off simulations of the MSP HMR initiative.

The overall approach is to based around modelling the interdependence of the economy, demographic developments and housing at a local level, as well as reflecting the impact of broader economic developments on Greater Manchester. Employment forecasts therefore take account of both the supply and demand for labour; demographic forecasts reflect housing and labour market developments as well as factors affecting migration and natural changes in population; and housing forecasts reflect economic and demographic factors.

Geography

The model produces forecasts for each of the unitary authorities and counties within the North West region. The primary focus is on the authorities within the Manchester City Region. This is defined as follows:

- **Greater Manchester**
 - Bolton
 - Bury
 - Manchester
 - Oldham
 - Rochdale
 - Salford
 - Stockport
 - Tameside
 - Trafford
 - Wigan
- **City Region (Greater Manchester plus the following)**
 - Macclesfield
 - Warrington
 - Vale Royal
 - Congleton
 - High Peak

Manchester Central ward is also included (employees only). Other authorities and counties outside of the city region are also modelled, though less time and resource is spent verifying these projections.

Time periods

The GMFM model is constructed on an annual basis. Historic data for most variables has been collected for 20 or more years to provide a basis for estimating inter-relationships between variables and future trends. Forecasts are currently set up for the period up to 2032 consistent with existing available global, national and regional forecasts. It needs to be borne in mind, though, that in the longer term the further ahead the forecasts look the greater the chance that there will be a significant change in underlying drivers that will affect forecast accuracy – although in some ways the medium term forecasts are more likely to good approximations than the shorter term ones since we can be more confident about medium-term trends than short-term cyclical movements around the trend.

Using the model

The GMFM provides projections on a ‘policy neutral’ basis. That is, known investments and developments are included as are the effects of known policies. Unconfirmed, aspirational or policies at planning or development stage are not included. Though forecasts are built primarily around the economic relationships described in chapter 3 use of local knowledge and published material on local development is required to augment the results of the formal modelling process.

As with all forms of forecasting there are margins of error associated with the results which get larger over time. Furthermore the quality of data decreases as the geography gets smaller. Models of this form under current data quality levels are most helpful for identifying trends, growth rates and relativities either across or within areas. The long term trends are therefore important and users are encouraged to use the time series information and not rely on ‘point-in-time’ estimates.

Caveats

The GMFM model produces base forecasts, which can be compared with other published forecasts (though care should be taken over data definition issues), and as a guide to aid commentary or analysis of the working of the City Region and its Local Authority economies. These forecasts can in one sense be considered to provide baseline ‘policy off’ projections with which the actual outturn under policy initiatives could be compared. However it must be realised that there are inherent difficulties in using the forecasts as a ‘policy-off’ baseline. Three difficulties are worth listing:

- **Based on historical trends:** forecasts of the kind produced here reflect past trends and that these trends themselves include the results of past policies. Only when future policy initiatives differ from the past in either scale or nature can we expect these initiatives to produce marked deviations from the baseline projections.
- **Unconstrained:** the base projections are ‘unconstrained’ in the sense that they make no allowance for constraints on development which are greater than in the past. For instance, the population forecasts presented here are associated in the forecasts with higher levels of new house building than in the past. If planning restrictions or difficulties were to constrain or prevent the necessary level of building then the projected level of population is unlikely to materialise.

- **Complex relationships:** A number of the modelled relationships are complicated, in particular demand for housing is complex and it may not have been possible to capture the full set of influences in this model despite its large size. Subtleties such as whether migrants have a significantly different demand for housing than the existing population through such things as a willingness to live at much higher densities would require significant further research to ascertain.

Coverage

The following chapters provide more detailed information on the data used on the model and how the linkages in the model used for the forecasting and scenario work, but the list below gives a summary of the variables on the model to help provide an overview of what the model covers:

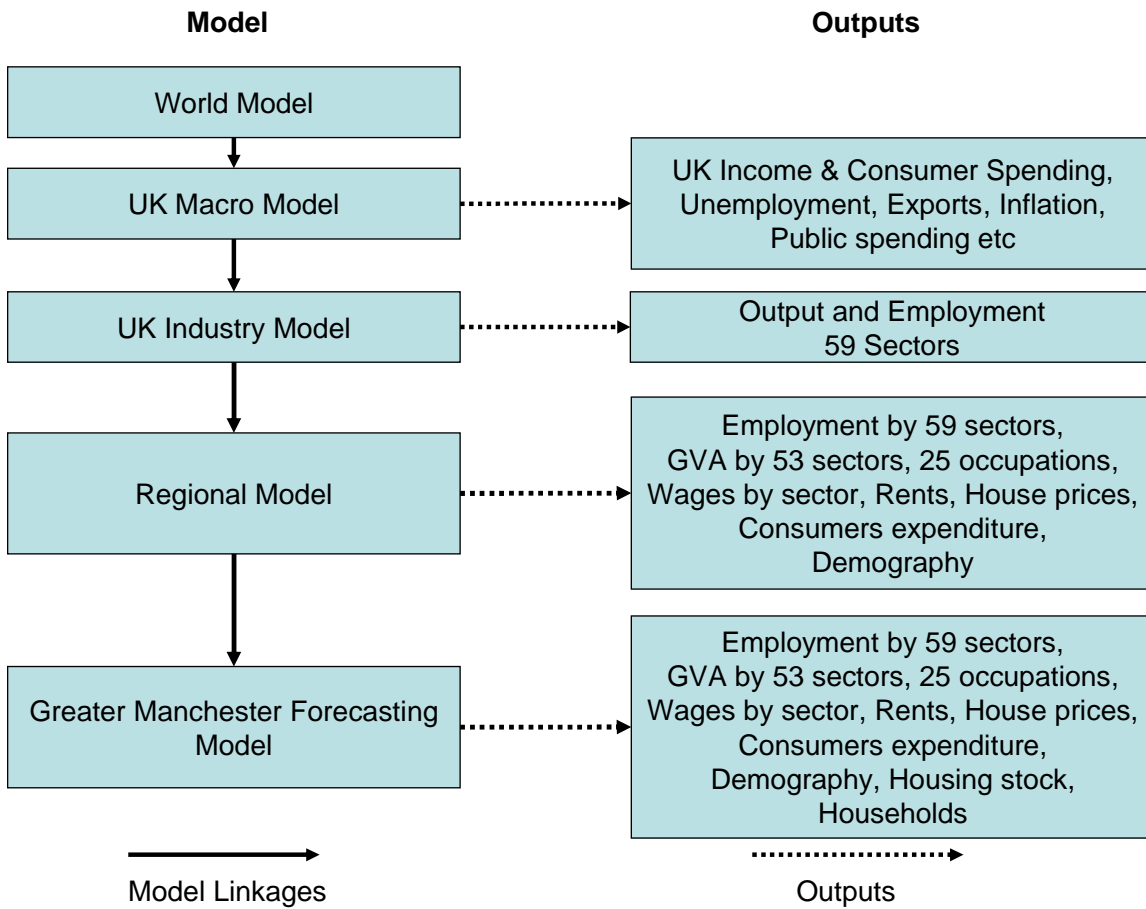
- **Demography**
 - Population
 - Total and working age (15-59/64)
 - By 5-year age band, male/female
 - Ethnic minority population
 - Migration
 - Total and working age (15-59/64)
 - 5 year age bands, male/female
 - Domestic and international – inflows, outflows and net
 - Births and deaths
 - Male/female
 - Natural increase
- **Labour market**
 - Employee jobs
 - Full time/part time – 14 sectors
 - Male/female – 14 sectors
 - 59 sectors
 - Self-employed jobs
 - 8 sectors – male/female totals
 - People based – 8 sectors
 - Total employment
 - Jobs- and people-based
 - 9 sectors
 - Resident employment/rate
 - Net commuting
 - By occupation 9 major groups
 - Unemployment/rate
 - Occupations/rates
 - Workplace/residence based
 - By 26 minor occupation groups
 - Skills
 - NVQ levels 0 – 4+
- **Economy**
 - GVA (£m, 2003 prices)
 - 61 sectors
 - Relative productivity (NW = 100)
 - 25 sectors
 - Average earnings

- 24 sectors
 - Consumer expenditure
 - Household income
- **Housing**
 - House prices (£000s, indexed 1990=100)
 - Housing stock
 - By tenure
 - Demolitions and completions
 - Households
 - Occupancy rates in 5 year age bands
 - Households by tenure
- **Floorspace**
- **Carbon emissions**

Links with other models

One of the important aspects of the GMFM is the link to existing forecasting models which ensures that all forecasts are consistent with the outlook for the world, UK macro and UK regional economies. The links are summarised in figure 2.1.

Figure 2.1: Links with the Oxford Economics suite of models



3: Model overview

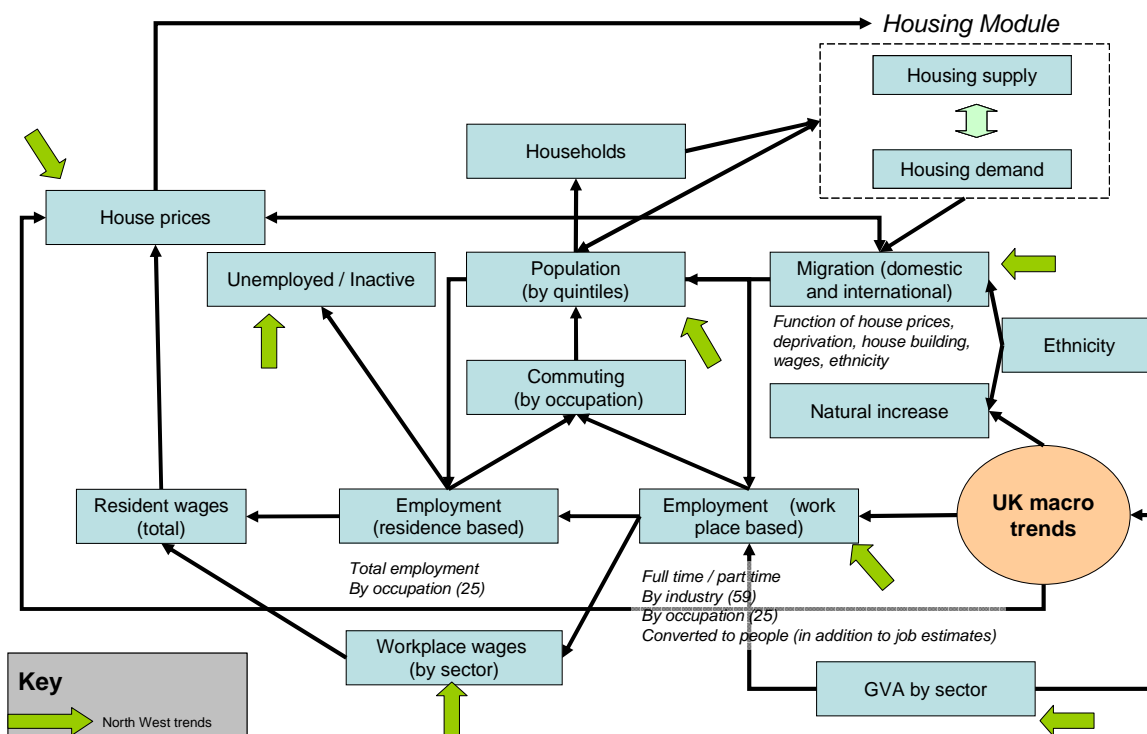
The structure of the Oxford economics Regional model which drives the North West projections (and the other ‘tiers’ of Oxford models) is not set out in this note – it can be requested from Oxford Economics if required.

Local area model structure

The overall model is very large, with around 20,000 variables across the economic, demographic and housing components of each area. Each variable is related to others within the models. Key variables are also related to variables in the other Oxford Economics models. The main internal relationships between variables are summarised in Figure 3.1. For convenience some aspects of demography (population and migration forecasts) are included within the economic model.

The sections that follow summarise the forecast methods of each of the elements of the model. Two areas, namely the demographics system and the housing system are covered in additional data at the end of the section as these areas are more complex and unique to this model. Additionally a summary of the work carried out under making housing count development in 2006 is also provided.

Figure 3.1: Main Relationships between variables in the GMFM Model



Economic variables

Workplace employees (jobs)

The starting point is the determination of workplace-based employment in each of 26 sectors, influenced by UK and North West regional employment in the same sectors and by measures of local demand. Employment in key 'export' sectors of manufacturing and financial and business services is also influenced by aspects of competitiveness, including relative wage costs and rents. The relationship with rents is particularly important for financial and business services. In this case, the influence is the difference in office rents between London and the North West. This is a particularly volatile influence and is, in our view, responsible for the much of the recent upsurge in growth in this sector across the North West, including in central Manchester. (This in turn is likely to underpin recent growth in demand for apartments and other owner-occupied dwellings in Central Manchester).

At local authority level some of the sectors are driven predominantly by population estimates others by total employment in the area and the remainder relative to the regional performance (largely exporting sectors). All sectors are also influenced by past trends in the local area and taken in totality employment is cross referenced with a number of variables (including population, relative performance across similar areas, historical cyclical performance and known policy) for checking and validation purposes. Where necessary, manual adjustments are made to the projected trends to reflect this validation process. The methods of sectoral projection are as follows:

- Agriculture - share of the North West
- Extraction - share of the North West
- Manufacturing: all sub-sectors - share of the North West
- Electricity, gas and water - share of the North West
- Construction - location quotient based upon total employment
- Distribution only - share of the North West
- Retailing - location quotient based upon total population
- Hotels - location quotient based upon total population
- Rail transport- location quotient based upon total population
- Air transport- share of the North West
- Water transport - share of the North West
- Other land transport - location quotient based upon total employment
- Other land services - location quotient based upon total employment
- Communications- share of the North West
- Business and finance - location quotient based upon total employment
- Insurance - location quotient based upon total employment
- Other finance - location quotient based upon total employment
- Business services - location quotient based upon total employment
- Public admin - location quotient based upon total population
- Health - location quotient based upon total population
- Education - location quotient based upon total population
- Other waste services - location quotient based upon total employment
- Other services miscellaneous - location quotient based upon total population

Note that this estimate is a jobs and not people measure (i.e. one person can have more than one job and would be counted more than once in this indicator).

Full time and part time employment

North West shares of part-time employees by 14 sectors (which are trend forecasts linked to national projections) are applied to the workplace employee estimates described above. Full-time employees are simply the total of employees minus the part-time employees for each of the 14 sectors.

Employment by gender

North West shares of male full-time employees by 14 sectors (which are trend forecasts linked to national projections) are applied to the workplace full-time employee estimates described above. Female full-time employees are simply the total of full-time employees minus the male full-time employees for each of the 14 sectors. The same method is applied to part-time employees and total male employees are simply the sum of full-time male employees plus part-time male employees.

Self employment (jobs)

Self employment data for the North West is LFS/APS based. The data is broken down by sector using both employee trends and the UK self employment by sector data. Data for the local authorities is Census based (and scale to the North West self employed jobs estimates) and is broken down by 9 sectors using the employees in employment sectoral structure. The sectors are forecast using the growth in the sectoral employees in employment data and the estimates are scaled to the regional estimate of self employment by sector. Self employment totals are broken down by gender using shares from the 2001 Census.

Self employment (people)

Self employed people, which are Census based are forecast at the growth rate of self employed jobs.

Workplace employment (people)

The data for employment from the Annual Business Inquiry (ABI) measures jobs rather than individuals. Because a model aiming to simulate housing demand needs to focus on people, we convert the number of jobs into numbers of employed people. To do this we measure and project numbers of full-time and part-time employees in each sector and area (see above). Individuals are assumed to hold only one full-time job each. Part-time jobs are assumed to account for half a full-time job. We have assumed that the 26,200 undercount of people in Manchester involves the same proportion of employed people as in the counted resident population for Manchester. The self-employed people are added to the full-time employees plus half of the part-time employees to arrive at an estimate of workplace based employment. An adjustment factor is applied to ensure consistency with the Census. No specific forecasting for this measure is required; it is calculated from the forecasted elements discussed above.

Total employment

Total employment includes the self-employed and Her Majesty's Forces (of which there are none in the City Region area). No specific forecasting for this measure is required - it is calculated from the forecasted elements discussed above.

Residence employment

Residence employment is based on a commuting matrix taken from the 2001 Census. This matrix tells us in a given area where the residents work. Using this information each available job (see

workplace employment people based above) is allocated to a resident of a given authority. This method assumes the proportions of commuting do not change over time. The exception to this rule is with respect to Manchester. Most of the largest migration flows are into Manchester for work, for example in 2001 only 35% of Manchester's jobs were taken by Manchester residents. Holding this constant would, with fast growth in the Manchester economy, lead to extremely high levels of in commuting which the current or planned infrastructure may not support. Indeed looking at the job estimates both workplace and resident based in the recent data suggests Manchester's proportion of jobs taken by Manchester residents has increased. As such this level is forecast.

Occupations (Workplace people based)

Occupations are forecast regionally using an occupation by industry occupation matrix (25 occupations, 14 industries). The coefficients within the matrix are projected based upon national trends in a similar matrix. This means that regionally occupational structure is predominantly dictated by changes in industrial structure though the model is capable of making regional specific adjustments. Locally occupations are forecasts using the regional matrix and the local industrial structure. For workplace based occupations the total workplace people based employment (see above) is used as the 'control total'. Using this method, without adjustment would produce an 'expected occupation structure' given regional characteristics. In other words, the number of managers in a given area would depend only upon trends in the regional occupational industry matrix and the local areas industrial structure. Comparison of this forecast method with the census reveals it to be a reasonable but not an entirely accurate forecast method. As such an adjustment factor is applied to ensure that the proportions of occupations match those reported in the Census. The adjustment factor is kept constant over the forecast though can be changed to simulate changes in occupation structure above and beyond that which industrial structure would predict.

Residence-based employment by Occupation

For residence occupations the percent of employment in each occupation (taken from the Census) is projected to grow at the same rate as the growth as in the workplace occupations (see above). The percents in each occupation are applied to the residence employed total (see above). This method assumes changes in workplace occupation structure occur at the same rate in the resident population.

Net Commuting

Net commuting of those in employment is obtained as a residual between residence-based and workplace-based estimates of numbers of people in employment. This is available both for total employment and for 9 occupation groups. These variables are used in the model as checks on the realism of the employment forecasts on resident and workforce bases. Our broad assumption will be that commuting flows remain broadly in line with past trends without significant changes in transport infrastructure. However, commuting flows may change as a consequence of new house building in an area. New house building will induce some automatic changes within the overall suite of models, but the commuting flows are examined to judge whether further adjustment is needed to residence-based employment to produce a balanced outcome (this is only done in extreme cases).

Unemployed, Inactive and Retired People

In addition to the employed, the demand for housing reflects the numbers of people not in work. Unemployment (claimant count) is projected based on regional trends and a measure of overall

labour market tightness (relative employment rate) in the local area. It is not at present directly affected by migration though they do impact indirectly through the employment rate (which has working age population as its denominator).

Inactivity is not modelled explicitly or by individual category (looking after the home, long term sick, retired etc.). Inactivity numbers can be calculated both in data and in the forecasts by subtracting the employed plus the unemployed from the population (either working age or 16 plus population)

Gross Value Added

GVA forecasts are available for 61 sectors at the level of the North West region as a whole. For areas within the region, data on total GVA is available at NUTS 3 level. This includes counties and former Metropolitan counties. Our forecasts at local authority level are obtained firstly by calculating an 'expected' GVA in each area. This is calculated by multiplying the North West region's GVA per employee in each sector by workplace employment in each sector within each local authority area. Expected GVA is then scaled to add the GVA at NUTS 3 level.

Workplace based wages

Data on average wages (or more formally compensation of employees) by sector is available in the regional accounts at regional level. Data for individual occupations is also available at regional level from the New Earnings Survey (NES) in the past and more recently the Annual Survey of Hours and Earnings (ASHE). At the level of individual local authorities estimates of total wages on a workplace basis and a residence basis are also available from the NES and now ASHE.

The growth in UK wages by sector is applied to the local area sectoral wage series (constructed using ASHE totals for authorities and regional industry totals) to give an estimate of wages within each sector. An adjustment factor is applied to reflect the relative occupation structure of each area. Hence areas where higher paying occupations are growing faster than the regional average will have higher wages. These wages estimates are then scaled to be consistent with regional wage totals.

Residence based wages

Residence based wages are constructed within the model by adjusting the workplace based wages for Manchester City Region. An adjustment factor, which is based upon ASHE workplace based and residence based data, is applied to ensure consistency with the published data. This factor is held constant but can be adjusted for scenario purposes. The workplace based wages in the Manchester City Region are calculated using the employment and workplace base wage data for the constituent authorities. Therefore changes in employment structure both by sector and occupation are accounted for at the Greater Manchester level.

Skills

The model produces forecasts for the number of resident people aged 15-74 with each 5 levels of qualifications. These are levels 0 (no qualifications) to level 4/5 (graduate and post-graduate) on the NVQ scale used in the census. Data on the number of those in employment at each qualification level in each of 9 occupations were obtained from the census for each area in 2001. Data on annual trends for the proportion of employees at each level was obtained from the LFS and used to construct an annual data series from 1997-2001. The forecasts for this series were

extrapolations of the data. For each local area, each qualification level within each occupation is forecast to grow at the North West regional rate for that qualification level. To ensure consistency and adding up to the regional totals one qualification level was left as a residual within each occupation. This was usually the largest. A similar procedure was used for those of working age not in employment and for those aged over retirement age (but under 74).

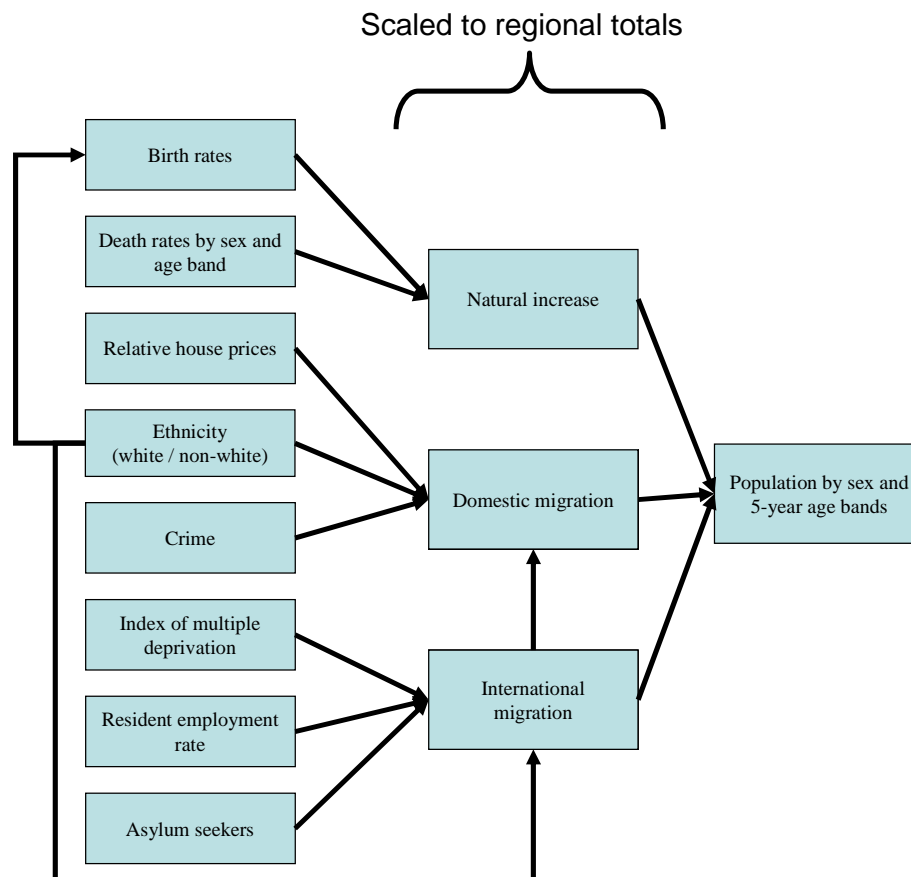
Demographic variables

Population and migration data are collected by five-year age groups as mid year estimates (MYE) for each area. The MYE data includes the revised figures for 1981-2000 published by NS in October 2004. The mid year estimate for 2001 includes the 26,200 undercount in Manchester, and we presume that the figures assume that the additional people have the same age distribution as the rest of the census population in Manchester.

Figure 3.2 illustrates the basic structure of the demographic model for each local authority, with changes in population broken down into 3 elements, each of which are described in more detail below. In summary, though:

- the 'natural increase' in the population is modelled by applying projected birth and death rates (forecast using ethnicity proportions) to appropriate elements of the existing population;
- migration, both domestic and international is modelled as the result of the interaction of a variety of economic, social and demographic factors.

Figure 3.2: Overview of components of the demographic model



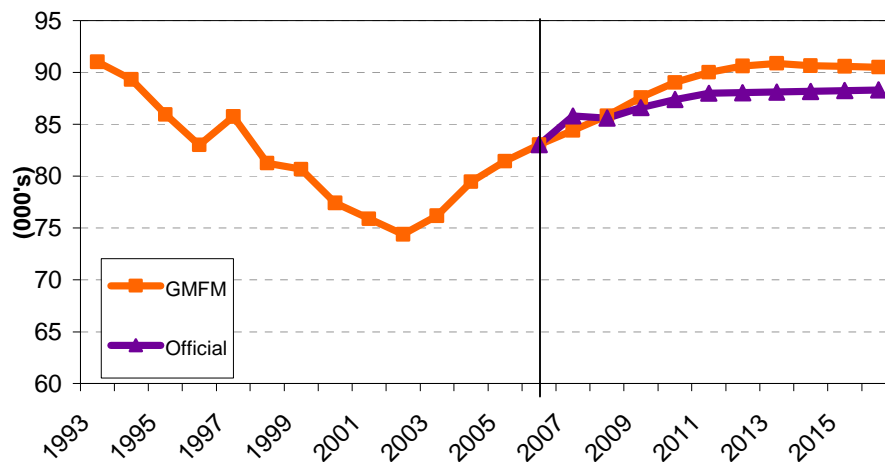
The natural increase in population

Birth rates have been derived for each district as a proportion of women aged 15-44, from Census data. These show a significant variation between districts – for baby boys the range is from 39 a year per 1000 women aged 15-44 in Blackburn to 26 in Sefton, with similar differences for baby girls. Such differences can arise from a variety of compositional differences between the populations of different districts, which might include factors such as ethnic origin, educational attainment, income levels and so on.

The projections assume that these differences in birth rates between districts persist into the future, and originally we did not attempt to model variations in these differentials over the future as, for example, the ethnic composition of the population changes. In the making housing count development work (see separate section below) birth rate equations incorporating ethnicity levels have been added to the projections methodology. The 2006 published data on births and deaths revealed a sharp up turn in births in many districts and a down turn in deaths from predicted (by official estimates) death rates. The birth rate increases are likely partly a function of the rising ethnicity levels (see Making Housing Count section) and falling deaths is probably a function of both improved medical care and out migration of retired people, possibly out of the UK altogether. Any error in the births equation to predict the number of births in the last year of data is held constant over the future (in practice the errors are small). The births estimated using the projected rates are scaled to total births for the region to ensure adding up.

Regionally the projection of birth and death rates (and consequently natural increase) is achieved by taking growth rates from the latest published National Statistics projections (which are in turn consistent with the Government Actuary Department (GAD) projections) and applying them to the current levels of births and deaths (2006). Figure 3.3 below shows the longer term birth rate projections (in numbers terms) for the North West region, from the GMFM and from the latest (2006 based) NS projections (which are based upon GAD country level estimates).

Figure 3.3: Projected births numbers, National Statistics and Oxford Economics



Source: NS, Oxford Economics

Death rates are specified for each sex and age group, derived from ONS figures for the North West region. These range from well under 1 death per year for every 1000 young people in the population, up to around 214 deaths per year for every 1000 men aged 85 or more (see Table 3.1).

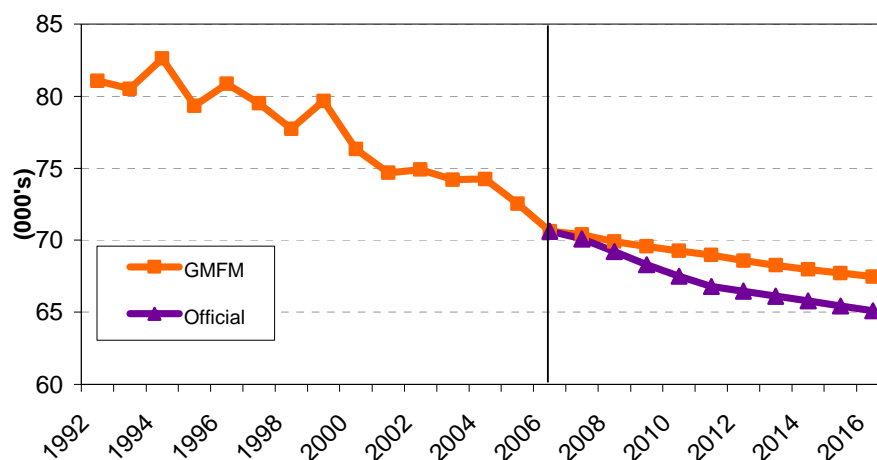
Table 3.1: Death Rates in the North West, 2007

	Male	Female
0-1	5.50	4.80
1-4	0.24	0.24
5-9	0.09	0.09
10-14	0.12	0.17
15-19	0.45	0.22
20-24	0.74	0.25
25-34	0.92	0.43
35-44	1.60	0.90
45-54	3.78	2.58
55-64	9.20	5.80
65-74	25.40	16.10
75-84	70.20	49.30
85 and above	179.10	153.60

Source: ONS Mortality Statistics

Note: per 1000 of the population in each age group

Projections are also available from the same source and continue to depict falling death rates. Using the death rate projections from ONS (2006 based) and the most recent deaths data (2007), the number of deaths is projected by projecting forward the death rate from the official projections onto the last data point. This has the effect as shown in the figure below which depicts the official (04 based) and current GMFM death projection in number terms.

Figure 3.4: Projected deaths numbers, NS and Oxford

Source: NS, Oxford Economics

At Local Authority level the official death rate projections are used to estimate deaths which are then scaled to the total number of regional deaths. This approach is simplified by estimating deaths of young people, working age and retirement age persons and allocating the numbers across five year age bands but the effect is the same in practice. There are therefore no differences in death rates across districts, The population structure is the determinant of the number of deaths. The model assumes any error in the equations ability to predict in the last year of data represent unknown factors and this is kept constant over the forecast (in practice these 'errors' are relatively small).

The **natural increase** in the population therefore results from a combination of a) the ageing of the surviving population by a year at a time, b) applying death rates to each sex and age group, and c) adding new births based on the number of women of child-bearing age and an equation based on the ethnic composition of the area.

Domestic migration

Domestic migration is modelled by an equation relating net inflows to a variety of economic and demographic factors. Equations were originally estimated separately for inflows and outflows, using data from the Census across all local authorities in the north of England.¹ Similar factors affect both inward and outward migration flows, but in net terms, working age domestic migration depends on²:

- **Ethnicity(-)**. The Making Housing Count development work identified ethnic proportions as an important factor in migration flows. The evidence suggests that as ethnic proportions increase in an area either through migration or natural increase levels to domestic out migration increase. Therefore, ethnic proportions (white and non-white identified separately) are negatively associated with domestic migration.
- **International migration (-)**. Imperial evidence shows that where there are inflows of international migration, there are also outflows of domestic migrations. Therefore domestic migration is negatively associated with net international migration.
- **Crime (-)**. Imperial evidence shows that domestic migration and crime levels are negatively associated.
- **Share of the change in NW net migration (+/0)**. In addition to migration flows that can be explained in terms of local factors, there are also more regional influences on migration within the UK. In practice, as net domestic migration into the North West has risen (to around zero from a historical tendency for net outflows each year) this has had more impact on net migration flows in the more rural districts of the region than in the cities, in particular in Cheshire, Cumbria and Lancashire rather than the districts of Greater Manchester or Merseyside. This means that where our regional modelling produces a different level of net domestic migration than that produced by the purely local equations, we allocate the difference across certain districts only rather than across all districts equally – the shares are shown in Table 3.2

¹ See Geoffrey Meen, 'A Simulation Model of Economic Segregation and Deprivation', University of Reading Centre for Spatial and Real Estate Economics, August 2004 for more details.

² Previous versions of the domestic migration equation contain IMD, vacancy rates and young people as factors. The equations undergo continual monitoring and revision as recent trends and migration become better understood.

Table 3.2: Changes in regional domestic net migration- allocation by district

	2001 (%)
Blackburn	5
Blackpool	5
Bolton	1
Bury	1
Cheshire	16
Cumbria	15
Halton	0
Knowsley	6
Lancashire	30
Liverpool	0
Manchester	0
Oldham	0
Rochdale	0
Salford	0
Sefton	0
St Helens	0
Stockport	0
Tameside	5
Trafford	9
Warrington	0
Wigan	1
Wirral	6

Source: OEF/RF calculations

Although these are the factors that are identified explicitly in the domestic migration equations, that does not mean that they are the only factors that will affect migration, since effects can operate indirectly through an impact on the direct drivers. This is the case with house prices, for example. We have not been able to identify a separate effect from house prices at the local level, but this does not mean that house prices have no effect on migration in the model – there is an effect at the regional level, and this will feed through into the districts as described above. Similarly, although unemployment and wages are not identified directly as driving forces in the local domestic migration equations, they will have an impact through the regional equation.

Ethnicity is projected separately for white and non-whites. The equation was estimated using cross sectional Census data and evidence from published literature (see Making Housing Count paper for fuller details). The projections are based on a stocks and flows method with international migration flows, both in and out assigned ethnic proportions.

Crime levels are currently held constant over the forecast period. It may be possible in further work to establish links between crime and deprivation or wealth.

Inflows are estimated by keeping the share of the North West flat. Outflows are simply the difference between the net and the inflow of international migration.

Once these economic and demographic factors determine our projections of net inward or outward migration, these are then split between the sex and age groups on the model in accordance with the average pattern over recent years.

International migration

Net international migration is projected based on a number of factors, as follows:

- **Ethnicity (+).** Levels of white and non white ethnicity within the population (which themselves depend upon migration flows) are positively related to net international migration flows. In other words, international migration flows are highest into areas with existing ethnic communities.
- **IMD(+).** Analysis shows that levels of IMD are positively correlated with international inflows. This may be a reflection of affordable or available accommodation in these locations.
- **Residence employment rate (+).** Research shows residence employment rates are positively related to net international migration flows. This is likely to reflect the attraction of migrants to areas with a record of employment opportunity.
- **Asylum seekers (+).** These provide a positive boost to the international migration flows.

Changes in **deprivation** are modelled in the same underlying way as migration, through a relationship estimated on cross-section data across local authorities, derived primarily from the Census³. The index of multiple deprivation depends on the following factors that are correlated with areas of deprivation:

- Unemployment (+)
- % of population with no qualifications (+)
- % of elderly in population (-)
- % of population with long-term illness (+)
- % of non-white in population (+)

Asylum seekers are not modelled and are set flat at the last value (from components of change data).

Outflows are estimated by taking last years value and adding on half the change in net migration (estimated as explained above). Inflows are simply the difference between the net and the outflow of international migration.

Once these economic and demographic factors determine our projections of net inward or outward migration, these are then split between the sex and age groups on the model in accordance with the average pattern over recent years.

Modelling population at the regional level

Our population forecasts at the local authority level are constrained to be consistent with our forecasts for changes in the population of the North West region as a whole. In this sense, our model is 'top-down', although the detailed modelling at the local authority level means the model has many of the characteristics of a 'bottom-up' model. In practice we find that the constraints have little impact on the forecast, but they are valuable in ensuring that the full set of numbers produced is internally consistent. They also mean that the factors we identify as important in determining population changes at the regional level, and which are reflected in our regular forecasts for the regions across the UK, are automatically reflected at a sub-regional level as well.

³ See Geoffrey Meen, 'Non-Linear Behaviour in Local Housing Markets and the implications for Sustainable Mixed-Income Communities in England', University of Reading Centre for Spatial and Real Estate Economics, March 2004 for more details.

The natural increase in population at the regional level is derived from official projections, as a proportion of the existing population. In this sense, therefore, our regional forecasts are entirely consistent with the official projections⁴. However, this is very different from saying we are simply taking the official projections as an assumption, since the migration element of population change is modelled explicitly within our forecasts. This is an important feature of analysing the links between economic, demographic and housing markets. Official projections of migration are based simply on the continuation of recent trends, while our approach depends on looking at the economic forces driving recent patterns of migration as well as simple trends.

Our estimation of the relationship between past developments in the net domestic migration of working age people into the North West and economic drivers has identified four significant factors:

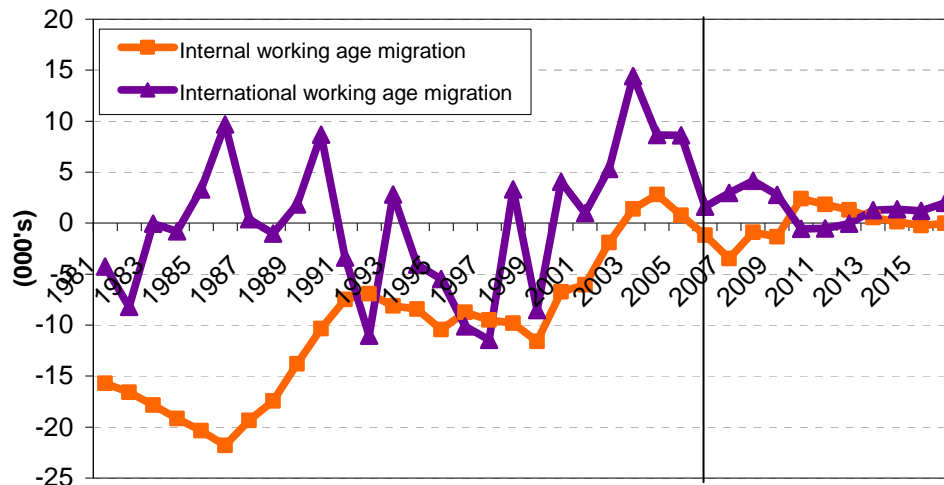
- An increase in unemployment in the North West relative to UK average tends to push up outward migration or reduce inward migration (and vice versa).
- Similarly, an increase in house prices in the North West relative to London tends to push up outward migration or reduce inward migration.
- In contrast, an increase in average wages in the North West relative to London tends to push up inward migration or reduce outward migration.
- There is a relatively small effect from changes in net international migration into the UK, whereby the share of this coming into the North West is enough to generate some crowding out of domestic migration in the sense that an increase in net inward international migration to the UK tends to lead to a reduction in net domestic migration into the North West (or an increase in net domestic migration out of the North West).

Similar effects are identified by our estimation of the determinants of net international migration into the North West:

- An increase in house prices in the North West relative to London tends to reduce the amount of international migration coming into the region.
- In contrast, an increase in average wages in the North West relative to London tends to push up inward international migration to the region.
- An increase in the overall level of international migration into the UK pushes up the numbers migration from overseas into the North West – other things equal, around 8% of any increase in overall international migrants to the UK find their way into the North West.

Forecasting the overall number of international migrants into the UK (and therefore the effect this will have on the North West) is far from straightforward given the political sensitivity of the figures and debate about how policy should seek to control immigration. Our projections are close to central official projections in the longer run (assuming a net inflow of 145,000 per year). In the short run the forecasts are higher than official projections but not as high as some recent years where figures have reached over 250,000, but still sufficient to have a substantial cumulative impact on the population of the UK and of the North West. For the region as a whole, this leads to the migration forecasts shown in figure 3.5, which underlie the district forecasts presented next.

⁴ Where existing data is available official projections of natural increase are adjusted according to the new information.

Figure 3.5: North West net migration of working age people

Source: NS, Oxford Economics

Housing variables

Coverage

The geographical coverage of the housing model is the same as for the demographic model, with models constructed for each of the unitary authorities and counties within the North West region. The housing, and other, models are constructed on an annual basis. Historic data is much more limited for housing than for most other elements of the system, and in a number of cases it has only been possible to collect data for the period 1998-2004 or 2005.

The model produces forecasts for housing demand and supply, split between owner-occupied housing, the social rental sector and the private rental sector. There are also forecasts for housing vacancies, consistent with the supply and demand estimates, and for house prices relative to the regional average. The impossibility of sourcing adequate data means that we have not been able to distinguish between different sizes of houses (e.g. flats, terraced, semis and detached, or 1-bed, 2-bed, 3-bed, etc) within the housing model.

Data issues

The model requires a time-series of data for the key variables. In principle, a consistent stock-flow accounting of housing data over time would be desirable, so that in any period the change in the housing stock can be matched exactly to the level of completions less demolitions. But in practice the available data does not appear robust to enough achieve this consistency over time. The housing model uses Housing Investment Programme data on housing stock and combines this with data on completions and demolitions supplied by the local authorities themselves where available. Over the past, we allow for a residual category so that the system 'adds up'. In the historical data this residual may be large in any one year, but tends to cancel out over time, suggesting that one of the main inconsistencies between the different sources of data is in terms of timing differences. Over the forecast this residual category is set to zero, so that the housing flows identity is achieved by assumption.

A further complication is that the available data on vacant property does not always appear to be consistent with estimates of the number of vacant dwellings calculated by subtracting the numbers of households from the dwelling stock. Indeed, in some cases the vacancy data clearly look implausible. It is hard to reconcile the apparent increase in vacancies in Manchester over the past five years with the rising population of the district, for example. In the model we therefore define a ‘model consistent’ vacancy rate defined as the excess of properties over households, as a percentage of households. While the different direction of change in the recent past in Manchester makes it hard to reconcile this model consistent rate with the actual vacancy data, in the case of Salford, it has been suggested to us that a plausible real vacancy rate might lie half way between the two.

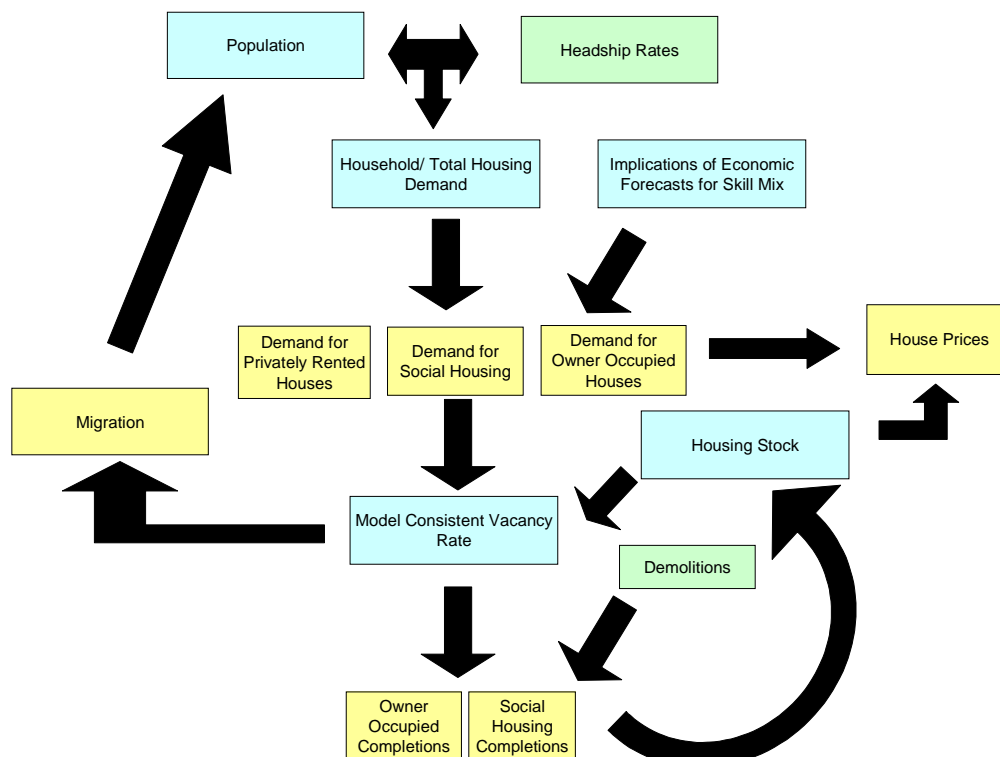
Model Structure

Figure 3.6 illustrates the basic structure of the housing model for each local authority. Key elements of this structure, which are discussed in turn below, are:

- the use of ‘headship rates’ to turn population forecasts into projections for the number of households forecast for each district;
- a breakdown of the number of households by tenure choice, to estimate demand for owner-occupation, social housing and private rented housing;
- modelling of the housing stock through demolitions and new completions; and
- modelling of house prices in each district relative to the regional average, depending on factors such as the degree of deprivation in the district and the prevalence of owner-occupation.

The diagram also illustrates feedbacks into the demographic part of the modelling through the impact on migration decisions (as discussed above) of vacancy rates, themselves derived from interactions between numbers of households and the housing stock.

Figure 3.6: The Housing Model



From Population to Households

The model produces forecasts for the population by five-year age groups (POPj). These are combined with estimates of the share of the population of each five-year age group who form households (rather than being part of someone else's household), known as the 'headship rate'. The initial GMFM approach to headship rates was to base these purely on the age distribution of the population, reflecting the marked tendency for older people to be more likely to be the head of their own household rather than living as part of another household (eg with their parents). Headship rates for all ages were projected to rise gradually over time, reflecting official projections of declining numbers of people per household.

This approach has been modified in two ways. First, we have now been able to obtain from ONS the implied projections of headship rates for different age groups that underlie the 2003-based household projections (see Table 3.3). Despite housing difficulties for young people, these show headship rates generally increasing more rapidly for younger people, and this has now been incorporated into the model.

Table 3.3: Headship rates

Age	2001	2026	Average annual % change 2001-2026
15-19	0.03	0.04	0.81
20-24	0.23	0.25	0.31
25-29	0.43	0.43	0.07
30-34	0.53	0.59	0.45
35-39	0.57	0.65	0.55
40-44	0.57	0.64	0.46
45-49	0.57	0.63	0.35
50-54	0.58	0.63	0.32
55-59	0.59	0.63	0.25
60-64	0.61	0.64	0.17
65-69	0.65	0.65	0.04
70-74	0.69	0.68	-0.08
75-79	0.75	0.72	-0.17
80-84	0.80	0.76	-0.20
85+	0.86	0.83	-0.11
Total	0.42	0.48	0.48

Source: Oxford Economics calculations from ONS 2003-based household projections

Second, we have taken account of evidence of a significantly higher number of people per household for non-white ethnic minorities (Table 3.4). Our approach is to build in lower headship rates (ie higher people per household) where non-white ethnic minorities are increasing as a share of population, based on the overall difference for England and Wales between the average number of people per household for non-white ethnic minorities compared with the overall average.

Table 3.4: People per household, 2001

	WBr	WEM	NWEM	White	All
England and Wales	2.35	2.18	3.21	2.35	2.40
North West	2.36	1.97	3.50	2.35	2.39
Bolton	2.33	1.91	3.65	2.32	2.42
Bury	2.39	1.93	3.74	2.38	2.43
Manchester	2.25	1.91	3.14	2.21	2.35
Oldham	2.33	1.78	4.39	2.31	2.47
Rochdale	2.36	1.79	4.10	2.34	2.46
Salford	2.28	1.97	3.07	2.27	2.29
Stockport	2.34	2.01	3.31	2.33	2.36
Tameside	2.34	1.82	3.57	2.32	2.37
Trafford	2.33	1.93	3.09	2.30	2.35
Wigan	2.41	1.92	3.14	2.40	2.41
Gr Man	2.33	1.91	3.48	2.32	2.39
Cheshire	2.40	2.14	3.23	2.40	2.41
Warrington	2.44	2.04	3.55	2.43	2.45

Source: 2001 Census

Tenure choice

The forecasts of households provide the implied total demand for housing. This is then broken down into households renting from the social sector (local authorities, registered social landlords), owner-occupiers, and those renting in the private sector. In summary:

- The social rented tenure share is forecast based on the occupational structure of the resident population, modified by the age structure of the population and an affordability indicator. In turn the affordability indicator is projected to change over time according to the movements in lower quartile house prices and lower quartile residence-based earnings, while lower quartile prices are by default projected to grow at the same rate as average house prices.
- Once the social rented tenure share is determined, the split of the remainder between owner-occupation and private renting, is determined in a similar manner to the social rented tenure share outlined above, based on occupations, young households and affordability constraints. There is also a relative price term in the equation comparing rents with a proxy for mortgage payments estimated by multiplying house prices by the mortgage rate.

Incomes are clearly an important factor in determining tenure choice, and low incomes are clearly a barrier to aspirations of owner-occupation and private renting. Clearly, it is the incomes of people who live in an area that are most relevant rather than incomes of those who work in an area. Comparing results of the 1991 census with the 2001 census shows that the tenure choice by occupation has been relatively stable. Differences in the mix of occupations across time and across districts have had a significant impact on aggregate tenure choice. As a first stage in the modelling process, therefore, GMFM uses information on the occupations of the resident population.

Of course, tenure choice is strongly connected with the affordability of the types of tenure. This is especially important for households at the lower end of the income scale who make many of the

marginal decisions. We have therefore included a series on lower quartile earnings on the model. Residence-based earnings data used here are taken from the Annual Survey of Hours and Earnings (ASHE) from 2002, the first year for which this data are available. Such data includes greater income distribution, but is only available for a limited time period. And while data are robust over the cross-section of the economy, they are not a valid time series and are not reported with as much reliability as mean wages. However, this information has been used to benchmark a mapping of wages by sector to lower quartile wages using shifts in the occupational mix of employment.

In addition, a clear difference in tenure choice across age groups is visible in census data, with owner-occupation more widespread among older households. Renting (both private and social) is generally more widespread in younger, less settled households. Differences are evident for households with a head aged under-25 and to a lesser extent for under-35s. Distribution of tenure choice is more settled for older households. Looking at households with heads aged under-35 as a whole, it is clear that owner-occupiers are less widespread than among the wider population, while social renting takes a higher share. Even excluding social renting, owner-occupiers take a much smaller share than in the wider population. This is partly due to lower incomes and lower accumulated wealth for these households, but also due to the more unsettled nature of the households.

In practice, adjusting estimates of tenure choice based on occupation shares by taking account of the relative concentration of under-35 households leads to a much closer indicator of the expected share of social renting within housing tenure. Similar analysis shows that the relative share of even younger households (under-25s) gives additional information. The share of households entering social housing in a period is therefore modelled as reflecting the occupational composition of that district with an estimated adjustment based on the relative share of households aged under 35 and the relative share of households aged under 25. A further factor to determine affordability is also included.

Housing Supply

The evolution of the housing stock (HS) will depend upon the number of completions and the number of demolitions each year. In practice these are to some extent policy variables. But in order to illustrate the implications of our other projections for housing, the model includes equations that aim to mimic the impact of policy that is, in a sense, 'neutral'. This means that demolitions are projected to continue at a level in line with the average over recent years, while completions are projected at a level that matches the change in housing demand in such a way that the model consistent vacancy rate remains broadly constant.

House Prices

The housing model also contains equations for average house prices in each district relative to overall North West average house prices. The equations show this relativity being affected by:

- the relative Index of Multiple Deprivation (IMD);
- the relative level of wages; and
- the relative share of owner occupied housing.

In practice, the key feed-backs from the housing model work through the effects on migration of changes in the property vacancy rate. House prices themselves are largely an output of the system rather than an input elsewhere in the model.

4: Data used

Labour market

Employees in employment

Description: Mid year employee job estimates – consistent with national sectoral data.

Data: 1991 – 1995 Annual Employment Survey (AES)
1995 – 1997 Annual Employment Survey rescaled to ABI
1998 – 2007 Annual Business Inquiry (ABI)
2008 – 2009 Economic & Labour Market Review (ELMR)

Latest data:

Regional data: 2009
Local Authority data: 2007
Monthly data: 2009

Next release:

Regional data: ABI 2008 results available December 2009
ELMR June 2009 data available September 2009
Local Authority data: ABI 2008 results available December 2009
Monthly data: June 2009 data available September 2009

Methodology:

There are two sources of employee jobs data for Great Britain as shown in the table below – the ABI and the Monthly Digest of Statistics, table 3.3, employee jobs: all industries. The figures shown are for June 2008 and are mid-year estimates of employee jobs which are used in the Oxford Economics regional model. Our model uses the Monthly Digest of Statistics estimate of employee jobs to be consistent with other data in the model and also this series is timelier as quarterly estimates are produced.

A scaling factor is used to convert the ABI data into a mid-year series matching the data in the Monthly Digest of Statistics. This is calculated as the Monthly Digest series divided by the ABI series and is also shown in the table below.

Table 4.1: Comparison of sources of GB employee jobs data

	ABI data (000s, December 2008)	Monthly Digest of Statistics (000s, June 2008)	Scaling factor
Agriculture, forestry and fishing	252	257	1.02
Extraction and utilities	180	175	0.97
Manufacturing	2,798	2,781	0.99
Construction	1,310	1,275	0.97
Wholesale and retail distribution	4,442	4,455	1.00
Hotels and restaurants	1,794	1,793	1.00
Transport and communications	1,572	1,565	1.00
Financial intermediation	1,039	1,030	0.99
Business services	4,770	4,689	0.98
Public administration & defence	1,450	1,415	0.98
Education	2,469	2,348	0.95
Health and social work	3,287	3,305	1.01
Other personal services	1,403	1,399	1.00
Total employees	26,764	26,486	0.99

Source: ABI, Monthly Digest of Statistics, Oxford Economics

Note: Data from the Monthly Digest of Statistics publishes the extraction and utilities sectors together. For comparison we have aggregated the ABI data for these sectors.

Below is an abstract from the Monthly Digest of Statistics table which contains the GB sector employee figures to which our regional figures correspond. It is very important that our regional employee figures match up exactly to this series as this series is linked though to the national accounts.

Figure 4.1: Monthly Digest of Statistics, Table 3.3 (July Edition)

Labour market

3.3 Employee jobs: all industries^{1,2}
Great Britain

continued Not seasonally adjusted Thousands

SIC 1992 Division or Classes	Agriculture, hunting, forestry and fishing	Mining and quarrying, electricity, gas and water supply	Manufacture of food, drink and tobacco	Manufacture of clothing, leather and wood products	Paper, printing and recording media	Chemicals, chemical products and man-made fibres	Rubber and plastic products	Non-metallic mineral products, metal and metal products	Machinery and equipment, nec	Electrical and optical equipment	Transport equipment	Coke, nuclear fuel and other manufacturing, nec
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SIC 1992 Division or Classes	LMA1	LMA4	LMAH	LMAO	LMAF	LMAQ	LMAE	LMAI	LMAJ	LMAK	LMAU	LMAV	LMAW	LMAX
2005	326	121	429	129	27	364	196	196	496	273	324	322	201	192
2006	329	125	420	114	73	375	190	189	481	303	306	306	192	188
2007	342	169	396	104	70	362	182	179	472	260	297	301	188	187
2008	357	175	385	89	73	348	173	175	485	309	317	306	187	187
2007 Q3	342	169	396	104	70	362	182	179	472	260	297	301	188	187
Q3	348	173	389	102	75	358	180	177	476	271	304	302	189	189
Q4	325	172	389	101	74	354	179	178	472	270	294	302	191	191
2008 Q1	345	173	385	89	70	349	179	178	486	270	290	305	187	187
Q2	357	175	385	89	73	348	173	175	485	309	317	306	187	187
Q3	340	174	390	88	69	337	172	180	441	304	311	295	190	190
2008 Q1	345	173 ¹	383 ¹	91	87 ¹	327 ¹	171 ¹	158 ¹	425 ¹	254	271	282	175 ¹	175 ¹
2008 Feb	-	173	387	89	75	351	179	175	490	309	311	305	188	188
Mar	-	173	385	89	75	349	179	178	490	270	290	305	187	187
Apr	-	174	385	90	74	348	179	176	484	269	289	305	187	187
May	-	174	385	90	74	348	173	175	484	309	306	306	188	188
Jun	-	175	385	90	73	348	173	175	485	309	317	306	187	187
Jul	-	174	384	89	73	348	177	174	483	260	286	305	188	188
Aug	-	175	384	89	73	348	177	172	480	260	286	304	184	184
Sep	-	175	382	88	72	343	176	170	457	258	285	302	182	182
Oct	-	175	382	88	71	341	175	169	454	266	284	301	184	184
Nov	-	174	382	87	70	341	174	168	447	265	283	299	182	182
Dec	-	174	380	86	69	337	173	166	441	264	281	295	180	180
2008 Jan	-	174 ¹	387 ¹	93	88	334	172 ¹	164	435	260 ¹	277 ¹	295 ¹	178	178
Feb	-	174	385	92	88 ¹	330	171	161 ¹	430	257	275	298	179	179
Mar	-	173	383	91	87	327 ¹	171	159	425 ¹	254	271	282	175	175
Apr	-	174	383	91	87	325	169	158	422	251	269	279	173	173
May	-	174	383	90	86	323	168	158	420	248	267	277	172	172

SIC 1992 Division or Classes	Construction	Wholesale and retail trade and repairs	Hotels and restaurants	Transport and storage	Post and telecommunications	Financial intermediation	Real estate	Renting, research, computer and other business activities	Public administration and defence, compulsory social security	Education	Health and social work activities	Other community social and personal activities
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SIC 1992 Division or Classes	LMAW	LMAZ	LMAA	LMAJ	LMDC	LMDD	LMDE	LMDF	LMDD	LMDF	LMDD	LMDF	LMDD	LMDF
2005	1 188	4 478	1 513	1 074	491	1 044	441	3 027	1 450	2 274	3 188	1 365	1 365	1 365
2006	1 224	4 432	1 797	1 077	482	1 040	442	4 019	1 454	2 311	3 220	1 406	1 406	1 406
2007	1 224	4 429	1 783	1 067	485	1 045	442	4 183	1 450	2 328	3 249	1 382	1 382	1 382
2008	1 275	4 452	1 782	1 101	484	1 030	445	4 244	1 415	2 340	3 205	1 398	1 398	1 398
2007 Q3	1 224	4 429	1 783	1 067	485	1 045	442	4 183	1 450	2 328	3 249	1 382	1 382	1 382
Q3	1 261	4 418	1 764	1 090	481	1 049	447	4 227	1 448	2 306	3 257	1 379	1 379	1 379
Q4	1 282	4 578	1 782	1 068	485	1 042	441	4 251	1 440	2 352	3 264	1 370	1 370	1 370
2008 Q1	1 277	4 452	1 749	1 096	480	1 044	445	4 215	1 421	2 352	3 282	1 374	1 374	1 374
Q2	1 275	4 452	1 782	1 101	484	1 030	445	4 244	1 415	2 340	3 205	1 398	1 398	1 398
Q3	1 224	4 429	1 783	1 067	485	1 045	442	4 183	1 450	2 328	3 249	1 382	1 382	1 382
Q4	1 261	4 474	1 783	1 068	474	1 036	437	4 148	1 425	2 370	3 270	1 382	1 382	1 382
2008 Q1	1 289	4 502	1 718	1 065	438	890	427	4 041	1 401	2 342	3 282	1 380	1 380	1 380

¹ The data in this table have not been adjusted to reflect the 2001 Census population data. Further information can be found at <http://www.statistics.gov.uk/StatBase/Product.asp?vln=6785>.

² Estimates for employee jobs and worldwide jobs for Great Britain use the Annual Business Inquiry as a benchmark for which the quarterly movements are based. There is a discontinuity in the employee jobs series between December 2005 and September 2008 due to improvements to the annual benchmark. Further information can be found at <http://www.statistics.gov.uk/StatBase/Product.asp?vln=6785>.

Source: Office for National Statistics

The table below shows both the raw data from the ABI and scaled employee data as used in the Oxford Economics model for the North West region. The ABI data is scaled to be consistent with the GB series as shown above and hence the 11 regions add to the GB series. The scaling factor which is applied to the raw ABI data for the North West is also shown in the table below and is the same as the scaling factor shown in the table above for GB (Note: the scaling factor for extraction and utilities and manufacturing is slightly different as these are aggregates of sub-sectors).

Table 4.2: Sectoral scaling factors, North West, 2007

	ABI data (000s, December 2007)	OE/RF scaled data (000s, 2007)	Scaling factor
Agriculture, forestry and fishing	16	16	0.97
Extraction and utilities	12	12	0.96
Manufacturing	377	381	1.01
Construction	154	147	0.96
Wholesale and retail distribution	515	517	1.00
Hotels and restaurants	206	206	1.00
Transport and communications	171	171	1.00
Financial intermediation	104	103	0.99
Business services	486	477	0.98
Public administration & defence	179	175	0.98
Education	289	274	0.95
Health and social work	389	391	1.01
Other personal services	140	139	1.00
Total employees	3,038	3,007	0.99

Source: ABI, Oxford Economics

Note: The extraction and utilities sectors have been aggregated together

Data for 2008 for the region is taken from the ELMR. This is used as it is more up-to-date until the ABI data becomes available. When the ABI data is released, this data is used instead if available.

The table below compares the raw data from the ABI for 2007 to the scaled data which is used within the GMFM. The data for the North West region has been scaled down by 1.0%, as shown by the scaling factor of 0.99 in the table above. This ensures that the regional data remains consistent with the UK macro data. Consequently, all of the local areas within the Greater Manchester area are scaled down slightly, the biggest change is seen in Salford where the ABI data is scaled down by 1.2%, a downward revision of 2,000 employees.

Table 4.3: Comparison of ABI total employee data with GMFM data, 2007

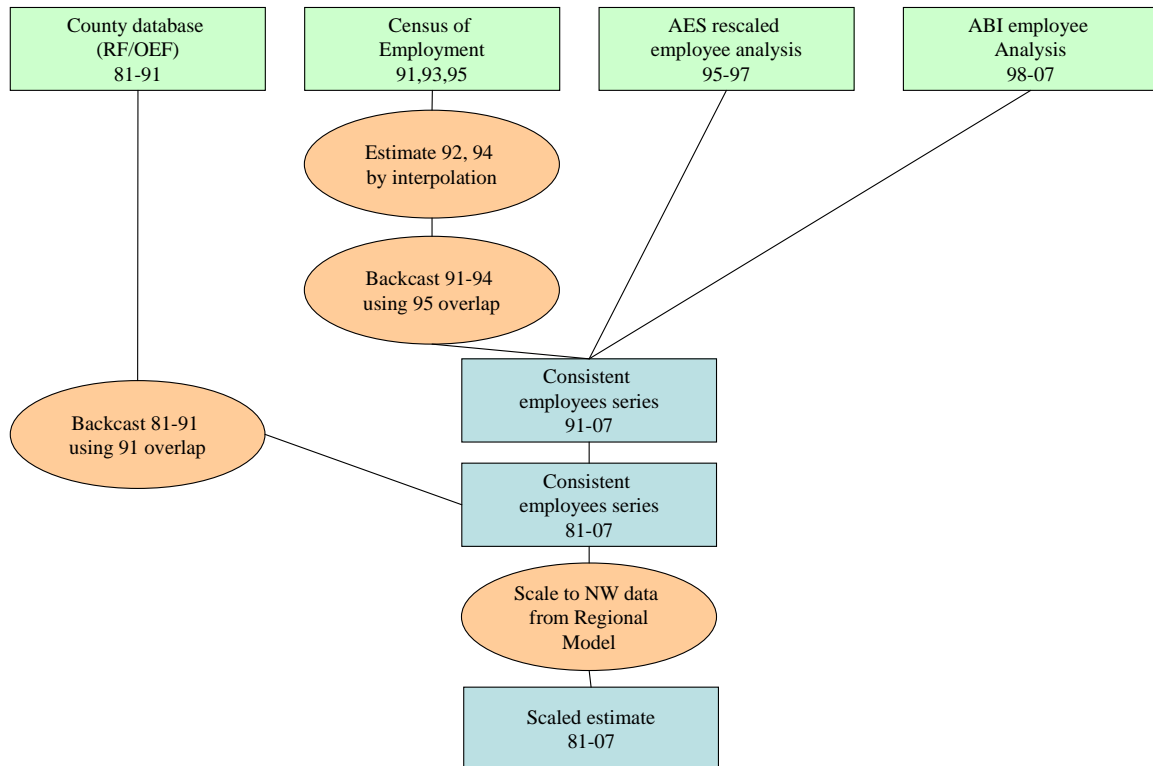
	ABI data (000s, December 2007)	OE/RF scaled data (000s, 2007)	Difference
Bolton	106	105	-0.8%
Bury	63	63	-0.5%
Manchester	309	306	-1.1%
Oldham	79	79	-0.8%
Rochdale	79	79	-0.5%
Salford	117	115	-1.2%
Stockport	123	122	-1.0%
Tameside	71	71	-0.5%
Trafford	126	124	-1.1%
Wigan	101	100	-0.8%
North West	3,038	3,007	-1.0%

Source: ABI, Monthly Digest of Statistics, Oxford Economics

Within the GMFM, employees in employment are broken down into 59 sectors. The sectoral data is also scaled as described above to ensure the data adds to the regional sectoral aggregates.

The sources and methodology behind the construction of the employees in employment series used within GMFM are summarised in the diagram below:

Figure 4.2: Sources and methodology of employee data within GMFM



Male / female employees in employment

Description: Mid year male and female employee job estimates – consistent with employee job estimates see above.

Data: 1991-1995 Annual Employment Survey (AES)
 1995 – 1997 Annual Employment Survey rescaled to ABI
 1998 – 2007 Annual Business Inquiry (ABI)

Latest data:

Regional data: 2007

Local Authority data: 2007

Next release:

Regional data: ABI 2008 results available December 2009

Local Authority data: ABI 2008 results available December 2009

Data for male and female employees in employment is also taken from the ABI. The proportion of male employees within each sector (14 sectors) are applied to the scaled employees in employment estimates described above so produce estimates of male employee jobs. Female employee jobs are calculated as by taking the male estimate from the total. The table below shows the effect of the scaling on total male employees.

Table 4.4: Comparison of ABI total male employee data with GMFM data, 2007

	ABI data (000's, 2007)	OE/RF scaled data (000s, 2007)	Difference (%)
Bolton	53.5	53.2	-0.6%
Bury	29.4	29.4	-0.1%
Manchester	153.8	152.1	-1.1%
Oldham	41.2	40.9	-0.7%
Rochdale	42.6	42.5	-0.2%
Salford	61.0	60.3	-1.1%
Stockport	63.4	62.8	-0.9%
Tameside	35.7	35.7	-0.2%
Trafford	69.9	69.1	-1.1%
Wigan	53.3	52.9	-0.7%
North West	1,541.5	1,526.7	-1.0%

Source: ABI, Oxford Economics

The table above compares the scaled data for male employees in employment compared to the raw data from the ABI. The scaled data for the region is slightly less than the raw data, where the ABI gives a value of 1541.5 for total male employees in employment whereas the scaled series is 1526.7, 1.0% lower. This scaled series is consistent with the scaled sector split as described above. The effect of the scaling is also shown. The effects of the scaling are a similar pattern to the employees in employment scaling shown in Table 4.3 above.

Full-time/part-time split

Description: Mid year full-time and part-time employee job estimates consistent with employee job estimates see above.

Data: 1991-1995 Annual Employment Survey (AES)
1995 - 1997 Annual Employment Survey rescaled to ABI
1998 - 2007 Annual Business Inquiry (ABI)

Latest data:

Regional data: 2007

Local Authority data: 2007

Next release:

Regional data: ABI 2008 results available December 2009

Local Authority data: ABI 2008 results available December 2009

Data for full-time and part-time employees in employment also comes for the ABI. The proportion of full-time employees within each sector (14 sectors) are applied to the scaled employees in employment estimates described above so produce estimates of full-time employee jobs. Part-time employee jobs are calculated as by taking the male estimate from the total. This gives a full-time/part-time series consistent with the scaled sectoral totals described above. The table below shows the effect of the scaling on full-time employee employees.

Table 4.5: Comparison of ABI full-time employee data with GMFM data, 2007

	ABI data (000's, 2007)	OE/RF scaled data (000s, 2007)	Difference (%)
Bolton	72.5	72.0	-0.7%
Bury	43.1	42.9	-0.4%
Manchester	223.2	220.6	-1.1%
Oldham	56.7	56.2	-0.8%
Rochdale	56.4	56.3	-0.3%
Salford	84.5	83.5	-1.2%
Stockport	86.0	85.1	-1.0%
Tameside	49.4	49.2	-0.4%
Trafford	87.8	86.8	-1.2%
Wigan	69.8	69.1	-0.9%
North West	2,103.5	2,082.3	-1.0%

Source: ABI, Oxford Economics

The table above sets out the raw full-time employee data and the scaled series. The amount of the scaling is also shown. The effect of scaling the data revises downwards the levels of full-time employment in all of the areas. Note that part-time employee estimates are also lower than the ABI for the reasons explained in the section under employees in employment. The biggest change is within Salford and Trafford where the scaled data is 1.2% different from the raw series. Also is worth pointing out that the pattern of the amount of scaling is very similar to that shown in Table 4.3.

Self employment

Description: Mid year self employment job estimates

Data: Monthly Digest of Statistics
 Census 2001 for local area estimates.
 Regional Data for the North West is available from the LFS

Latest data: Regional - 2008
 Local authorities - 2007

Next release: 2009, available January 2010

Self employment data for the UK is taken from the Monthly Digest of Statistics Table 4.2 - Self employment jobs (ONS series name BCAG). The annual figure used within the model is the quarter 2 value each year. The table below shows that there is no difference between the source and the data used within the model at the UK level.

Table 4.6: Self employment in North West

	Monthly Digest of Statistics data (000's)	OE/RF scaled data (000's)	Difference (%)
2003	3896	3896	0.0
2004	3982	3982	0.0
2005	3961	3961	0.0
2006	4072	4072	0.0
2007	4164	4164	0.0

Source: Monthly Digest of Statistics, Oxford Economics

The value for GB total self employed is calculated as the UK series from Monthly Digest of Statistics minus the Northern Ireland total self employed value. Northern Ireland data for self employment is published by Department of Enterprise, Trade and Investment within the Quarterly Employment Survey.

The sectoral data for GB is requested from the ONS (the data requested data was formerly published within Labour Market Trends, Table B11). The sectoral data is provided for 26 SIC codes. The GB sector data is scaled to the constructed GB self employment total consistent with the UK series.

The regional data (total) is taken from the Labour Force Survey Quarterly Supplement and is scaled to the GB sector series. The table below sets out the LFS data and the data used within the model. The effects of the scaling are shown by the difference column. The effect of the scaling is to increase self employment by almost 9% in each year. This is a result of definitional differences within the data series. The LFS data is a people based estimate of self employment whereas the series from Monthly Digest of Statistics which is used to scale to, is a job based estimate of self employment. Scaling to the jobs based self employment series ensures that the self employment data remains consistent with the employees in employment series, which is also jobs based.

Table 4.7: Self employment in North West

	LFS Self employment data	OE/RF scaled data (000's)	Difference (%)
2003	348.0	368.7	5.9
2004	372.5	384.7	3.3
2005	350.0	380.2	8.6
2006	360.7	388.8	7.8
2007	357.8	388.8	8.7

Source: LFS, Oxford Economics

The basis of self employment data for the local areas within the GMFM is the Census of Population, 2001. There are a number of steps in constructing a self employment series for the local areas within Greater Manchester. These are described below:

- 1: Using the regional data, ratios of self employment to employees in employment are calculated and then applied to the local area employees in employment data by 9 sectors to give a first round estimate of self employment by sector within the local areas.
- 2: This first round estimate of self employment by sector is scaled to the self-employment totals taken from the Census of Population 2001. The scaling factor is held constant across all years to produce a time series estimate of self-employment by sector matching the Census of Population in 2001.
- 3: Finally, this constructed self employment series is then scaled to the regional sectoral series to convert to a jobs estimate and to ensure that the 9 sectors for the local area data add to the regional series.

Table 4.8: Comparison of self employment data with GMFM data, 2001

	Census data (000s, 2001)	OE/RF scaled data (000s, 2001)	Difference 2001
Bolton	12.0	13.3	11.2%
Bury	8.8	9.7	10.3%
Manchester	18.8	21.4	14.0%
Oldham	9.4	10.4	9.7%
Rochdale	9.2	10.1	10.3%
Salford	8.6	9.7	12.1%
Stockport	15.2	17.0	11.5%
Tameside	9.4	10.3	10.3%
Trafford	11.2	12.6	12.3%
Wigan	12.8	14.1	10.3%
North West	327	361	10.6%

Source: Census, Oxford Economics

The table above compares the 2001 self-employment data taken from the Census of Population with the series used within the GMFM. The scaled series used within GMFM is considerably higher than the series from the Census. Self employment within all areas has been scaled upwards to be consistent with the regional data. Data for the North West is over 10% higher than the Census. In general urban areas within the region are above the regional average in terms of the impact of scaling and rural areas are below. The scaling to the jobs based estimate, and not people as per the data from the Census, keeps the self employment series consistent with the employees in employment series.

Employees in HMF forces

Description: Mid year estimate of employees in Her Majesty's Forces based within the UK

Data: DASA

Latest data: 2008

Next release: Quarter 1 2009, available Autumn 2009

Data for employees in Her Majesty's Forces is taken from DASA. The data shows that within the North West all the employees in HMF forces are located within the Cumbria and Lancashire areas; hence there is not a lot of information in the table below. The data for the North West matches the raw source exactly. There is no scaling involved in this series.

Table 4.9: Comparison of employees in forces data with GMFM data, 2007

	DASA data (000s, 2007)	OE/RF scaled data (000s, 2007)	Difference
Bolton	-	0.0	-
Bury	-	0.0	-
Manchester	-	0.0	-
Oldham	-	0.0	-
Rochdale	-	0.0	-
Salford	-	0.0	-
Stockport	-	0.0	-
Tameside	-	0.0	-
Trafford	-	0.0	-
Wigan	-	0.0	-
North West	1.7	1.70	0.0%

Source: DASA, Oxford Economics

Unemployment

Description: Mid year claimant count unemployment – seasonally adjusted

Data: Local authorities: Nomis – Claimant count with rates and proportions
Regional : Nomis – Claimant Count seasonally adjusted

Latest data: 2008

Next release: 2009, Spring 2010

Note: Annual average values are calculated from the monthly data.

The table below compares the raw unemployment data with the scaled series. The scaling ensures that the local areas add to the North West series which is seasonally adjusted. The changes as a result of the scaling are also set out in the table below. The seasonally adjusted series for the region is slightly less than the unadjusted series. The amount of the scaling is small, with less than 1% downward scaling in each of the areas within the GMFM.

Table 4.10: Comparison of unemployment data with GMFM data, 2008

	NOMIS data (000's 2008)	OE/RF scaled data (000s, 2008)	Difference (000'S)
Bolton	4.84	4.80	0.0
Bury	2.59	2.57	0.0
Manchester	11.54	11.46	-0.1
Oldham	4.32	4.29	0.0
Rochdale	4.27	4.24	0.0
Salford	4.27	4.24	0.0
Stockport	3.39	3.36	0.0
Tameside	3.73	3.71	0.0
Trafford	2.52	2.50	0.0
Wigan	5.49	5.45	0.0
North West	115.5	115.6	0.0

Source: Nomis, Oxford Economics

Residence based employment

Description: Number of people who are working resident within an area (irrespective of their location of work)

Data: Local authorities: Census of Population
Annual Population Survey (APS)
Region: Census of Population
Annual Population Survey (APS)

Latest data: 2008

Next release: 2009, available January 2010

The residence employment data used within the GMFM is based upon the Census and APS data. A moving average of the residence employment rate from the APS data is used as the data is very volatile at local level. This is applied to the population data used within the GMFM to get an estimate of residence employment. This first round estimate is scaled to Census figure in 2001 and the scaling factor is kept constant across the historical series.

The table below compares the 2001 Census data with the data used within GMFM. The data used in within the model, matches the Census figures 2001 exactly.

Table 4.11: Comparison of Census residence employment with GMFM data, 2001

	Census (000's, 2001)	OE/RF scaled data (000's, 2001)	Difference (%)
Bolton	114.4	114.4	0.0%
Bury	83.9	83.9	0.0%
Manchester	152.1	152.1	0.0%
Oldham	92.8	92.8	0.0%
Rochdale	86.9	86.9	0.0%
Salford	89.9	89.9	0.0%
Stockport	136.1	136.1	0.0%
Tameside	96.3	96.3	0.0%
Trafford	99.1	99.1	0.0%
Wigan	135.6	135.6	0.0%
North West	2,909.7	2,909.6	0.0%

Source: Census, Oxford Economics

Note: Manchester value includes the 9,600 undercount as agreed

The residence employment rate is then calculated using the scaled series of residence employment data and the population data used within GMFM. The table below compares the residence employment rate used within GMFM (which is scaled to the Census series) with the raw APS data. The biggest change is within Oldham where the APS data is scaled down by 8.8% in 2005. The scaling keeps the series consistent with the Census data.

Table 4.12: Comparison of APS residence employment rate with GMFM data, 2008

	APS data (%, 2008)	OE/RF scaled data (%, 2008)	Difference (%)
Bolton	70.6	70.1	-0.7%
Bury	73.7	76.0	3.2%
Manchester	60.1	58.7	-2.4%
Oldham	66.5	64.0	-3.7%
Rochdale	70.9	66.1	-6.7%
Salford	69.8	72.4	3.8%
Stockport	76.2	76.9	0.9%
Tameside	72.3	72.7	0.5%
Trafford	77.1	80.0	3.8%
Wigan	75.8	69.9	-7.8%
North West	71.3	71.9	0.9%

Source: Census, Oxford Economics

Box 1: Worked example – residence employment calculation

The differences between current APS estimates of residence employment rate and GMFM estimate can be quite significant in any given year. By way of example we set out below the calculation of Rochdale for 2008 where the difference is greatest (table 3.12).

Table B1: Comparison of sources of residence employment data

	Residence employment ('000's)	Residence employment rate (%)
Census - 2001	86.9	68.2
LFS/APS - 2001	84.0	71.2
Difference	2.9	-3.0

Source: Census, LFS/APS, Oxford Economics

Note: the estimated APS series backcast on the basis of the growth in the LFS series.

The table shows the difference between the Census data and the LFS/APS series. The census data for residence employment rate is over 3 percentage points lower than the LFS/APS series.

The table below sets out the steps in constructing the residence employment series.

Residence employment	2001	2002	2003	2004	2005	2006
Census	68.2	-	-	-	-	-
APS/LFS	71.7	73.1	75.5	71.4	72.2	73.0
APS/LFS - 3 year average	74.0	73.4	73.3	73.0	72.2	71.6
Scaled to census	69.1	68.7	68.6	68.3	67.5	66.9
Scaled to regional figure	69.1	68.4	68.5	68.2	67.6	67.1

Source: Oxford Economics calculations

Rochdale is much lower because the Census data is much lower than the APS data for 2001.

It is worth considering whether this is appropriate or whether to convert to or merge over time to the APS series. If we were to convert to the APS series, this would affect the commuting patterns, which would no longer match those from the Census in 2001 unless a 'staged' merge process is applied.

Total employment – people based

Employees in employment – people estimates

Description: the number of people who are an employee

Data: Local Authorities: Census of Population
Region: Census of Population

Latest data: 2001

Next release: 2011

This series is constructed on the basis that all of the full-time employee jobs are filled by only one person and the part-time employee jobs by less than one person, as one person could have two or more part-time jobs. This series converts the employees in employment job based series to a people based series by assuming each full-time employee has one job, each part-time employee has two and each self employed person one. A modifier is then applied to estimate produced to ensure it hits the Census figure (adjusted in Manchester for the undercount).

Self-employment – people estimates

Description: the number of self employed people working

Data: Local Authorities: Census of Population
Region: Census of Population

Latest data: 2001

Next release: 2011

The series converts the self-employment jobs estimates to people based estimates. It is calibrated to match the Census in 2001. It is distinct from the self employed job estimates discussed earlier which are higher (as people have multiple jobs) it is also constructed sectorally based on the self employed job estimates.

Total employment – people estimates

Description: the total number of people in employment

Data: Local Authorities: Census of Population
Region: Census of Population

Latest data: 2001

Next release: 2011

This series is the sum of people based employees in employment and people based self employment. The table below compares the Census data from employment with the data used within the GMFM. The data within GMFM matches the Census data exactly in 2001.

Table 4.13: Comparison of census employment data with GMFM data, 2001

	Census employment (000's 2001)	GMFM data (000s, 2001)	Difference (%)
Bolton	106.8	106.7	0.0%
Bury	62.9	62.9	0.0%
Manchester	277.1	277.1	0.0%
Oldham	83.0	83.0	0.0%
Rochdale	76.7	76.7	0.0%
Salford	102.3	102.3	0.0%
Stockport	118.8	118.8	0.0%
Tameside	74.9	74.9	0.0%
Trafford	113.0	113.0	0.0%
Wigan	106.3	106.3	0.0%
North West	2,912.4	2,912.4	0.0%

Source: Census, Oxford Economics

Note: Manchester value includes the 9,600 undercount as agreed

Commuting

Description:

Data: Local Authorities: Constructed
Region: Constructed

Latest data: N/A

Next release: N/A

This series is constructed by subtracting the residence employment from the total employment people based series to give net commuting flows. The net commuting flows will match those from the Census as both the residence employment and the people based total employment series match the Census values in 2001.

The table below compares the Census commuting flows with the data constructed within GMFM. The table shows that there is no difference between the series with GMFM data and the Census data in 2001.

Table 4.14: Comparison of net commuting flows from the Census with GMFM data, 2001

	Census net commuting, (000's 2001)	GMFM data (000s, 2001)	Difference (%)
Bolton	-7.7	-7.7	0.0%
Bury	-21.0	-21.0	0.0%
Manchester	125.0	125.0	0.0%
Oldham	-9.8	-9.8	0.0%
Rochdale	-10.2	-10.2	0.0%
Salford	12.4	12.4	0.0%
Stockport	-17.3	-17.3	0.0%
Tameside	-21.3	-21.3	0.0%
Trafford	13.9	13.9	0.0%
Wigan	-29.3	-29.3	0.0%
North West			0.0

Source: Census, Oxford Economics

Note: Manchester value includes the 9,600 undercount as agreed

Occupations

Workplace based occupations

Description:

Data:	Local Authorities:	Census of Population
	Region:	Census of Population
		Annual Population Survey (APS)

Latest data: 2005

Next release: 2006, available January 2008

The basis of occupation data is the Census. We calculate the ratio of occupations within each sector for 2001. From 2002 onwards we use Labour Force Survey. We do our own analysis from the dataset and construct a matrix of occupation by sector. Again, we calculate ratios of each occupation within each sector. These ratios are applied to the sector employee data for the region to estimate occupations within each sector. These are then aggregated to calculate the occupations across all industries.

The share of each occupation within each sector for the region is applied to the workplace based employee jobs sectoral data for each local area, to give an estimate of occupations within each sector. The occupations by sector are then aggregated to give occupations by 25 Standard Occupations Classifications which is consistent with the workplace based total employment data, people based.

The table below compares Manchester's workplace based occupational shares from the Census with the shares used within GMFM. The table shows that there is very little difference between the Census shares and the model data. The differences are mainly a result of scaling and sectoral differences between Census and ABI. These shares are employed to the total employment people based series (explained above) to produce the number employed within each occupation.

Table 4.15: Comparison of Manchester’s occupation shares from the Census with GMFM data, 2001

	Census data, (2001, %)	GMFM data, (2001, %)	Difference
11. Corporate managers	10.2	10.4	0.1
12. Managers and proprietors in agriculture and services	4.1	4.0	-0.1
21. Science and technology professionals	3.5	3.6	0.2
22. Health professionals	1.6	1.5	-0.1
23. Teaching and research professionals	6.1	5.8	-0.3
24. Business and public service professionals	3.5	3.6	0.1
31. Science and technology associate professionals	2.5	2.6	0.1
32. Health and social welfare associate professionals	5.0	4.8	-0.2
33. Protective service occupations	0.6	0.6	0.0
34. Culture, media and sports occupations	3.1	3.1	0.0
35. Business and public service associate professionals	6.0	6.1	0.1
41. Administrative occupations	12.7	13.0	0.3
42. Secretarial and related occupations	3.8	3.8	0.0
51. Skilled agricultural trades	0.3	0.3	0.0
52. Skilled metal and electrical trades	2.5	2.5	0.1
53. Skilled construction and building trades	1.8	2.0	0.1
54. Textiles, printing and other skilled trades	1.9	1.8	-0.1
61. Caring personal service occupations	4.8	4.5	-0.3
62. Leisure and other personal service occupations	2.0	2.0	0.0
71. Sales occupations	5.9	5.6	-0.3
72. Customer service occupations	1.6	1.6	0.0
81. Process, plant and machine operatives	3.0	3.2	0.2
82. Transport and mobile machine drivers and operatives	3.0	3.1	0.1
91. Elementary trades, plant and storage related occupations	2.5	2.5	0.0
92. Elementary administration and service occupations	8.1	7.9	-0.1

Source: Census, Oxford Economics

Residence based occupations

Description:

Data: Local Authorities: Census of Population
Region: Census of Population

Latest data: 2001

Next release: 2011

The source of residence based occupations is the Census of Population. Census data is residence based, hence we taken the share of each occupation to total residence employment. This share of occupations of employment grows at the rate of change in the workplace based occupation share to give a series of shares across time. These shares are then applied to the residence employment data, giving a first round estimate of residence based occupations. This series is then scaled to ensure that the residence based occupation data adds to the residence employment totals.

The table below compares the residence occupation shares from the Census with the shares used within GMFM. The table shows that there is no difference between the series. The shares used within the model for Manchester 2001 matches exactly to the census data. These shares

are applied to the residence employment data (as explained above) to produce residence based occupations. .

Table 4.16: Comparison of Manchester’s residence occupation rates from the Census with GMFM data, 2001

	Census data, (2001, %)	GMFM data, (2001, %)	Difference
11. Corporate managers	7.64	7.64	0.0
12. Managers and proprietors in agriculture and services	3.13	3.13	0.0
21. Science and technology professionals	3.19	3.19	0.0
22. Health professionals	1.51	1.51	0.0
23. Teaching and research professionals	5.76	5.76	0.0
24. Business and public service professionals	3.30	3.30	0.0
31. Science and technology associate professionals	1.90	1.90	0.0
32. Health and social welfare associate professionals	3.87	3.87	0.0
33. Protective service occupations	0.44	0.44	0.0
34. Culture, media and sports occupations	2.55	2.55	0.0
35. Business and public service associate professionals	4.55	4.55	0.0
41. Administrative occupations	9.70	9.70	0.0
42. Secretarial and related occupations	2.87	2.87	0.0
51. Skilled agricultural trades	0.39	0.39	0.0
52. Skilled metal and electrical trades	3.17	3.17	0.0
53. Skilled construction and building trades	2.36	2.36	0.0
54. Textiles, printing and other skilled trades	2.43	2.43	0.0
61. Caring personal service occupations	5.38	5.38	0.0
62. Leisure and other personal service occupations	2.29	2.29	0.0
71. Sales occupations	6.93	6.93	0.0
72. Customer service occupations	1.90	1.90	0.0
81. Process, plant and machine operatives	4.16	4.16	0.0
82. Transport and mobile machine drivers and operatives	4.10	4.10	0.0
91. Elementary trades, plant and storage related occupation	3.83	3.83	0.0
92. Elementary administration and service occupations	12.67	12.67	0.0

Source: Census, Oxford Economics

Demography

Population – total

Description: total population, all ages

Data: Local Authorities: National Statistics, mid year population estimates
Region: National Statistics, mid year population estimates

Latest data: 2007

Next release: 2008 available August 2009

The table below compares the ONS population data with the data used within GMFM. The table shows that there is no difference between the source and the data used within the model.

Table 4.17: Comparison of population data with GMFM data, 2007

	Mid Year Estimates (000's 2007)	GMFM data (000s, 2007)	Difference (%)
Bolton	262.3	262.3	0.0%
Bury	183.3	183.3	0.0%
Manchester	458.1	458.2	0.0%
Oldham	219.5	219.5	0.0%
Rochdale	206.1	206.0	0.0%
Salford	219.2	219.2	0.0%
Stockport	280.9	280.9	0.0%
Tameside	214.4	214.4	0.0%
Trafford	212.8	212.8	0.0%
Wigan	305.6	305.5	0.0%
North West	6,864.3	6,864.2	0.0%

Source: NS, Oxford Economics

Working age population

Description: male population aged 15-64 plus female population aged 15-59

Data: Local Authorities: National Statistics, mid year population estimates
Region: National Statistics, mid year population estimates

Latest data: 2007

Next release: 2008 available August 2009

The table below compares the working age population data from the ONS with the data used within GMFM. The table shows that there is very little difference between the source and the data used within the model, any changes within the series are less than 1%. This is due to rounding.

Table 4.18: Comparison of working age population data with GMFM data, 2007

	Mid Year Estimates (000's 2007)	GMFM data (000s, 2007)	Difference (%)
Bolton	163.8	163.8	0.0%
Bury	115.6	115.5	-0.1%
Manchester	320.4	320.6	0.1%
Oldham	136.0	136.3	0.2%
Rochdale	130.2	130.1	-0.1%
Salford	142.6	142.5	-0.1%
Stockport	174.9	174.9	0.0%
Tameside	136.8	136.8	0.0%
Trafford	134.0	134.1	0.1%
Wigan	194.3	194.3	0.0%
North West	4,334.1	4,334.1	0.0%

Source: NS, Oxford Economics

Population by 5 year age bands

Population data by 5 year age bands by sex are also taken from the same source as mentioned above. The data used is the raw data from the source as there is no scaling applied to this series.

International migration

Description: net international migration flows

Data: Local Authorities: National Statistics, components of change
 Region: National Statistics, components of change

Latest data: 2007

Next release: 2008 available August 2009

The table below compares the international migration data taken from the ONS components of change data with the data used within GMFM. The table shows that there is no significant difference between the source and the data used within the model. Any slight differences which can be seen are a result of rounding, as we treat international migration as the differential to ensure that population adds over time.

Table 4.19: Comparison of international migration data with GMFM data, 2007

	Components of change data, (000's, 2006)	GMFM data (000s, 2007)	Difference (000's)
Bolton	-0.4	-0.3	0.1
Bury	-0.2	-0.2	0.0
Manchester	5.6	5.7	0.1
Oldham	0.0	0.0	0.0
Rochdale	-0.3	-0.3	0.0
Salford	0.9	1.0	0.1
Stockport	-0.4	-0.5	0.0
Tameside	-0.3	-0.2	0.1
Trafford	0.0	0.0	0.0
Wigan	-0.4	-0.5	-0.1
North West	2.3	2.5	0.2

Source: NS, Oxford Economics

Internal migration

Description: net domestic migration flows

Data: Local Authorities: National Statistics, components of change
 Region: National Statistics, components of change

Latest data: 2007

Next release: 2008 available August 2009

The table below compares the internal migration data taken from the ONS components of change data with the data used within GMFM. The table shows that there is no significant difference between the source and the data used within the model, any difference is a result of rounding..

Table 4.20: Comparison of internal migration data with GMFM data, 2007

	Components of change data, (000's, 2006)	GMFM data (000s, 2007)	Difference (000's)
Bolton	-0.8	-0.3	0.5
Bury	0.1	-0.2	-0.3
Manchester	-2.9	-2.6	0.3
Oldham	-1.2	-0.9	0.2
Rochdale	-1.2	-0.7	0.5
Salford	-0.5	-0.6	-0.1
Stockport	0.1	-0.3	-0.5
Tameside	-0.2	-0.4	-0.2
Trafford	0.1	-0.3	-0.4
Wigan	0.2	0.7	0.5
North West	-5.5	-2.8	2.7

Source: NS, Oxford Economics

Births

Description: number of births per 1000 of population

Data: Local Authorities: National Statistics, components of change
Region: National Statistics, components of change

Latest data: 2007

Next release: 2008 available August 2009

The table below compares the ONS births data from the components of change with the data used within GMFM. The table shows that there is no difference between the source and the data used within the model.

Table 4.21: Comparison of births data with GMFM data, 2007

	Components of change births data, (000's, 2006)	GMFM data (000s, 2007)	Difference (%)
Bolton	3.7	3.7	0.0%
Bury	2.3	2.3	0.0%
Manchester	7.4	7.4	0.0%
Oldham	3.2	3.2	0.0%
Rochdale	3.0	3.0	0.0%
Salford	3.1	3.1	0.0%
Stockport	3.3	3.3	0.0%
Tameside	2.7	2.7	0.0%
Trafford	2.8	2.8	0.0%
Wigan	3.5	3.5	0.0%
North West	84.4	84.4	0.0%

Source: NS, Oxford Economics

Deaths

Description: number of deaths per 1000 of population

Data: Local Authorities: National Statistics, components of change
Region: National Statistics, components of change

Latest data: 2007

Next release: 2008 available August 2009

The table below compares the ONS deaths data from the components of change with the data used within GMFM. The table shows that there is no difference between the source and the data used within the model.

Table 4.22: Comparison of deaths data with GMFM data, 2007

	Components of change deaths data, (000's, 2006)	GMFM data (000s, 2007)	Difference (%)
Bolton	2.7	2.7	0.0%
Bury	1.8	1.8	0.0%
Manchester	4.0	4.0	0.0%
Oldham	2.2	2.2	0.0%
Rochdale	2.0	2.0	0.0%
Salford	2.4	2.4	0.0%
Stockport	2.7	2.7	0.0%
Tameside	2.3	2.3	0.0%
Trafford	1.9	1.9	0.0%
Wigan	3.2	3.2	0.0%
North West	70.4	70.4	0.0%

Source: NS, Oxford Economics

Output

GVA

Description: Gross Value Added in real 2003 prices

Data: Local Authorities: Constructed, Regional Accounts
Region: National Statistics, Regional Accounts

Latest data: 2007 totals, 2006 sector data

Next release: 2008 totals, 2007 sector data available winter 2009

Regional GVA data by 24 sectors is taken from Regional Accounts. This data is scaled to match the UK national accounts as published in the Blue Book. Volume indices by sector are taken from the Blue Book to convert the GVA data into real 2003 prices.

GVA data is available from Regional Accounts for the NUTS level 3 geographies. We construct an estimate of GVA within the local authorities using the local authorities' employment data and North West productivity. This is then scaled to match the NUTS level 3 data.

The table below compares the data used within the GMFM with the Regional Accounts data. At the NUTS level 3, there is very little difference between the source and the GMFM data. Any differences are due to scaling to the North West industry data. This is shown for 2003 as this is the base year and the only time when nominal equals real price GVA.

Table 4.23: Comparison of GVA data with GMFM data, 2003

	Regional Accounts 2003	GMFM 2003	Difference (%)
Manchester	-	10,894	-
Salford	-	3,493	-
Stockport	-	3,876	-
Tameside	-	2,342	-
Trafford	-	4,658	-
Greater Manchester South (NUTS 3)	25,312	25,264	-0.2%
Bolton	-	3,431	-
Bury	-	2,091	-
Oldham	-	2,379	-
Rochdale	-	2,522	-
Wigan	-	3,391	-
Greater Manchester North (NUTS 3)	13,722	13,815	0.7%

Source: Regional Accounts, Oxford Economics

Housing

Housing stock

Description: Housing stock

Data: Local Authorities: DCLG – Housing Strategy Statistical Appendix Tables

Latest data: 2008

Next release: 2009

Data on housing stock by local authority comes from DCLG. Total housing stock is broken down by private and social housing stock. Using ratios taken from the Census, we share out the private housing stock into owner occupied and other private categories.

The table below compares the data from DGLC with the data in GMFM. The data used within the model matches the source exactly.

Table 4.24: Comparison of housing stock data with data used within GMFM data, 2008

	DCLG data (000's 2008)	GMFM data (000s, 2006)	Difference (%)
Bolton	119.3	119.3	0.0%
Bury	80.9	80.9	0.0%
Manchester	214.0	214.0	0.0%
Oldham	92.6	92.6	0.0%
Rochdale	90.1	90.1	0.0%
Salford	104.3	104.3	0.0%
Stockport	125.0	125.0	0.0%
Tameside	97.9	97.9	0.0%
Trafford	95.8	95.8	0.0%
Wigan	137.8	137.8	0.0%
North West	3,165.0	3,165.0	0.0%

Source: DCLG, Oxford Economics

House prices

Description: House prices

Data: Local Authorities: DCLG – Land registry house prices, table 585
Region: DCLG – Mix adjusted house prices, table 593

Latest data: 2008

Next release: 2009, available spring 2010

Data on house price by local authority comes from DCLG. The table below compares the data from DGLC with the data in GMFM. The data used within the model matches the source exactly. Data for the North West is shown in the table below and it is worth pointing out that it is taken from a different source.

Table 4.25: Comparison of house prices with data used within GMFM data, 2008

	DCLG data (£000's 2008)	GMFM data (£000s, 2008)	Difference (%)
Bolton	139.3	139.3	0.0%
Bury	146.5	146.5	0.0%
Manchester	145.0	145.0	0.0%
Oldham	128.8	128.8	0.0%
Rochdale	128.7	128.7	0.0%
Salford	136.3	136.3	0.0%
Stockport	194.4	194.4	0.0%
Tameside	133.2	133.2	0.0%
Trafford	245.8	245.8	0.0%
Wigan	128.8	128.8	0.0%
North West	296.4	296.4	0.0%

Source: DCLG, Oxford Economics

Housing completions

Description: Housing completions

Data: Local Authorities: DCLG – Table 253 Housing starts and completions by district

Latest data: 2008

Next release: 2009, available spring 2010

Data on housing starts and completions by local authority comes from DCLG. These have been adjusted based on some figures provided to Oxford Economics as part of the original project, which we believe were derived from Housing Investment Programme data.

The table below compares the data from DGLC with the data in GMFM. The biggest difference between the data within the model and the source is within Manchester, where the GMFM data is 800 higher. Wigan is the only area where housing completions are lower within the model than the data source would indicate. Data for the North West is not used within the model.

Table 4.26: Comparison of DCLG data with used within GMFM data, 2008

	DCLG data (000's 2008)	GMFM data (000s, 2008)	Difference (000's)
Bolton	1.2	1.2	0.0
Bury	0.5	0.5	0.0
Manchester	3.1	4.0	0.8
Oldham	0.5	0.5	0.0
Rochdale	0.3	0.4	0.1
Salford	1.0	1.3	0.3
Stockport	0.4	0.4	0.0
Tameside	0.8	1.1	0.3
Trafford	0.5	0.5	0.0
Wigan	1.4	1.3	-0.1
North West	-	-	-

Source: DCLG, Oxford Economics

No. of households

Description: Households

Data: DCLG Table 406

Latest data: 2004

Next release: 2005, available 2008

Data on the total number of households by local authority is taken from DCLG. The total numbers of households are broken down by 5 year age bands to give households by the occupants' age. The households by age series is estimated by applying headship rates calculated from the census to the total household series.

The table below compares the data from DCLG with that used within GMFM. The table shows that there are no differences between the source of data and the data used by Oxford Economics within the GMFM.

Table 4.27: Comparison of DCLG data with GMFM data, 2004

	DCLG data (000's 2004)	GMFM data (000s, 2004)	Difference (%)
Bolton	111.0	111.0	0.0%
Bury	76.0	76.0	0.0%
Manchester	189.0	189.0	0.0%
Oldham	89.0	89.0	0.0%
Rochdale	85.0	85.0	0.0%
Salford	95.0	95.0	0.0%
Stockport	121.0	121.0	0.0%
Tameside	92.0	92.0	0.0%
Trafford	92.0	92.0	0.0%
Wigan	129.0	129.0	0.0%
North West	2,895.0	2,896.0	0.0%

Source: DCLG, Oxford Economics

Household income

Compensation of employees

Description: Compensation of employees

Data: Local Authorities: Constructed
Region: National Statistics, Regional Accounts

Latest data: 2007 totals, 2006 sector data

Next release: 2008 totals, 2007 sector data available winter 2009

Regional compensation of employee's data is taken from Regional Accounts part 2. This data is scaled to be consistent with the UK national accounts as published in the Blue Book.

Compensation of employees is constructed for the local authorities within GMFM. The data is estimated using the employment and earnings data to produce a first round estimate for the local areas. This is then scaled to ensure that the local authorities add to the North West compensation of employees' series.

Gross mixed income

Description: Gross mixed income

Data: Local Authorities: Constructed
Region: National Statistics, Regional Accounts Part 2

Latest data: 2007

Next release: 2008, available winter 2009

Regional gross mixed income data is taken from Regional Accounts part 2. This data is scaled to be consistent with the UK national accounts data as published in the Blue Book table 6.1.3.

Gross mixed income is constructed for the local authorities within GMFM. The data is estimated using the self employment data for the local areas. Shares of each local authority to the North West self employment total are constructed and applied to the North West series of gross mixed income to produce a first round estimate for the local areas. This is then scaled to ensure that the local authorities add to the North West gross mixed income series.

Rest of household income

Description: Rest of household income

Data: Local Authorities: Constructed
Region: National Statistics, Regional Accounts Part 2

Latest data: 2007

Next release: 2008, available winter 2009

Regional rest of household income data is taken from Regional Accounts part 2. This data is scaled to be consistent with the UK national accounts data as published in the Blue Book tables 6.1.3. and 6.1.4.

Rest of household income is constructed for the local authorities within GMFM. The data is estimated using shares of population and applying these to the North West series of rest of household income to produce a first round estimate for the local areas. This is then scaled to ensure that the local authorities add to the North West rest of household income series.

Deductions from household incomes

Description: Deductions from household income

Data: Local Authorities: Constructed
Region: National Statistics, Regional Accounts Part 2

Latest data: 2007

Next release: 2008, available winter 2009

Regional deductions from household income data is taken from Regional Accounts part 2. This data is scaled to be consistent with the UK national accounts data as published in the Blue Book table 6.1.4.

Deductions from household income are constructed for the local authorities within GMFM. The data is estimated using shares of compensation of employees and applying these to the North West series of deductions from household income to produce a first round estimate for the local areas. This is then scaled to ensure that the local authorities add to the North West series.

Personal disposable income

Description: Personal disposable income in real 2003 prices

Data: Local Authorities: Constructed
Region: National Statistics, Regional Accounts

Latest data: 2007

Next release: 2008, available winter 2009

Regional personal disposable income data is taken from Regional Accounts part 2. This data is scaled to be consistent with the UK national accounts data as published in the Blue Book tables 6.1.3. and 6.1.4.

Nominal disposable household income is constructed within the model. It is the sum of compensation of employees, gross mixed income, rest of household income minus deductions from household income. This nominal series is then converted into a real series using a UK deflator.

Consumers expenditure

Description: Consumers expenditure

Data: Local Authorities: Constructed
Region: National Statistics, Regional Accounts

Latest data: 1999

Next release: Unknown

Regional consumers' expenditure data is taken from Regional Accounts part 2. This data is scaled to be consistent with the UK national accounts data as published in the Blue Book tables 6.2 and 6.2.

Consumers' expenditure for the local areas within GMFM is forecast by applying each areas share of North West population to the North West consumers' expenditure series. This produces a first round estimate for the local areas. This first round estimate is then scaled to ensure that the local authorities add to the North West rest of consumers' expenditure series.

As explained above the data on household income is broadly constructed due to the lack of reliable data. Consequently these series do not form an important part of the model and are included for reference. Further bespoke work may be carried out to link such series to other reliable indicators.

Workplace based earnings

Description: Workplace based average earnings

Data: Local Authorities: Annual Survey of Hours and Earnings
Region: National Statistics

Latest data: 2008

Next release: 2009 available November 2009

Data on average earnings for the North West is available from regional accounts. At the local level average earnings is estimated. This series is constructed using both ASHE data and the North West earnings data. A ratio of actual over expected is calculated for each area and applied to the North West earnings from regional accounts to give an estimate of earnings in the local area. The ratio of actual to expected is based upon an estimate of earnings calculated using North West ASHE data by sector and the local areas workplace based employee jobs. This is compared to the local areas wages value from ASHE.

The table below compares the earnings relative to the North West from ASHE compared to those from GMFM. The table shows the both series are similar with the biggest difference in Rochdale, where relative earnings are higher in ASHE than the data in GMFM would suggest. The differences are largely due to the fact that the North West wages to which the local areas are scaled, come from the Regional Accounts which are in turn scaled to the National Accounts. In addition, the Regional Accounts data provides sectoral information not available at local level within ASHE and the figure below are the totals of GMFM sectoral estimates.

Table 4.28: Comparison of earnings data with GMFM data, 2008

	ASHE data, (NW=100, 2008)	GMFM data (NW=100, 2008)	Difference
Bolton	88.3	90.2	1.9
Bury	98.0	95.7	-2.2
Manchester	112.8	114.5	1.7
Oldham	86.3	86.8	0.6
Rochdale	90.5	96.6	6.1
Salford	97.0	97.7	0.7
Stockport	100.2	98.0	-2.2
Tameside	92.5	93.9	1.3
Trafford	111.1	108.9	-2.3
Wigan	93.7	95.9	2.2
North West	100.0	100.0	0.0

Source: ASHE, Oxford Economics

Residence based earnings

Description: Residence based average earnings

Data: Local Authorities: Annual Survey of Hours and Earnings
Region: National Statistics

Latest data: 2008

Next release: 2009 available November 2009

For both the North West and the Manchester City Region it is assumed that residence based earnings is equal to workplace based earnings. At the local level residence based average earnings is estimated using workplace based earnings for the Manchester City Region. Residence based wages relative to the City region are calculated from ASHE. These are applied to earnings of the Manchester City Region to produce an estimate of residence based earnings.

The table below compares the earnings relative to the North West from ASHE compared to those from GMFM. The table shows that both series are fairly similar with the biggest difference in Oldham, where relative earnings is slightly lower in ASHE than the data in GMFM would suggest. The differences are a result of residence earning being linked to workplace base earnings – see the description above for differences in workplace based earnings.

Table 4.29: Comparison of earnings data with GMFM data, 2007

	ASHE data, (NW=100, 2007)	GMFM data (NW=100, 2007)	Difference
Bolton	98.9	94.2	-4.7
Bury	102.7	101.7	-1.0
Manchester	89.9	92.3	2.3
Oldham	93.4	99.1	5.7
Rochdale	99.5	94.8	-4.8
Salford	92.6	89.0	-3.6
Stockport	108.1	105.2	-2.9
Tameside	88.5	87.4	-1.1
Trafford	118.7	115.9	-2.8
Wigan	95.6	91.6	-4.0
North West	99.3	100.0	0.7

Source: ASHE, Oxford Economics