GLAECONOMICS

The historic performance of the GLA's medium-term economic forecast model

Gordon Douglass & Adam van Lohuizen

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Introduction

Since 2003 GLA Economics has produced a bi-annual economic forecast as a basis for the GLA's medium-term planning projections. As time progresses and more data become available, it becomes possible to identify turning points in the data that may not have been readily available at the time of the original forecast. Further, underlying trends continuing or new trends being established can also become apparent over time. Forecast models thus require evaluating and updating in order to take account of this process.

This note has therefore undertaken a review of the accuracy of previous GLA Economics' forecasts for the growth of total Gross Value Added (GVA), total employment, household expenditure and household income. It found that revisions to the "historic data" had a significant impact on the performance of GLA Economics' forecasts. It nevertheless also further found that GLA Economics' forecasts performed comparably with other forecasts of the London economy.

Finally this note briefly reviews some areas for improvement in the previous forecasting process in place before the publication of London's Economic Outlook May 2016[1] in light of the evolving nature and understanding of London's economy. The changes implemented to strengthen this process for future forecasting rounds based on this review are then outlined

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[1] GLA Economics, May 2016, 'London's Economic Outlook - Spring 2016: The GLA's medium-term planning projections'.

Background

London's Economic Outlook (LEO) is published twice yearly, providing forecasts for GVA (including some industry estimates), employment, and household expenditure and income for the Greater London area. Forecasts are published for the current calendar year, and the two subsequent years. These forecasts form the basis of the GLA's medium-term planning projections as well as being used by Transport for London (TfL) and other members of the GLA group. Prior to May 2016 the forecast was based on an in-house model built by Volterra Consulting Limited.

Data limitations

The data sources available for the LEO forecasts have a number of issues around the quality and timeliness of their estimates, as economic data at the regional level is limited.

The Office of National Statistics (ONS) only publishes GVA data for London on an annual basis, in current prices only, and at a significant delay in time. Currently, the latest data available for London is 2014 at the aggregate and industry GVA level, however in previous ONS releases industry level GVA lagged a further year behind the aggregate data. Furthermore, as both of these datasets are published at current prices they do not measure real growth in the economy, ie, taking account of inflation. Household income data is similar, although with slightly longer lags as is household expenditure data.

Given the limitations with these official datasets, GLA Economics has in the past used regional estimates of historic economic data from an independent data provider (Experian Economics (EE)), which is timelier than the ONS data that is available and expressed in real not nominal terms. However, these figures, especially for the latest time periods, can be subject to significant revision, particularly following the release of new ONS data. This issue also means that simply analysing how accurate, or otherwise, forecasts have been is fraught with difficulty because of issues around what the 'true' statistical position actually is.

These limitations will be evident at a number of points in this paper but can be summarised by a few examples. One such is that revisions can lead to a continuing varying view on the accuracy of the forecast; thus prior to a revision a given forecast may give a close match to the "actual" observed historic growth rate, while after a revision this accuracy may be greatly reduced. Further, in part the forecasts highlight expected trends in growth i.e. an acceleration/deceleration be it gradual or marked from the most recently experienced growth rate of a variable. If however this background historic rate undergoes significant revisions after the production of the forecast even if the forecast got the direction and percentage point change in the forecast growth rates of later years correct the change in the starting historic data can misleadingly indicate a failing in the forecast itself rather than the underlying historic data revision.

Forecast Performance

Gross Value Added

Overall, the GLA Economics forecasts of GVA have tended to underestimate the volatility of the London economy in terms of output and this has thus often resulted in forecasts underestimating economic growth on average. Forecasts have been less accurate the further into the future the forecast is made, with the mean absolute error increasing the further forecasts are made into the future (see Table 1).

However, this underestimate was in part due to revisions[2] in the underlying historic data used in this analysis as also indicated by Table 1 where the mean absolute error of the forecast was lower prior to data revisions on the "actual" growth rate. Thus prior to these revisions the forecast accuracy was far higher and therefore a large fraction of the implied inaccuracy of GLA Economics' forecast can in fact be put down to the evolving understanding of the historic data, information on which was not available at the time of the production of the forecasts. Further, overall, revisions to the GVA data have been quite significant, with absolute average revisions of 2.5 percentage points, compared to an average GVA growth rate of 3.3 per cent. These revisions have usually been upwards with an average revision of 1.3 per cent (0 percentage points would mean they were equally weighted up and down).

Notwithstanding this point the volatility during the financial crisis also had a stronger impact on the accuracy of the longer-term forecasts. Thus when 2009 is excluded, the one and two-year ahead forecasts were to an extent more accurate than the in-year forecasts. In more recent times however, the forecasts have become more accurate with the mean absolute forecast error much lower in the forecasts produced from 2012 onwards compared to the historical error. However, this is partially likely due to the impact of data revisions being lower in more recent times. Thus as noted above the mean absolute forecast error based on data estimates at the time of the forecast is significantly lower than those based on the latest estimates.

Consensus forecasts[3] for London GVA have been slightly more accurate than GLA Economics' forecasts for the in-year and 2-year ahead forecasts, with GLA Economics being on average 0.2 and 0.1 percentage points less accurate respectively for these years. For the 1-year ahead forecasts, the gap was in the opposite direction with the consensus forecasts 0.1 percentage points less accurate on average. It should however be again noted that these slight differences in the accuracy of the GLA Economics' and consensus' forecasts are in part reflections of the impact of data revisions, with GLA Economics' forecasts generally performing slightly better than the consensus in forecasting the unrevised GVA growth rates. Note that the appendix to this note provides further analysis on the accuracy of the in-year, 1-year ahead and 2-year ahead forecasts for GVA that have been produced by GLA Economics.

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[2] Note in this case revisions refer to the change in the data between the first estimate of the historic growth rate and the estimate of the historic growth rate at the time of the forecast review.
[3] The consensus is the average forecast from independent forecasters for London at the time of production of each GLA Economics forecast.

Table 1: GVA forecast performance measures

	Average Forecast Growth (%)	Average Actual Growth (%)[4]	Mean absolute error (%)	Mean absolute error excl. 2009 (%)	Mean absolute error (2012-14) (%)	Mean absolute error prior to revisions (%)
In-year forecast	1.8	3.3	2.4	2.4	0.5	0.6
1-year forecast	2.1	3.1	2.5	2.1	0.8	1.4
2-year forecast	2.7	3.2	2.9	2.2	1.3	1.6

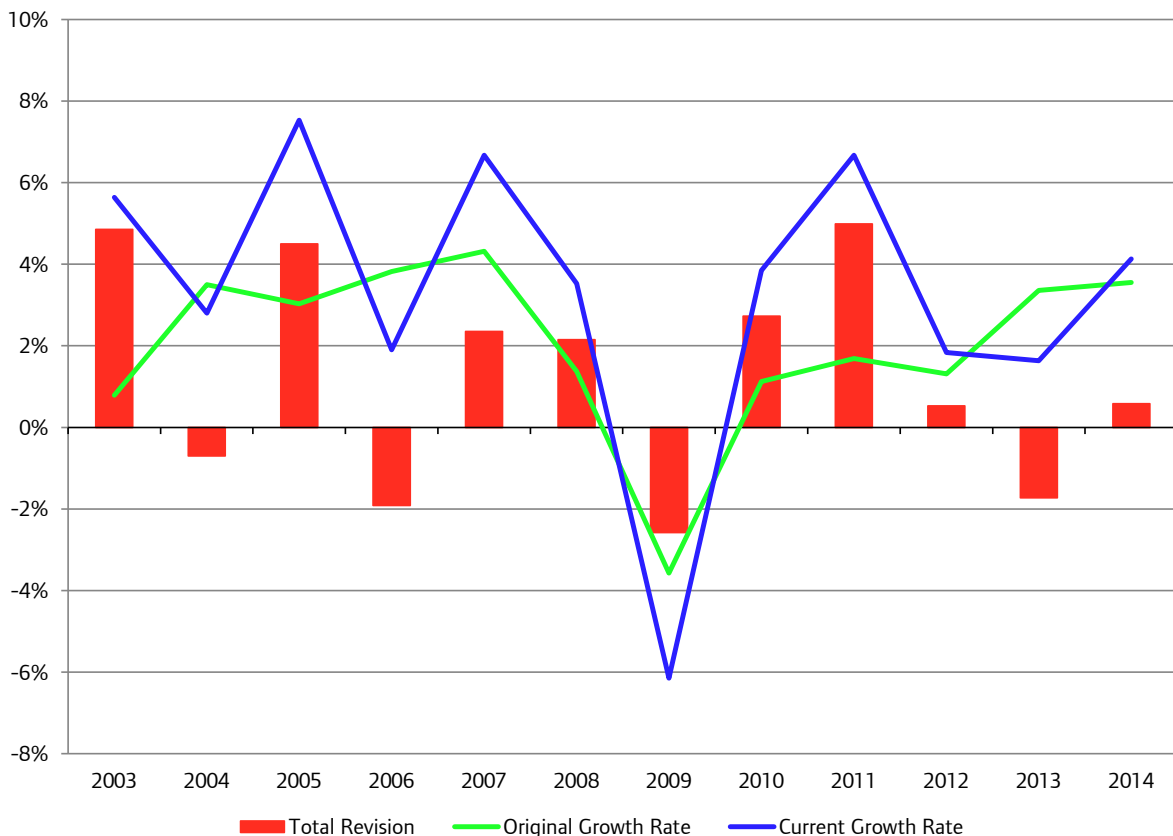*Source: GLA Economics' calculations*

Data revisions

As shown by Figure 1, the historic data series for London GVA has been subject to significant revisions from when their initial estimates were released, which also form the historic background for GLA Economics' forecasts. Revisions to EE's data is likely to be expected given the time lag in the production of ONS GVA data for London, and the subsequent revisions that are also made to the ONS series after its initial release which are both likely to heavily impact on EE's own estimates of GVA for London.

Overall, revisions to annual growth rates of GVA have tended to be upward revisions rather than downward revisions, with eight upward revisions made since 2003 compared to just four downward revisions. Furthermore, upward revisions to growth have tended to be stronger than downward revisions, with upward revisions since 2003 averaging 2.8 percentage points, compared to the average downward revision to growth of 1.7 percentage points. The strongest upward revision was 2011 where growth was revised upwards from 1.7 per cent to 6.7 per cent, whilst the strongest downward revision was in 2009 when a contraction in the economy of 3.6 per cent was revised down further to a contraction of 6.1 per cent.

Since 2013, revisions have been smaller to the series; however this is to be expected as revisions are likely to increase over time as the ONS releases more data which is likely to result in further revisions.

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[4] Average actual growth represents the average growth over the years to which that type of forecast applies in order to make them comparable.

Figure 1: GVA data revisions

Source: EE[5] and GLA Economics' calculations based on EE data

Employment[6]

Employment growth forecasts overall have underestimated actual growth over most of the past decade. Forecasts have become less accurate the further into the future the forecasts have been made, as shown by an increase in the average forecast error for further out forecasts (see Table 2). However this accuracy increases for the 2-year ahead forecast if the impact of the Great Recession is removed.

Unlike the GVA forecasts, the employment forecasts have been less accurate in recent times, with forecasts not predicting the strong increase in employment growth that has been seen over the past couple of years resulting in higher forecast errors. The consensus forecasts of employment for London have been slightly more accurate than GLA Economics' forecasts for the in-year forecast but similar in the 1-year and 2-year ahead time horizons. The main explanation for the underestimates produced by GLA Economics' forecasts of employment would appear to be the unexpectedly strong recent growth in employment given relatively sluggish GVA growth, which has led to a "productivity puzzle" that all forecasters have had difficulty forecasting or explaining. However, revisions to the historic dataset also help to explain some of this forecast underperformance, although to a lesser extent than seen in the

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[5] Note that the current data refers to EE the data at the time of the forecast model review in December 2015 to February 2016, since then a number of new estimates have been released by EE.
[6] As measured by workforce jobs.

GVA forecasts above. Note that the appendix to this note provides further analysis on the accuracy of the in-year, 1-year ahead and 2-year ahead forecasts for employment that have been produced by GLA Economics.

Table 2: Employment forecast performance measures

|	Average Forecast Growth (%)	Average Actual Growth (%)[7]	Mean absolute error (%)	Mean absolute error excl. 2009 (%)	Mean absolute error (2012-14) (%)	Mean absolute error prior to revisions (%)
In-year forecast	0.4	1.6	1.6	1.6	2.7	1.3
1-year forecast	0.3	1.7	1.8	1.8	3.7	1.5
2-year forecast	0.7	1.9	2.0	1.8	3.5	1.8

Source: GLA Economics' calculations

Data revisions

As shown by Figure 2, data revisions have been relatively minor for this dataset, with an overall average revision to growth of 0.2 percentage points. This is perhaps to be expected given the timeliness of the ONS workforce jobs series which will influence EE's own estimates of workforce jobs in London. Since 2003, workforce jobs have been revised up six times by an average of 0.9 percentage points, the largest revision was in 2008 when an upward revision of 2.3 percentage points was made. Five years were revised downwards by an average of 0.7 percentage points, with a 1.1 percentage point downward revision in 2013 showing the biggest change. In 2011 the series remained unrevised.

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[7] Average actual growth represents the average growth over the years to which that type of forecast applies in order to make them comparable.

Figure 2: Employment data revisions
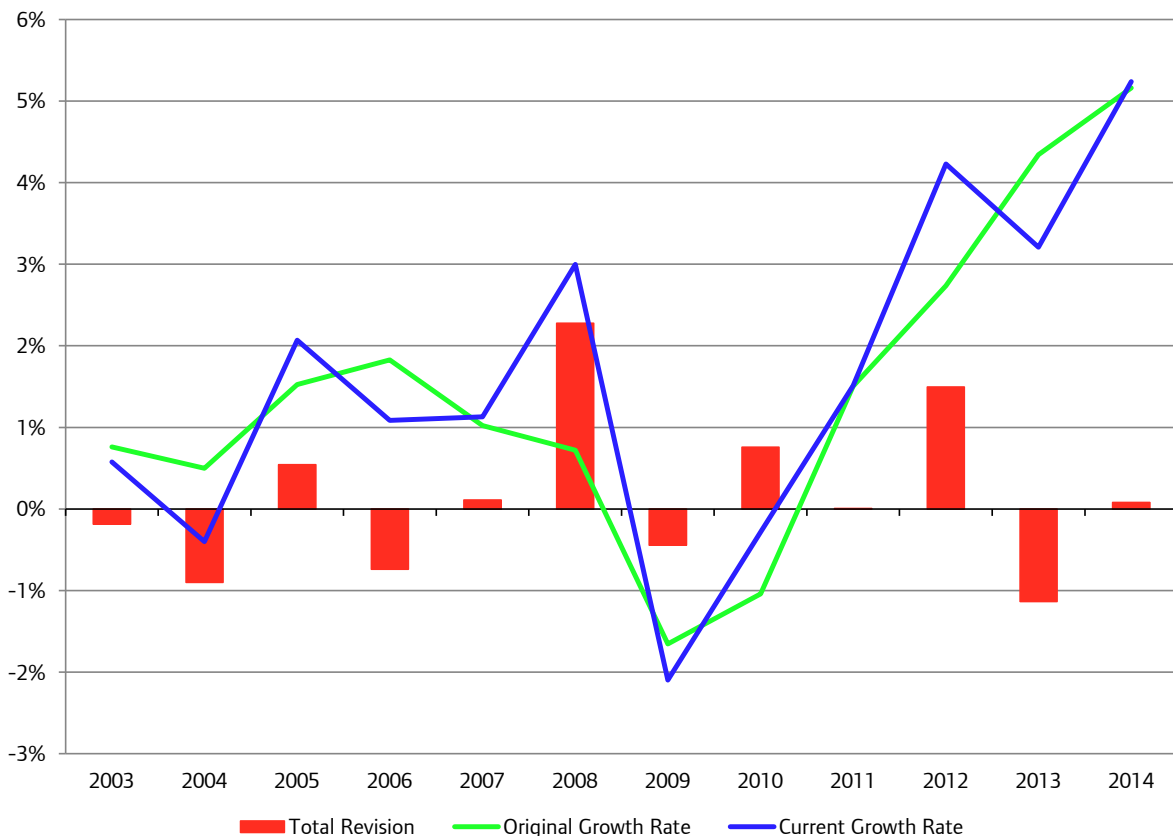
Source: EE and GLA Economics' calculations based on EE data

Household expenditure

The accuracy of GLA Economics' forecasts for household expenditure have varied depending on the time horizon of the forecast. In-year forecasts have tended to underestimate growth in household spending, 1-year ahead forecasts have been relatively similar to the actually observed growth rates on average, whilst 2-year ahead forecasts have tended to overestimate growth on average (see Table 3).

However, the average absolute forecast error has increased the further the time horizon of the forecast, reflecting the fact that over and under-estimates of growth are offsetting one another when looking at the average forecast. The mean absolute error of the forecasts excluding the year 2009 is however generally lower than that for the forecasts covering the entire forecasting history with the exception of the 2-year ahead forecast which has a similarly sized error. While forecasting has been generally more accurate in forecasts produced recently i.e. since 2012, for in-year and 1-year ahead forecasts, but has a higher average absolute error for the 2-year ahead forecasts.

Forecasts for household expenditure were generally more accurate prior to revisions in the historic dataset, with the exception of the 1-year ahead forecast which is a more accurate forecast of the revised dataset on average. Data revisions have averaged 1.3 per cent in absolute terms, relative to an average annual expenditure growth rate of 1.7 per cent. Revisions have broadly been just slightly more downward than upward (with an average downward revision of just under 0.1 per cent). Note that the appendix to this note provides further analysis

on the accuracy of the in-year, 1-year ahead and 2-year ahead forecasts for household expenditure that have been produced by GLA Economics.

Table 3: Household expenditure forecast performance measures

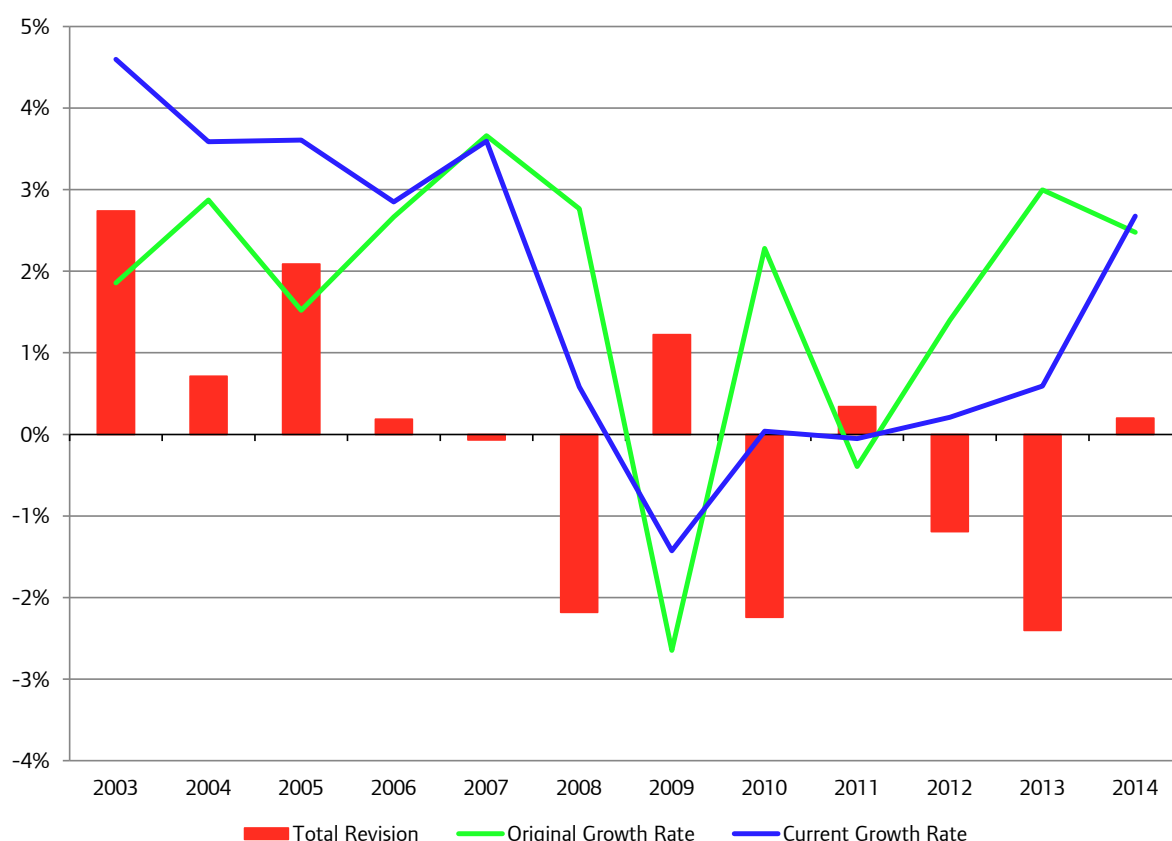|	Average Forecast Growth (%)	Average Actual Growth (%)[8]	Mean absolute error (%)	Mean absolute error excl. 2009 (%)	Mean absolute error (2012-14) (%)	Mean absolute error prior to revisions (%)
In-year forecast	1.2	1.7	1.3	1.2	0.8	0.8
1-year forecast	1.5	1.5	1.4	1.4	0.8	1.6
2-year forecast	2.3	1.3	1.6	1.3	1.7	1.1

Source: GLA Economics' calculations

Data revisions

Revisions to the historic dataset for household expenditure tend to have little bias, being revised down on average by just under 0.1 percentage points per year on average (see Figure 3). However, revisions to the data have been significant, with upward revisions to the data made in seven years between 2003 and 2014 by an average of 1.1 per cent, with downward revisions made in five years at an average of 1.6 percentage points. The strongest upward revision to the series was in 2003 when it was revised up by 2.7 percentage points, whilst the largest downward revision was in 2013 with a downward revision of 2.4 percentage points.

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[8] Average actual growth represents the average growth over the years to which that type of forecast applies in order to make them comparable.

Figure 3: Household expenditure data revisions

Source: EE and GLA Economics' calculations based on EE data

Household income

The accuracy of household income forecasts have tended to vary depending on the time horizon of the forecasts (see Table 4). In-year average forecast growth of 1.5 per cent is below the actual observed average growth of 2.3 per cent. The 2-year forecasts tend to overestimate growth on average, whilst 1-year forecasts are more broadly in-line.

The average absolute forecast error declines slightly the longer the forecast horizon, but when removing the effects of the Great Recession, in-year forecasts have been slightly more accurate than future forecasts. More recent forecasts, ie, post 2012, have been slightly more accurate than all the combined forecasts since 2003, particularly the 1-year forecasts where the average absolute error is much lower than the entire forecast series.

Data revisions do not appear to have impacted as significantly on the forecasting accuracy of household income compared to their impact on other variables examined in this review. In fact, the average absolute error generally increases based on the originally published data compared to the latest estimates. The revisions have been mostly upwards with an overall average revision to growth of 0.9 per cent, while the average absolute revision was by 1.5 percentage points. However, revisions have been much smaller in recent times, even accounting for the fact that more recent data could still be revised, with the mean absolute revision since 2012 of 0.5 percentage points much lower than 1.8 percentage points prior to this (see Figure A4). Note that the appendix to this note provides further analysis on the accuracy of the in-year, 1-year ahead and 2-year ahead forecasts for household income that have been produced by GLA Economics.

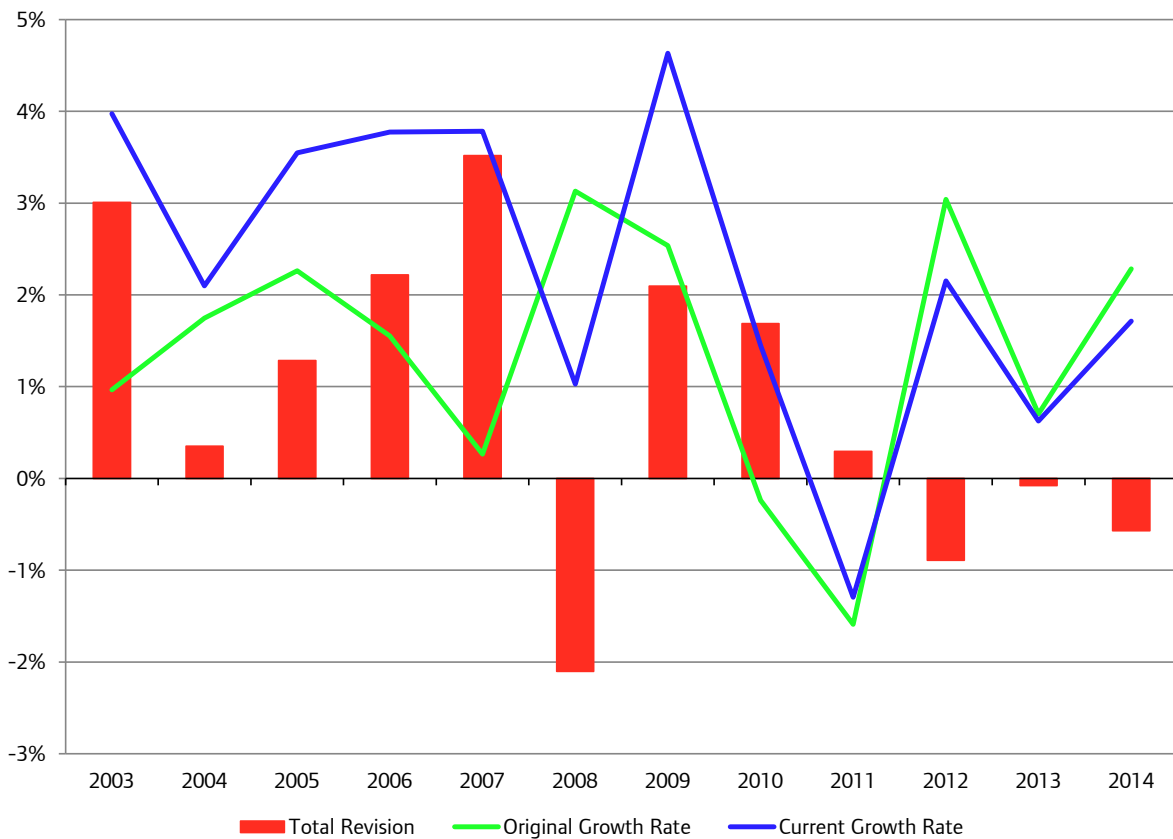## Table 4: Household income forecast performance measures[9]

	Average Forecast Growth (%)	Average Actual Growth (%)[10]	Mean absolute error (%)	Mean absolute error excl. 2009 (%)	Mean absolute error (2012-14) (%)	Mean absolute error prior to revisions (%)
In-year forecast	1.5	2.3	1.5	1.0	1.1	1.7
1-year forecast	2.3	2.1	1.4	1.2	0.5	1.4
2-year forecast	2.7	2.1	1.3	1.2	1.2	1.5

Source: GLA Economics' calculations

Data revisions

Household income has been revised upward on average by 0.9 percentage points between 2003 and 2014. Upward revisions have been made in eight years over this period by an average of 1.8 percentage points, with upward revisions made every year between 2003 and 2011, except for 2008. Downward revisions were made in 2008 and each year between 2012 to 2014, by an average of 0.9 percentage points (see Figure 4).

Figure 4: Household income data revisions

Source: EE and GLA Economics' calculations based on EE data

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[9] Note that in the GLA forecasts published in 2003 contained no forecast for household income, therefore the examination of the performance of the household income forecast is for the forecast years 2004 to 2014.

[10] Average actual growth represents the average growth over the years to which that type of forecast applies in order to make them comparable.

Forecasting process

This forecast review has shown that data revisions have generally had a significant impact on GLA Economics' ability to develop accurate forecasts. Thus in general the GLA Economics' forecasts more accurately described the historic dataset prior to revisions in it. Still, the GLA Economics' forecasts have performed generally well when compared to other forecasters, both in terms of revised and unrevised datasets. However, the average absolute errors of the GLA Economics' forecasts both for the revised and unrevised datasets have on average been greater than one which indicates that there was room for improvement in terms of forecast accuracy.

On reflection a few issues that could improve the forecasting process were evident. These issues for improvement in the pre-May 2016 forecasting model included:

- the pre-May 2016 model was based on annual data, and therefore did not take into account any quarterly trends, thus adapting the model to forecast for quarterly growth should help to capture these trends; and
- the inclusion of a wider array of explanatory variables in the model, with these variables having a stronger theoretic relationship with the variable being forecast than was the case in the pre-May 2016 forecast model should also help to improve forecast accuracy.

This section analyses these issues in more detail, and outlines the adopted solutions to mitigate these challenges.

Frequency of data

The first issue with the previous forecast model is that it was an annual forecast model. Whilst this is justifiable given that the ONS only publishes annual data for London for the series forecast except for workforce jobs, this was less than ideal for two reasons:

- annual data provides less data-points than a quarterly series would, which is likely to reduce the predictive power of the model; and
- annual data can hide the underlying quarterly trends that are taking place within the economy.

As noted, the fact that annual data is used means that there are a limited number of observations on which the model is based, which is likely to reduce the predictive power of the model and the quality of the estimates it produces.

However, a bigger issue with the annual model is that the trends in the indicators can be masked by the annual data as opposed to quarterly data. This can impact on all the variables that are forecast, GVA, workforce jobs, household expenditure and income. Thus for example a forecast produced in the middle of the current year for average annual growth in GVA in this year of x per cent can have significantly different assumptions about the underlying quarterly performance of GVA in the latter part of the year depending upon the economy's performance in the first part of the year. So although the previous model implicitly took into account the quarterly performance of the economy it did not attempt to fully quantify it and could thus miss some of these trends which would in turn inform the annual forecast. It should of course be noted that there could be data issues with this quarterly analysis process, as these quarterly trends are based on estimates that could be revised as more data for London is published by the ONS.

Forecast improvement 1: Quarterly data

Quarterly data has now been included in the forecast model, which is then used to forecast annual growth. Available quarterly data is also now used to inform in-year forecasts, and evaluate 1-year and 2-year forecasts for all variables that are forecast: GVA; workforce jobs; household income; and household expenditure.

Variables of the forecasting model

The coefficients of the explanatory variables used in the pre-May 2016 model were last updated for the May 2012 LEO forecast[11] by Volterra Consulting Limited who built the pre-May 2016 forecast model. Leaving such a long period of time without re-estimating the coefficients based on the latest available data meant that there are observations available that could improve the predictive power of the model that had not been incorporated into the model. This impact could be exacerbated given that revisions have been made to the historical series since these coefficients were calculated, which means that the coefficients in the model are based on an older time-series, that may now be quite different to the latest data.

This thus indicated that a review of the explanatory variables of the forecast model could potentially improve the forecast accuracy of the GLA Economics forecast model. This is not to say that there would necessarily be variables available that would have improved the model, in many cases it is unlikely that there are variables that will have sufficient explanatory power. However it's important to understand the limitations of the model being used in order to understand the quality of its output and suggest improvements to it.

Forecast improvement 2: Development of a new forecasting process

This review thus suggested that a new forecasting process, including a new model should be developed. Three different approaches to developing a new forecasting process for the LEO forecasts were thus identified. These include, in order of preference:

- a **bottom-up** approach to model GVA and employment by industry within the model matched with forecasts of headline GVA and employment. The household indicators would be forecast on their own, based on the best available indicators, which may be GVA or employment forecasts;
- a **top-down** approach to model all headline variables within the model, with non-model processes used to build-up industry group forecasts for GVA, employment, household income and consumption; or
- a **non-model** approach which involves quantitative analysis of the data, and research encompassing the wider economic outlook to support qualitatively supported forecasts.

The bottom-up approach was the preferred option; however upon further research enough explanatory variables that can inform a forecast model that provides reliable estimates were not available. Therefore a modified **top-down approach** was chosen instead.

A benefit of a top-down approach is that a number of independent forecasts are available from the Office of Budget Responsibility, the Bank of England, HM Treasury Summary of Independent forecasters, GLA Intelligence Unit, ONS, external forecasters etc. for relevant explanatory variables such as UK GDP and employment growth forecasts, London population growth projections, UK consumption and income growth forecasts etc. This approach has the

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[11] GLA Economics, May 2012, 'London's Economic Outlook – Spring 2012: The GLA's medium-term planning projections'.

benefit of using credible, independent forecasts as the basis for assessing the GLA's economic outlook whilst also allowing for the inclusion of other relevant explanatory variables where appropriate. The explanatory relationship between these variables and London growth was then econometrically estimated. A process to portion out the forecast levels of GVA and employment to the industry forecasts, looking at the quarterly data and historical trends, as well as other indicators to develop a narrative was then undertaken.

Conclusion

This paper summarises the historic performance of the previous forecast model used by GLA Economics to produce the GLA's medium-term planning projections. This review showed that although the performance of the forecast had been generally relatively sound, especially prior to revisions in the historic datasets, areas of improvement could be identified. These improvements were then fed into the production of GLA Economics' new forecasting model.

Appendix

This appendix goes into further detail on the accuracy of GLA Economics forecasts for growth in GVA, employment, household expenditure and household income in London in the forecast year, 1-year ahead and 2-years ahead.

Gross Value Added

In-year forecasts
In-year forecasts of GVA have averaged an annual growth rate of 1.8 per cent over the forecasting period (ie, 2003-2014) and have been on average 1.5 percentage points lower than actual GVA growth. This compares to an average annual growth rate from the consensus forecast of 1.9 per cent. Removing 2009 (the Great Recession) and the GLA Economics' forecasts have underestimated GVA growth by 1.9 percentage points on average. In absolute terms, the average absolute forecast error has been 2.4 percentage points of growth each year.

However, forecast accuracy appears to have improved in recent times, with GVA growth underestimated on average by just 0.2 percentage points since 2012, with an average absolute forecast error of 0.5 percentage points. Although, this could be due to the minimal revisions made to the data for these more recent years up until the time of this review.

Revisions are a large contributor to the forecast error, as significant revisions to the GVA series have been made. The mean absolute error drops from 2.4 percentage points to 0.6 percentage points for in-year forecasts when compared to the originally published GVA estimates. Revisions to the historic data thus go a very long way towards explaining the underestimates produced by GLA Economics' forecasts.

In comparison to the consensus forecast the relative performance of GLA Economics' forecast is somewhat dependent on which historic dataset examined the 'original', which is more closely related to the data available at the time of the forecast, or the revised 'current' dataset. However, in both cases the forecasters' accuracy is more aligned with the unrevised than revised datasets. Thus in examining the forecast in relation to the 'current' available historic data the GLA Economics' in-year forecasts for GVA are quite similar to the consensus forecasts, with the absolute forecast error of 2.2 percentage points for the consensus forecasts being slightly lower than the 2.4 percentage points for GLA Economics' forecasts (see Figure A1). However, the mean absolute error of the forecasts are identical for GLA Economics and the consensus forecasts when comparing the forecasts to the GVA series growth rates given prior to data revisions standing at 0.6 percentage points.

Figure A1: London GVA growth and in-year forecasts
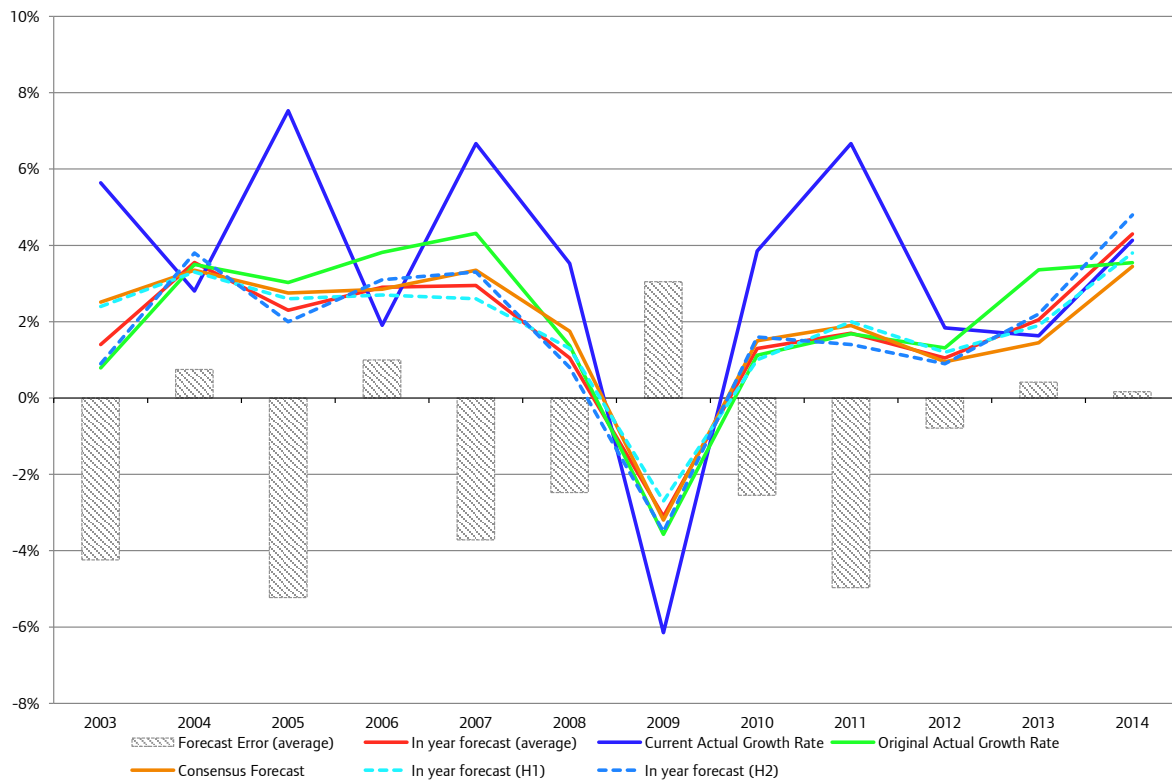
Source: EE and GLA Economics' analysis

One-year forecasts

Looking ahead, the 1-year forecasts have also tended to underestimate economic growth, with the average annual forecast growth rate of 2.1 per cent over the forecast period (ie, 2004 to 2014) being on average 1.0 percentage points lower than actual growth. This compares to an annual average consensus forecast growth rate of 2.4 per cent. However, the recession year in 2009 has a significant impact on GLA Economics' estimate, as growth was overestimated by 7.1 percentage points for this year. Removing this effect, the one-year forecasts have underestimated growth on average by 1.8 percentage points i.e. GLA Economics' forecast was on average 1.8 per cent lower than the actual outcome.

In absolute terms, the forecast error after data revisions has averaged 2.5 percentage points each year, which falls to 2.1 percentage points when 2009 is excluded. Once again and like the in-year forecasts, the one-year forecasts have been more accurate in recent times, with an average absolute forecast error of 0.8 percentage points since 2012 when minimal data revisions have been made, however this includes the 2014 forecast which was underestimated by 1.7 percentage points.

As was also the case for the in-year forecast, removing the impact of revisions to the dataset reduces the average absolute forecast error, in this case from 2.5 percentage points to 1.4 percentage points. Thus again data revisions played a significant role in the forecasts seeming underperformance.

Still looking at the 'current' or post revisions data it can be seen that the consensus forecasts exhibit a slightly worse profile to the GLA Economics' forecasts, with the consensus forecasts being slightly less accurate with an average absolute error of 2.6 percentage points, compared to 2.5 percentage points for the GLA Economics' forecasts. This can be attributed to lower

forecasts from GLA Economics in 2009 when the London economy contracted (see Figure A2). However, as was noted above the mean absolute error is smaller, and also slightly lower for GLA Economics compared to the consensus forecast, when comparing the forecasts to the GVA series prior to data revisions, standing at 1.4 percentage points and 1.5 percentage points respectively. Thus data revisions also go a fair part of the way in describing the underperformance of the consensus forecasts as well.

Figure A2: London GVA growth and one-year forecasts
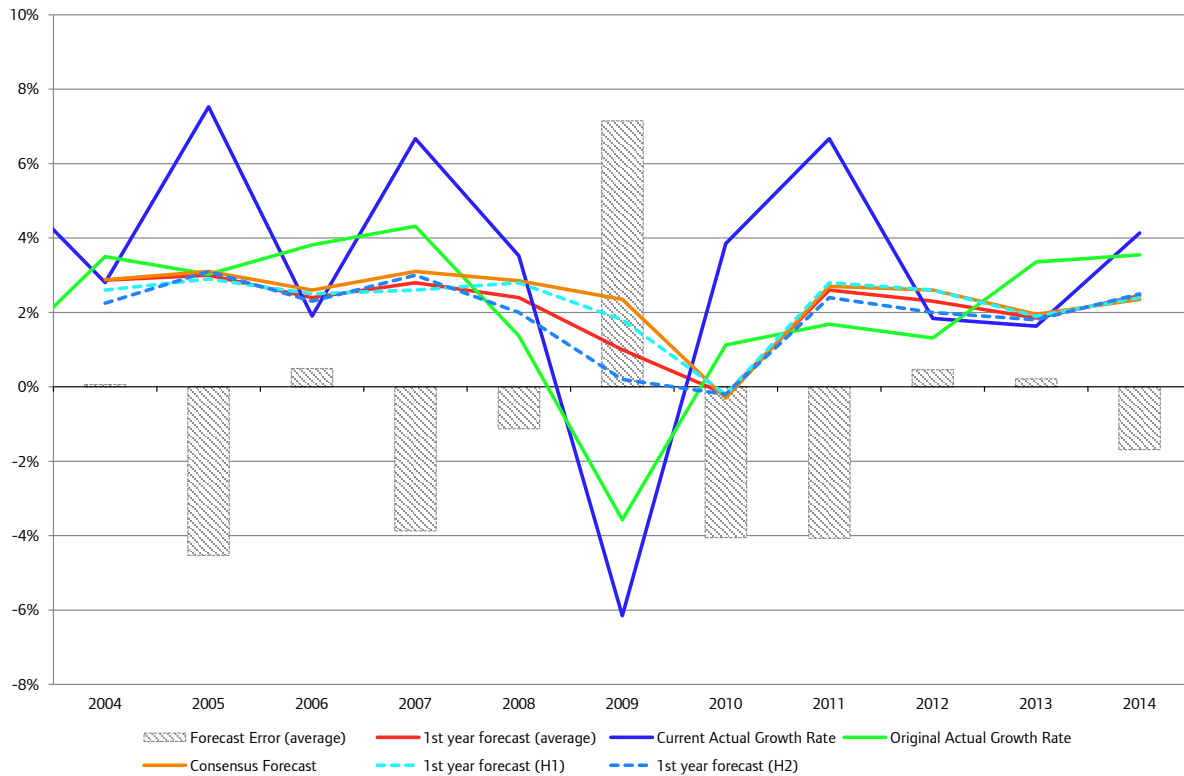
Source: EE and GLA Economics' analysis

Two-year forecasts

2-year ahead forecasts have underestimated economic growth by 0.5 percentage points on average and by 1.5 percentage points when 2009 is excluded. However, in absolute terms the forecast error has averaged 2.9 percentage points or 2.2 percentage points when 2009 is excluded.

The average absolute forecast error falls from 2.9 percentage points to 1.6 percentage points for two-year ahead forecasts if revisions to the dataset are ignored. This is slightly above the average absolute forecast error observed for the 1-year ahead forecast prior to data revisions and again indicates that the forecasts was more accurate in predicting the outcome given the data available at the time of the forecasts than the headline average absolute forecast error might imply.

As was the case with the forecasts made over shorter time horizons, the average absolute forecast error has been smaller since 2012, averaging a much lower 1.3 percentage points per year. This could be attributed to the lack of data revisions in recent years.

Consensus forecasts again are broadly similar to those from GLA Economics, with the GLA Economics' forecasts averaging 2.7 per cent growth rate compared to 2.9 per cent for the

consensus of the forecast period (ie 2005-2014). While, the consensus forecasts have been slightly more accurate with an average absolute error of 2.8 percentage points, compared to 2.9 percentage points for GLA Economics' forecasts (see Figure A3). However, prior to revisions to the dataset GLA Economics' forecasts were slightly more accurate with an average absolute error of the forecast of 1.6 percentage points compared to 1.7 percentage points for the consensus forecasts. Thus again it can be seen that dataset revisions have increased the forecast error compared to that indicated by the original historic datasets.

Figure A3: London GVA growth and two-year forecasts
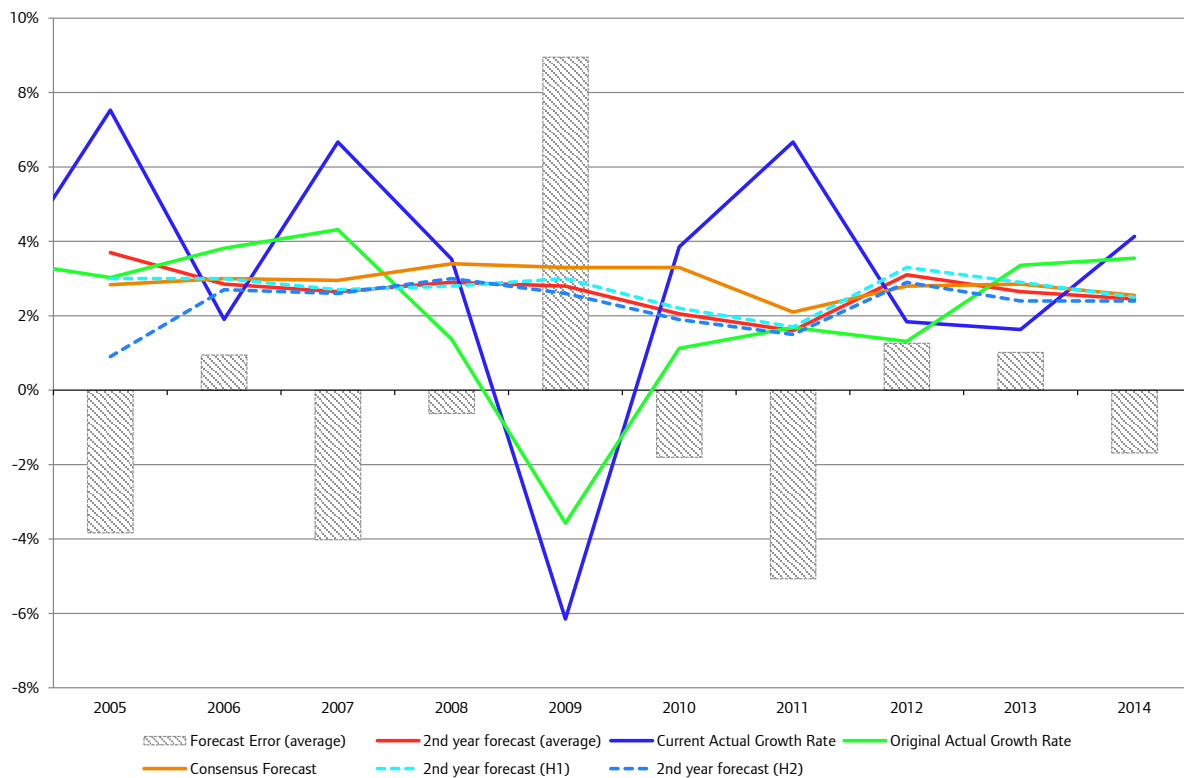
Source: EE and GLA Economics' analysis

Employment

In-year forecast

Employment forecasts on average have been 1.2 percentage points lower than the actual growth rates. There were three years between 2003 and 2014 where growth forecasts exceeded actuals, by an average of 0.7 percentage points. The remaining nine years underestimated employment growth by an average of 1.9 percentage points. The absolute forecast error averaged 1.6 percentage points over this period, which falls to 1.3 percentage points when based on the original historic datasets prior to revisions.

Consensus forecasts have tended to be slightly higher than GLA Economics' forecasts, with the consensus averaging forecasts of 0.6 per cent annual growth rates compared to 0.4 per cent for GLA Economics. Given that GLA Economics' forecasts have underestimated the actuals, this has seen the consensus forecasts being more accurate with an average absolute forecast error of 1.3 percentage points, compared to 1.6 percentage points for GLA Economics' forecasts (see Figure A4). When compared to the data series prior to revisions, the consensus forecasts have an average absolute forecast error of 1.1 percentage points which is slightly more accurate than

the GLA Economics' forecasts which have an average absolute forecast error of 1.3 percentage points.

Figure A4: London employment growth and in-year forecasts[12]
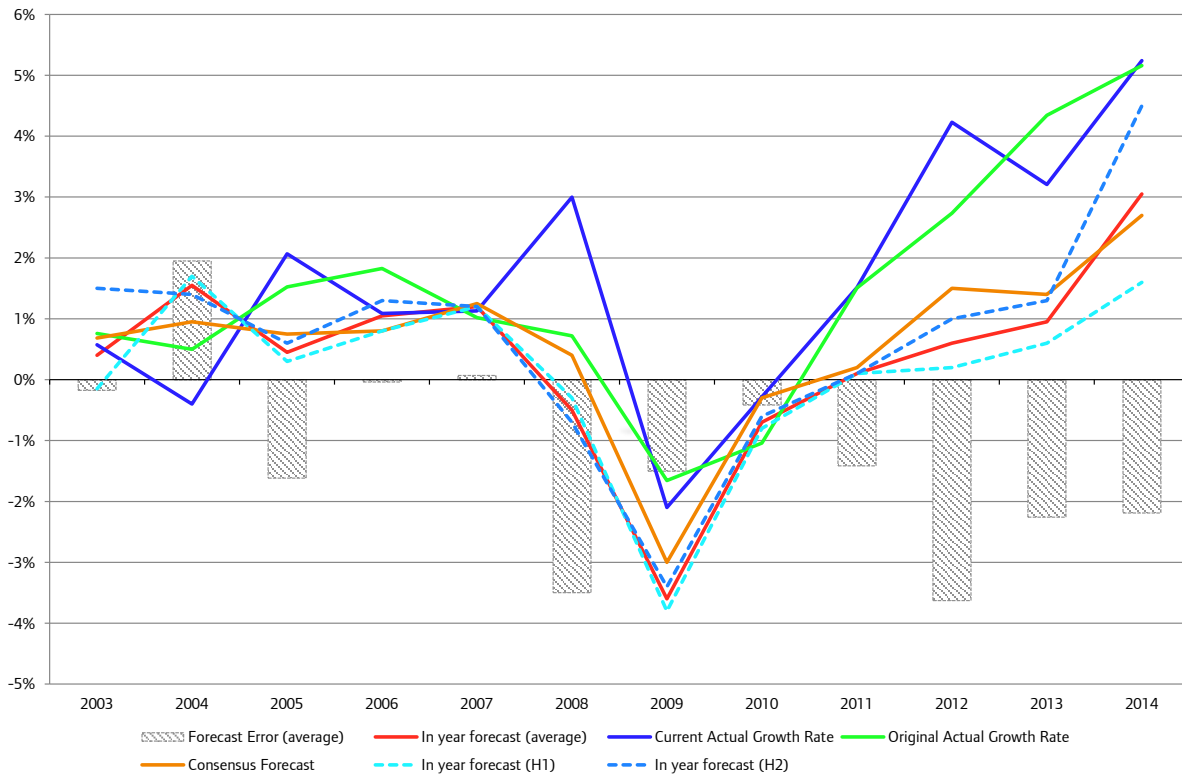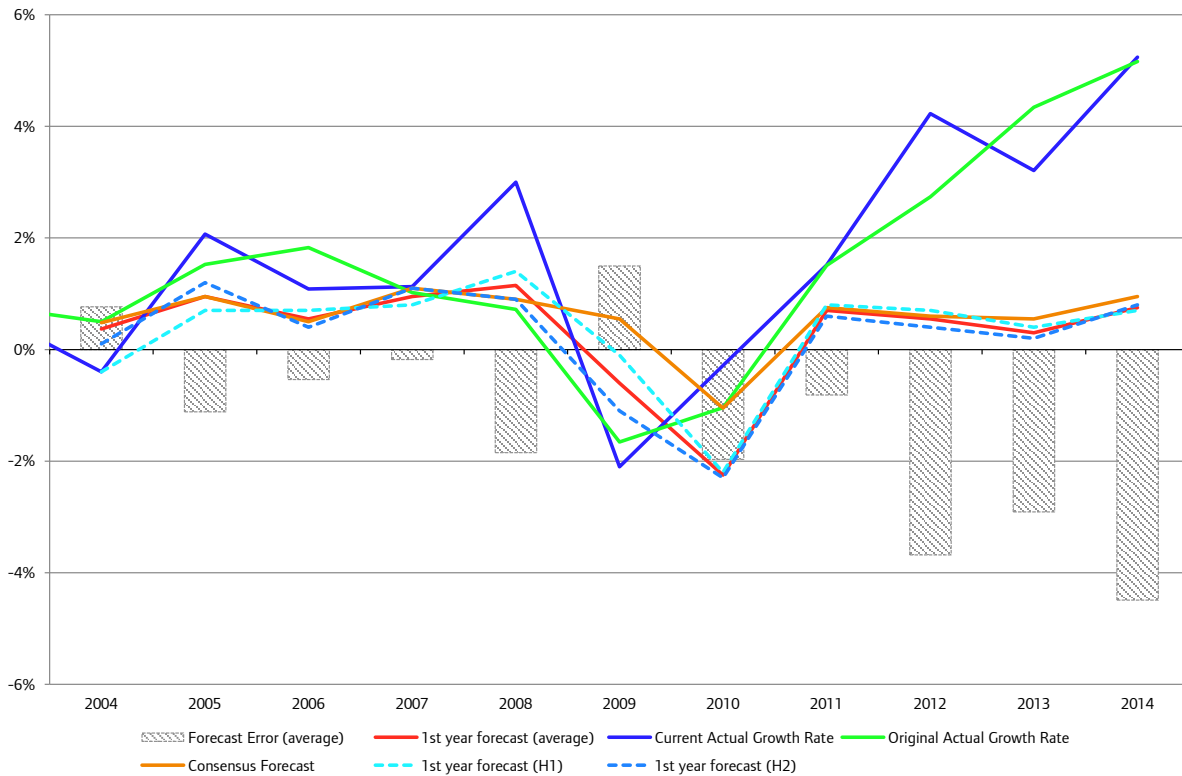

Source: EE and GLA Economics' analysis

One-year forecast

1-year ahead forecasts have underestimated employment growth by an average of 1.4 percentage points. Growth was only overestimated in 2004 (by 0.8 percentage points) and during the Great Recession in 2009 (by 1.5 percentage points) when employment contracted more than forecast. The remaining years underestimated employment growth by an average of 1.9 percentage points, with the absolute forecast error over the period averaging 1.8 percentage points, falling to 1.5 percentage points when based on pre-revision data.

Again, like the in-year the consensus forecasts were generally higher than the GLA Economics' forecasts, averaging growth of 0.6 per cent a year, compared to 0.3 per cent for GLA Economics. However, in terms of accuracy both the GLA Economics and consensus forecasts have the same average absolute errors of 1.8 percentage points likely reflecting the better performance of the GLA Economics' forecast in 2009 (see Figure A5). Measuring the forecasts prior to dataset revisions, the consensus forecasts were slightly more accurate with an average absolute forecast error of 1.4 percentage points, compared to 1.5 percentage points for GLA Economics' forecasts.

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[12] EE rather than ONS data on Workforce Jobs is referenced in this and the following employment charts for consistency purposes as EE data was the historic time series used in GLA Economics forecasts prior to May 2016.

**Figure A5: London employment growth and one-year forecasts**

Source: EE and GLA Economics' analysis

Two-year forecast

2-year ahead forecasts on average have been understated by 1.2 percentage points compared to the actuals, and have been understated in each year except 2009 and 2010 following the Great Recession when they were over-estimated. In absolute terms, the forecast error has averaged 2.0 percentage points per year (1.8 per cent pre-revisions). The largest errors have occurred since the Great Recession when employment growth has expanded strongly, while at the same time employment growth forecasts had been quite modest.

Again, like the in-year and 1-year ahead forecasts the consensus forecasts were generally higher than the GLA Economics' forecasts, averaging growth of 1.0 per cent a year, compared to 0.7 per cent for GLA Economics. However, in comparison to the consensus forecast the GLA Economics' forecasts has performed equally as well with both forecasts having an average absolute forecast error of 2.0 percentage points (see Figure A6). The trend is similar when comparing the estimates prior to data revisions, with the average absolute error for both the consensus forecasts and GLA Economics' forecasts standing at 1.8 percentage points.

Figure A6: London employment growth and two-year forecasts
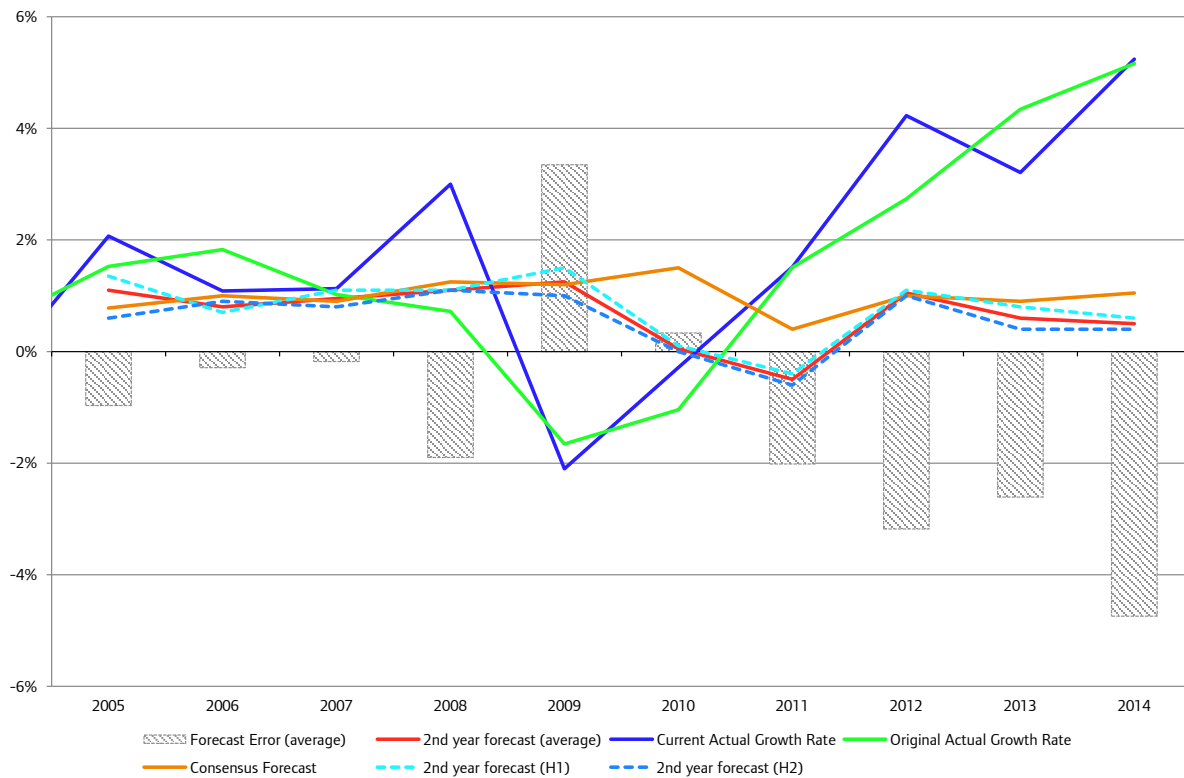
Source: EE and GLA Economics' analysis
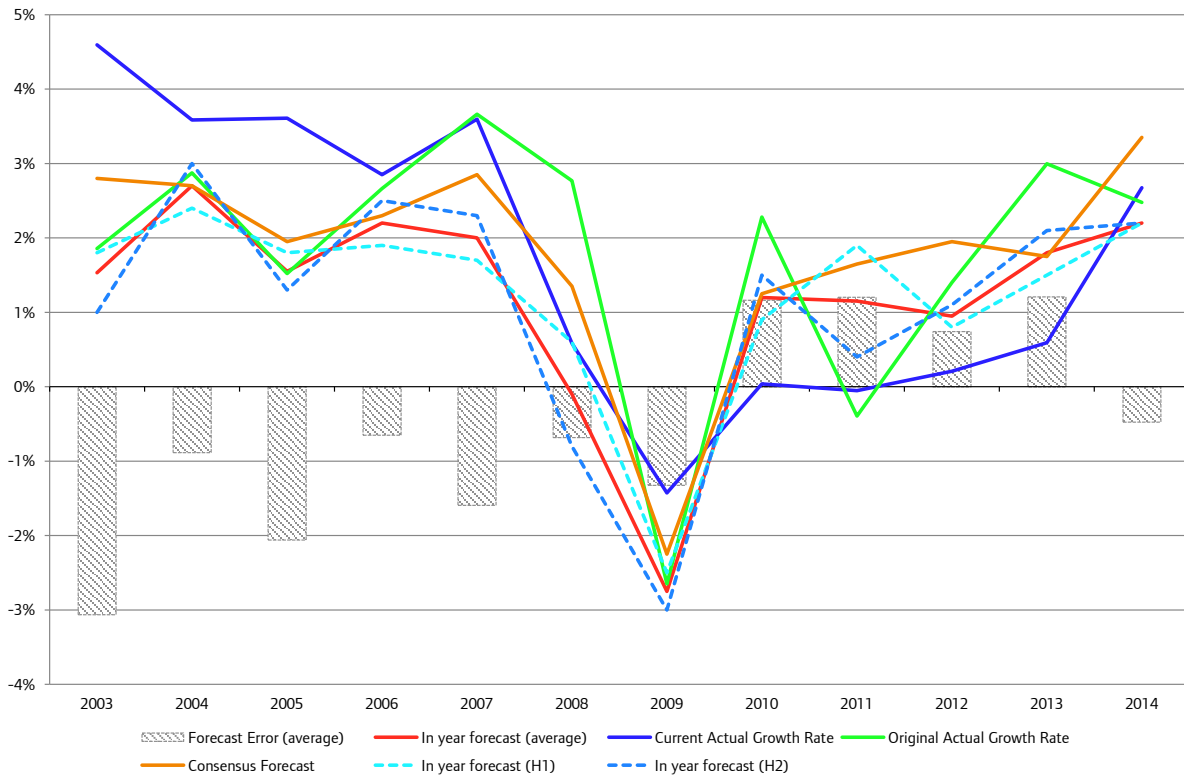
Household Expenditure

In-year forecast

The in-year forecasts for household expenditure have on average underestimated the actual results by 0.5 percentage points. The trend has been that forecasts underestimated household spending in the lead-up to the Great Recession, with forecasts since then over-estimating spending except for the last examined forecast in 2014 (see Figure A7).

The mean absolute error has been 1.3 percentage points, which falls slightly to 1.2 percentage points if 2009 is excluded, whilst forecasts have been more accurate in recent times with an average absolute error of 0.8 percentage points since 2012. However, if the data had not been revised the mean absolute error since 2003 would fall to 0.8 percentage points. Thus, as has been the case for a number of other forecasts examined in this review, it again highlights the impact on the accuracy of the forecasts of revisions to the comparison historic dataset.

The consensus forecasts of household expenditure have a lower mean absolute error compared to the GLA Economics' forecasts standing at 1.1 percentage points against 1.3 percentage points. However, prior to data revisions, the consensus forecasts were less accurate, with a mean absolute forecast error of 1.1 percentage points, compared to 0.8 percentage points for the GLA Economics' forecasts.

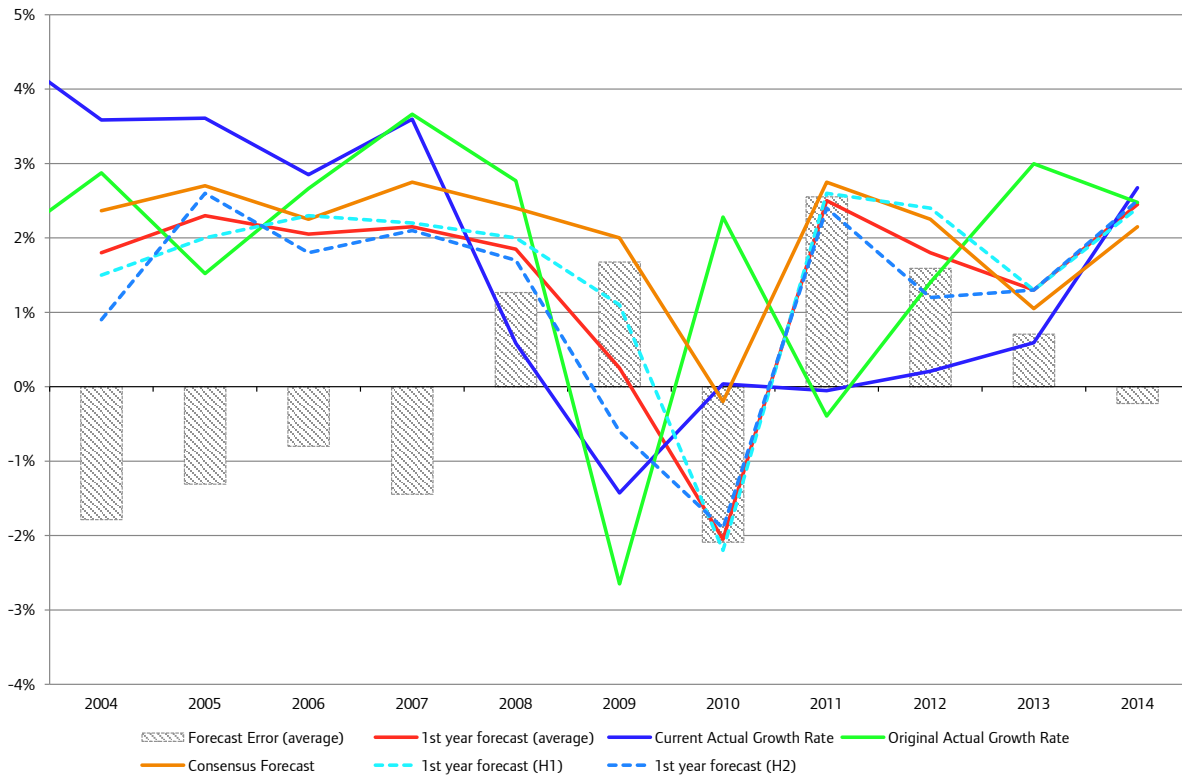**Figure A7: Household expenditure in-year forecasts**

Source: EE and GLA Economics' analysis

One-year forecast

1-year ahead household expenditure forecasts underestimated household spending in the lead-up to the Great Recession, but have generally overestimated them since then – offsetting one another (see Figure A8). The mean absolute error of the 1-year ahead forecasts was 1.4 percentage points which is slightly higher than the in-year forecasts, whilst the mean absolute error increases when examining the accuracy of the forecasts to the pre revisions dataset to 1.6 percentage points.

The consensus forecasts were identical in accuracy to those produced by GLA Economics with a mean absolute error of 1.4 percentage points. However, when ignoring data revisions GLA Economics' forecasts where slightly more accurate with a mean absolute error of 1.6 percentage points compared to a mean absolute error of 1.7 percentage points for the consensus forecasts.

**Figure A8: Household expenditure one-year forecasts**

Source: EE and GLA Economics' analysis

Two-year forecast

On average the 2-year ahead forecasts have overestimated household expenditure growth by 1.0 percentage points. Forecasts since the Great Recession have overestimated spending growth, whilst prior to this forecasts underestimated growth (see Figure A9). The mean absolute error of the GLA Economics' forecast has been 1.6 percentage points, which falls to 1.1 percentage points prior to revisions in the historic dataset.

The GLA Economics' forecasts were more accurate than the consensus forecasts with an average absolute error of 2.0 percentage points for the consensus forecasts, compared to 1.6 percentage points for the GLA Economics' forecasts. This 0.4 percentage point difference remains when considering the data prior to revisions in the historic dataset, with the consensus forecast having an average absolute error of 1.5 percentage points compared to 1.1 percentage points for the GLA Economics' forecasts.

Figure A9: Household expenditure one-year forecasts
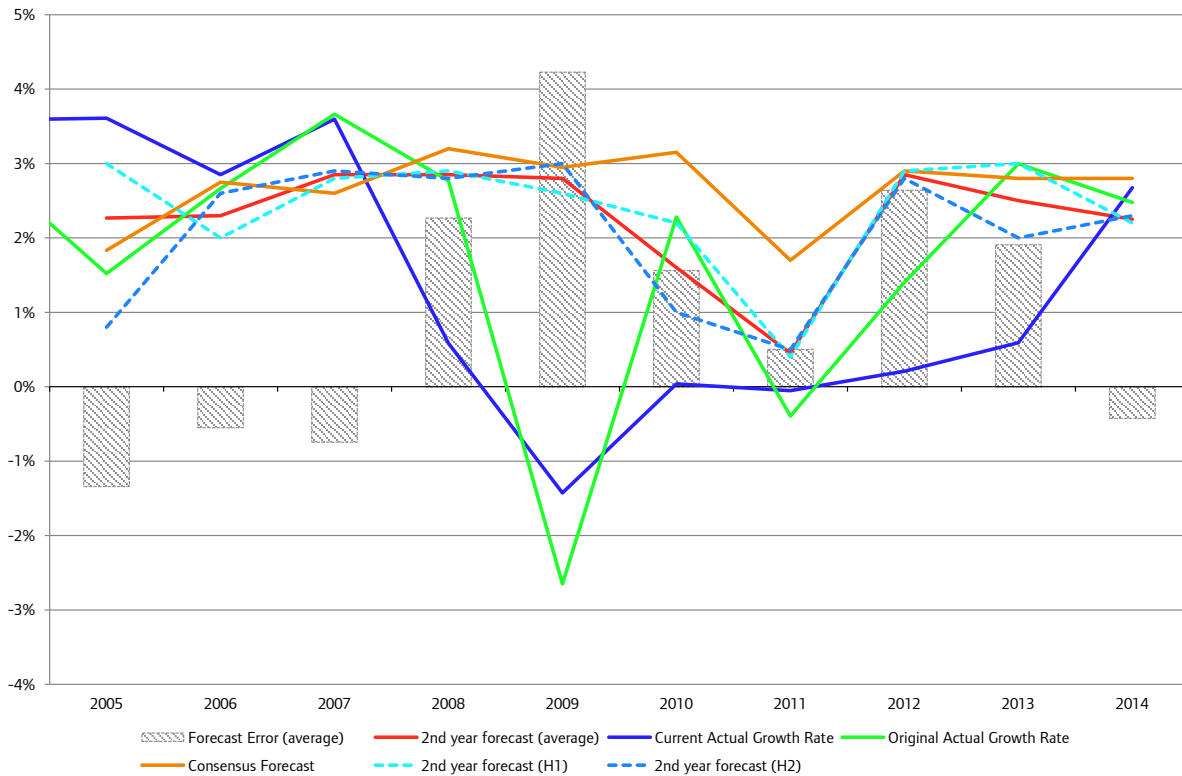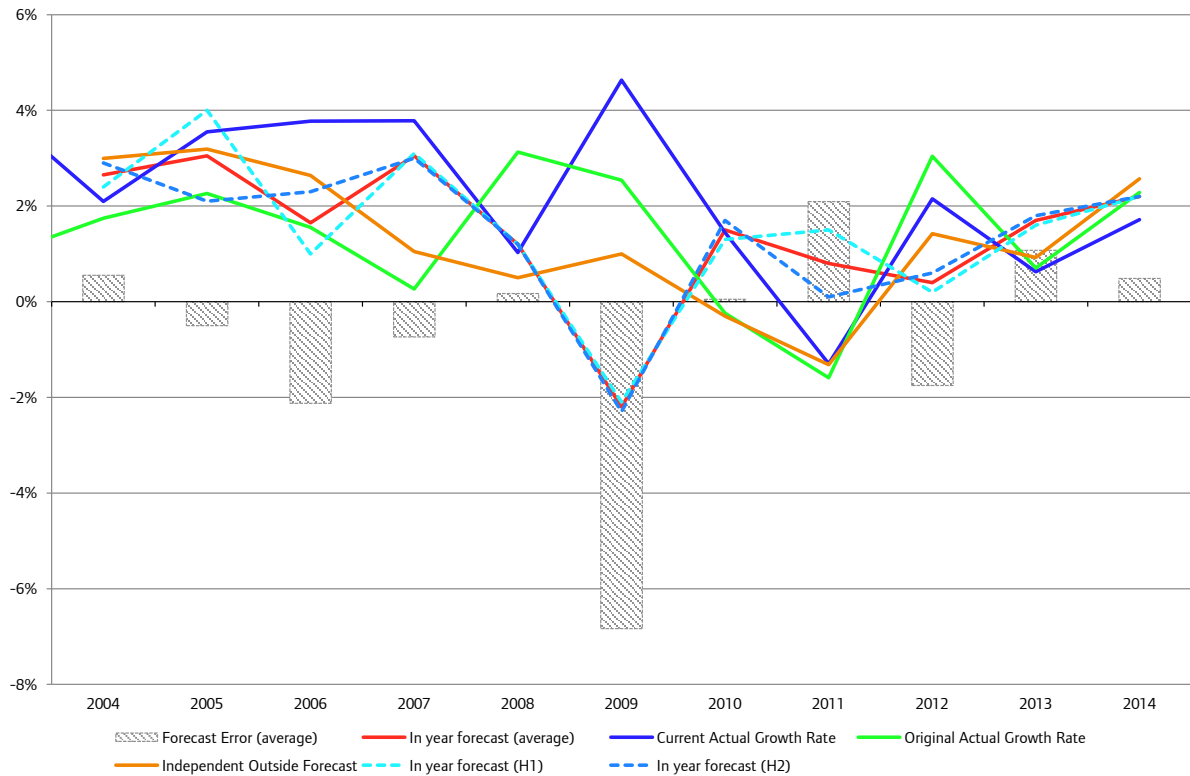

Source: EE and GLA Economics' analysis

Household Income

In-year forecast

Household income in-year forecasts have tended to underestimate growth, forecasting an average increase of 1.5 per cent, compared to the 2.3 per cent actual increases on average (see Figure A10). The mean absolute error of the forecasts is 1.5 percentage points, which declines to 1 percentage point when excluding the 2009 recession. Based on the original published data before revisions the absolute forecast error increases to 1.7 percentage points.

It should be noted that no consensus forecast for household income is produced for London as most forecasters do not as yet produce a forecast for household income at the regional level. Therefore to provide an indication of the accuracy of the GLA Economics' forecast compared to other forecasters the concurrent forecast of household income produced by an independent forecaster at the time of production of each GLA Economics' forecast is provided in the following charts on household income.

**Figure A10: Household income in-year forecasts**

Source: EE and GLA Economics' analysis

One-year forecast

1-year ahead forecasts for household income growth slightly overestimated actual growth on average, with average annual growth forecasts of 2.3 per cent slightly higher than 2.1 per cent average growth seen in the historic dataset (see Figure A11). While, the mean absolute error is slightly lower for the 1-year ahead forecast at 1.4 percentage points than the in-year forecast, however it is higher than the in-year forecasts when excluding the Great Recession at 1.2 per cent. In the 2012 onwards forecasts, the 1-year ahead forecasts have been more accurate, with an average absolute error of just 0.5 percentage points. While if data revisions are ignored, the average absolute forecast error remains steady at 1.4 percentage points.

**Figure A11: Household income one-year forecasts**
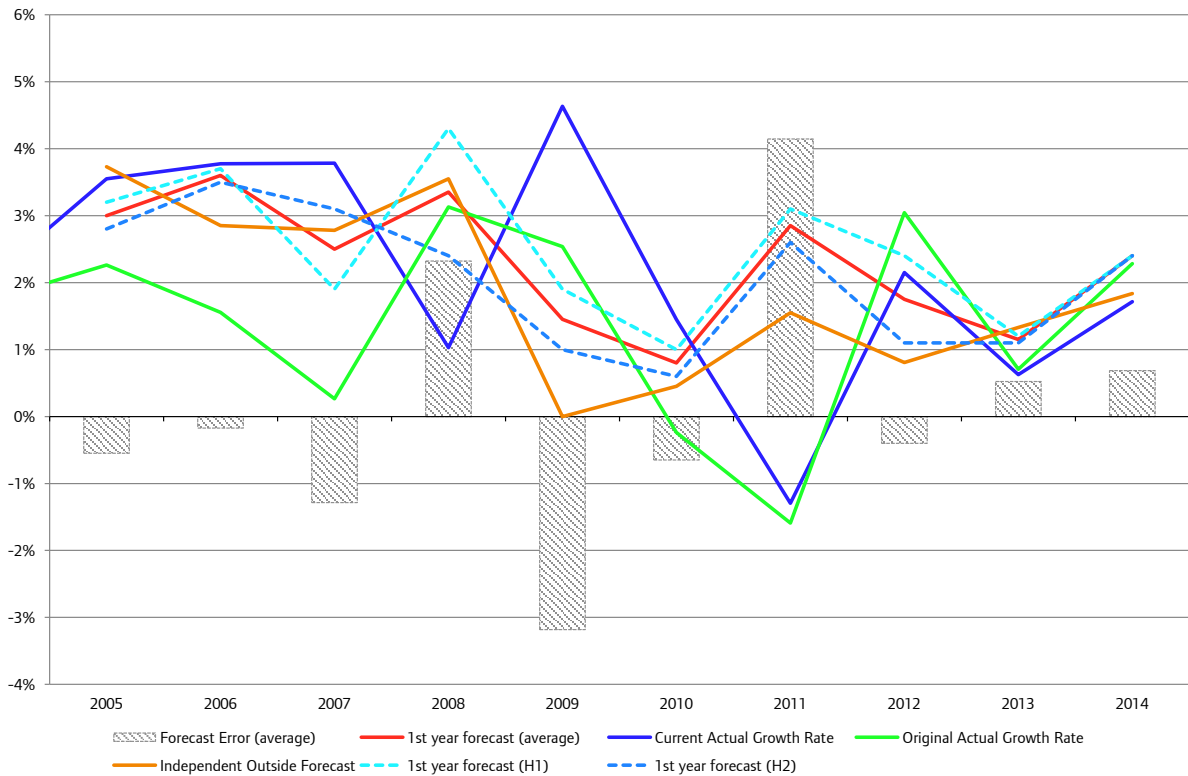
Source: EE and GLA Economics' analysis

Two-year forecast

The 2-year ahead forecasts have tended to overestimate growth, with an average forecast of 2.7 per cent growth compared to the actual average growth rate of 2.2 per cent (see Figure A12). Growth has been overestimated in most years, except for 2006, 2007 and 2009 when growth was weaker than forecast. The average absolute error is quite consistent whether the Great Recession is excluded (1.2 percentage points) or not (1.3 percentage points), or when just looking at forecasts for 2012 onwards (1.2 percentage points). However, when data revisions are excluded the average absolute error increases to 1.5 percentage points.

Figure A12: Household income two-year forecasts
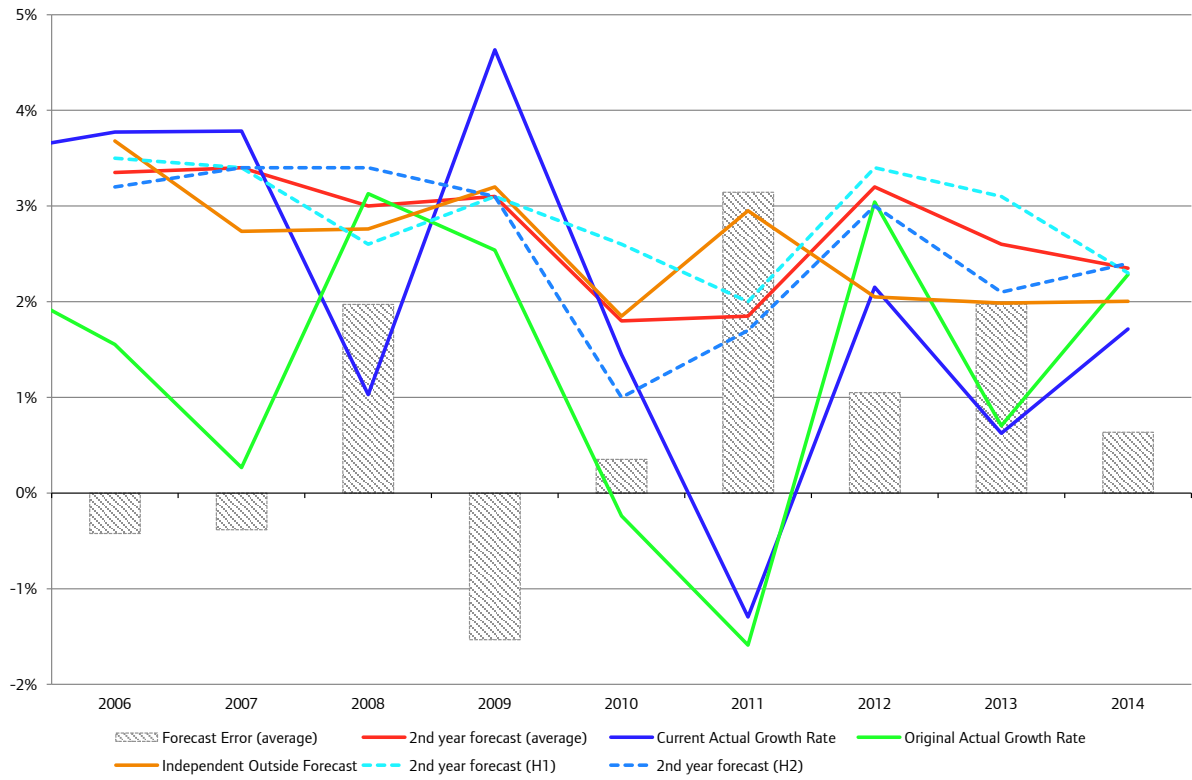
Source: EE and GLA Economics' analysis

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