UK Trade in Goods Statistics

Improving the statistical estimates for trade below the collection threshold for EU trade (Intrastat)

Jonathan Digby-North, Matthew Greenaway, Catherine Putz and Gary Brown

Office for National Statistics

Contents

0 Executive Summary

This report summarises an investigation into the statistical methods used to estimate trade breakdowns for businesses below the Intrastat collection threshold. The investigation was prompted by an upcoming change to the threshold value. The current methodology was compared to a range of alternative methods; the robustness of these methods to the changed threshold was measured at a country, HS2 Chapter and country by HS2 Chapter level. Methods for addressing future changes to the threshold were also investigated.

The main findings indicate that the current method can be improved upon by fine tuning, but an alternate method – probably requiring more investment in systems – would be the optimal choice.

The resulting recommendations to estimate trade breakdowns for the traders which will fall below the new threshold (that is, 93% coverage) are given in the table below.

	Priority	
	Country or HS2 Chapter level	Country by HS2 Chapter level
Retention of Current Methodology	JATT = **1/7** of Below Threshold Trade	JATT = **11/14** of Below Threshold Trade
Adopting Optimum Methodology	JATT = **6/35** of Below Threshold Trade	JATT = **3/10** of Below Threshold Trade

1 Introduction

1.1 Background

The HMRC Intrastat survey collects information on trade between the Member States of the EU. These data are used by ONS in the Overseas Trade Statistics (OTS) publication which is a significant component of the Balance of Payments & National Accounts, and are also used by many Government organisations (for example, Eurostat, BIS, DEFRA, Welsh Government) as well as large numbers of individual businesses.

The survey avoids becoming a census by only collecting data from businesses whose total trade exceeds a given threshold. Businesses above this threshold are all required to complete the survey, whilst businesses below the threshold are not sampled. Estimates at a country and (Harmonised System) HS2 Chapter (product) level are required by Eurostat for all businesses, including those below the threshold. As only the total value of 'arrivals' (imports) and 'dispatches' (exports) is known for businesses below the thresholds – all traders are VAT registered on the HMRC administrative system – the way in which these values are allocated to country/HS2 Chapter breakdowns for those below the threshold is a major issue. HMRC currently estimate total UK arrivals and total dispatches by assuming that businesses just above the threshold have similar country/HS2 Chapter breakdowns to those below.

The threshold is set according to VAT records held by HMRC (specifically Box 8: Total EU Supplies and Box 9: Total EU Acquisitions). In 2009, the threshold was £270K - set so that arrivals and dispatches were collected for the largest (by trade value) businesses which make up 97% of total trade. Since 2010 the thresholds have been £600K (~95%) for arrivals and £250K (~97%) for dispatches. The current methodology to allocate totals below the threshold was developed when both thresholds corresponded to 97.5% coverage.

In the near future the arrivals threshold is likely to change to 93%: the issue investigated in this report is whether the allocation methodology will still work when this change happens, or whether new methodology is needed. The arrivals threshold is likely to change again in the future, so any new methodology needs to be easily adaptable to accommodate future changes to the survey threshold.

The long-term future is one of single flows - all countries collecting only dispatches and relying on other countries dispatches information to inform arrivals. The UK is likely to retain some arrivals survey whatever the EU solution, as the UK trade gap would grow bigger if we relied on dispatch information from other countries (anecdotally, arrivals are always bigger than other countries dispatches). Additionally, a small arrivals survey would still be worthwhile as the top 250 businesses provide 50% of total arrivals. However, this issue is not investigated in this report.

This report was funded by the Quality Improvement Fund (QIF)[1] to use past and current arrivals data to assess the current methodology for estimating breakdowns when the threshold changes to 93%, and to recommend best practice going forwards. The clients are Andrew Brown, Rafael Mastrangelo and Mark Herrigan (HMRC). The project team is: Gary Brown, Matt Greenaway, Jonathan Digby-North and Catherine Putz (ONS).

[1] https://gss.civilservice.gov.uk/statistics/methodology-and-quality/quality-improvement-fund/

1.2 Data

Two distinct data types were provided by HMRC, under a Data Usage Agreement.

- Administrative VAT records for all businesses held by HMRC, which includes total arrivals and dispatches, and SIC (Standard Industrial Classification). There are quality issues with the latter data, as the SIC is added when businesses register but may not be frequently updated.

- Responses to questions on arrivals and dispatches, by country and HS2 Chapter, to the Intrastat survey for 2009 (when the threshold was 97%) and 2010-2011 (when the threshold was 95% for arrivals and 97% for dispatches). The latest 2012 data (same thresholds as 2010-2011) became stable around September 2013 – these data have been used to check the stability of the results. We only use the arrivals data in this work.

2 Methods

2.1 Current Methodology

The businesses below the threshold are known as 'Below Threshold Traders' (BTT). If the businesses in the BTT account for X% of total trade, then the proportional breakdowns of the (smallest) businesses just above the threshold which account for the same proportion of total trade, defined as 'Just Above Threshold Traders' (JATT), are used along with the 'Total Above Threshold Traders' (TATT) to allocate totals.

- The proportional breakdown of JATT is calculated using the previous year's data (*y*) for country (*i*) at a 4-digit (that is, HS4) product level (*j*) as:

$$\frac{JATT_{ij,y}}{TATT_{ij,y}}$$

- For each month (*x*) of the current year, the allocation to BTT (hence BTTA) is calculated for country (*i*) at an 8-digit (that is, CN8) product level (*k*, within *j*) by multiplying the factor calculated at the 4-digit product level by the TATT in that month for a given (*i,k*) combination:

$$BTT_{ik,x} = \frac{JATT_{ij,y}}{TATT_{ij,y}} . TATT_{ik,x}$$

- These BTTA estimates are then scaled so they sum to the known VAT total of the BTT returns in the given month by multiplying the above equation by a scaling factor, given by:

$$SF = \frac{BTT_{VAT,x}}{\sum \frac{JATT_{ij,y}}{TATT_{ij,y}} . TATT_{ij,x}}$$

The scaled estimates are then aggregated to country by HS2 Chapter level estimates. Data at CN8 level are considered relatively unstable, and EU minimum requirements are to publish at HS2 Chapter by country, but 8,500 UK estimates at CN8 level are still published every month.

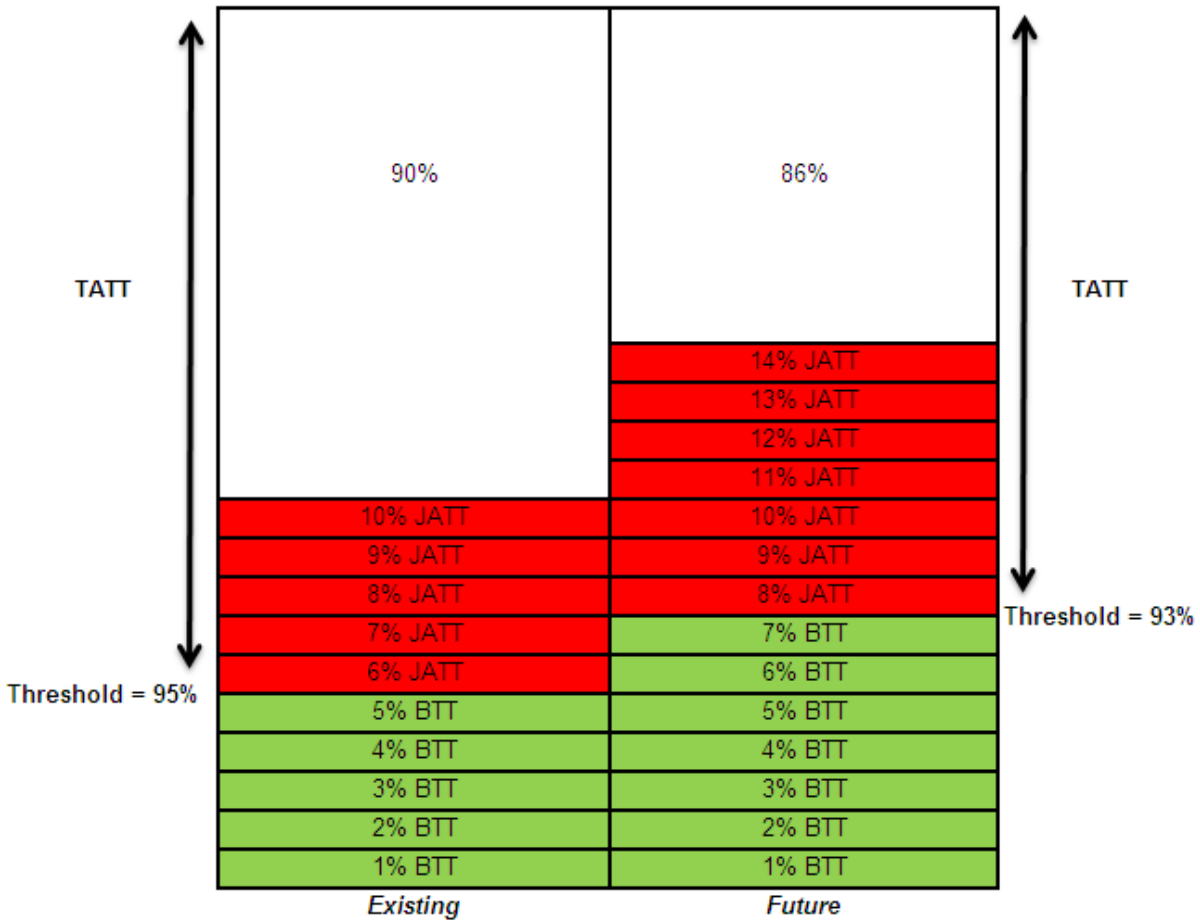


Figure 1: Current method with existing and future thresholds

The underlying assumption of the current method is shown on the left-hand side of Figure 1. When using a JATT (red) populated to contain the same amount of total trade as contained in the BTT (green), the proportion of the TATT which is included in the JATT (within a given country/HS2 Chapter combination) can be used to estimate BTT values. We refer to the businesses making up the bottom 1% of total trade as band 1 or 'B1', the next 1% as band 2 or 'B2', etc. The BTT at present can therefore be referred to as 'B1-5', and the JATT can be referred to as B6-10, or alternatively, the total trade in the JATT is 100% of the total trade in the BTT.

The obvious extension of the current method is to extend the JATT to cover B8-14, as illustrated on the right-hand side of Figure 1, so that the JATT continues to cover the same fraction of total trade as the BTT. To test the validity of using this method when the threshold is reduced to 93%, we need to use the businesses in the 8%-14% bands (B8-14) to estimate BTTAs for those in the 1%-7% bands (B1-7). However, since the businesses in B1-5 have not been surveyed in recent years; we do not have the 'true' breakdowns by country and HS2 Chapter to compare

with the estimates. We instead calculate breakdowns for B6-7 and compare them with actual Intrastat returns from 2011 and 2012, mirroring the approach taken in the May 2013 HMRC report entitled "Modelling Reduced Coverage for Intrastat - 93 per cent Arrivals" (see below) using 2010 and 2011 data. This is justifiable by the implicit assumption in the current method that the proportions in B1-5 (currently in the BTT) are the same as the proportions in B6-7 (currently in the JATT).

To calculate which businesses are in the different percentile bands using the data that are available (that is, the TATT), we assume that the current target threshold of 95% of total trade was exactly reached (in practice this may not be strictly true due to issues such as non-response, but the final coverage rate is always very close to the target). The traders are first ordered by ascending trade value and the cumulative total calculated. All businesses which then had a cumulative total value less than 1/95 of total trade were placed in B6, those which had cumulative totals between 1/95 and 2/95 of total trade were placed in B7, and so forth.

2.2 Alternative Methods

The obvious alternative to using B8-14 as the JATT is using a JATT of a different size. A number of other modifications & alternatives to the current methodology were considered:

1) Calculate breakdowns using previous years JATT using factors calculated (a) on a monthly/annual basis and (b) at different levels (CN8, HS4 or HS2 Chapter).
   - Advantage: if estimation at HS2 or HS4 level avoids use of unstable CN8 comcodes
   - Disadvantage: published SITC codes can only be aggregated from HS6 and CN8 estimates
2) Calculate JATT for specific numbers of businesses, rather than for specific VAT percentiles.
   - Advantage: future-proof
   - Disadvantage: doesn't utilise similarity between percentile bands
3) Estimate breakdowns using JATT within SIC groups.
   - Advantage: theoretically estimates will be more accurate
   - Disadvantage: low quality of SIC information held by HMRC
4) Estimate BTT by surveying a sample of businesses under the threshold.
   - Advantage: estimates will be unbiased, based on data rather than assumptions
   - Disadvantage: extra costs for HMRC and extra burden on small businesses
5) Use administrative data – VIES – to estimate BTT. The VIES data set represents a European sales list – both country and cost are recorded, but not industry.
   - Advantage: these data are already available and are also available from other countries
   - Disadvantage: this is a new data source, of questionable quality, which HMRC have only just started exploring, back data for arrivals are very sparse and only exist for dispatches for the last five years

2.3 Methods Chosen For Testing

We tested using the current method with a different sized JATT, and using a different sized JATT with different levels/periods (method 1) and with specific numbers of businesses (method 2). These methods were chosen as these changes to the current methodology should be more feasible to implement using the current HMRC IT system. As discussed under ‘current

methodology', the evaluation of methods is complicated by the lack of information for B1-5, so we evaluate results by comparison with actual survey returns for the businesses in B6-7.

In summary, we will test:

- the current method with B8-14 as the JATT (total trade in JATT = total trade in BTT);
- the current method with different JATT sizes; and
- methods using different levels/periods and different numbers of businesses to define the JATT.

Results will be produced at a country level, HS2 Chapter level, and country by HS2 Chapter level – this will allow recommendations to be based on the level of detail which is of most interest to HMRC.

3 Results

3.1 Previous Work

In the May 2013 report "Modelling Reduced Coverage for Intrastat – 93 per cent Arrivals" HMRC retrospectively tested the impact of a change to a 93% arrivals threshold using the current methodology on 2010 and 2011 data, using the Intrastat returns of those businesses that would be exempt from the survey should the threshold change (that is, B6-7). They found annual total value changes of 0.16% in 2010 and 0.26% in 2011, and an impact of less than 1% for 50% and 73% of Member States for 2010 and 2011, respectively. In terms of the impact on the actual values, 20 Member States were impacted by less than £50m in 2010, with 22 being the figure for 2011. The majority of the UK's smallest trading partners were impacted by less than £10m per year. At a HS2 Chapter level, nearly a third of the chapters were impacted by less than 1% for 2010. The number of chapters with less than 1% impact almost doubles for 2011.

These summary statistics are quite encouraging, but it can be seen that the current methodology does not do so well for certain Member States and HS2 Chapters. For example, even though there is only around a 0.6% impact on the Netherlands in both 2010 and 2011, this equates to an underestimate of £140m-£160m. Italy and the Irish Republic are other examples – the percentage change for the Irish Republic was around 1.4% (both years), which means the model has underestimated the value by £180m-£190m. For Italy in 2010 a 1.6% impact equated to a £223m underestimate.

The examples above make up three of the six Member States which account for nearly three quarters of total trade. It is therefore important to consider actual changes for the largest countries as well as percentage changes. For example, a 10% percentage change for Cyprus would have little impact, but a 1% percentage change in Germany may constitute a non-negligible discontinuity.

3.2 Exploratory graphical analysis

As exploratory analysis, the changing nature of the breakdowns between bands was first investigated to better understand the nature of the data.

Heatmaps were constructed – using the 2010 arrivals data – with country along the horizontal axis and HS2 Chapter along the vertical axis. There are 26 countries and 98 HS2 Chapters, so the maps are large. There are seven different colours on the maps - the darkest (purple) rectangles show country/HS2 Chapter combinations which contribute the most to the total trade in each band whilst the light blue rectangles show combinations which do not contribute at all to the total trade in that band. The countries and HS2 Chapters in B6 are ordered by the proportion of total trade that they conduct, averaged across all HS2 Chapters (for countries) and across all countries (for HS2 Chapters), with the highest of these being on the right (for countries) and at the top (for HS2 Chapters). Subsequent heatmaps retain the order from the B6 map so comparisons between them can be more easily made. The maps were created for B6, B7, B8, B9, B10, B11, B12, B13 and B14 and are shown in Appendix A, with those for B6 and B14 also shown in Figure 2.

From Figure 2 it can be seen that for businesses in B6 the total trade is spread out over many country/HS2 Chapter combinations. For a given country there is a range of different products for which the trade contributes a significant proportion to the total. When considering B14, which contains fewer but larger businesses, there is a noticeable change in the spread of country/HS2 Chapter combinations which contribute a significant proportion to the total trade value, in that it is much narrower and clustered around the top right hand corner. For a given country there are a much smaller number of products which contribute significantly to the total trade in B14 than there are in B6. This indicates that although the total trade is the same for both bands, it is concentrated over fewer country/HS2 Chapter combinations than for B6.

This analysis shows that when we are choosing the bands to allocate country/HS2 Chapter breakdowns to B6-7, we should be aware that the distribution of the proportions changes significantly the further away from B6-7 we get, meaning bands close to those being estimated for will be more representative than those further away. The graphs in Appendix A suggest that this phenomenon intensifies around B10, suggesting that JATTs larger than B8-10 may perform poorly.

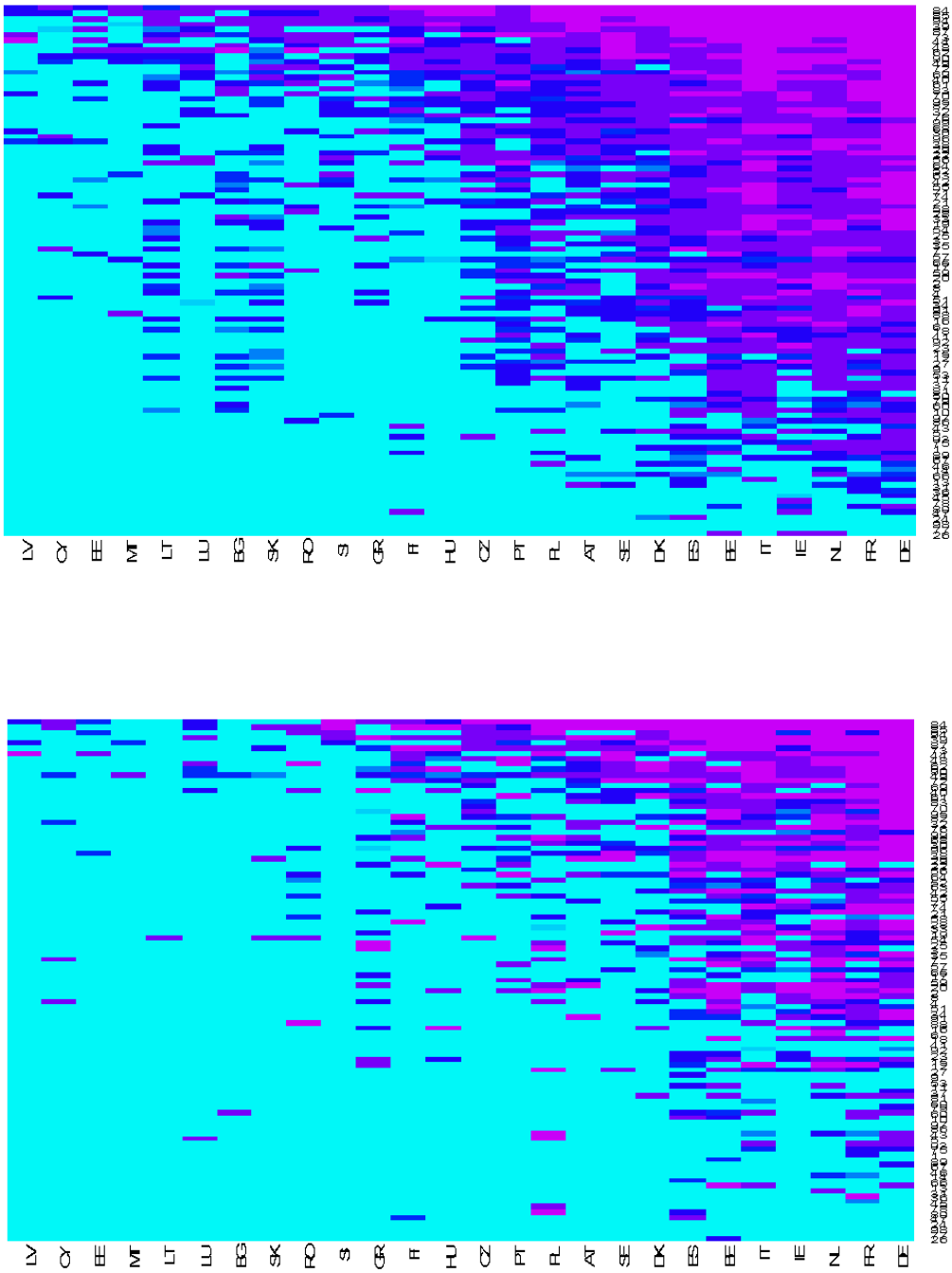


Figure 2: Heatmaps showing proportion of total arrivals trade (for a given band) conducted, by country and HS2 Chapter, for B6 (top panel) and B14 (bottom panel) bands

3.3 Exploratory statistical analysis

Based on the exploratory graphical analysis it was initially decided to test – using the 2011 arrivals data – a selection of bands when attempting to replicate the breakdowns of the businesses in B6-7. It was thought that as the distribution of the proportions changes significantly as the distance from the bands which are being estimated for increases, it was not necessary to test any bands beyond B14 (the limit of the current methodology).

The bands tested were B8, B8-9, B8-10, B9, B9-10, B11-12, B11-14 and B12-14. In addition to these bands, we also used a varying proportion of the number of businesses in B6-7 to define the JATT. The way in which this was implemented is outlined in Figure 3, for a given proportion (X) of B6-7 being tested.

Figure 3: Flow diagram for defining JATT using number of businesses

The proportions (of the number of businesses in B6-7 to use in the JATT) tested were 5%, 10%, 15%, 20%, 25%, 50%, 75% and 100%.

We therefore utilised two methods for specifying the size of the JATT – 'bands', in terms of the percentage of total trade included, and 'proportions', in terms of the proportion of the **number** of businesses in B6-7 included in the JATT. Both methods are broadly equivalent, and produce results which can be converted into proportions of the **total trade** in B6-7 utilised in the JATT – we discuss this in more detail later.

Each of the above JATT bands/proportions were tested varying both the period from which the factor was calculated (that is, using the same month from the previous year or the entire year's data – hereafter 'Monthly' or 'Annual'), and the level at which it was calculated (8-digit [CN8], 4-digit [HS4] and 2-digit [HS2]). These methods were used to produce estimates for each month of 2011 at a country level, HS2 Chapter level and country by HS2 Chapter level. The estimates and actual values for B6-7 were added to the actual values from the TATT to give total estimates and total actual values at each level.

The first summary statistic used to quantify how well each of the models performed was the absolute percentage difference between the estimated and actual total values for a given month at a given level. The median percentage difference over all months and members of that level was then calculated, resulting in one value for each band/proportion of B6-7 at each level. The results are shown in Appendix B, with the bands/proportions tested along the horizontal axes. The different models tested are shown as different colours, with '4 Annual' indicating that the factor was calculated at a 4-digit level using annual data from the previous year.

When estimating BTTAs at a country (or HS2 Chapter) level it is important to consider that the percentage differences that the median is calculated from could be very large for countries that

conduct small amounts of trade, which could be skewing the overall results. For example, when using the B9 band and the 8-digit Monthly model at a country level (2011 data), the median percentage difference between the estimated and actual values ranges from around 4.5% for Cyprus to 0.1% for Germany, but as Germany accounts for around 500 times more trade than Cyprus they should obviously not be treated equally when assessing which model gives the best estimates.

The absolute difference between the estimated and actual total values was consequently calculated instead of the percentage difference. Monthly differences were calculated for each member of each level and summed over all months to give a yearly total difference for each member of each level. The median difference over all members of that level was then calculated. The results are shown in Appendix C.

3.4 Conclusions from exploratory analyses

- Businesses in percentile bands which are further away from those which are to be estimated for are less representative of the businesses in the target bands than those which are closer.

- Using percentile bands instead of a given proportion of the number of businesses in B6-7 to define the JATT significantly limits the options when deciding on the best overall combination of JATT size and model.

- Absolute differences were more much more informative than percentage differences when using these as a summary measure at a given level.

- An alternative method of evaluating how well a given model performs was needed.

It was therefore decided that the methods used to evaluate how well a given model performed at each level would be as follows.

a) The total (not median) annual absolute difference between the estimated and actual values.

b) The value of the Pearson's correlation coefficient obtained by comparing annual estimated and actual values.

The exploratory analysis specified JATT size in terms of percentage of total trade (as 'percentile bands') and in terms of numbers (as 'proportions of the number of businesses in B6-7'). These two methods are identical for particular bands and proportions – 'B8-14' is the same as a JATT of about 78% of the number of businesses in B6-7 for the 2010 data (which is used to calculate the allocation factors to apply to the 2011 data). Because of this, and because the percentile bands only allow a limited number of options to be tested, we decided that to find the optimum JATT and model combination, increasing proportions of the number of businesses in B6-7 (rather than percentile bands) should be tested at regular intervals for each of the six models. Until now, only eight different proportions of B6-7 have been tested (see above) with large gaps between consecutive proportions – it was therefore decided that each model should be tested

using a grid with spacing equal to 2% of the number of businesses in B6-7. It was felt that this method would give a more complete picture (as many more combinations of JATT/model are being tested), and, by using the evaluation methods described above, should allow for the easier detection of the best JATT size to utilise for a given model. We then convert these results into percentile bands and percentages of BTT (that is, B6-7) total trade included in the JATT. This method can also accommodate future reductions to the coverage threshold as the above steps can be easily applied to different BTT sizes (see §6).

3.5 Main Analysis

To recap, we are testing the following models.

- A simple extension of the current methodology – using B8-14 to form a JATT at the 4-digit level with factors calculated using a full year's worth of data.
- Using the same basic '4-digit Annual' model, but a different sized JATT.
- Calculating the BTTAs at different product levels, using monthly or annual data and using different sized JATTs.

We define the size of the JATT in terms of the proportion of the number of businesses in B6-7 used in the JATT, which is equivalent to the 'percentile bands' approach but has more granularity to the testing. The first JATT tested was 2% of the number of businesses in B6-7, which was increased in steps of 2% until the factor that was being applied each time was constant (the plots only show up to 130%). The total annual absolute difference between the estimated and actual total values and the corresponding value of Pearson's correlation coefficient was recorded for each JATT size and model combination at each level.

Appendices D1 and D2 show the total absolute difference and Pearson's correlation coefficient against JATT size, respectively, for each model at each of the levels of interest (country, country by HS2 Chapter and HS2 Chapter), for the 2011 arrivals data. Appendices D3 and D4 show the same information as D1 and D2, but for the 2012 arrivals data. Note that the horizontal axis in these plots is the percentage of the number of businesses in B6-7 used in the JATT, not the percentage of the number of businesses in B1-7 (the full BTT as it will stand after the change).

In each plot there are three filled black symbols, which are described below.

- The square shows the current methodology (B8-14 using the 4-digit Annual model).

- The triangle shows the proportion of B6-7 used in the JATT which gave the minimum total absolute difference (or the maximum correlation coefficient) between the actual and estimated values for the current model (4-digit Annual).

- The circle again represents the best proportion of B6-7 to use in the JATT, but this is over *all* six models and so is the optimum overall method to use in the estimation.

From this analysis we will calculate the best proportion of B6-7 to use with the current model (that is, calculating the factor at a 4-digit level using annual data – the triangle in the plots), and our best estimate of the overall optimum method to use (the circle in the plots).

3.5.1 Combining results from 2011 and 2012

In order to make any recommendations, the results from the 2011 and 2012 data needed to be combined so as to obtain the best possible estimate of the optimal JATT/model combination. To this end, the data were combined and a mean value of the total absolute difference/correlation coefficient was calculated for each JATT size, with the data then re-plotted and the optimal JATT size recalculated. This method of combining the 2011 and 2012 results was chosen because just adopting the mean of the two best JATT sizes for 2011 and 2012 does not result in a good estimate of the best JATT size to use for either 2011 or 2012, due to the volatility of the data. This is illustrated in Figure 4 where results from the 4-digit annual model for 2011 (blue) and 2012 (red) data are shown at a country level. The shapes on each plot are described below.

- Circles represent the best JATT size for each year.
- Triangles represent the best JATT when calculating mean values for each JATT size and re-plotting (the method we utilise in this report).
- Squares represent the simple mean of the two best JATT sizes from each year.

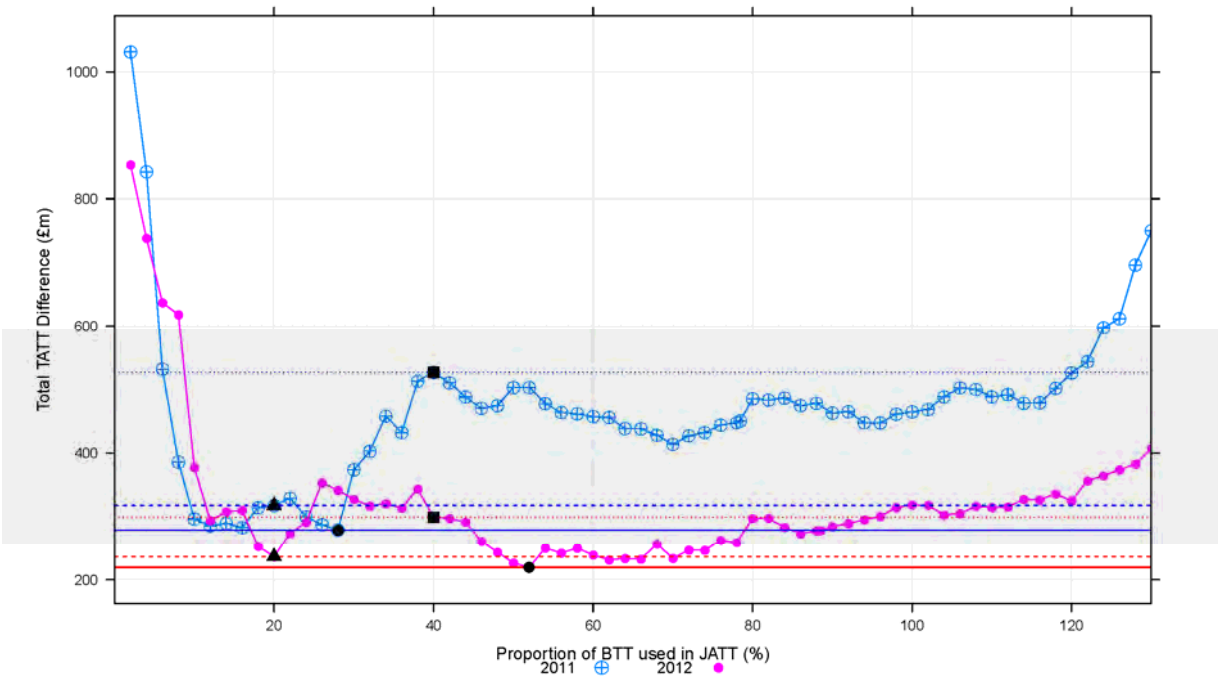


Figure 4: Total absolute difference against JATT size at a country level (using the 4-digit Annual model) for 2011/12, showing the two methods for combining the data from both years.

The difference between the red solid and dashed lines is £17m – this is the increase in the total absolute difference value for 2011 by using the mean ‘re-plotting’ method. The corresponding

difference using the average of the two best JATT sizes is £79m (difference between the solid and dotted red lines). For 2012, the figures are £39m and £248m, respectively. This demonstrates that first calculating mean total absolute differences and correlation coefficients for each JATT size then recalculating the best JATTs to use is the preferred method of combining the results from 2011 and 2012.

3.5.2 Results

Figures 5 and 6 show the mean values of the total absolute difference and correlation coefficients against the proportion of the number of businesses in B6-7 used in the JATT, separately for each model. We wish to obtain the smallest possible difference and the largest possible correlation, so the minimum points on the difference graphs and the maximum points on the correlation graphs are highlighted using circles and squares:

- circles show the best JATT size for each year across all models; and
- triangles show the best JATT size using the current model ('4-digit Annual')

The findings, together with the results from using the 2011 and 2012 data separately, are summarised in Tables 1a and 1b. Table 1c gives the total absolute difference and correlation coefficients obtain by using the current methodology – B8-14 JATT size and a 4-digit Annual model – for the 2011 and 2012 data, this is not shown on the graphs since the equivalent proportion of B6-7 used is different for 2011 (78.5%) and 2012 (88.5%).

When considering the combined data in Table 1a, it can be seen that when using the current model (4-digit Annual) at the country or HS2 Chapter level, the best proportion of the number of businesses in B6-7 to use in the JATT is 18-22%, depending on the method of evaluation. Taking the mean of these four results gives an average of 21%, which is the value we adopt for the optimum proportion of the number of businesses in B6-7 to use in the JATT at a Country/HS2 Chapter level.

At the country by HS2 Chapter level, the best proportion of the number of businesses in B6-7 to use is either 60% (using total absolute difference) or 78% (using the correlation coefficients). When using the total absolute difference evaluation method, there is very little change when using 60% compared to 78% of the number of businesses in B6-7 in the JATT (£8.4m), but over the same range the correlation coefficient is still clearly increasing to its maximum value at 78%. For this reason we adopt 78% as the optimum proportion to use in the JATT at the country by HS2 Chapter level.

Now considering the overall optimum method to use without constraining ourselves to the current model (see Table 1b), the optimal JATT size to use at a country level is 24% of the number of businesses in B6-7 (using either method of evaluation) combined with the 4-digit Monthly model. At a HS2 Chapter level, the correlation coefficient evaluation gave 26% as the best proportion to use, again with the 4-digit Monthly model, whilst the total absolute difference method gave 44% using the 2-digit Annual model. If we look at the data in more detail though, the next best JATT/model combination is actually again 26% using the 4-digit Monthly model, which has a difference only £5.8m higher than when using the 44% 2-digit Annual combination. We therefore adopt 25%, combined with the 4-digit Monthly model as the optimal JATT size/model combination for both the country and HS2 Chapter level. For the country by HS2 Chapter level both methods of evaluation give 40% as the optimal proportion of B6-7 to use in the JATT, again combined with the 4-digit Monthly model.

Table 1c shows results from a B8-14 JATT with the current 4-digit Annual model, which would be equivalent to a JATT size of 78.5% for the 2011 results and 88.5% for the 2012 results. It can be seen that results are notably worse than using alternative methods - this is discussed in more detail in the next section.

In summary, our chosen models are as follows.

Current model with optimal JATT size

- At the Country or HS2 Chapter level – 21% of the number of businesses in B6-7 used in JATT
- At the Country by HS2 Chapter level – 78% of the number of businesses in B6-7 used in JATT

Optimal model with optimal JATT size

- At the Country or HS2 Chapter level – 25% of the number of businesses in B6-7 with the 4-digit Monthly model
- At the Country by HS2 Chapter level – 40% of the number of businesses in B6-7 with the 4-digit Monthly model

A general pattern is that it is optimal to use a larger JATT for more detailed breakdowns – the HS2 Chapter by country level requires a larger JATT than the HS2 Chapter or country levels. However, all levels require a smaller JATT than the equivalent of a B8-14 band.

Figure 5a: Mean total absolute difference against proportion of B6-7 used in JATT – Country level

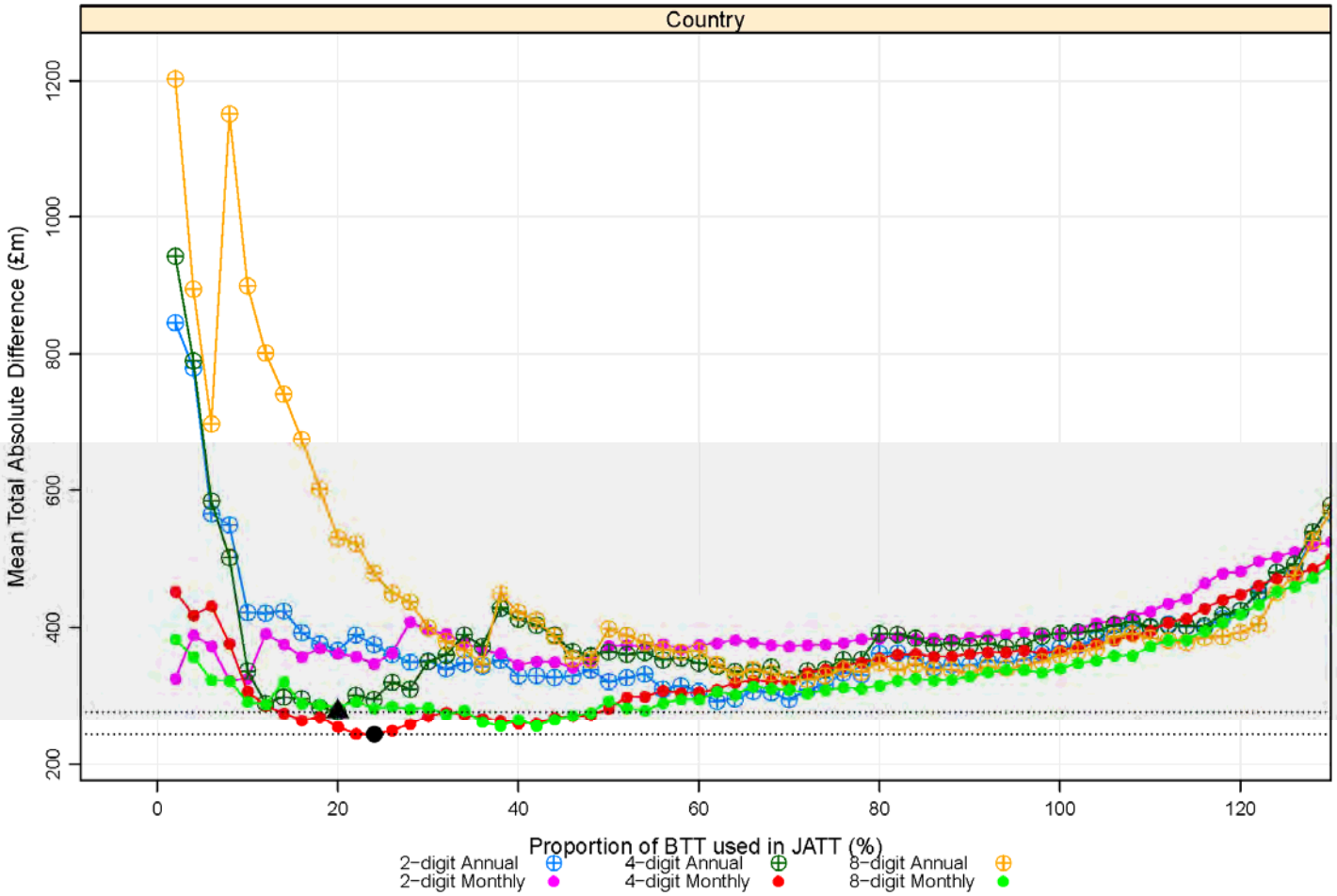


Figure 5b: Mean total absolute difference against proportion of B6-7 used in JATT – Country by HS2 Chapter level

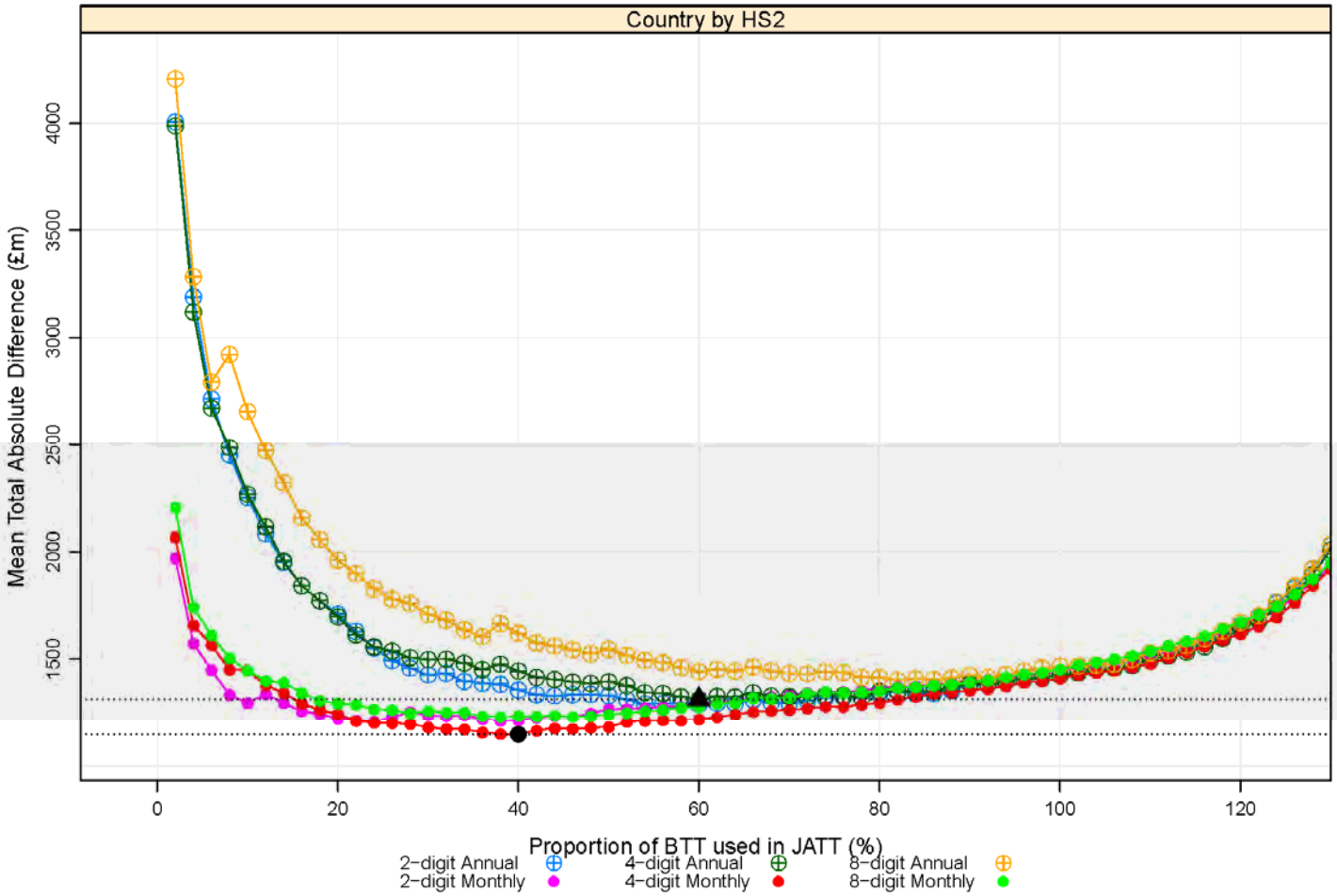


Figure 5c: Mean total absolute difference against proportion of B6-7 used in JATT – HS2 Chapter level

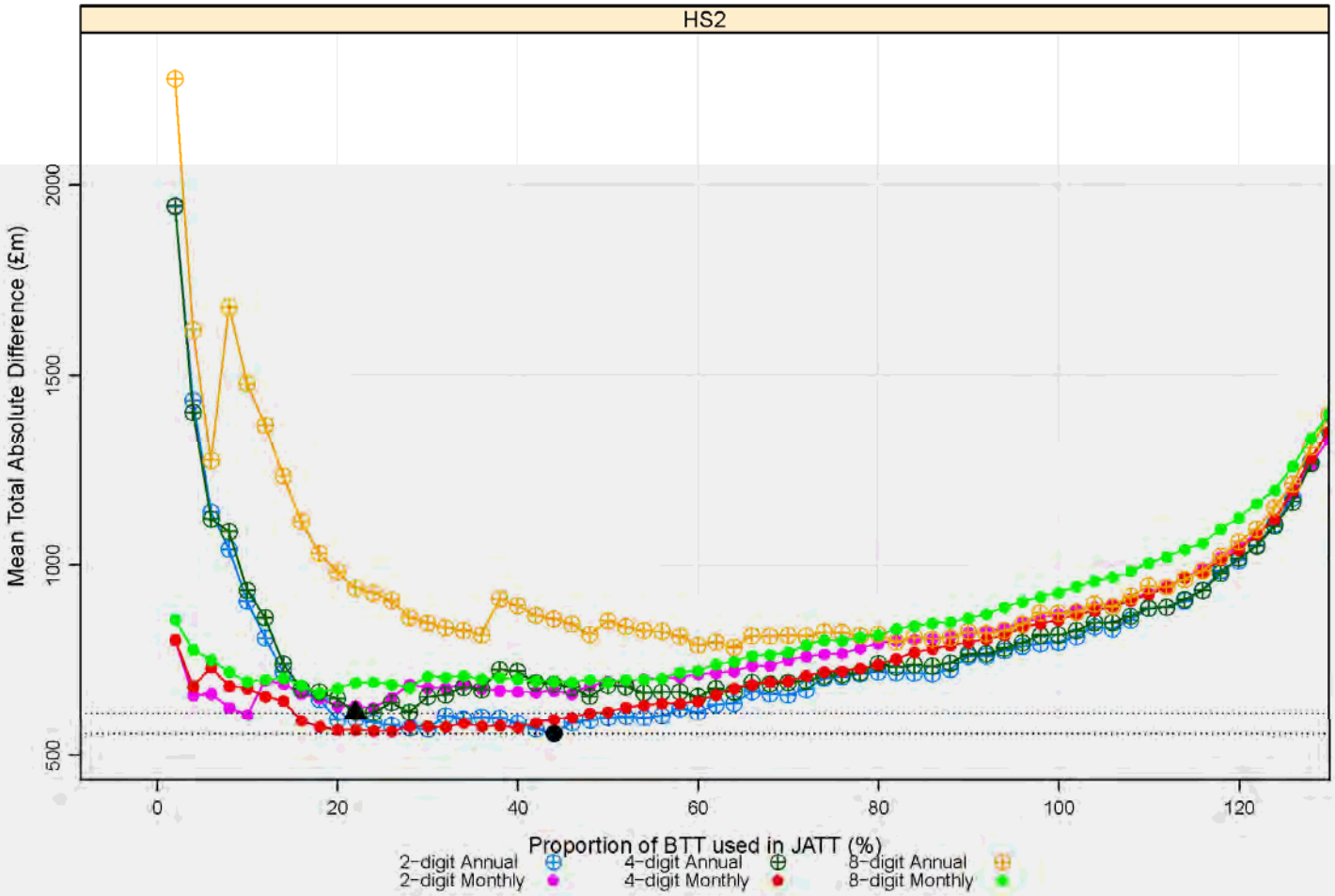


Figure 6a: Mean correlation coefficient against proportion of B6-7 used in JATT – Country level

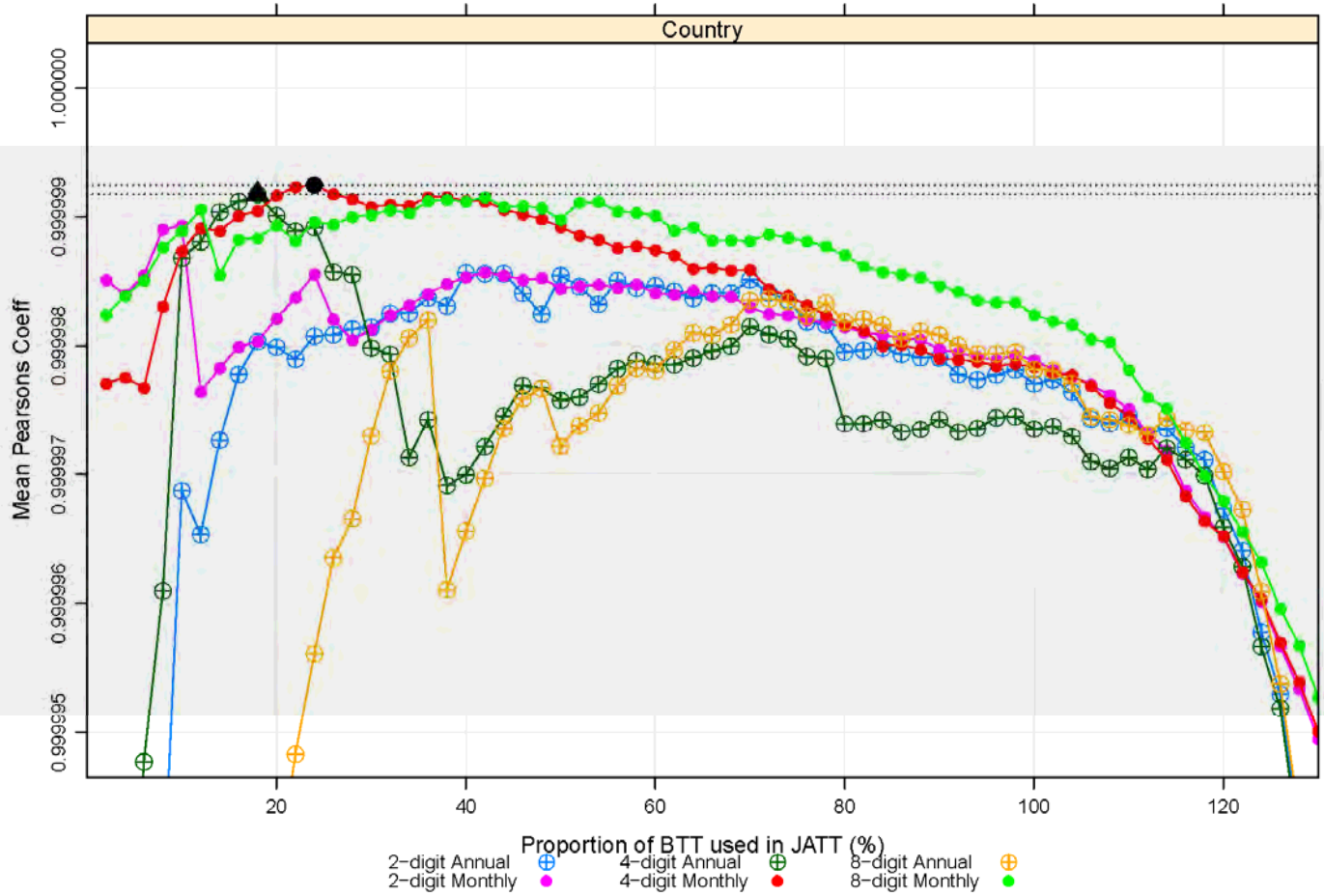


Figure 6b: Mean correlation coefficient against proportion of B6-7 used in JATT – Country by HS2 Chapter level

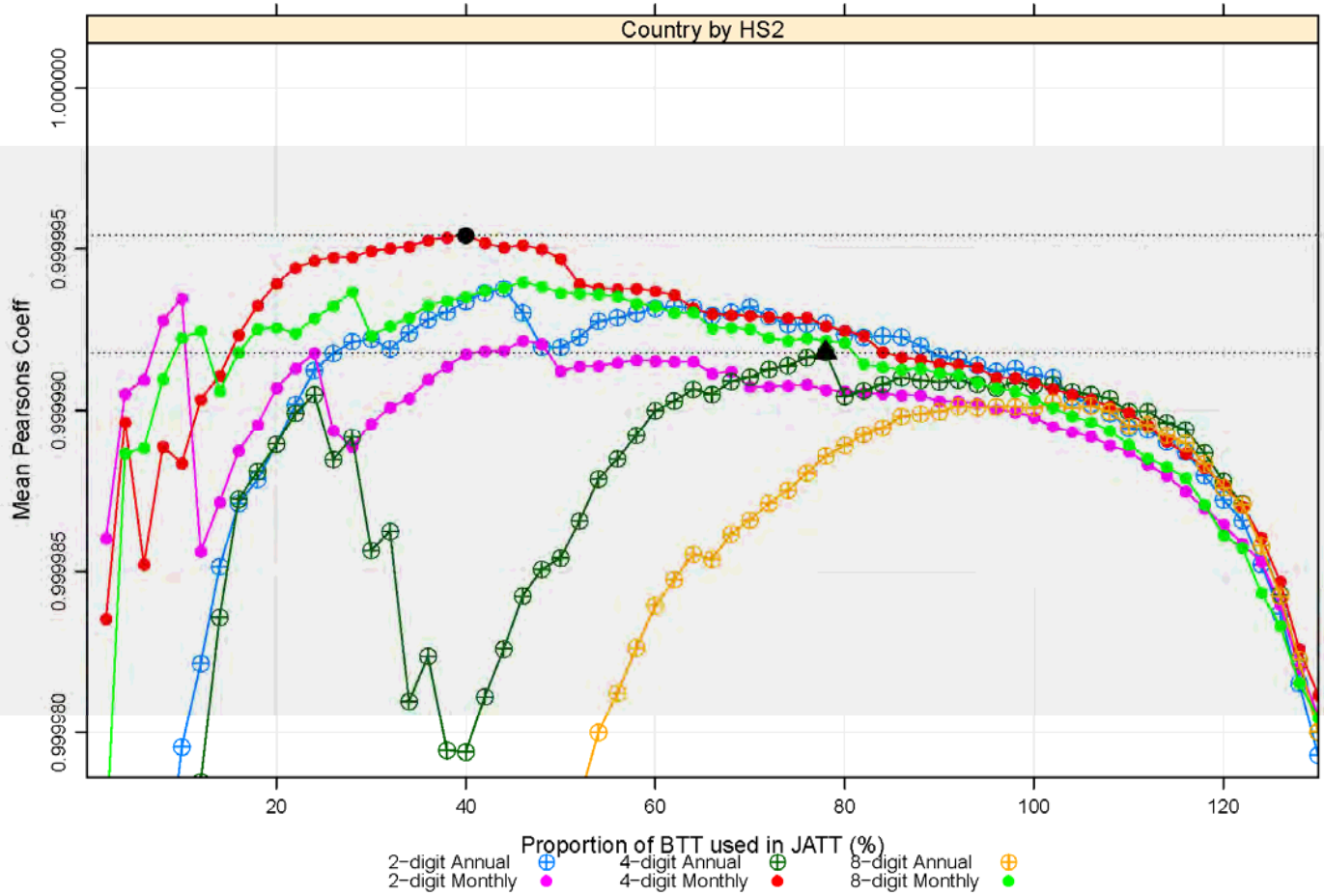


Figure 6c: Mean correlation coefficient against proportion of B6-7 used in JATT – HS2 Chapter level

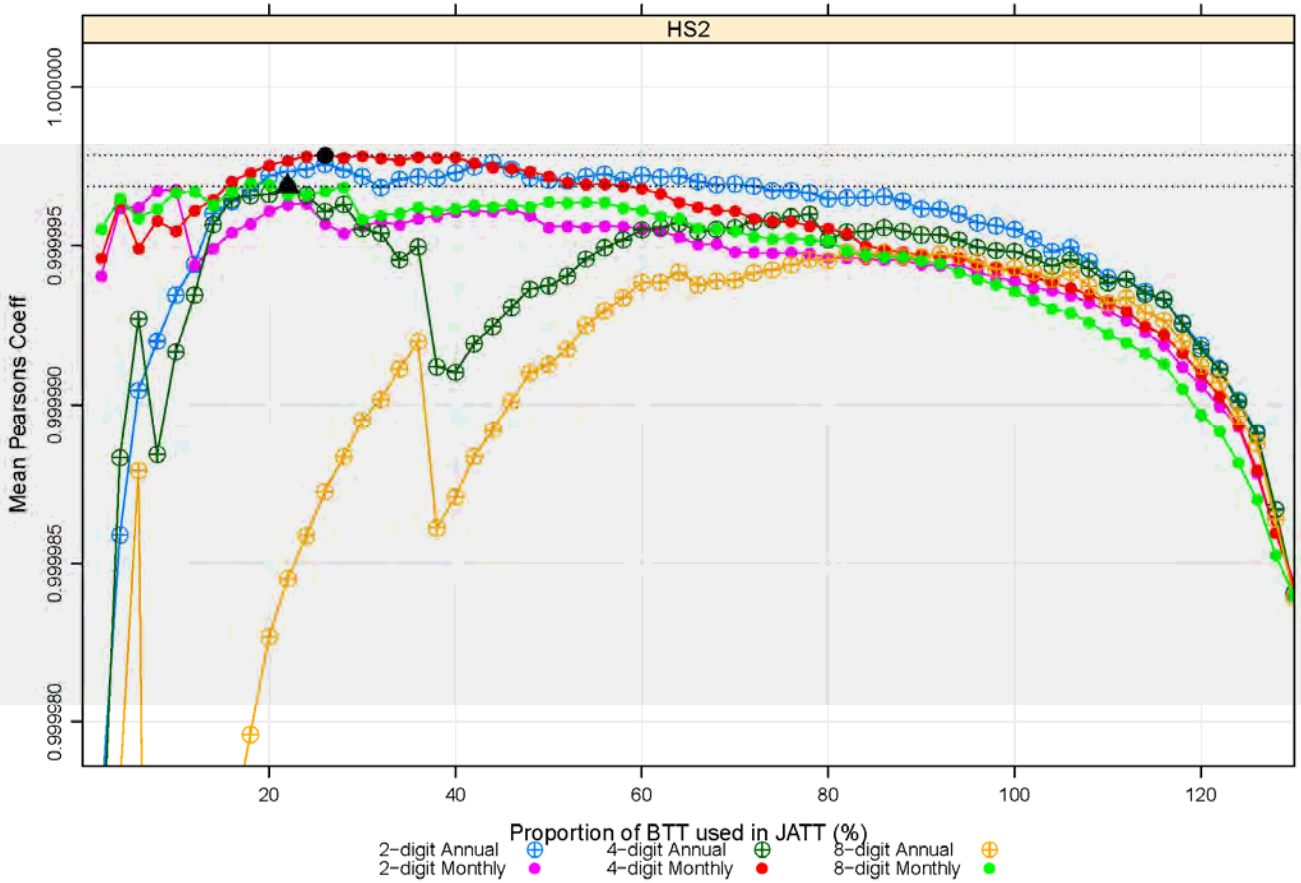


Table 1: Summary of results by method of evaluation, level of detail of interest and year

Table 1a: Optimal JATT size for current model (4-digit Annual)

		Country Level			HS2 Chapter Level			Country by HS2 Level		
Year	Evaluation Method	Optimal JATT Size (% of number of businesses in B6-7)	Correlation Coeff	Total Absolute Difference (£m)	Optimal JATT Size (% of number of businesses in B6-7)	Correlation Coeff	Total Absolute Difference (£m)	Optimal JATT Size (% of number of businesses in B6-7)	Correlation Coeff	Total Absolute Difference (£m)
2011	Total Absolute Difference	28%	0.999998938	278.8	28%	0.999998395	512.4	60%	0.99998592	1312.3
	Correlation Coeff	16%	0.999999221	282.7	28%	0.999998395	512.4	28%	0.999993084	1393.6
2012	Total Absolute Difference	52%	0.999999072	219.4	48%	0.999996978	625.1	78%	0.999994188	1281.3
	Correlation Coeff	20%	0.999999346	236.3	76%	0.999997208	637.0	78%	0.999994188	1281.3
Combined	**Total Absolute Difference**	20%	**0.999999007**	**276.9**	22%	**0.999996856**	**611.9**	60%	**0.999989993**	**1313.2**
	Correlation Coeff	18%	**0.999999172**	**283.4**	22%	**0.999996856**	**611.9**	78%	**0.999991791**	**1321.6**

Table 1b: Optimum JATT size and model combination

		Country Level			HS2 Chapter Level			Country by HS2 Level		
Year	Evaluation Method	Optimal JATT Size/Model Combination	Correlation Coeff	Total Absolute Difference (£m)	Optimal JATT Size/Model Combination	Correlation Coeff	Total Absolute Difference (£m)	Optimal JATT Size/Model Combination	Correlation Coeff	Total Absolute Difference (£m)
2011	Total Absolute Difference	42% 8-digit Monthly	0.999999276	233.2	30% 2-digit Annual	0.999998791	444.0	40% 4-digit Monthly	0.999995694	1117.3
	Correlation Coeff	42% 8-digit Monthly	0.999999276	233.2	28% 2-digit Annual	0.999998863	455.8	40% 4-digit Monthly	0.999995694	1117.3
2012	Total Absolute Difference	22% 4-digit Monthly	0.999999494	198.1	26% 4-digit Monthly	0.999997934	538.1	38% 4-digit Monthly	0.999995141	1172.6
	Correlation Coeff	24% 4-digit Monthly	0.999999507	199.4	18% 8-digit Monthly	0.999997964	607.9	50% 8-digit Monthly	0.999995293	1222.0
Combined	**Total Absolute Difference**	24% 4-digit Monthly	**0.999999244**	**243.4**	44% 2-digit Annual*	**0.999997607**	**556.8**	40% 4-digit Monthly	**0.999995427**	**1148.2**
	Correlation Coeff	24% 4-digit Monthly	**0.999999244**	**243.4**	26% 4-digit Monthly	**0.999997838**	**562.6**	40% 4-digit Monthly	**0.999995427**	**1148.2**

*** Next best is 26% 4-digit Monthly - see text for details**

Table 1c: Current Methodology (B8-14 with 4-digit Annual model)

	Country Level		HS2 Chapter Level		Country by HS2 Level	
Year	Correlation Coeff	Total Absolute Difference (£m)	Correlation Coeff	Total Absolute Difference (£m)	Correlation Coeff	Total Absolute Difference (£m)
2011	0.99999702	450.4	0.999994953	777.0	0.999989447	1353.6
2012	0.99999838	278.0	0.999996934	670.9	0.999993604	1315.4

4 Application to 2011/2012 data

We now turn to applying these methods to the 2011 and 2012 datasets so that model comparisons can be made for individual countries and HS2 Chapters. The impact of retaining the current methodology instead of either using the optimal JATT size for the current model (4-digit Annual), or the overall optimal model (4-digit Monthly) combined with the appropriate JATT size (for the level of most interest) can also be studied.

As the number of data points in a table/plot comparing three methods at a Country by HS2 level would be 3 x 98 x 26 = 7644, we show the results at only a country and HS2 Chapter level. The two methods from the analysis above which are most appropriate for this level of detail are used, together with the current methodology.

- *Current Methodology (CM)* **– B8-14** using the **4-digit Annual** model
- *Current Model with Optimal JATT size (CMOJ)* **– 21% of the number of businesses in B6-7** with the **4-digit Annual** model
- *Optimum Methodology (OM)* **– 25% of the number of businesses in B6-7** with the **4-digit Monthly** model

4.1 Country level

Figures 7a and 7b show the relative difference between the actual and estimated values for the above three models, by country, when applied to the 2011 and 2012 datasets, respectively. The graphs are ordered by increasing trade value for that year. The corresponding data table on which the figures are based is presented in Appendix E1 – this contains the actual value, estimate, relative percentage difference and actual/absolute difference, ordered by actual trade value for the given year.

We analyse these graphs separately for 'high trade', 'medium trade' and 'low trade' countries, defined using the mean trade value over 2011 and 2012.

- High trade (>£10bn) – Germany, Netherlands, France, Belgium, Italy, Irish Republic, Spain
- Medium trade (£2.5bn - £10bn) – Sweden, Poland, Denmark, Czech Republic, Hungary, Austria
- Low trade (<£2.5bn) – Finland, Portugal, Slovakia, Romania, Luxembourg, Greece, Lithuania, Latvia, Slovenia, Bulgaria, Estonia, Malta, Cyprus

In the low trade group:

- using the CM or the CMOJ would result in 10 of the 13 Member States seeing an impact of less than 1% for 2011. This rises to 12 Member States if the OM is used;

- for 2012, using the CM or CMOJ has an impact of <1% for eight of the 13, rising to nine for the OM;

- in 2011, four Member States would see a value impact of >£3m when using the CM – this drops to two Member States when using the OM;

- in 2012, around half of the Member States (6/13) are impacted by more than £3m when using the CM, which drops slightly to 5/13 when using the OM;

- the largest gain to be made by using an alternative method to the CM in the low trade group is for Romania – in 2011 the absolute difference between the estimated and actual values for the CM is £16.1m (1.3%). Using the CMOJ it reduces to £11.6m (1.0%) but by using the OM it reduces to only £1.2m (0.1%). In 2012 the figures were £14.9m (1.2%) for the CM, £1.4m (0.1%) for the CMOJ and £2.5m (0.2%) for the OM;

- another large gain to be made is for Finland, where the absolute differences for 2011 are £8.7m (CM), £8.5m (CMOJ) and £1.4m (OM). For 2012 the CM performs even worse for Finland than in 2011, with a difference of £11.8m – this is reduced to only £1.1m when using the OM; and

- for some Member States the CM does a better than the OM – for Greece the OM gave a difference of £1.1m in 2011 and £8.0m in 2012. The corresponding figures for the CM are £0.1m in 2011 and £2.5m in 2012.

For the medium trade group:

- using the CM gives the lowest total absolute differences (£70.6m for 2011; £24.9m for 2012). Using the CMOJ increases these differences by £7m and £24m, respectively, whilst adopting the OM over the CM increases the differences by £24m and £30m, respectively; and

- for 2011, the OM does better than the CM for the top three members of this group (Sweden, Poland and Denmark), but worse for the bottom three (Czech Republic, Hungary and Austria). For 2012 the OM again does better for three countries and worse for the remaining three. The CMOJ generally does worse than the CM for this group.

The seven Member States which make up the large trade group accounted for 79% of total trade in both 2011 and 2012. It is therefore very important that the models perform well for these Member States. For this group:

- the total absolute differences for these seven countries when using the OM are £168.1m (2011) and £109.8m (2012). Using the CMOJ increases these figures by around £20m and £47m, respectively. If the CM is used the total absolute differences are £335.6m (2011) and £189.8m (2012). Therefore, by adopting the OM over the CM, the overall difference will be reduced by 50% for 2011 and 42% for 2012. By adopting the CMOJ over the CM the difference is reduced by 44% and 17%, respectively;

- for 2011, the CM does particularly badly when compared to the OM for Italy, the Irish Republic and Spain – the absolute differences for the CM are £24.3m, £90.2m and £50.8m, respectively. By using the OM these are reduced to £1.2m, £38.1m and £0.3m, respectively; and

- for 2012, the OM and CM estimates for both Italy and Spain are similar to each other, but the impact on the Irish Republic is reduced by around 50% by using the OM over the CM. The CMOJ performs better than both the OM and the CM for three members of this

group in 2011 (Germany, Netherlands and Belgium) – using the CMOJ over the CM again reduces the difference for the Irish Republic by around 50%. For 2012 this figure is 71% (a reduction of £66.7m) but this model performs the worst for the Netherlands, France and Belgium.

In general, the current model with the optimum JATT size and the optimal methodology are consistently better than the current methodology, particularly for the countries with the largest trade. The differences between the current model with the optimum JATT and the optimal methodology, while clear at the country level, are less consistent, with the optimal methodology doing better for some countries in some years and worse in others.

4.2 HS2 Chapter level

The performance of the above models on the 2011 and 2012 data at a HS2 Chapter level are shown in Figures 8a and 8b, respectively. These are again ordered by increasing trade value for each year. The corresponding data tables can be found in Appendix E2.

The total absolute differences between the estimated and actual values when using the CM on the 2011 and 2012 data are £777.1m and £670.9m, respectively. Using the CMOJ reduces the 2011 value by 29% (to £551.2m) but has little impact (<1%) on the 2012 value. Adopting the OM reduces the 2011 CM value by 25% (to £583m) and reduces the 2012 value by 19% (to £543.4m).

For the 2011 data, the CM performs the best (in terms of absolute differences) only 28% of the time, with the OM and CMOJ doing the best 34% and 38% of the time, respectively. If only the chapters which have trade values in excess of £1bn are considered (there are 37 in 2011; see Appendix E1), the CMOJ performs better than the other two methods for over half (51%) of these products, with the OM doing the best 27% of the time. For the remaining 22% the CM performs the best.

For the 2012 data, the OM performs the best 41% of the time, with the CMOJ and CM values being 29% and 30%, respectively. If we again restrict ourselves to those chapters which have trade values greater than £1bn (there are 36 in 2012), then it can be seen that the CMOJ and OM models do equally well (both do best 39% of the time), with the CM only being better than the other two for eight of the 36 chapters.

We now highlight a few of the chapters (in the 2011 data) for which the alternate models do significantly better than the CM, and also where the CM performs significantly better.

- For chapter 84 using the CM results in a total absolute difference of £40.1m – this is reduced to £23.9m by using the OM and falls by 94% (to £2.5m) when using the CMOJ.
- For chapter 39 the CMOJ reduces the CM difference from £42.7m to £17.8m.
- Using the CM results in a difference of £82.1m for chapter 71 – this is reduced to £26.4m by using the OM and to just £6.1m by adopting the CMOJ.

- Chapter 62 sees the difference fall from £20m (using CM) to £6.4m (CMOJ) and £0.3m (OM).

- For chapter 28 the CM does much better than the OM, with the CM resulting in a £4.4m difference and the OM in a £26.9m difference. The corresponding CMOJ value is £16m.

5 Practical application of results

Until now, the optimal JATT size to use in each model has been described in terms of the proportion of the number of businesses in the simulated BTT (that is, B6-7). As the data for businesses in B1-5 are not available and there are over one hundred thousand businesses in these bands, it is clear that the optimal JATT sizes calculated in §3.5.2 need to be defined in terms of percentile bands, as illustrated in figure 1 (page 6), not proportions of the number of businesses in B6-7, when making any recommendations.

To this end, different JATTs were constructed – increasing in size by steps of 0.1 percentiles – and the corresponding number of businesses which would be included in these JATTs noted. This figure was then expressed as a proportion of the number of businesses in B6-7. The results are shown in Figure 9. The red horizontal lines show the optimal proportion of B6-7 to use in the JATT – for the two different levels of interest – if the current model is retained (that is, 4-digit Annual). The blue horizontal lines show the same information but if the optimum methodology is to be adopted. The relationship between the proportion of B6-7 used in the JATT and the corresponding percentile band range upper limit which would include that number of businesses is plotted using the 2010, 2011 and 2012 annual datasets. We note here that the JATT sizes for the optimum methodology are in terms of proportions of the number of businesses which are in B6-7 when defined using the monthly, not annual, datasets. To check that the conversions between the proportions and percentiles using the annual data are still valid, we also constructed JATTs for each month and checked that the resulting conversion to percentile bands was, on average, the same.

It is clear that in Figure 9 the results for 2011 and 2012 are relatively consistent, whilst the results for 2010 seem to diverge from the others. We therefore use the more recent data to make the conversion to percentile band ranges, choosing the JATT size (to the nearest 0.1 percentile) which is large enough to include the recommended value for each of the two years (2011 and 2012).

If the current method is to be retained then:

- if the country/HS2 Chapter level is of most interest, a proportion of 21% of B6-7 is equivalent to using **B8** in the JATT (that is, the businesses which account for the 1% of trade just above the threshold); and

- if the country by HS2 Chapter level is of most interest, a proportion of 78% of B6-7 is equivalent to using **B8-12.5** in the JATT (that is, the businesses which account for the 5.5% of trade just above the threshold).

If the optimum methodology is to be adopted then:

- if the country/HS2 Chapter level is of most interest, a proportion of 25% of B6-7 is equivalent to using **B8-8.2** in the JATT (that is, the businesses which account for the 1.2% of trade just above the threshold);

- if the country by HS2 Chapter level is of most interest, a proportion of 40% of B6-7 is equivalent to using **B8-9.1** in the JATT (that is, the businesses which account for the 2.1% of trade just above the threshold).

Figure 7a: Difference between actual and estimated values for various models at country level – 2011

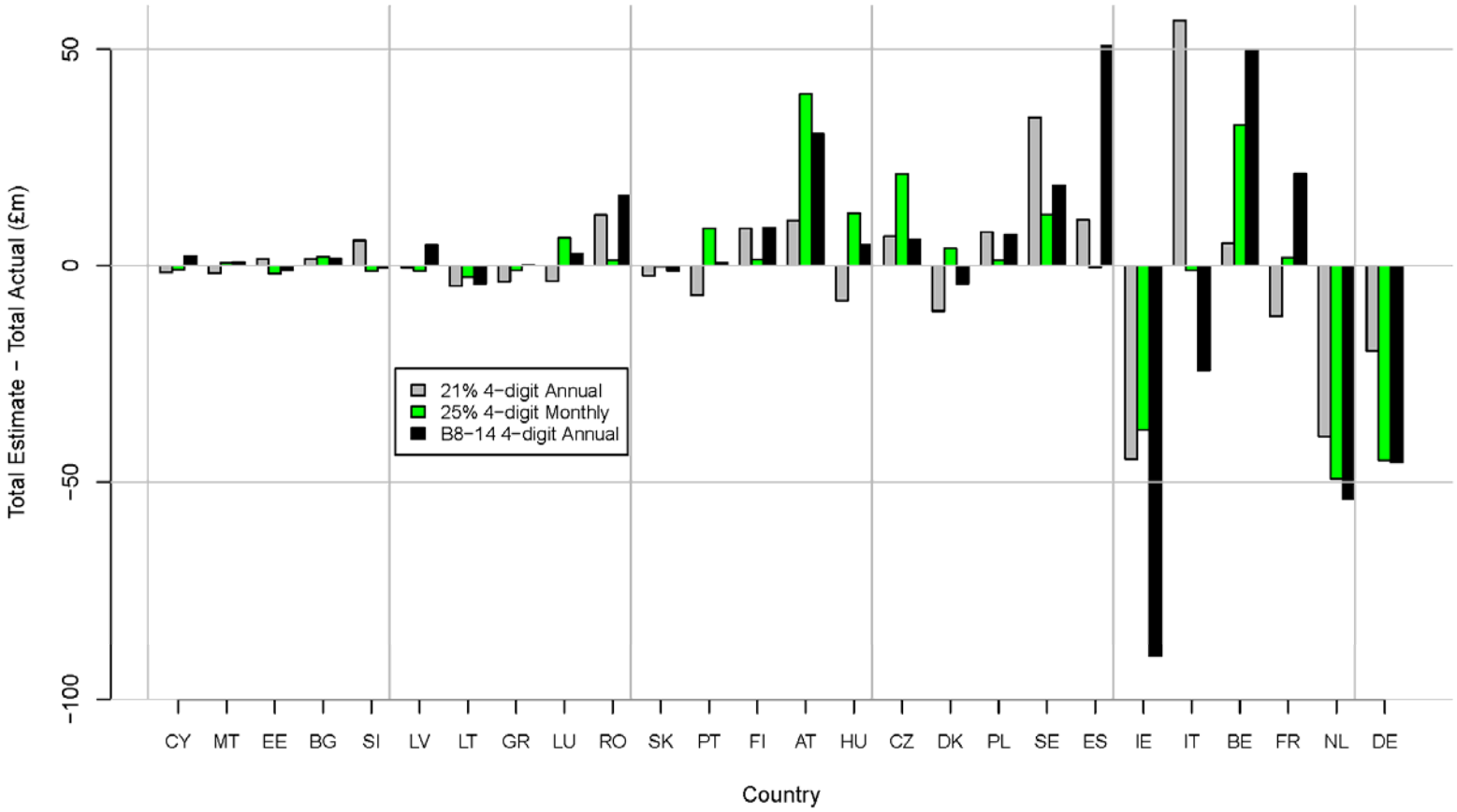


Figure 7b: Difference between actual and estimated values for various models at country level – 2012

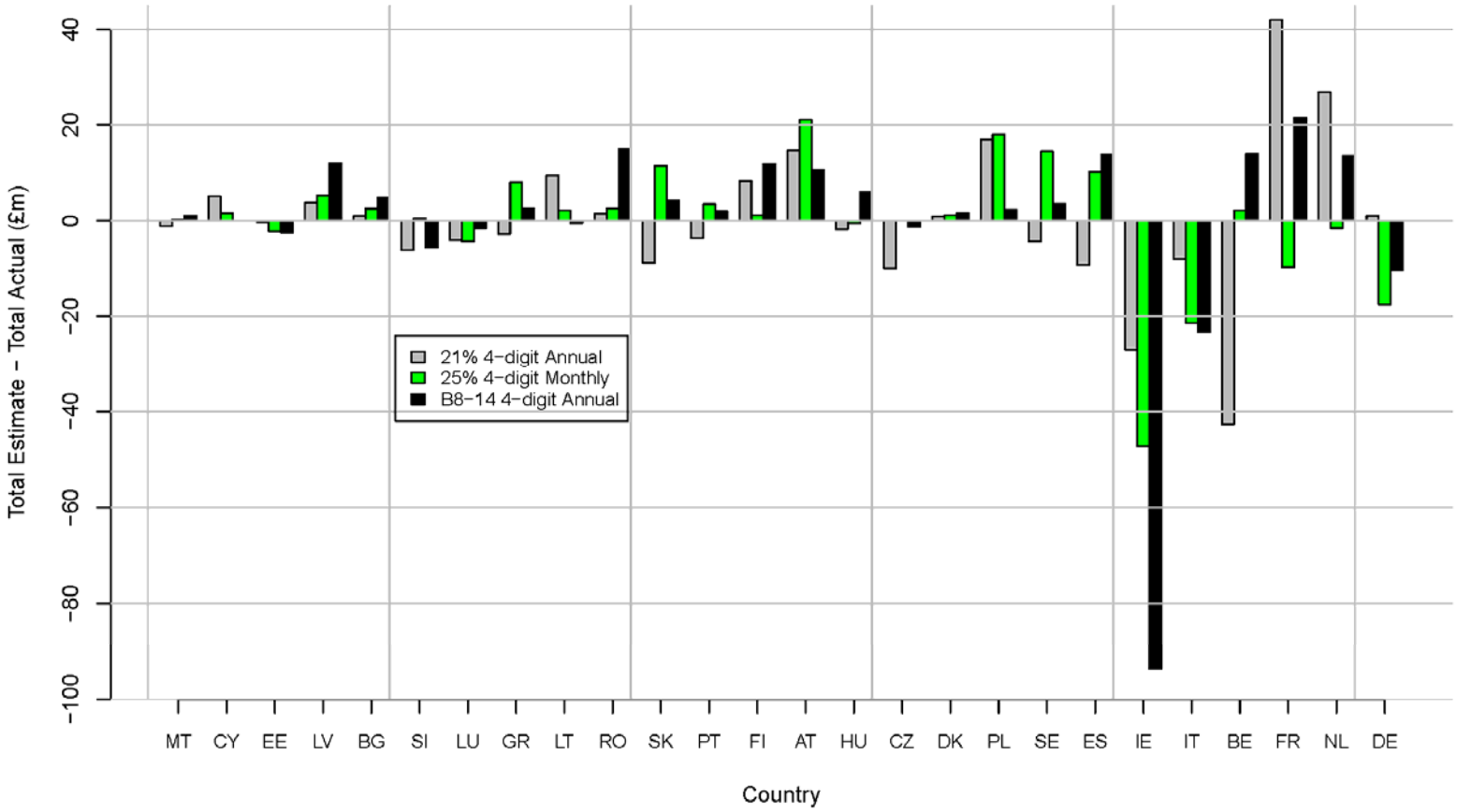


Figure 8a: Difference between actual and estimated values for various models at HS2 Chapter level – 2011

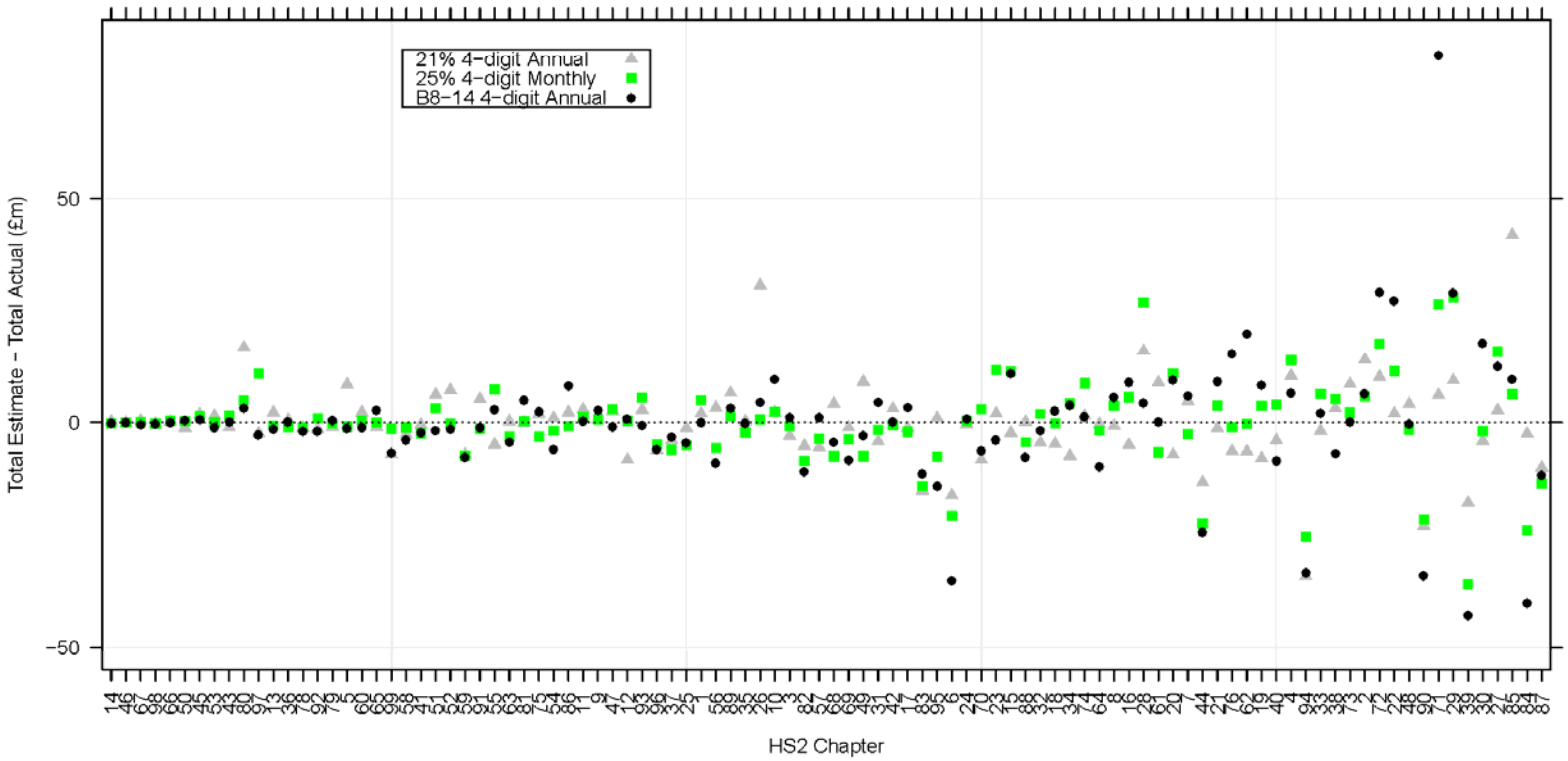


Figure 8b: Difference between actual and estimated values for various models at HS2 Chapter level – 2012

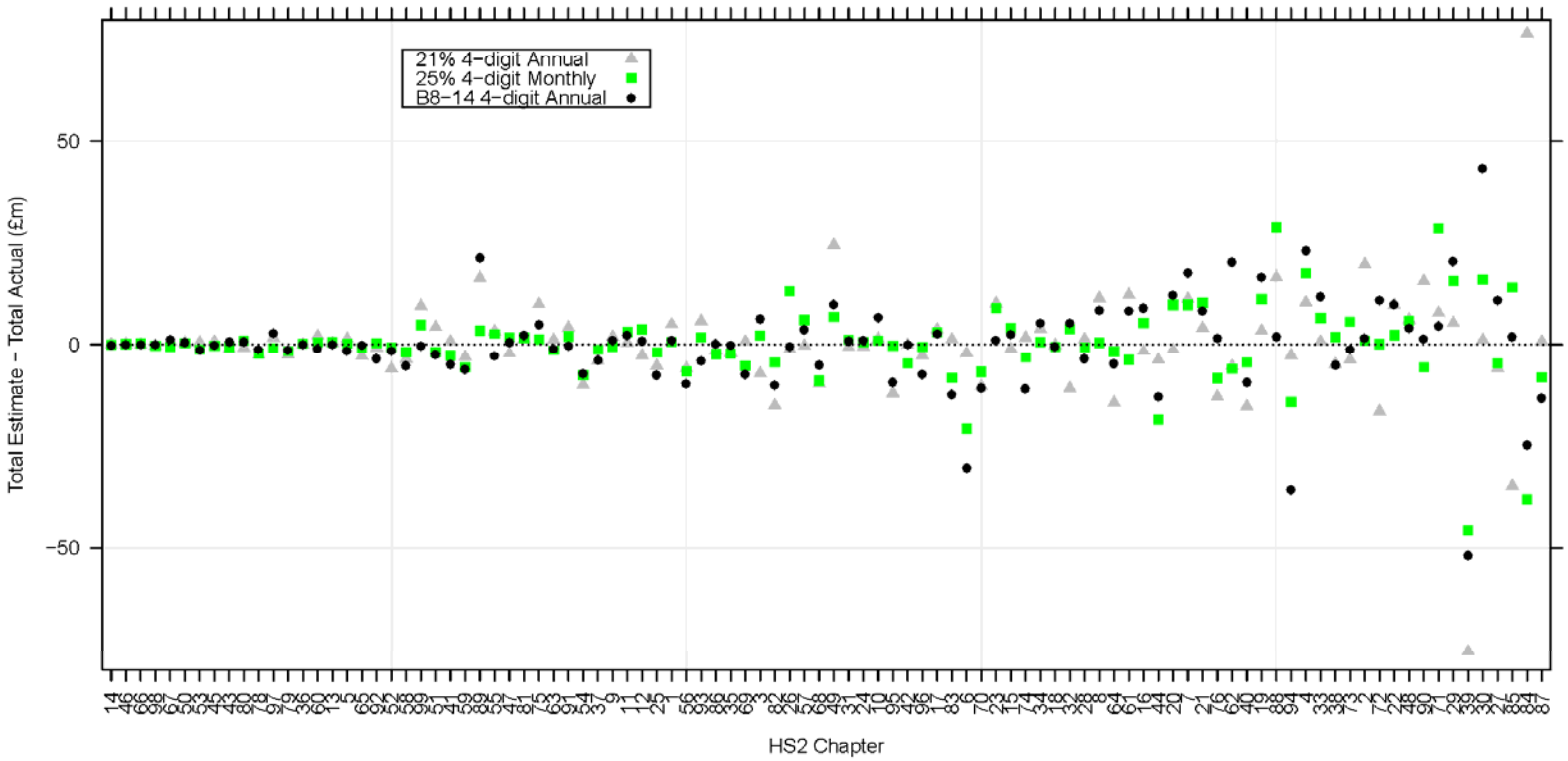
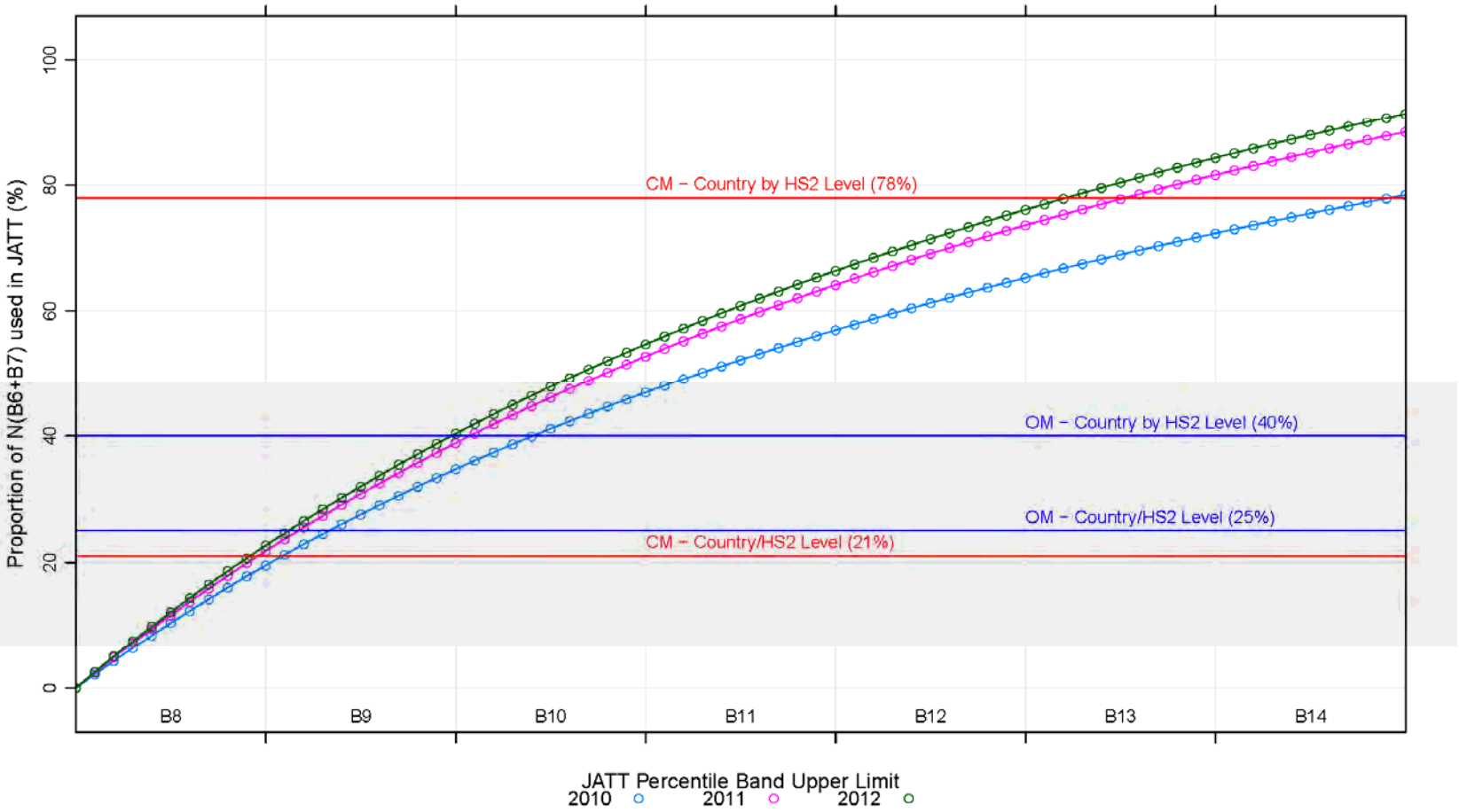


Figure 9: JATT Conversion between Proportion of N(B6+B7) and Percentile Band Range – Annual Datasets



6 Future Reductions to Intrastat Coverage

This section provides some general guidance relating to the issue of possible further reductions to the coverage rate of the survey.

If the size of the BTT is to be increased beyond 7% of total trade, we advise that analyses similar to those detailed in this report be undertaken to determine the effects on the quality of the estimates. As the BTT gets larger, the businesses in the JATT (of whatever size) will get increasingly different from those in the BTT. This is especially true for the many thousands of businesses in the lower percentile bands, and could result in poor BTT estimates if additional analysis is not undertaken.

During the analysis it is important that the level of detail which is of most interest (that is, country/HS2 Chapter or country by HS2 Chapter) be taken into account when deciding on the best JATT size to adopt. This is because the JATT size which produces the best estimates at a high level of detail will be very different from that which produces the best estimates at a low level of detail. We also recommend that the quality measures used in this report – the total absolute difference between estimates/survey returns and the corresponding value of the correlation coefficient – are used to quantify how well a given model will perform. A variety of different JATTs should be constructed and tested, comparing the quality of the estimates to each other and to the quality of the estimates that are produced under whichever threshold is being used at the time.

In addition to the above, it is strongly recommended that the benefits of other methods of estimating the breakdowns be assessed. For example, if the BTT increases beyond a certain size, it may be that the accuracy of the estimates can only be maintained by sampling some fraction of the BTT and using standard estimation methods to obtain allocations.

7 Summary and Recommendations

7.1 Summary

This report has compared the current methodology for BTTAs to viable alternate methods for when the Intrastat arrivals survey coverage changes from its current value to 93% of total trade. The methods tested scenarios listed below.

- A simple extension of the current methodology – using B8-14 to form a JATT at the 4-digit level with factors calculated using a full year's worth of data.
- Using the same basic '4-digit Annual' model, but a different sized JATT.
- Calculating the factors used for the BTTAs at different levels of product detail and using monthly or annual data, and using different sized JATTs.

Each permutation of the above was tested at three levels of interest – at the country level, the HS2 Chapter level and the country by HS2 Chapter level.

From the exploratory analyses (§3.2 and §3.3) it was decided that increasing proportions of the number of businesses in the simulated BTT (that is, B6-7) would be used to define the JATT. Each of these proportions (and for each of the six models) were tested using two evaluation methods, namely the total absolute difference between the actual and modelled values at a given level of interest, and the Pearson's correlation coefficient between these values. This allowed for the determination of the optimum JATT size to use to obtain either the minimum total absolute difference or the maximum value of the correlation coefficient.

The analysis was carried out on both the 2011 and 2012 arrivals data separately (see Appendices D1-4) and the results combined (§3.5.1). From these combined results we determined, for each level of interest:

- the optimal proportion of the simulated BTT (that is, B6-7) to use to define the JATT when using the current model (that is, calculating the factor at the HS4 product level and using the previous year's annual data); and
- the optimum overall methodology to use (that is, optimal overall JATT size/model combination).

The current methodology (that is, using B8-14 to define the JATT combined with the current model) together with the above two alternate methods were applied to 2011 and 2012 data, with the results compared and contrasted in §4. Section 5 then discussed how these results would be applied in practice.

Section 6 gave some general guidance regarding further future reductions to the coverage rate.

7.2 Recommendations

Based on the finding of this report we can make two recommendations for each level of detail (that is, country, HS2 Chapter and country by HS2 Chapter) for when the coverage rate reduces to 93% of total trade. The first is the optimal JATT size to use if the current model is to be retained (calculating the factor at the HS4 product level using the previous year's annual dataset), with the second being the optimum overall JATT size/model combination to use.

At a ***country*** or ***HS2 Chapter*** level of detail we recommend the following.

- Retaining the current model and using a JATT equal to **1/7** of the Below Threshold Trade (**B8**).

or

- Calculating the allocation factor at the HS4 product level but using the data from the same month of the previous year and a JATT size equal to **6/35** of the Below Threshold Trade (**B8-8.2**).

At a ***country by HS2 Chapter*** level of detail we recommend the following.

- Retaining the current model and using a JATT equal to **11/14** of the Below Threshold Trade (**B8-12.5**).

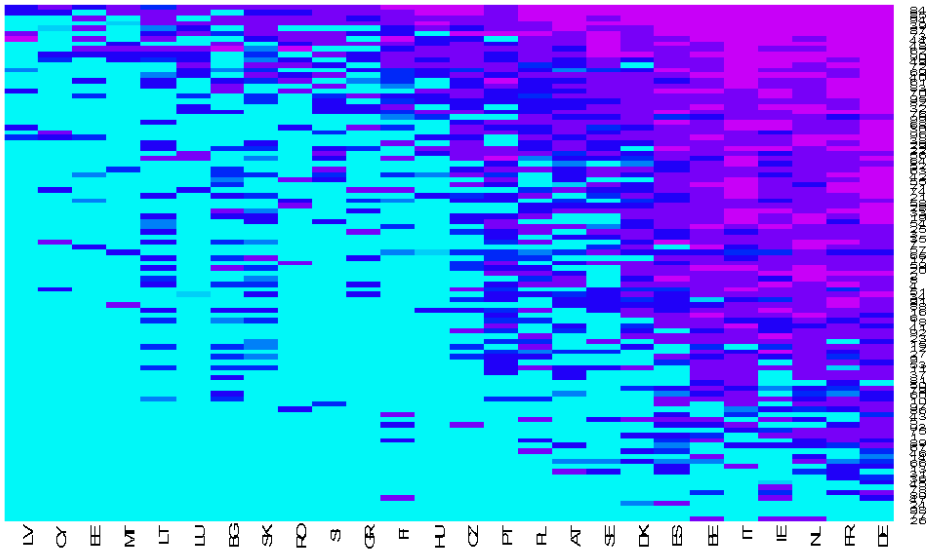
or

- Calculating the allocation factor at the HS4 product level using the data from the same month of the previous year and a JATT size equal to **3/10** of the Below Threshold Trade (**B8-9.1**).

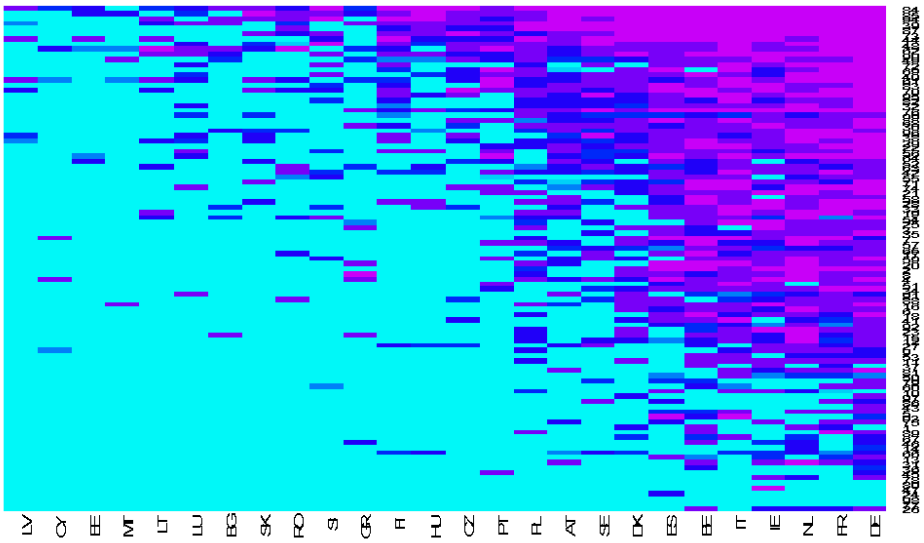
We advise HMRC, in consultation with the relevant stakeholders, to first choose which level of detail is the most important in terms of accuracy, and then, after considering the relevant IT costs and implementation practicalities involved, to decide whether to adopt an alternative method or to simply redefine the JATT size whilst retaining the current model.

Appendix A: Heatmaps for various percentile bands

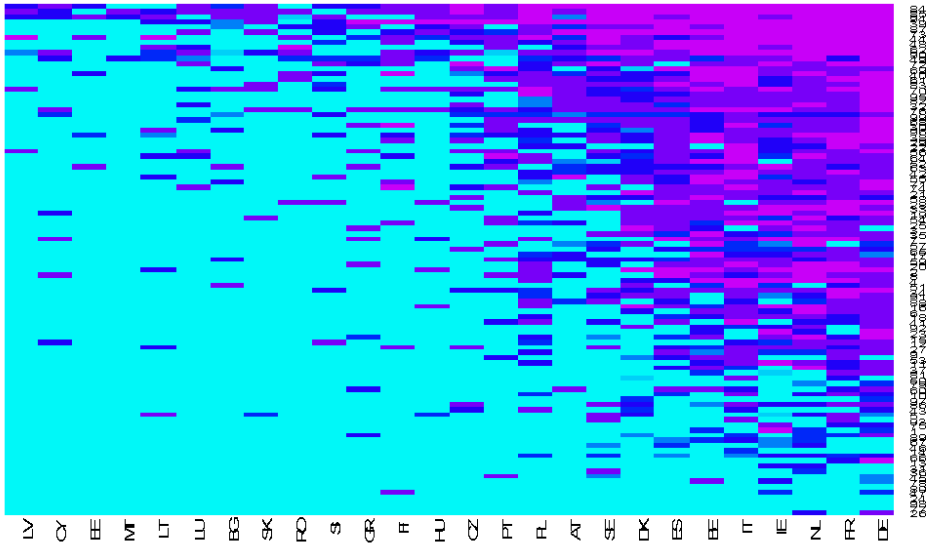
6% Band



7% Band



8% Band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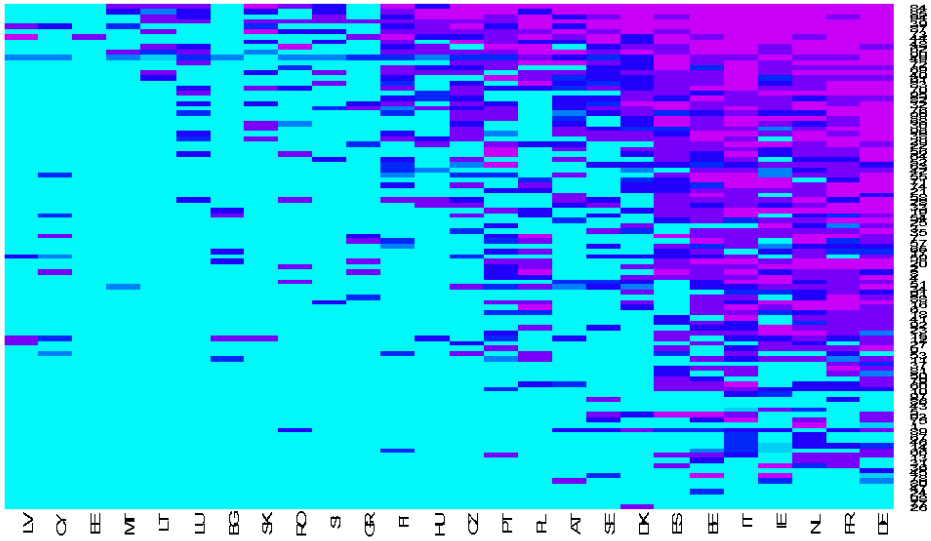
9% Band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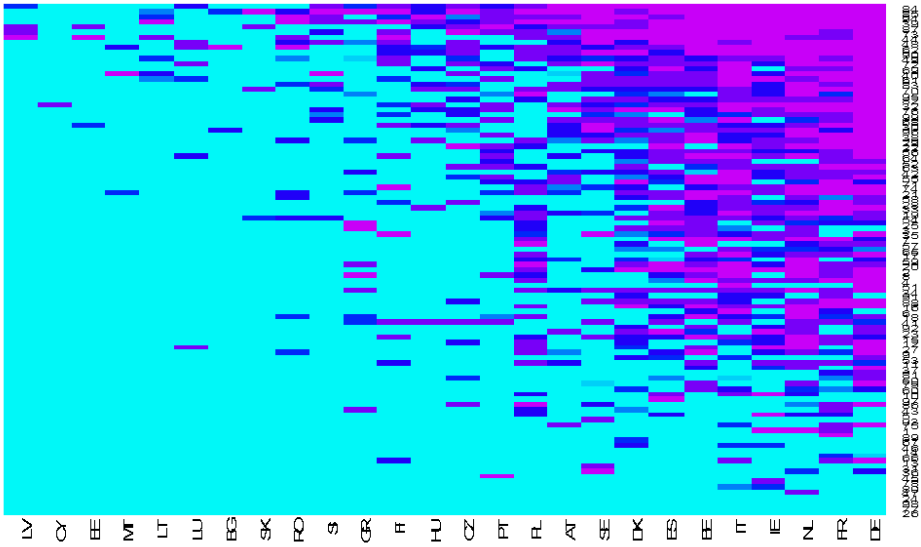
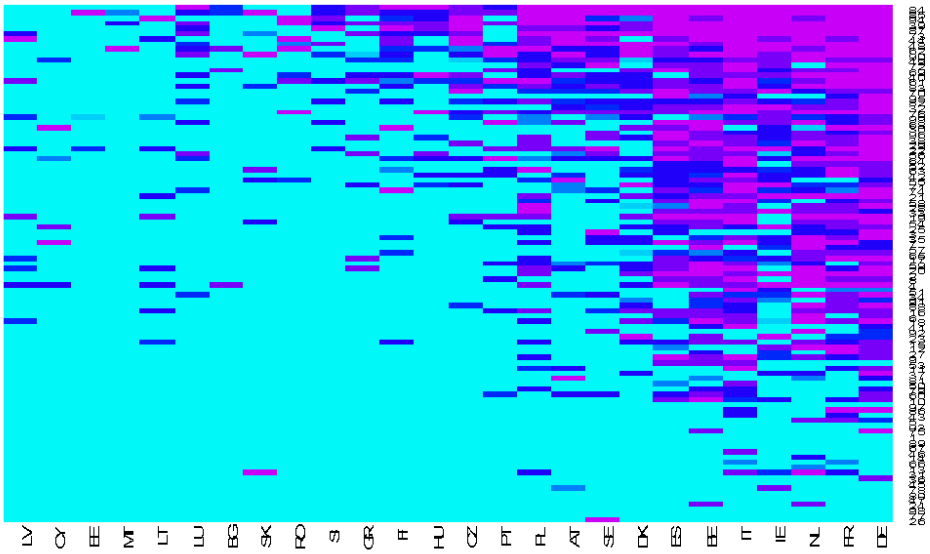
10% Band

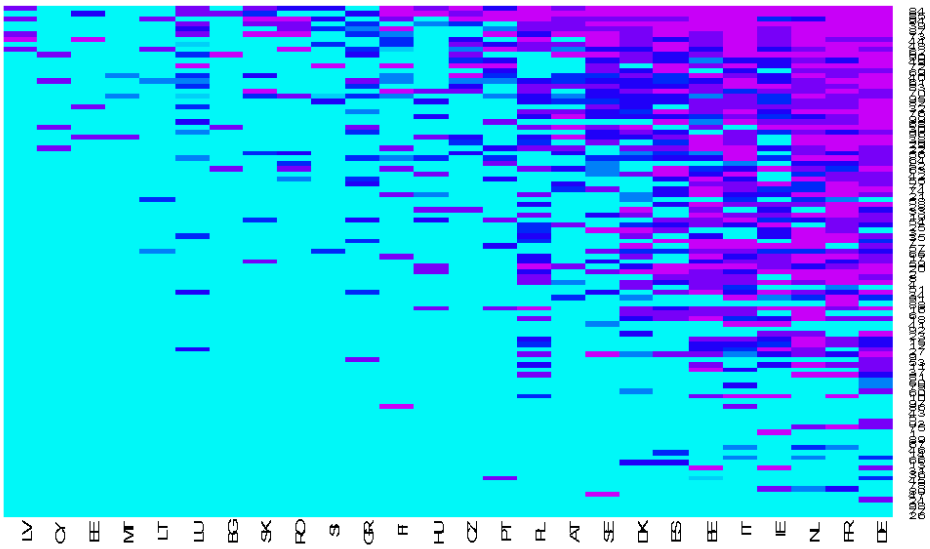
11% Band



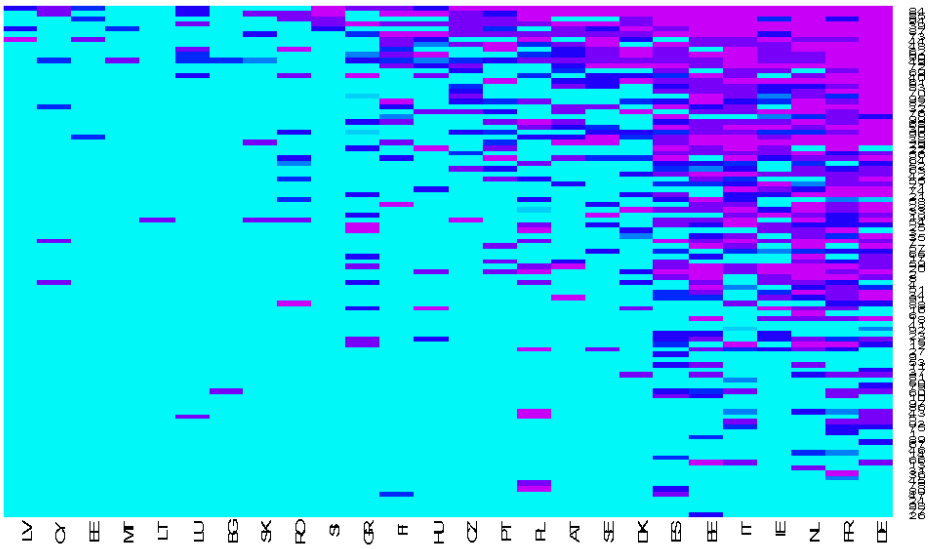
12% Band



13% Band



14% Band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Appendix B: Median percentage difference

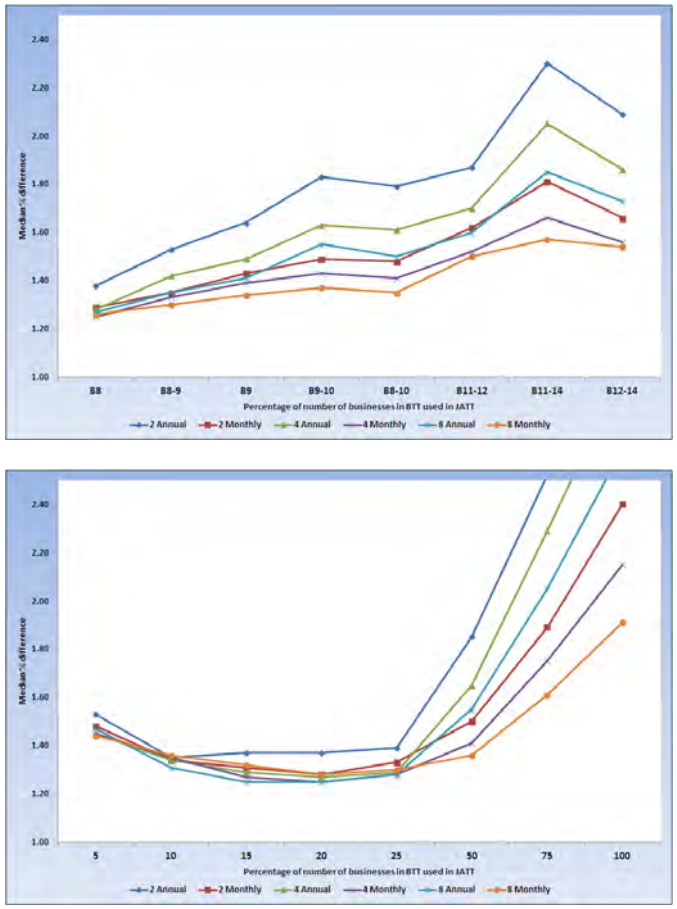


Figure B1: Country by HS2 Chapter level

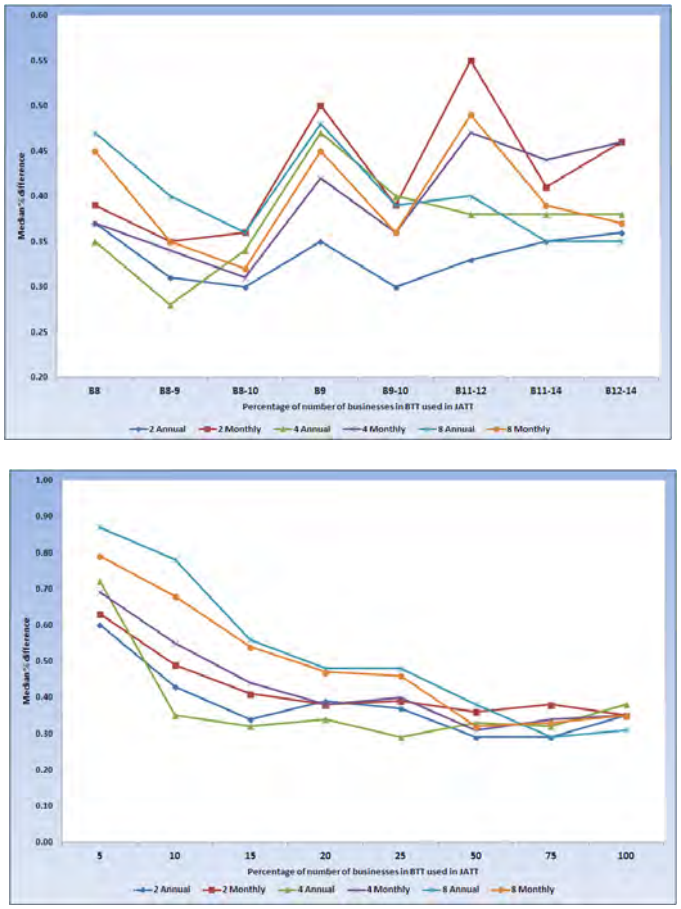


Figure B2: Country level

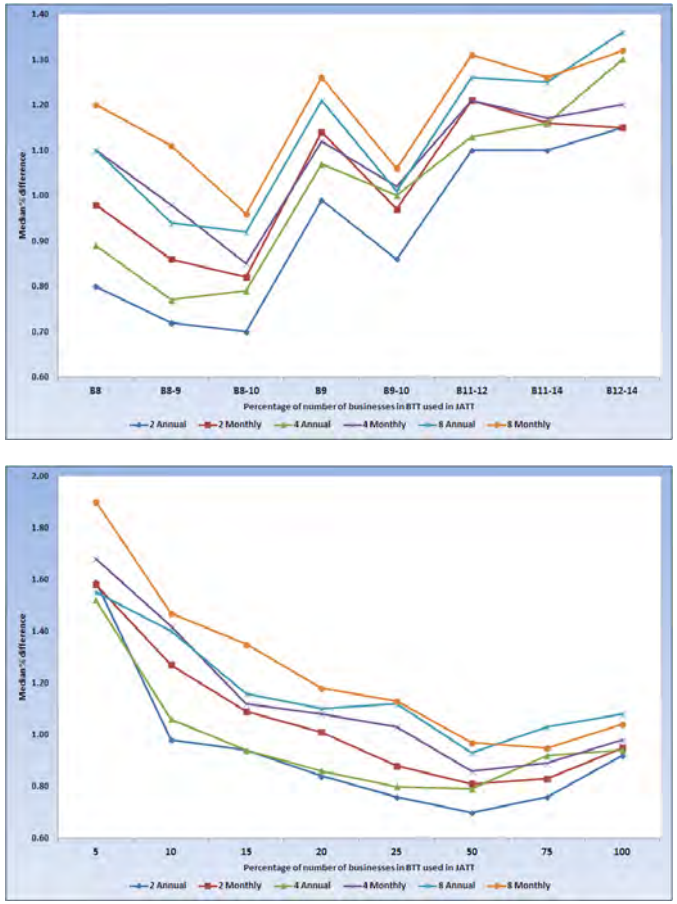


Figure B3: HS2 Chapter level

Appendix C: Median absolute difference

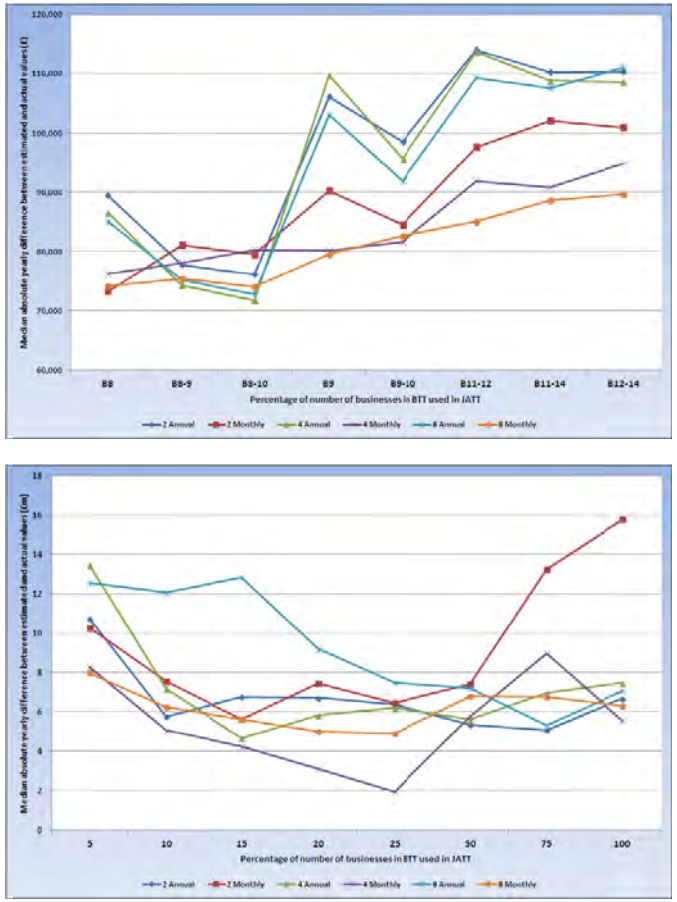


Figure C1: Country by HS2 Chapter level

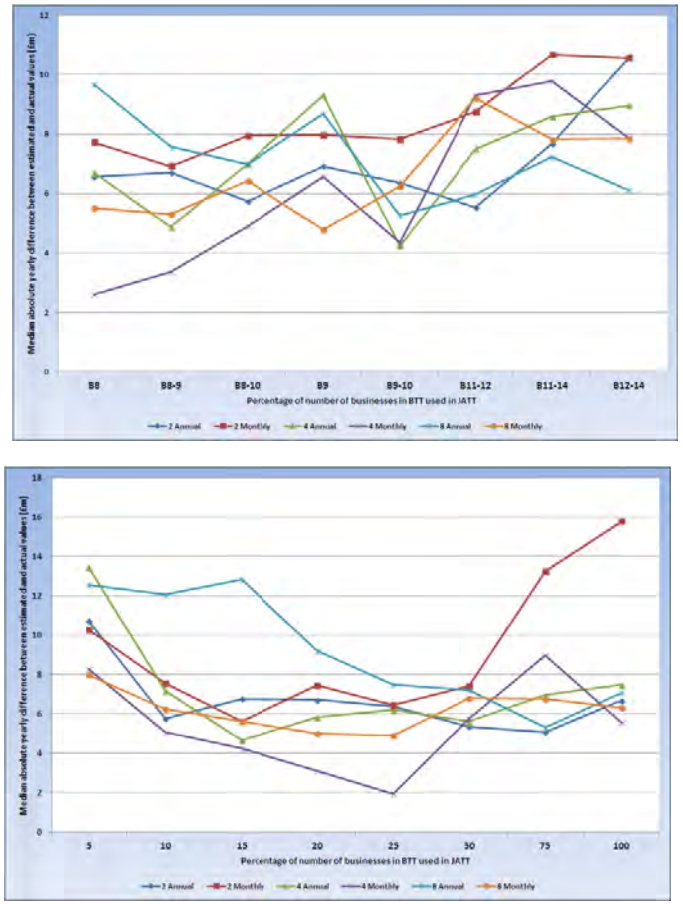
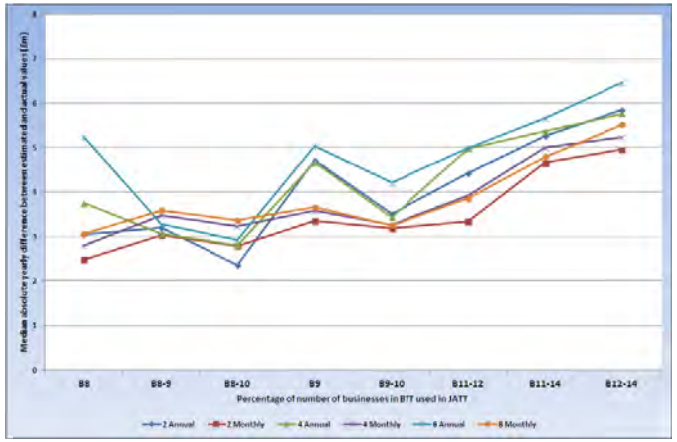


Figure C2: Country level



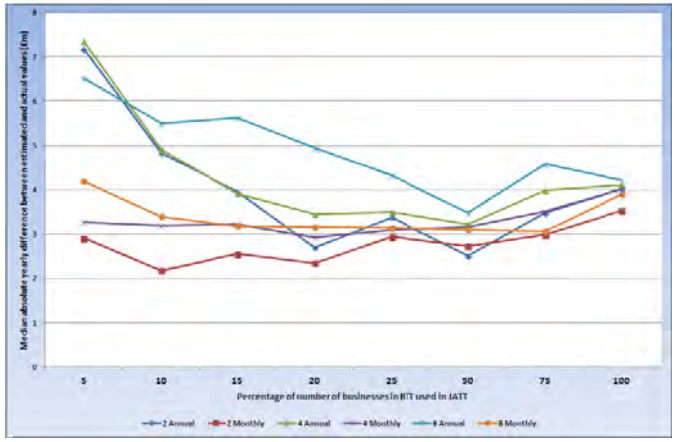
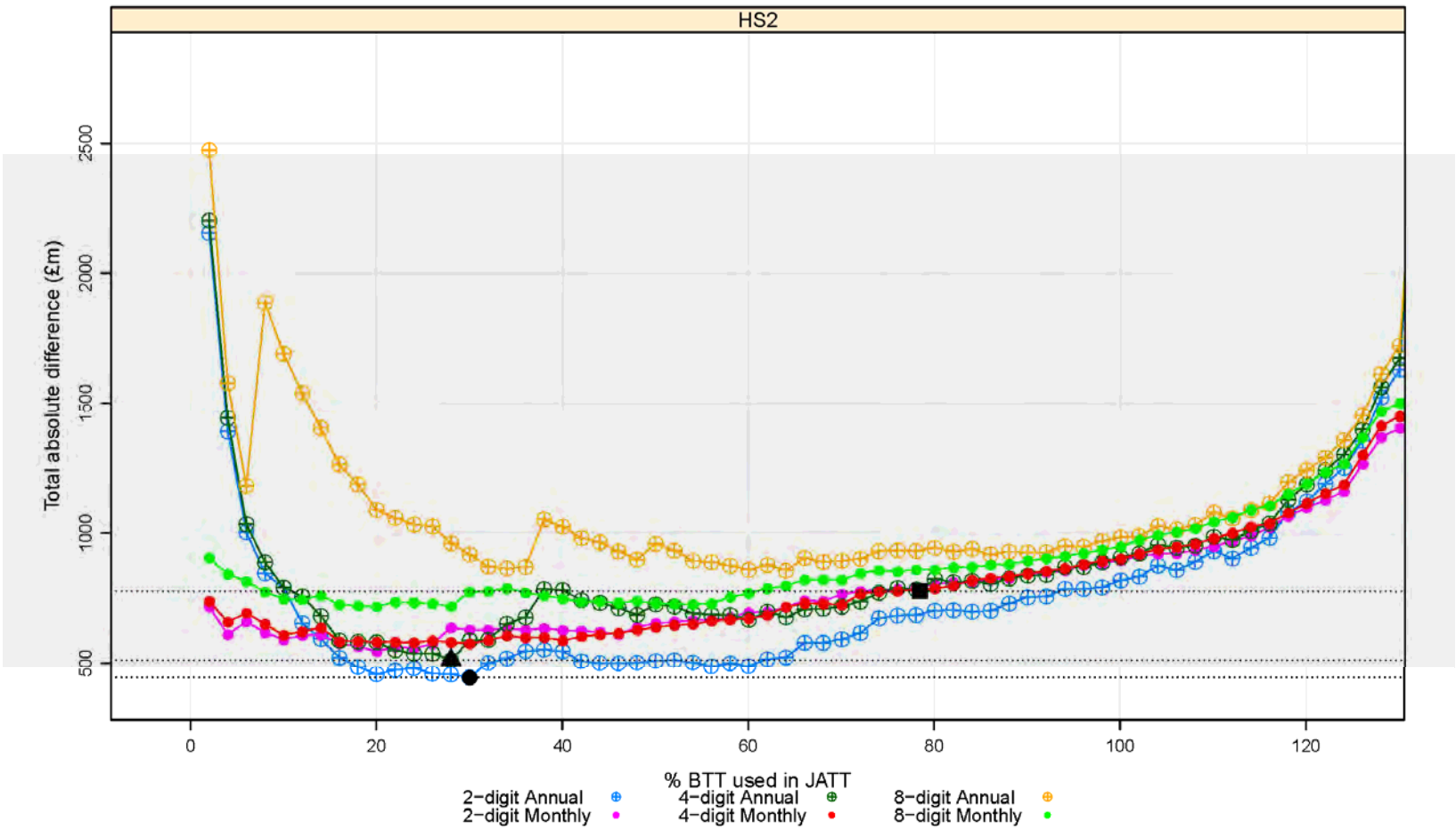
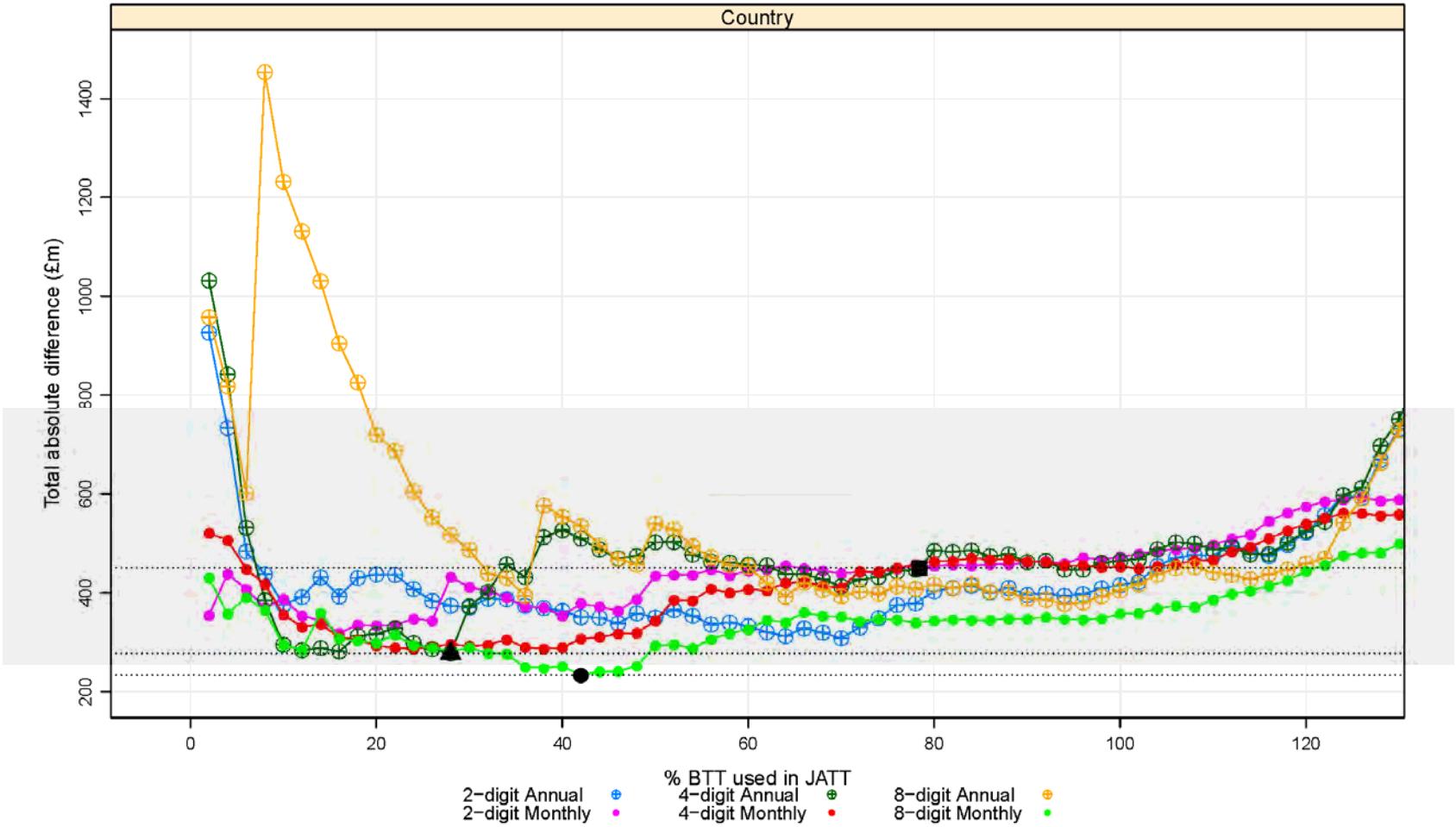
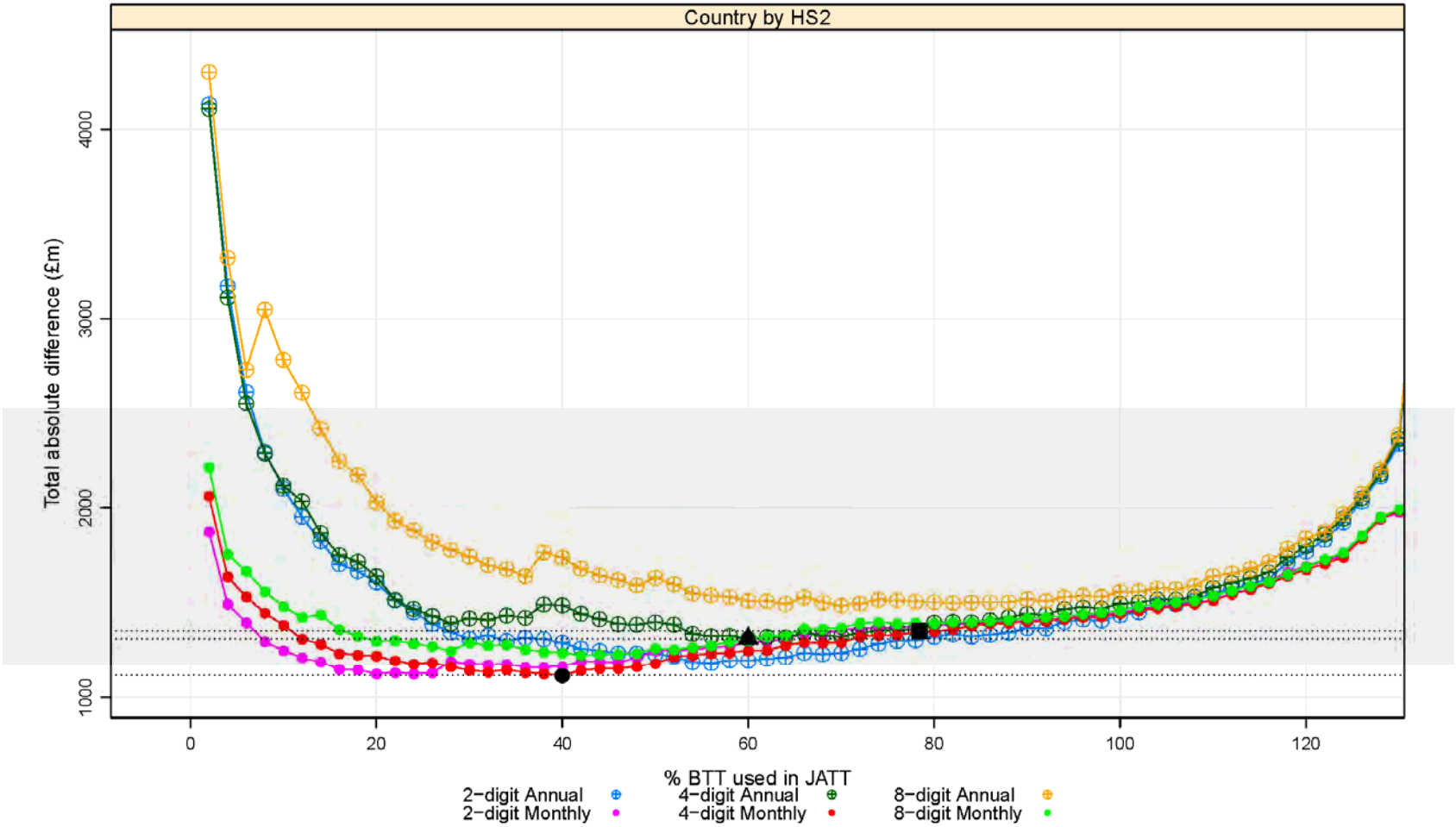


Figure C3: HS2 Chapter level

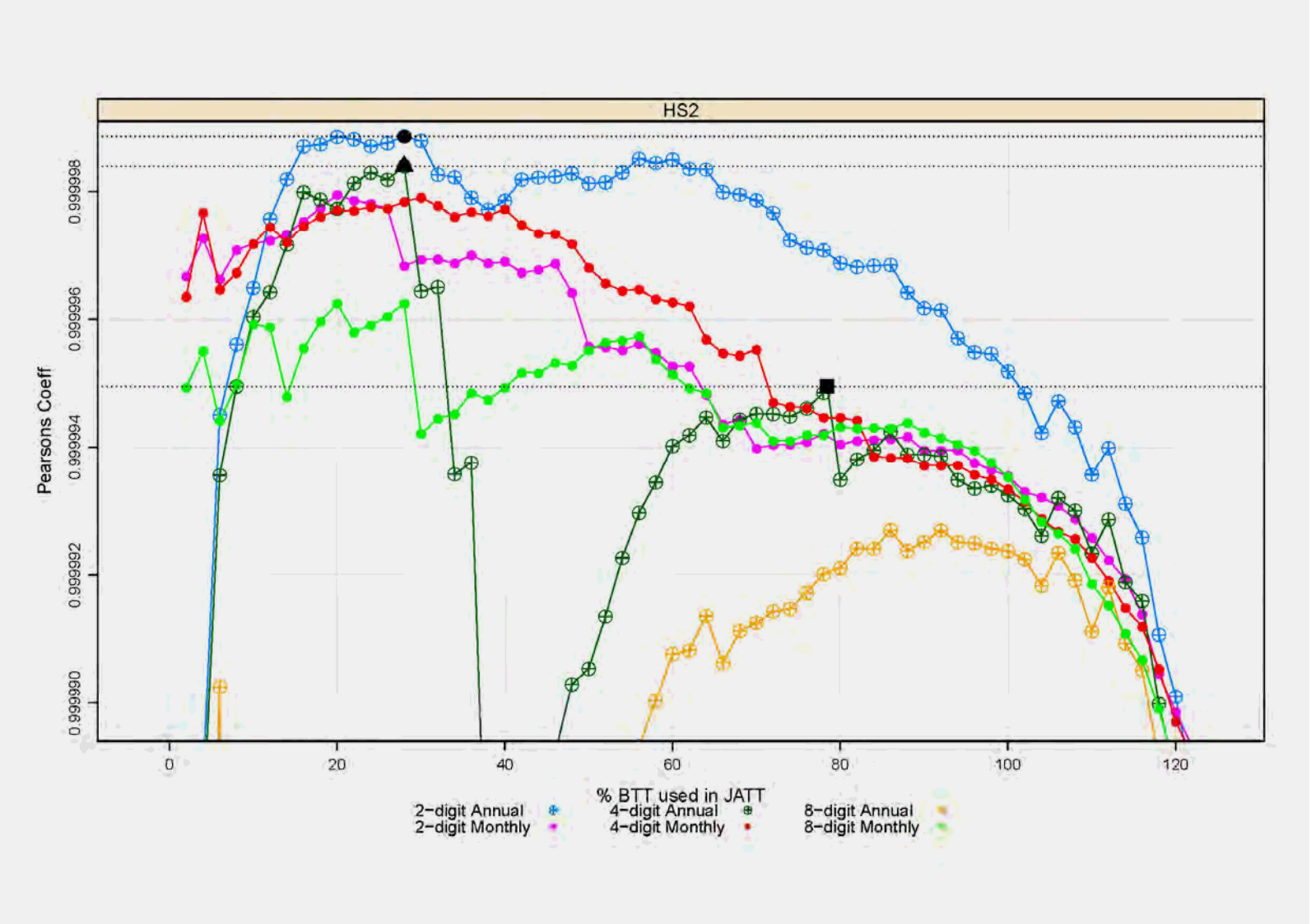
Appendix D1: Total absolute difference against BTT size used in JATT for each model, 2011

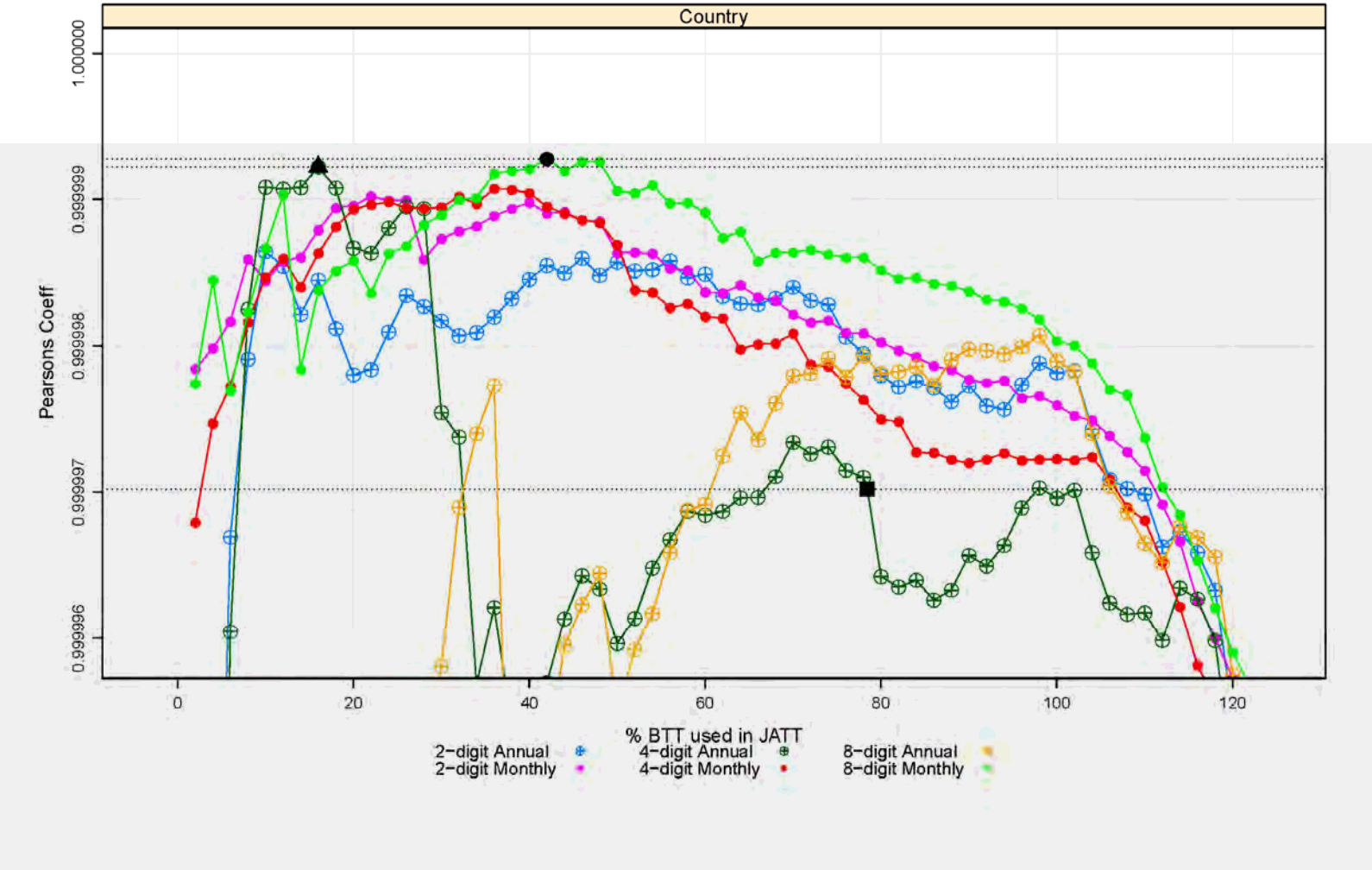


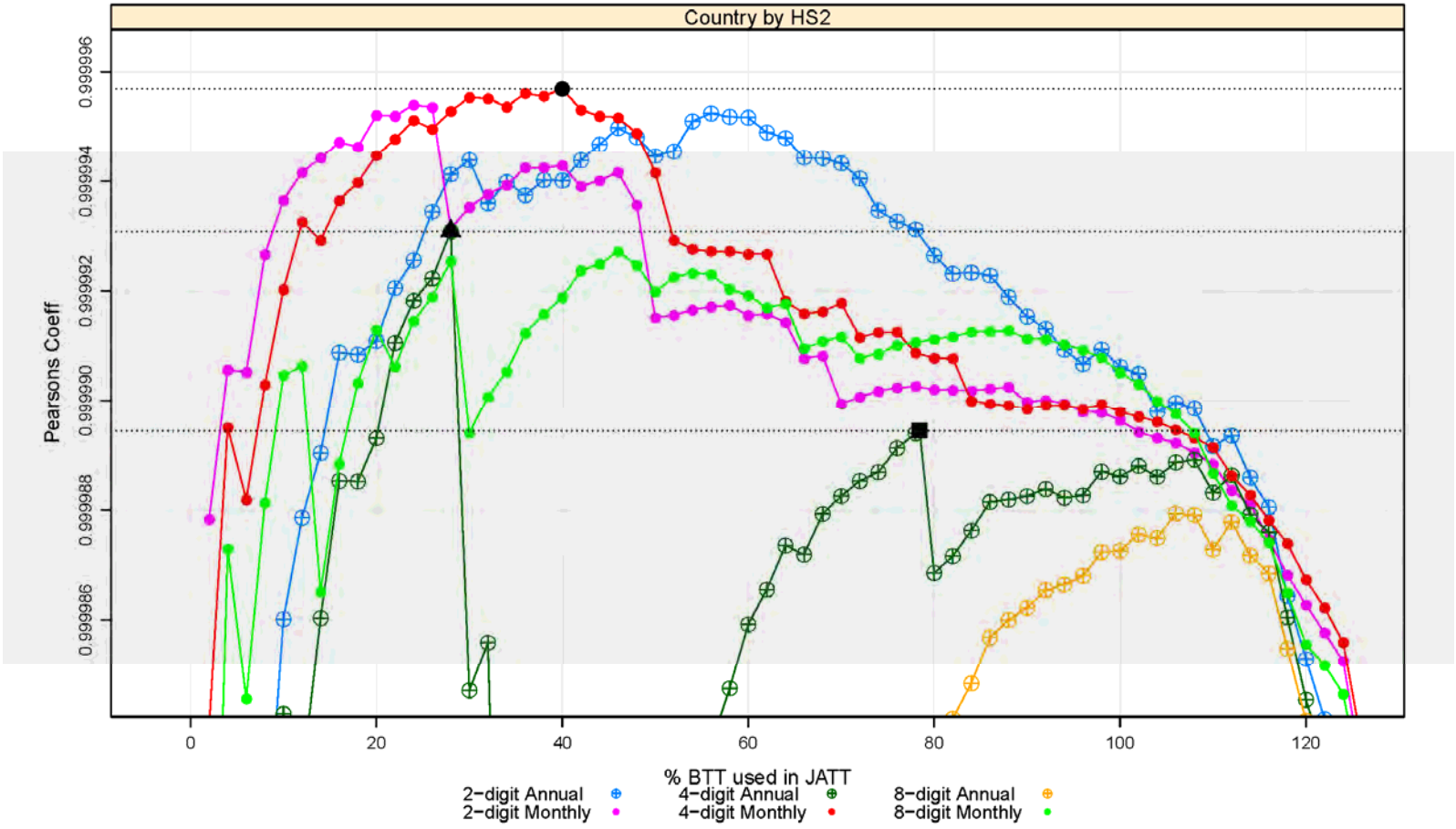

Country
Total absolute difference (£m)
200
400
600
800
1000
1200
1400
0
20
40
60
80
100
120
% BTT used in JATT
2−digit Annual
2−digit Monthly
4−digit Annual
4−digit Monthly
8−digit Annual
8−digit Monthly


Country by HS2
Total absolute difference (£m)
1000
2000
3000
4000
0
20
40
60
80
100
120
% BTT used in JATT
2−digit Annual
2−digit Monthly
4−digit Annual
4−digit Monthly
8−digit Annual
8−digit Monthly

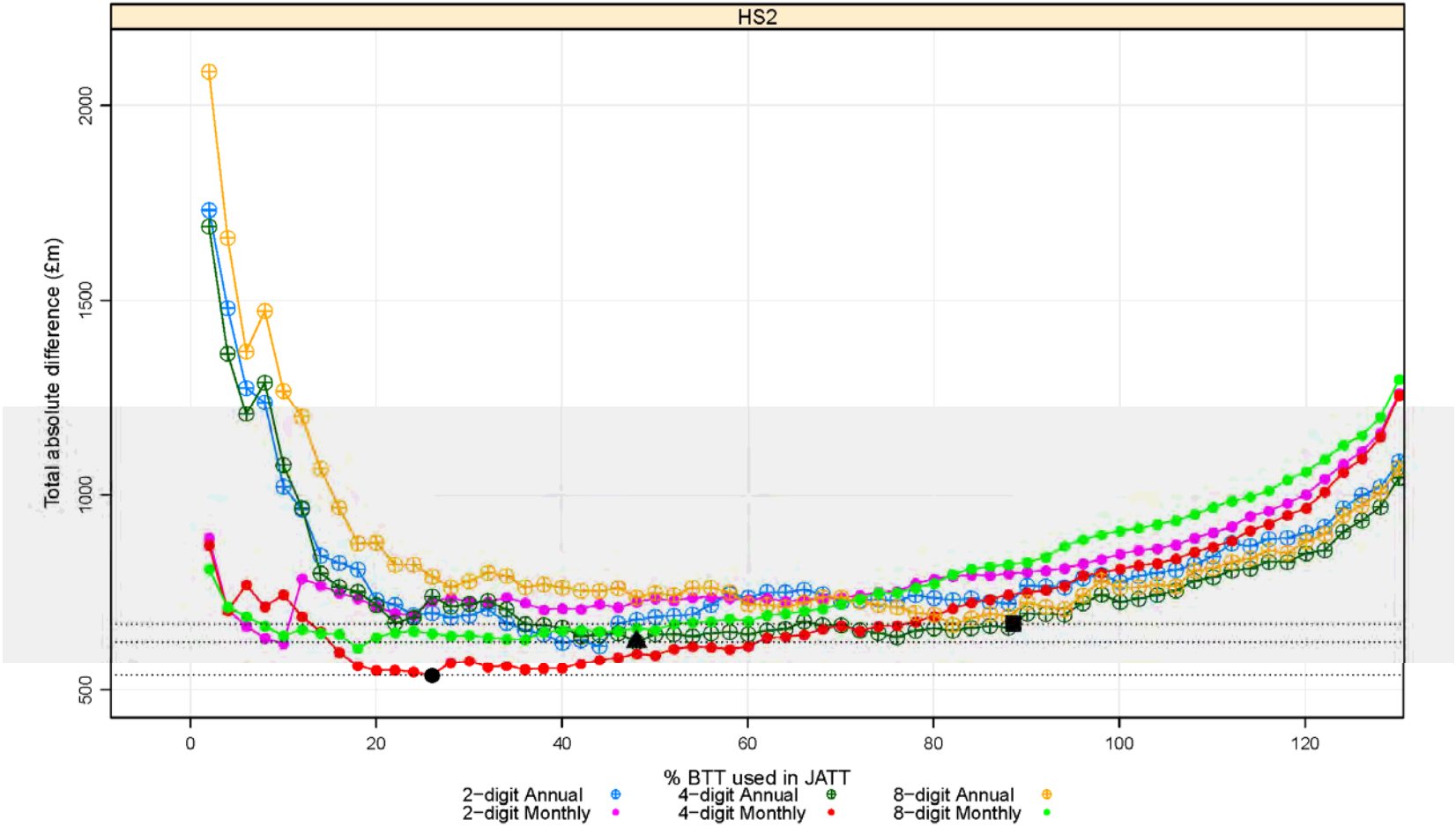
Appendix D2: Pearson's correlation coefficient against size BTT used in JATT for each model, 2011

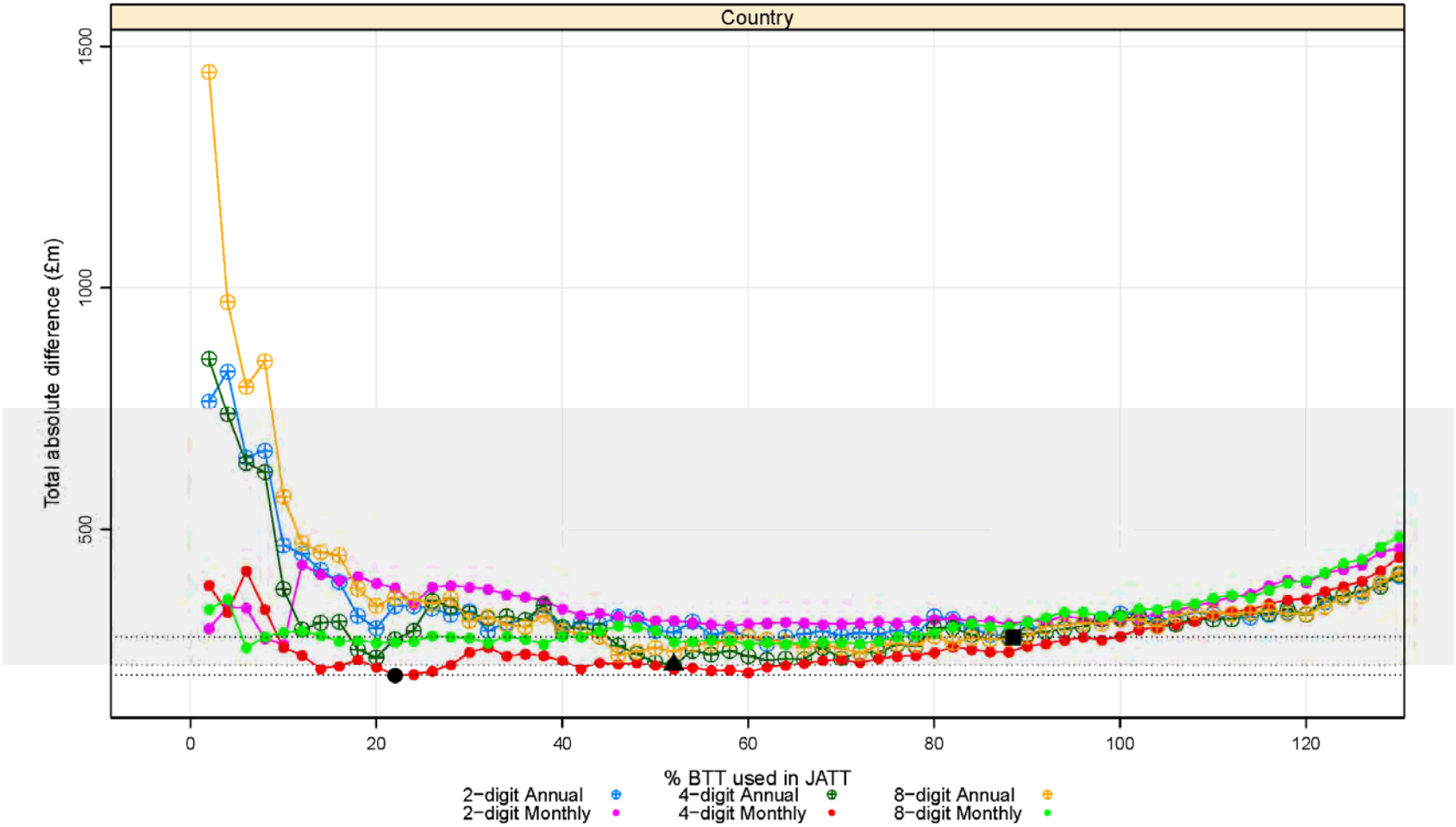


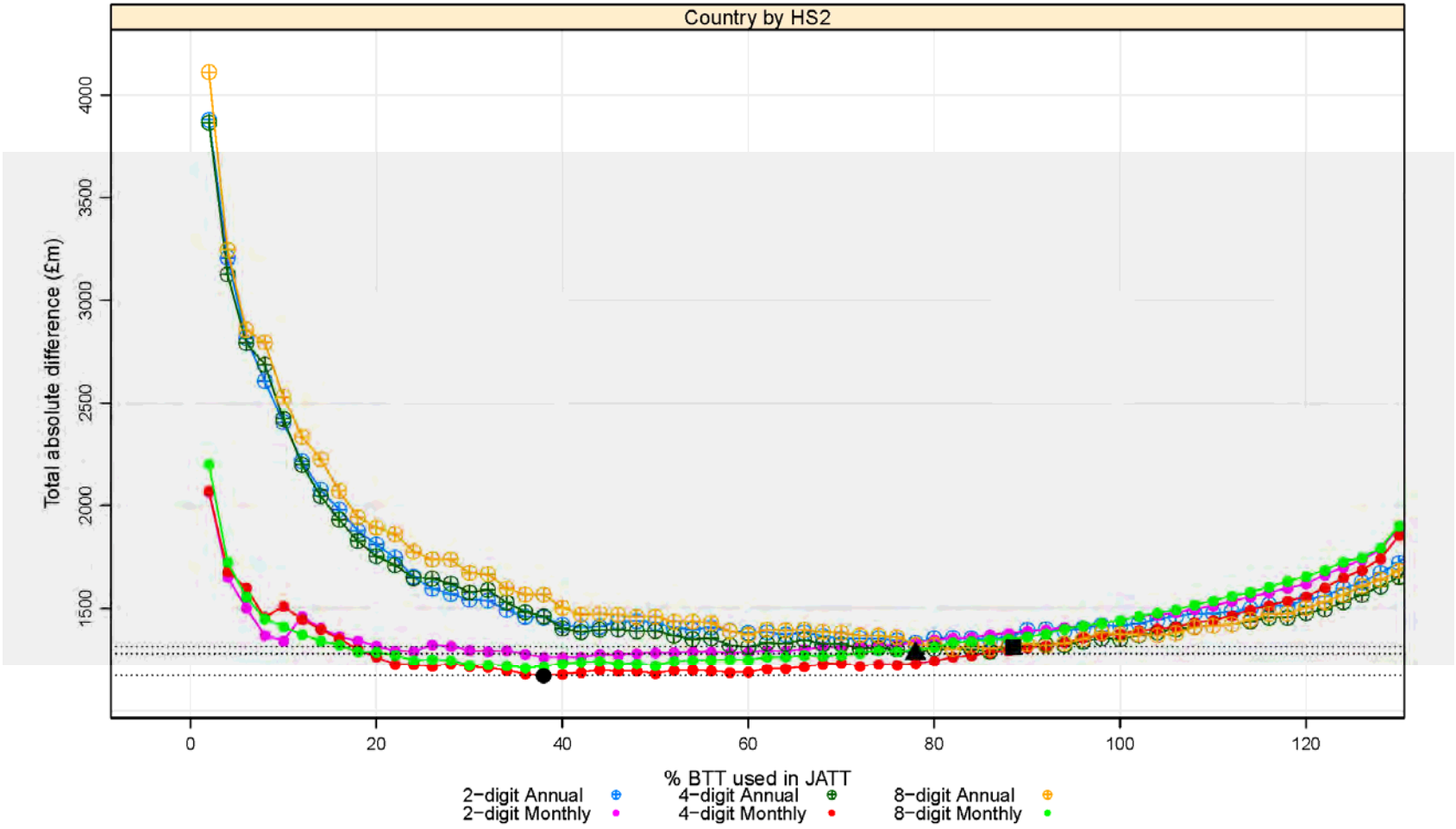

Country
Pearsons Coeff
1.000000
0.999999
0.999998
0.999997
0.999996
0
20
40
60
80
100
120
% BTT used in JATT
2−digit Annual
2−digit Monthly
4−digit Annual
4−digit Monthly
8−digit Annual
8−digit Monthly


Country by HS2
Pearsons Coeff
0.999986
0.999988
0.999990
0.999992
0.999994
0.999996
0
20
40
60
80
100
120
% BTT used in JATT
2−digit Annual
2−digit Monthly
4−digit Annual
4−digit Monthly
8−digit Annual
8−digit Monthly

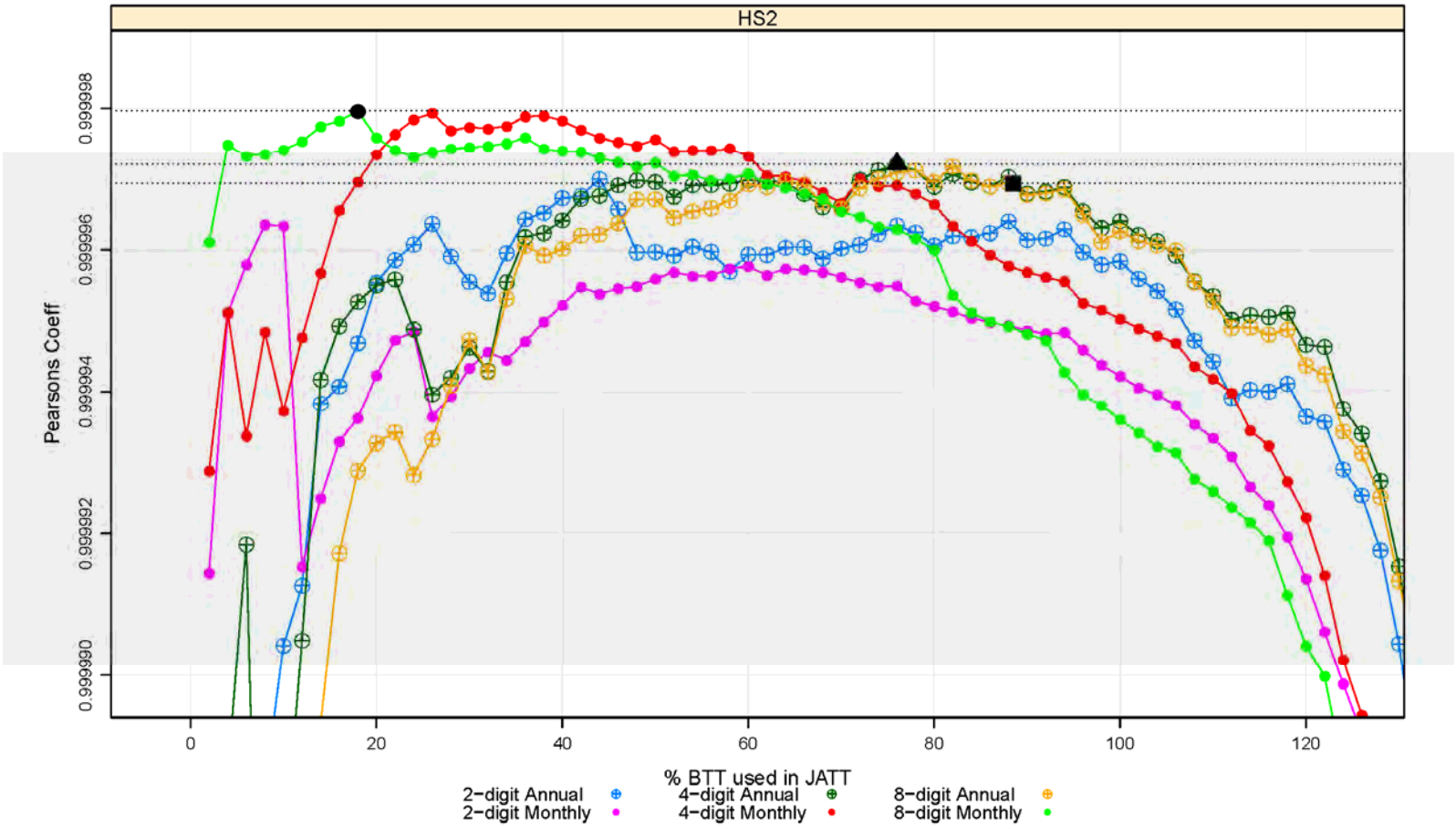
Appendix D3: Total absolute difference against BTT size used in JATT for each model, 2012

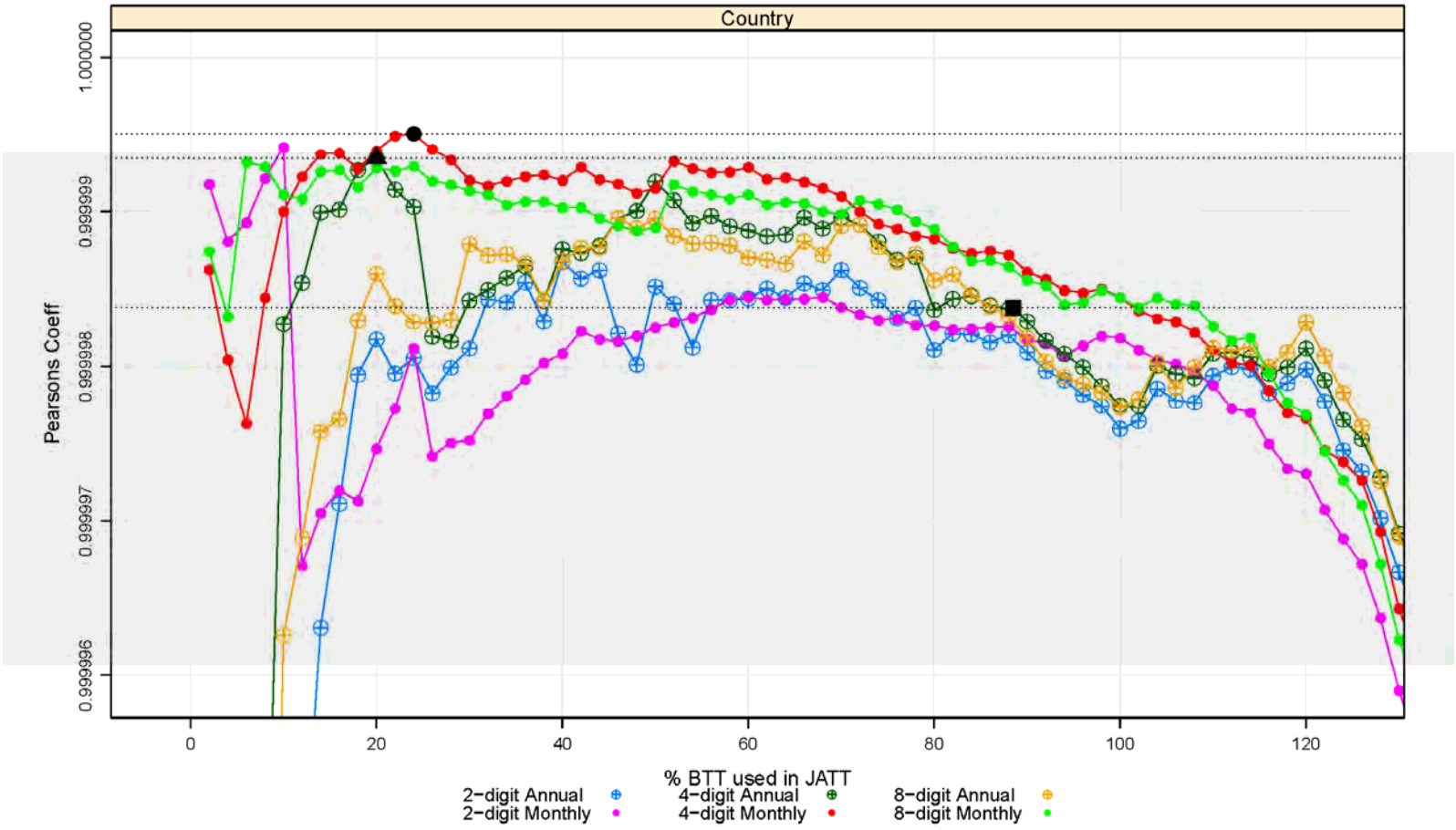


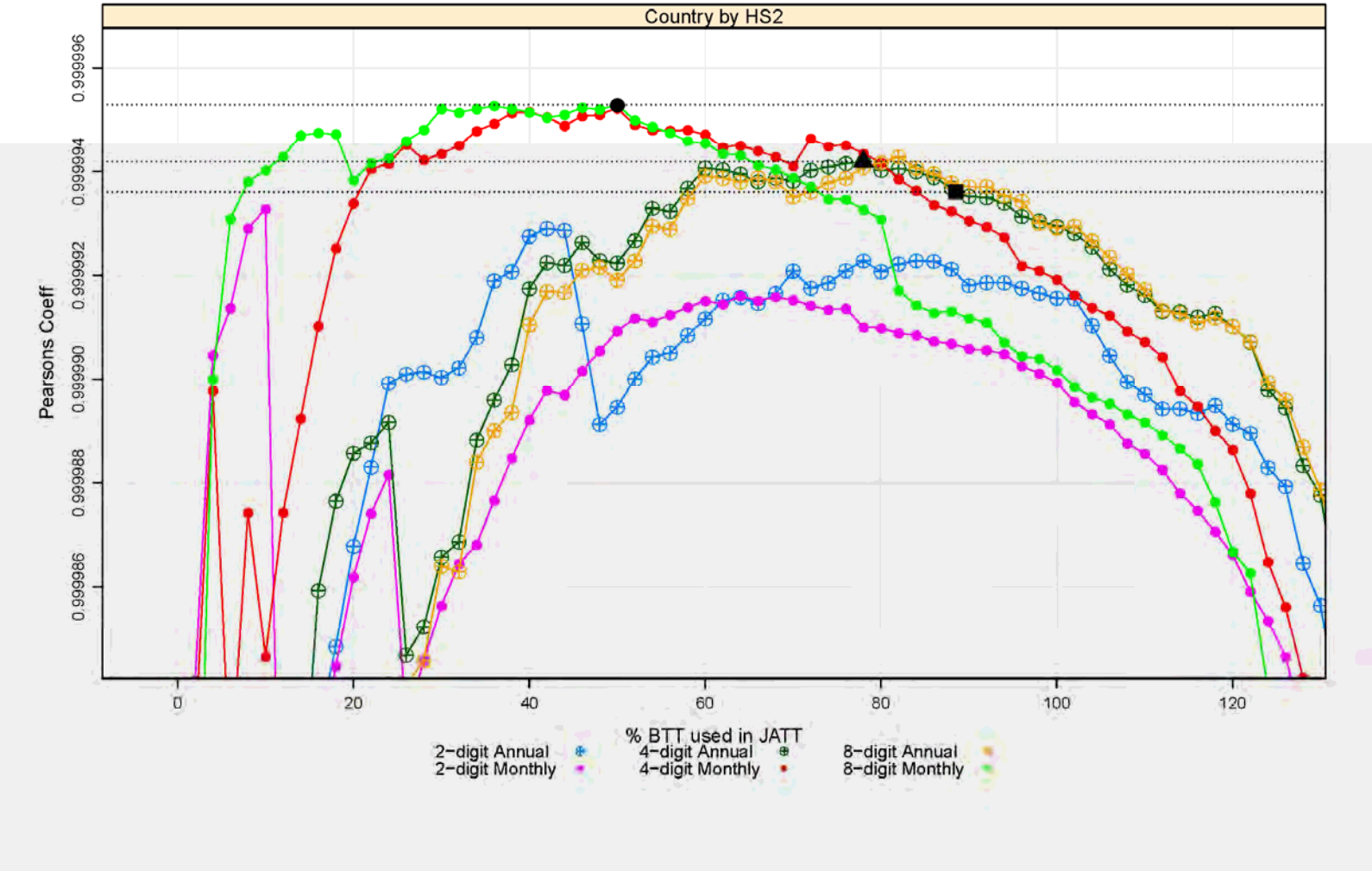

Country
Total absolute difference (£m)
1500
1000
500
0
20
40
60
80
100
120
% BTT used in JATT
2−digit Annual
2−digit Monthly
4−digit Annual
4−digit Monthly
8−digit Annual
8−digit Monthly


Country by HS2
Total absolute difference (£m)
1500
2000
2500
3000
3500
4000
0
20
40
60
80
100
120
% BTT used in JATT
2−digit Annual
2−digit Monthly
4−digit Annual
4−digit Monthly
8−digit Annual
8−digit Monthly

Appendix D4: Pearson's correlation coefficient against BTT size used in JATT for each model, 2012




Country
Pearsons Coeff
1.000000
0.999999
0.999998
0.999997
0.999996
0
20
40
60
80
100
120
% BTT used in JATT
2−digit Annual
2−digit Monthly
4−digit Annual
4−digit Monthly
8−digit Annual
8−digit Monthly


Country by HS2
Pearsons Coeff
0.999986
0.999988
0.999990
0.999992
0.999994
0.999996
0
20
40
60
80
100
120
% BTT used in JATT
2-digit Annual
2-digit Monthly
4-digit Annual
4-digit Monthly
8-digit Annual
8-digit Monthly

Appendix E1: Applying Models – Country level data

Year / Country		Actual (£m)	Estimate (£m)			Difference (£m)			Percentage Difference			Absolute Difference (£m)		
			21% 4-digit Annual	25% 4-digit Monthly	B8-14 4-digit Annual	21% 4-digit Annual	25% 4-digit Monthly	B8-14 4-digit Annual	21% 4-digit Annual	25% 4-digit Monthly	B8-14 4-digit Annual	21% 4-digit Annual	25% 4-digit Monthly	B8-14 4-digit Annual
2011	Germany	48338.9	48319.2	48293.9	48293.4	-19.7	-45.0	-45.5	0.0	-0.1	-0.1	19.7	45.0	45.5
	Netherlands	26912.5	26873.0	26863.3	26858.7	-39.5	-49.3	-53.9	-0.2	-0.2	-0.2	39.5	49.3	53.9
	France	22113.1	22101.3	22114.9	22134.2	-11.7	1.8	21.1	-0.1	0.0	0.1	11.7	1.8	21.1
	Belgium	18312.2	18317.4	18344.6	18362.1	5.1	32.4	49.9	0.0	0.2	0.3	5.1	32.4	49.9
	Italy	13048.7	13105.2	13047.5	13024.4	56.5	-1.2	-24.3	0.4	0.0	-0.2	56.5	1.2	24.3
	Irish Republic	12340.5	12295.8	12302.4	12250.3	-44.7	-38.1	-90.2	-0.4	-0.3	-0.7	44.7	38.1	90.2
	Spain	11013.4	11023.8	11013.1	11064.1	10.4	-0.3	50.8	0.1	0.0	0.5	10.4	0.3	50.8
	Sweden	7427.9	7461.9	7439.7	7446.4	34.0	11.7	18.4	0.5	0.2	0.3	34.0	11.7	18.4
	Poland	6905.5	6913.1	6906.7	6912.5	7.6	1.2	7.1	0.1	0.0	0.1	7.6	1.2	7.1
	Denmark	5622.3	5611.8	5626.2	5618.1	-10.5	3.9	-4.2	-0.2	0.1	-0.1	10.5	3.9	4.2
	Czech Republic	4103.0	4109.8	4124.0	4109.0	6.8	21.0	6.0	0.2	0.5	0.2	6.8	21.0	6.0
	Hungary	3020.9	3012.8	3032.9	3025.6	-8.1	12.0	4.7	-0.3	0.4	0.2	8.1	12.0	4.7
	Austria	2688.6	2698.9	2728.0	2718.8	10.4	39.4	30.2	0.4	1.5	1.1	10.4	39.4	30.2
	Finland	2352.4	2360.9	2353.8	2361.0	8.5	1.4	8.7	0.4	0.1	0.4	8.5	1.4	8.7
	Portugal	1667.3	1660.4	1675.8	1667.9	-7.0	8.5	0.6	-0.4	0.5	0.0	7.0	8.5	0.6
	Slovakia	1453.7	1451.3	1453.4	1452.5	-2.4	-0.3	-1.3	-0.2	0.0	-0.1	2.4	0.3	1.3
	Romania	1221.3	1233.0	1222.5	1237.4	11.6	1.2	16.1	1.0	0.1	1.3	11.6	1.2	16.1
	Luxembourg	855.9	852.3	862.3	858.6	-3.6	6.4	2.7	-0.4	0.7	0.3	3.6	6.4	2.7
	Greece	623.6	619.8	622.5	623.7	-3.8	-1.1	0.1	-0.6	-0.2	0.0	3.8	1.1	0.1
	Lithuania	558.4	553.7	555.7	554.2	-4.8	-2.8	-4.2	-0.9	-0.5	-0.8	4.8	2.8	4.2
	Latvia	328.5	328.0	327.3	333.2	-0.5	-1.3	4.7	-0.2	-0.4	1.4	0.5	1.3	4.7
	Slovenia	323.7	329.5	322.4	323.2	5.8	-1.4	-0.5	1.8	-0.4	-0.2	5.8	1.4	0.5
	Bulgaria	263.3	264.8	265.2	264.8	1.5	2.0	1.6	0.6	0.8	0.6	1.5	2.0	1.6
	Estonia	194.1	195.6	192.2	193.0	1.5	-1.9	-1.1	0.8	-1.0	-0.6	1.5	1.9	1.1
	Malta	126.8	125.0	127.4	127.5	-1.8	0.6	0.7	-1.4	0.5	0.5	1.8	0.6	0.7
	Cyprus	96.7	95.0	95.6	98.7	-1.7	-1.0	2.1	-1.7	-1.1	2.1	1.7	1.0	2.1
2012	Germany	50951.1	50952.1	50933.6	50940.7	1.0	-17.6	-10.4	0.0	0.0	0.0	1.0	17.6	10.4
	Netherlands	29510.2	29537.0	29508.5	29523.7	26.8	-1.6	13.5	0.1	0.0	0.1	26.8	1.6	13.5
	France	22388.3	22430.3	22378.6	22409.7	41.9	-9.7	21.3	0.2	0.0	0.1	41.9	9.7	21.3
	Belgium	17608.8	17566.1	17610.9	17622.7	-42.7	2.1	13.9	-0.2	0.0	0.1	42.7	2.1	13.9
	Italy	13262.4	13254.3	13241.0	13239.1	-8.0	-21.4	-23.3	-0.1	-0.2	-0.2	8.0	21.4	23.3
	Irish Republic	12148.4	12121.4	12101.1	12054.8	-26.9	-47.3	-93.6	-0.2	-0.4	-0.8	26.9	47.3	93.6
	Spain	10805.4	10796.0	10815.5	10819.2	-9.3	10.1	13.8	-0.1	0.1	0.1	9.3	10.1	13.8
	Sweden	8834.4	8829.9	8848.7	8837.8	-4.4	14.4	3.5	-0.1	0.2	0.0	4.4	14.4	3.5
	Poland	7188.4	7205.2	7206.4	7190.6	16.8	18.0	2.2	0.2	0.3	0.0	16.8	18.0	2.2
	Denmark	5371.4	5372.2	5372.4	5372.9	0.9	1.1	1.6	0.0	0.0	0.0	0.9	1.1	1.6
	Czech Republic	4304.6	4294.6	4304.6	4303.3	-10.0	0.0	-1.3	-0.2	0.0	0.0	10.0	0.0	1.3
	Hungary	2556.5	2554.7	2555.9	2562.4	-1.8	-0.6	5.9	-0.1	0.0	0.2	1.8	0.6	5.9
	Austria	2445.8	2460.3	2466.8	2456.3	14.5	21.0	10.5	0.6	0.9	0.4	14.5	21.0	10.5
	Finland	2058.8	2067.0	2059.9	2070.6	8.2	1.1	11.8	0.4	0.1	0.6	8.2	1.1	11.8
	Portugal	1634.5	1630.8	1637.9	1636.4	-3.7	3.4	1.9	-0.2	0.2	0.1	3.7	3.4	1.9
	Slovakia	1528.5	1519.7	1539.9	1532.7	-8.8	11.4	4.2	-0.6	0.7	0.3	8.8	11.4	4.2
	Romania	1239.1	1240.5	1241.6	1254.0	1.4	2.5	14.9	0.1	0.2	1.2	1.4	2.5	14.9
	Lithuania	710.7	720.0	712.8	710.2	9.4	2.1	-0.5	1.3	0.3	-0.1	9.4	2.1	0.5
	Greece	643.0	640.2	651.0	645.5	-2.9	8.0	2.5	-0.4	1.2	0.4	2.9	8.0	2.5
	Luxembourg	624.3	620.1	619.8	622.6	-4.1	-4.4	-1.7	-0.7	-0.7	-0.3	4.1	4.4	1.7
	Slovenia	296.4	290.1	296.7	290.7	-6.3	0.4	-5.6	-2.1	0.1	-1.9	6.3	0.4	5.6
	Bulgaria	271.1	272.0	273.6	275.9	0.9	2.4	4.8	0.3	0.9	1.8	0.9	2.4	4.8
	Latvia	265.1	268.8	270.3	277.0	3.7	5.2	11.9	1.4	2.0	4.5	3.7	5.2	11.9
	Estonia	205.0	204.6	202.7	202.5	-0.4	-2.3	-2.5	-0.2	-1.1	-1.2	0.4	2.3	2.5
	Cyprus	126.2	131.2	127.8	126.2	5.0	1.6	0.0	4.0	1.2	0.0	5.0	1.6	0.0
	Malta	106.1	105.0	106.3	107.1	-1.1	0.2	0.9	-1.0	0.2	0.9	1.1	0.2	0.9

Appendix E2: Applying Models – HS2 Chapter level data

Year / HS2 Code		Actual (£m)	Estimate (£m)			Difference (£m)			Percentage Difference			Absolute Difference (£m)		
			21% 4-digit Annual	25% 4-digit Monthly	B8-14 4-digit Annual	21% 4-digit Annual	25% 4-digit Monthly	B8-14 4-digit Annual	21% 4-digit Annual	25% 4-digit Monthly	B8-14 4-digit Annual	21% 4-digit Annual	25% 4-digit Monthly	B8-14 4-digit Annual
2011	87	31612.6	31602.6	31599.1	31600.9	-10.0	-13.5	-11.7	0.0	0.0	0.0	10.0	13.5	11.7
	84	22732.0	22729.5	22708.1	22691.9	-2.5	-23.9	-40.1	0.0	-0.1	-0.2	2.5	23.9	40.1
	85	17435.5	17477.4	17441.8	17445.1	41.9	6.3	9.7	0.2	0.0	0.1	41.9	6.3	9.7
	27	12181.3	12184.0	12197.2	12193.7	2.7	15.9	12.5	0.0	0.1	0.1	2.7	15.9	12.5
	30	10017.2	10013.1	10015.4	10035.0	-4.1	-1.8	17.8	0.0	0.0	0.2	4.1	1.8	17.8
	39	7603.6	7585.8	7567.7	7560.9	-17.8	-35.9	-42.7	-0.2	-0.5	-0.6	17.8	35.9	42.7
	29	6461.4	6470.8	6489.4	6490.4	9.4	28.0	29.0	0.2	0.4	0.5	9.4	28.0	29.0
	71	5506.0	5512.2	5532.4	5588.1	6.1	26.4	82.1	0.1	0.5	1.5	6.1	26.4	82.1
	90	4805.3	4782.4	4783.8	4771.3	-23.0	-21.5	-34.0	-0.5	-0.5	-0.7	23.0	21.5	34.0
	48	4734.6	4738.7	4733.0	4734.4	4.1	-1.6	-0.2	0.1	0.0	0.0	4.1	1.6	0.2
	22	3705.0	3706.9	3716.4	3732.3	2.0	11.4	27.4	0.1	0.3	0.7	2.0	11.4	27.4
	72	3657.7	3667.9	3675.3	3686.9	10.2	17.6	29.2	0.3	0.5	0.8	10.2	17.6	29.2
	02	3107.3	3121.4	3113.1	3113.9	14.0	5.8	6.5	0.5	0.2	0.2	14.0	5.8	6.5
	73	2750.2	2758.8	2752.4	2750.4	8.6	2.1	0.2	0.3	0.1	0.0	8.6	2.1	0.2
	38	2643.0	2646.1	2648.2	2636.1	3.2	5.2	-6.9	0.1	0.2	-0.3	3.2	5.2	6.9
	33	2491.4	2489.6	2497.8	2493.5	-1.8	6.4	2.1	-0.1	0.3	0.1	1.8	6.4	2.1
	94	2335.0	2300.9	2309.7	2301.7	-34.1	-25.4	-33.4	-1.5	-1.1	-1.4	34.1	25.4	33.4
	04	2270.7	2281.1	2284.6	2277.3	10.4	13.9	6.5	0.5	0.6	0.3	10.4	13.9	6.5
	40	2115.6	2111.7	2119.6	2107.1	-3.9	4.0	-8.5	-0.2	0.2	-0.4	3.9	4.0	8.5
	19	1946.0	1938.0	1949.6	1954.4	-8.0	3.7	8.4	-0.4	0.2	0.4	8.0	3.7	8.4
	62	1910.5	1904.1	1910.2	1930.5	-6.4	-0.3	20.0	-0.3	0.0	1.1	6.4	0.3	20.0
	76	1883.5	1877.2	1882.6	1898.9	-6.3	-0.9	15.4	-0.3	-0.1	0.8	6.3	0.9	15.4
	21	1817.2	1815.9	1820.9	1826.4	-1.3	3.7	9.2	-0.1	0.2	0.5	1.3	3.7	9.2
	44	1785.7	1772.4	1763.3	1761.3	-13.3	-22.4	-24.4	-0.7	-1.3	-1.4	13.3	22.4	24.4
	07	1733.3	1738.0	1730.7	1739.2	4.7	-2.6	5.9	0.3	-0.2	0.3	4.7	2.6	5.9
	20	1729.5	1722.3	1740.5	1739.0	-7.2	11.1	9.5	-0.4	0.6	0.6	7.2	11.1	9.5
	61	1556.5	1565.5	1549.8	1556.7	8.9	-6.7	0.2	0.6	-0.4	0.0	8.9	6.7	0.2
	28	1516.8	1532.9	1543.7	1521.2	16.0	26.9	4.4	1.1	1.8	0.3	16.0	26.9	4.4
	16	1490.1	1485.2	1495.7	1499.1	-4.9	5.7	9.0	-0.3	0.4	0.6	4.9	5.7	9.0
	08	1310.8	1310.0	1314.4	1316.4	-0.8	3.6	5.6	-0.1	0.3	0.4	0.8	3.6	5.6
	64	1285.1	1284.7	1283.3	1275.3	-0.4	-1.8	-9.8	0.0	-0.1	-0.8	0.4	1.8	9.8
	74	1279.8	1281.3	1288.5	1281.1	1.5	8.7	1.3	0.1	0.7	0.1	1.5	8.7	1.3
	34	1133.7	1126.3	1138.0	1137.6	-7.4	4.3	3.9	-0.7	0.4	0.3	7.4	4.3	3.9
	18	1116.7	1112.0	1116.6	1119.4	-4.7	-0.2	2.7	-0.4	0.0	0.2	4.7	0.2	2.7
	32	1099.7	1095.3	1101.6	1098.0	-4.4	1.9	-1.8	-0.4	0.2	-0.2	4.4	1.9	1.8
	88	1028.1	1028.2	1023.7	1020.4	0.2	-4.3	-7.6	0.0	-0.4	-0.7	0.2	4.3	7.6
	15	1023.9	1021.7	1035.3	1034.8	-2.3	11.4	10.9	-0.2	1.1	1.1	2.3	11.4	10.9
	23	885.0	887.0	896.7	881.1	2.0	11.7	-3.8	0.2	1.3	-0.4	2.0	11.7	3.8
	70	880.6	872.3	883.6	874.3	-8.3	3.0	-6.3	-0.9	0.3	-0.7	8.3	3.0	6.3
	24	817.5	817.1	817.8	818.4	-0.4	0.4	0.9	-0.1	0.0	0.1	0.4	0.4	0.9
	06	778.8	762.6	758.1	743.7	-16.2	-20.7	-35.0	-2.1	-2.7	-4.5	16.2	20.7	35.0
	95	770.4	771.4	762.9	756.4	1.0	-7.6	-14.0	0.1	-1.0	-1.8	1.0	7.6	14.0
	83	763.4	748.3	749.3	752.0	-15.1	-14.1	-11.4	-2.0	-1.9	-1.5	15.1	14.1	11.4
	17	638.2	637.0	636.1	641.5	-1.2	-2.0	3.3	-0.2	-0.3	0.5	1.2	2.0	3.3
	42	630.0	633.1	629.4	630.1	3.1	-0.6	0.1	0.5	-0.1	0.0	3.1	0.6	0.1
	31	623.9	619.8	622.2	628.4	-4.1	-1.7	4.5	-0.7	-0.3	0.7	4.1	1.7	4.5
	49	587.6	596.7	580.1	584.7	9.1	-7.5	-2.9	1.6	-1.3	-0.5	9.1	7.5	2.9
	69	545.0	543.8	541.2	536.6	-1.1	-3.8	-8.3	-0.2	-0.7	-1.5	1.1	3.8	8.3
	68	520.9	525.1	513.4	516.5	4.2	-7.5	-4.4	0.8	-1.4	-0.8	4.2	7.5	4.4

Year / HS2 Code		Actual (£m)	Estimate (£m)			Difference (£m)			Percentage Difference			Absolute Difference (£m)		
			21% 4-digit	25% 4-digit	B8-14 4-digit	21% 4-digit	25% 4-digit	B8-14 4-digit	21% 4-digit	25% 4-digit	B8-14 4-digit	21% 4-digit	25% 4-digit	B8-14 4-digit
	57	496.0	490.5	492.5	497.2	-5.5	-3.5	1.2	-1.1	-0.7	0.2	5.5	3.5	1.2
	82	446.5	441.4	438.0	435.7	-5.1	-8.5	-10.8	-1.2	-1.9	-2.4	5.1	8.5	10.8
	03	439.8	436.8	439.0	441.0	-3.0	-0.8	1.2	-0.7	-0.2	0.3	3.0	0.8	1.2
	10	406.0	408.2	408.4	415.6	2.2	2.4	9.6	0.5	0.6	2.4	2.2	2.4	9.6
	26	395.7	426.4	396.4	400.2	30.7	0.7	4.5	7.8	0.2	1.1	30.7	0.7	4.5
	35	395.5	395.8	393.3	395.5	0.3	-2.2	-0.1	0.1	-0.6	0.0	0.3	2.2	0.1
	89	393.4	399.9	394.8	396.7	6.6	1.4	3.3	1.7	0.4	0.8	6.6	1.4	3.3
	56	373.2	376.6	367.6	364.3	3.3	-5.6	-8.9	0.9	-1.5	-2.4	3.3	5.6	8.9
	01	326.5	328.5	331.4	326.5	2.0	4.9	0.0	0.6	1.5	0.0	2.0	4.9	0.0
	25	318.7	317.5	313.8	314.2	-1.2	-5.0	-4.5	-0.4	-1.6	-1.4	1.2	5.0	4.5
	37	287.2	283.2	281.2	284.1	-4.0	-6.0	-3.1	-1.4	-2.1	-1.1	4.0	6.0	3.1
	96	270.5	264.4	265.7	264.7	-6.1	-4.8	-5.8	-2.3	-1.8	-2.2	6.1	4.8	5.8
	93	269.8	272.7	275.4	269.2	2.9	5.6	-0.6	1.1	2.1	-0.2	2.9	5.6	0.6
	12	264.7	256.4	265.1	265.6	-8.3	0.4	0.9	-3.1	0.2	0.3	8.3	0.4	0.9
	47	259.9	262.5	262.9	259.0	2.5	3.0	-0.9	1.0	1.2	-0.4	2.5	3.0	0.9
	09	259.0	259.6	259.7	261.8	0.5	0.7	2.7	0.2	0.3	1.1	0.5	0.7	2.7
	11	253.7	256.6	254.9	254.1	2.9	1.2	0.4	1.2	0.5	0.2	2.9	1.2	0.4
	86	236.8	239.1	236.0	245.1	2.3	-0.8	8.3	1.0	-0.3	3.5	2.3	0.8	8.3
	54	235.8	236.8	234.0	229.9	1.0	-1.8	-5.9	0.4	-0.8	-2.5	1.0	1.8	5.9
	75	233.9	235.8	230.7	236.3	1.9	-3.2	2.5	0.8	-1.4	1.1	1.9	3.2	2.5
	81	220.4	220.4	220.7	225.4	0.0	0.3	5.0	0.0	0.1	2.3	0.0	0.3	5.0
	63	216.4	216.6	213.3	212.1	0.3	-3.0	-4.3	0.1	-1.4	-2.0	0.3	3.0	4.3
	55	185.0	180.2	192.3	187.9	-4.8	7.3	2.9	-2.6	4.0	1.6	4.8	7.3	2.9
	91	177.3	182.5	175.8	176.2	5.2	-1.5	-1.1	3.0	-0.8	-0.6	5.2	1.5	1.1
	59	156.9	149.8	149.5	149.3	-7.1	-7.4	-7.6	-4.5	-4.7	-4.8	7.1	7.4	7.6
	52	129.1	136.3	128.8	127.7	7.2	-0.2	-1.4	5.6	-0.2	-1.1	7.2	0.2	1.4
	51	118.4	124.6	121.6	116.8	6.2	3.2	-1.7	5.3	2.7	-1.4	6.2	3.2	1.7
	41	112.3	111.9	110.0	110.2	-0.5	-2.4	-2.2	-0.4	-2.1	-2.0	0.5	2.4	2.2
	58	101.0	98.3	99.9	97.2	-2.6	-1.1	-3.7	-2.6	-1.1	-3.7	2.6	1.1	3.7
	99	89.3	82.2	88.0	82.6	-7.1	-1.4	-6.7	-7.9	-1.5	-7.6	7.1	1.4	6.7
	65	64.6	63.5	64.5	67.4	-1.1	-0.1	2.8	-1.7	-0.1	4.4	1.1	0.1	2.8
	60	55.7	58.0	56.2	54.7	2.2	0.5	-1.0	4.0	0.9	-1.8	2.2	0.5	1.0
	05	55.7	64.1	54.7	54.4	8.5	-0.9	-1.3	15.2	-1.7	-2.4	8.5	0.9	1.3
	79	55.6	54.5	55.3	56.0	-1.1	-0.2	0.5	-1.9	-0.4	0.8	1.1	0.2	0.5
	92	54.6	53.1	55.6	52.7	-1.4	1.0	-1.9	-2.6	1.8	-3.5	1.4	1.0	1.9
	78	51.5	50.3	50.4	49.7	-1.2	-1.1	-1.9	-2.3	-2.2	-3.7	1.2	1.1	1.9
	36	45.4	46.0	44.5	45.6	0.6	-0.9	0.2	1.3	-2.0	0.4	0.6	0.9	0.2
	13	41.8	44.1	41.2	40.5	2.2	-0.6	-1.4	5.3	-1.5	-3.3	2.2	0.6	1.4
	97	38.8	36.4	49.8	36.1	-2.4	11.0	-2.7	-6.1	28.3	-7.0	2.4	11.0	2.7
	80	26.3	43.2	31.3	29.5	16.9	5.0	3.2	64.1	19.0	12.1	16.9	5.0	3.2
	43	23.3	22.2	24.9	23.5	-1.1	1.6	0.2	-4.6	6.7	0.7	1.1	1.6	0.2
	53	17.6	19.1	17.7	16.6	1.5	0.0	-1.0	8.3	0.2	-5.8	1.5	0.0	1.0
	45	17.1	18.9	18.5	17.8	1.8	1.4	0.7	10.4	8.2	4.2	1.8	1.4	0.7
	50	11.5	10.3	11.8	12.0	-1.2	0.3	0.5	-10.2	2.9	4.0	1.2	0.3	0.5
	66	9.2	9.4	9.7	9.3	0.2	0.5	0.1	1.8	5.0	0.8	0.2	0.5	0.1
	98	8.9	8.7	8.7	8.7	-0.3	-0.3	-0.3	-3.0	-3.0	-3.0	0.3	0.3	0.3
	67	5.8	6.2	6.0	5.4	0.4	0.1	-0.5	6.9	2.3	-8.3	0.4	0.1	0.5
	46	4.2	4.2	4.3	4.3	0.0	0.0	0.0	-1.0	0.5	1.0	0.0	0.0	0.0
	14	3.4	3.6	3.2	3.3	0.2	-0.2	-0.1	6.5	-6.3	-1.8	0.2	0.2	0.1

Year / HS2 Code		Actual (£m)	Estimate (£m)			Difference (£m)			Percentage Difference			Absolute Difference (£m)		
			21% 4-digit	25% 4-digit	B8-14 4-digit	21% 4-digit	25% 4-digit	B8-14 4-digit	21% 4-digit	25% 4-digit	B8-14 4-digit	21% 4-digit	25% 4-digit	B8-14 4-digit
2012	87	31237.3	31238.1	31229.2	31224.1	0.7	-8.2	-13.2	0.0	0.0	0.0	0.7	8.2	13.2
	84	22899.3	22976.0	22861.1	22874.5	76.7	-38.2	-24.8	0.3	-0.2	-0.1	76.7	38.2	24.8
	85	17601.6	17566.8	17615.7	17603.5	-34.8	14.1	1.9	-0.2	0.1	0.0	34.8	14.1	1.9
	27	14413.1	14407.2	14408.5	14424.1	-5.9	-4.7	11.0	0.0	0.0	0.1	5.9	4.7	11.0
	30	11264.9	11266.0	11280.9	11308.3	1.1	16.0	43.4	0.0	0.1	0.4	1.1	16.0	43.4
	39	7315.7	7240.2	7270.0	7263.9	-75.5	-45.7	-51.8	-1.0	-0.6	-0.7	75.5	45.7	51.8
	29	6685.2	6690.5	6700.8	6705.7	5.3	15.6	20.5	0.1	0.2	0.3	5.3	15.6	20.5
	71	6012.2	6020.1	6040.8	6016.8	7.8	28.6	4.6	0.1	0.5	0.1	7.8	28.6	4.6
	90	5111.9	5127.5	5106.1	5113.3	15.6	-5.8	1.4	0.3	-0.1	0.0	15.6	5.8	1.4
	48	4084.1	4090.3	4089.9	4088.3	6.2	5.8	4.1	0.2	0.1	0.1	6.2	5.8	4.1
	22	4055.0	4064.8	4057.4	4064.9	9.7	2.3	9.9	0.2	0.1	0.2	9.7	2.3	9.9
	72	3504.3	3487.8	3504.4	3515.3	-16.5	0.0	10.9	-0.5	0.0	0.3	16.5	0.0	10.9
	02	2992.5	3012.3	2993.5	2994.2	19.8	1.0	1.7	0.7	0.0	0.1	19.8	1.0	1.7
	73	2768.2	2764.3	2773.8	2767.0	-3.9	5.7	-1.2	-0.1	0.2	0.0	3.9	5.7	1.2
	38	2582.0	2577.1	2583.8	2576.9	-4.9	1.8	-5.1	-0.2	0.1	-0.2	4.9	1.8	5.1
	33	2544.9	2545.6	2551.5	2556.7	0.8	6.6	11.8	0.0	0.3	0.5	0.8	6.6	11.8
	04	2378.4	2388.8	2396.1	2401.5	10.4	17.6	23.1	0.4	0.7	1.0	10.4	17.6	23.1
	94	2366.0	2363.3	2351.7	2330.4	-2.8	-14.3	-35.6	-0.1	-0.6	-1.5	2.8	14.3	35.6
	88	2185.5	2202.1	2214.4	2187.6	16.5	28.9	2.0	0.8	1.3	0.1	16.5	28.9	2.0
	19	2141.9	2145.3	2153.1	2158.6	3.4	11.2	16.7	0.2	0.5	0.8	3.4	11.2	16.7
	40	2015.5	2000.2	2011.0	2006.2	-15.3	-4.5	-9.3	-0.8	-0.2	-0.5	15.3	4.5	9.3
	62	1912.0	1906.6	1906.0	1932.3	-5.4	-6.0	20.3	-0.3	-0.3	1.1	5.4	6.0	20.3
	76	1860.4	1847.4	1851.9	1862.0	-12.9	-8.5	1.6	-0.7	-0.5	0.1	12.9	8.5	1.6
	21	1843.5	1847.6	1853.8	1851.8	4.0	10.3	8.3	0.2	0.6	0.5	4.0	10.3	8.3
	07	1782.9	1794.2	1792.6	1800.6	11.3	9.8	17.7	0.6	0.6	1.0	11.3	9.8	17.7
	20	1765.8	1764.3	1775.5	1778.0	-1.4	9.8	12.2	-0.1	0.6	0.7	1.4	9.8	12.2
	44	1719.9	1716.1	1701.4	1707.1	-3.9	-18.5	-12.9	-0.2	-1.1	-0.8	3.9	18.5	12.9
	16	1664.5	1662.7	1669.8	1673.5	-1.8	5.3	9.0	-0.1	0.3	0.5	1.8	5.3	9.0
	61	1548.6	1560.9	1544.7	1556.9	12.3	-3.9	8.3	0.8	-0.3	0.5	12.3	3.9	8.3
	64	1386.8	1372.3	1385.1	1382.0	-14.4	-1.7	-4.8	-1.0	-0.1	-0.4	14.4	1.7	4.8
	08	1356.0	1367.4	1356.4	1364.5	11.5	0.4	8.5	0.9	0.0	0.6	11.5	0.4	8.5
	28	1290.4	1291.7	1289.6	1286.8	1.3	-0.8	-3.6	0.1	-0.1	-0.3	1.3	0.8	3.6
	32	1166.4	1155.5	1170.3	1171.8	-10.9	3.9	5.4	-0.9	0.3	0.5	10.9	3.9	5.4
	18	1138.7	1138.5	1138.0	1138.1	-0.2	-0.7	-0.6	0.0	-0.1	-0.1	0.2	0.7	0.6
	34	1131.7	1135.5	1132.2	1137.0	3.8	0.5	5.3	0.3	0.1	0.5	3.8	0.5	5.3
	74	1056.2	1057.9	1053.0	1045.3	1.7	-3.2	-10.9	0.2	-0.3	-1.0	1.7	3.2	10.9
	15	968.6	967.5	972.7	971.0	-1.2	4.1	2.4	-0.1	0.4	0.3	1.2	4.1	2.4
	23	945.8	956.0	954.8	946.9	10.2	9.0	1.0	1.1	1.0	0.1	10.2	9.0	1.0
	70	872.5	862.0	865.6	861.6	-10.4	-6.9	-10.9	-1.2	-0.8	-1.2	10.4	6.9	10.9
	06	787.6	785.4	766.8	757.3	-2.2	-20.9	-30.3	-0.3	-2.7	-3.9	2.2	20.9	30.3
	83	735.6	736.9	727.3	723.3	1.2	-8.4	-12.4	0.2	-1.1	-1.7	1.2	8.4	12.4
	17	711.8	715.5	714.8	714.4	3.7	3.0	2.6	0.5	0.4	0.4	3.7	3.0	2.6
	96	708.5	705.7	707.9	701.0	-2.8	-0.6	-7.5	-0.4	-0.1	-1.1	2.8	0.6	7.5
	42	692.0	691.9	687.4	692.0	-0.2	-4.7	-0.1	0.0	-0.7	0.0	0.2	4.7	0.1
	95	674.1	662.0	673.7	664.8	-12.1	-0.3	-9.3	-1.8	-0.1	-1.4	12.1	0.3	9.3
	10	654.0	655.4	655.1	660.8	1.3	1.0	6.8	0.2	0.2	1.0	1.3	1.0	6.8
	24	649.0	648.4	649.6	650.2	-0.7	0.6	1.1	-0.1	0.1	0.2	0.7	0.6	1.1
	31	571.4	570.7	572.5	572.4	-0.7	1.2	1.0	-0.1	0.2	0.2	0.7	1.2	1.0
	49	570.5	595.0	577.4	580.4	24.5	6.9	9.9	4.3	1.2	1.7	24.5	6.9	9.9

Year / HS2 Code		Actual (£m)	Estimate (£m)			Difference (£m)			Percentage Difference			Absolute Difference (£m)		
			21% 4-digit	25% 4-digit	B8-14 4-digit	21% 4-digit	25% 4-digit	B8-14 4-digit	21% 4-digit	25% 4-digit	B8-14 4-digit	21% 4-digit	25% 4-digit	B8-14 4-digit
	68	510.2	500.4	501.1	505.1	-9.7	-9.0	-5.0	-1.9	-1.8	-1.0	9.7	9.0	5.0
	57	504.3	504.0	510.4	508.0	-0.4	6.0	3.7	-0.1	1.2	0.7	0.4	6.0	3.7
	26	499.4	498.1	512.6	498.9	-1.2	13.2	-0.5	-0.3	2.6	-0.1	1.2	13.2	0.5
	82	469.0	453.9	464.6	459.1	-15.1	-4.4	-10.0	-3.2	-1.0	-2.1	15.1	4.4	10.0
	03	449.6	442.4	451.8	456.0	-7.2	2.2	6.4	-1.6	0.5	1.4	7.2	2.2	6.4
	69	417.3	418.1	412.0	409.9	0.8	-5.3	-7.4	0.2	-1.3	-1.8	0.8	5.3	7.4
	35	381.4	379.2	379.0	381.3	-2.2	-2.3	-0.1	-0.6	-0.6	0.0	2.2	2.3	0.1
	86	355.5	353.9	353.0	355.7	-1.6	-2.4	0.2	-0.5	-0.7	0.1	1.6	2.4	0.2
	93	315.6	321.4	317.3	311.6	5.8	1.7	-4.0	1.8	0.5	-1.3	5.8	1.7	4.0
	56	313.5	307.5	306.8	303.8	-6.0	-6.8	-9.7	-1.9	-2.2	-3.1	6.0	6.8	9.7
	01	310.7	315.7	311.3	311.8	5.0	0.6	1.1	1.6	0.2	0.4	5.0	0.6	1.1
	25	306.0	300.6	304.0	298.4	-5.4	-2.0	-7.6	-1.8	-0.6	-2.5	5.4	2.0	7.6
	12	272.8	270.0	276.6	273.8	-2.8	3.8	0.9	-1.0	1.4	0.3	2.8	3.8	0.9
	11	246.2	246.7	249.3	248.6	0.4	3.1	2.4	0.2	1.2	1.0	0.4	3.1	2.4
	09	246.1	248.0	245.6	247.2	1.9	-0.5	1.1	0.8	-0.2	0.4	1.9	0.5	1.1
	37	244.9	240.9	243.6	241.1	-4.1	-1.3	-3.9	-1.7	-0.5	-1.6	4.1	1.3	3.9
	54	231.5	221.5	223.9	224.3	-10.1	-7.6	-7.2	-4.4	-3.3	-3.1	10.1	7.6	7.2
	91	230.1	234.3	232.1	229.7	4.2	2.0	-0.4	1.8	0.9	-0.2	4.2	2.0	0.4
	63	226.7	227.8	225.2	225.7	1.1	-1.4	-1.0	0.5	-0.6	-0.4	1.1	1.4	1.0
	75	221.6	231.5	222.8	226.6	9.9	1.3	5.0	4.5	0.6	2.3	9.9	1.3	5.0
	81	204.4	205.7	206.0	206.6	1.3	1.6	2.2	0.6	0.8	1.1	1.3	1.6	2.2
	47	191.4	189.0	193.0	191.9	-2.3	1.7	0.5	-1.2	0.9	0.3	2.3	1.7	0.5
	55	165.8	169.1	168.4	163.1	3.3	2.6	-2.7	2.0	1.6	-1.7	3.3	2.6	2.7
	89	156.7	173.1	160.1	178.1	16.4	3.4	21.3	10.5	2.2	13.6	16.4	3.4	21.3
	59	149.5	146.4	143.8	143.3	-3.1	-5.7	-6.2	-2.1	-3.8	-4.2	3.1	5.7	6.2
	41	116.0	116.7	113.1	111.0	0.8	-2.8	-5.0	0.7	-2.4	-4.3	0.8	2.8	5.0
	51	108.0	112.3	106.1	105.5	4.3	-1.9	-2.5	4.0	-1.8	-2.3	4.3	1.9	2.5
	99	104.4	113.9	109.2	104.1	9.5	4.8	-0.3	9.1	4.6	-0.3	9.5	4.8	0.3
	58	97.5	93.7	95.6	92.2	-3.7	-1.9	-5.3	-3.8	-1.9	-5.4	3.7	1.9	5.3
	52	91.4	85.3	90.6	89.9	-6.1	-0.8	-1.5	-6.6	-0.9	-1.7	6.1	0.8	1.5
	92	73.1	72.2	73.4	69.6	-0.9	0.2	-3.5	-1.2	0.3	-4.8	0.9	0.2	3.5
	65	65.8	62.9	64.9	65.6	-3.0	-1.0	-0.2	-4.5	-1.5	-0.3	3.0	1.0	0.2
	05	57.5	58.9	57.7	55.9	1.4	0.2	-1.6	2.4	0.3	-2.8	1.4	0.2	1.6
	13	51.7	52.1	52.3	51.8	0.4	0.5	0.1	0.8	1.0	0.1	0.4	0.5	0.1
	60	51.1	53.2	51.6	50.1	2.1	0.5	-1.0	4.1	1.0	-2.0	2.1	0.5	1.0
	36	49.3	49.3	49.4	49.2	0.0	0.2	-0.1	0.1	0.4	-0.1	0.0	0.2	0.1
	79	49.1	46.5	47.5	47.8	-2.6	-1.7	-1.3	-5.3	-3.4	-2.7	2.6	1.7	1.3
	97	46.9	48.6	46.0	49.9	1.7	-0.9	2.9	3.6	-2.0	6.2	1.7	0.9	2.9
	78	36.2	33.6	34.0	34.9	-2.6	-2.3	-1.3	-7.3	-6.3	-3.6	2.6	2.3	1.3
	80	29.2	28.4	30.3	29.9	-0.8	1.1	0.7	-2.8	3.6	2.2	0.8	1.1	0.7
	43	29.1	27.9	28.4	29.8	-1.2	-0.7	0.8	-4.2	-2.4	2.6	1.2	0.7	0.8
	45	18.0	18.7	17.7	17.9	0.7	-0.3	-0.1	4.1	-1.8	-0.7	0.7	0.3	0.1
	53	17.5	18.0	16.2	16.0	0.5	-1.3	-1.5	2.6	-7.5	-8.4	0.5	1.3	1.5
	50	13.0	13.4	13.3	13.4	0.4	0.3	0.5	3.3	2.6	3.7	0.4	0.3	0.5
	67	12.6	13.3	12.0	13.9	0.7	-0.6	1.3	5.7	-4.4	10.5	0.7	0.6	1.3
	98	10.2	9.9	9.9	10.2	-0.3	-0.3	-0.1	-3.4	-3.4	-0.5	0.3	0.3	0.1
	66	5.9	5.8	6.1	5.9	-0.1	0.2	-0.1	-1.6	3.3	-1.3	0.1	0.2	0.1
	46	3.6	3.7	3.6	3.5	0.1	0.0	-0.1	2.8	0.5	-2.0	0.1	0.0	0.1
	14	2.4	2.4	2.2	2.2	0.0	-0.2	-0.2	0.3	-6.3	-7.4	0.0	0.2	0.2

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