

## Creating a SSHTPI

Revised: 5-Apr-2016

### Context

The index is intended to be a measure of the price of publicly funded social housing in Scotland (mainland and islands). To be updated quarterly. Held provisional for two quarters before becoming firm.

A set of location factors are to be published at the same time.

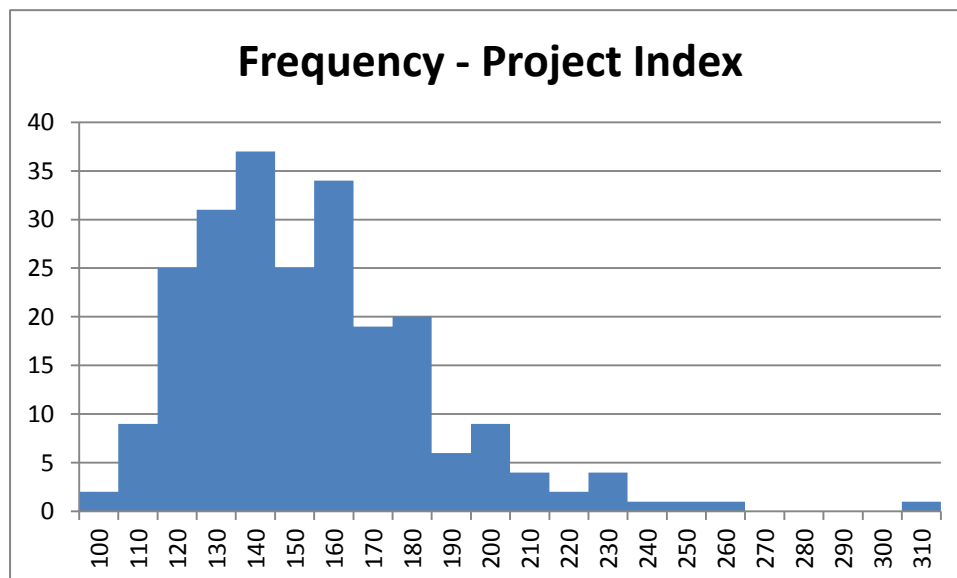
An adjustment for contract size will be published but only revised occasionally.

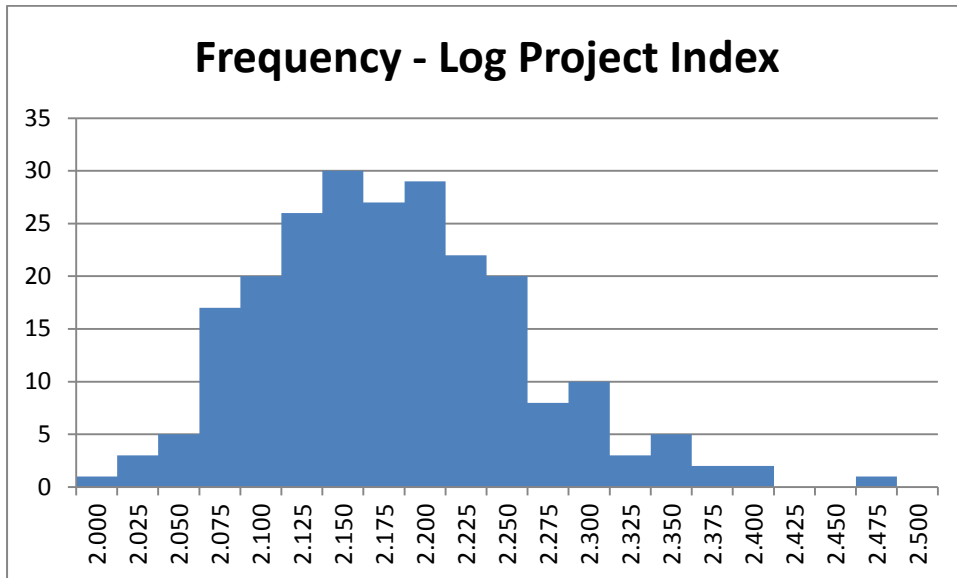
### Aggregating Project Indices

#### Averaging

Looking at the individual project indices it is clear that they are from a skewed distribution that is very variable and has some outliers.

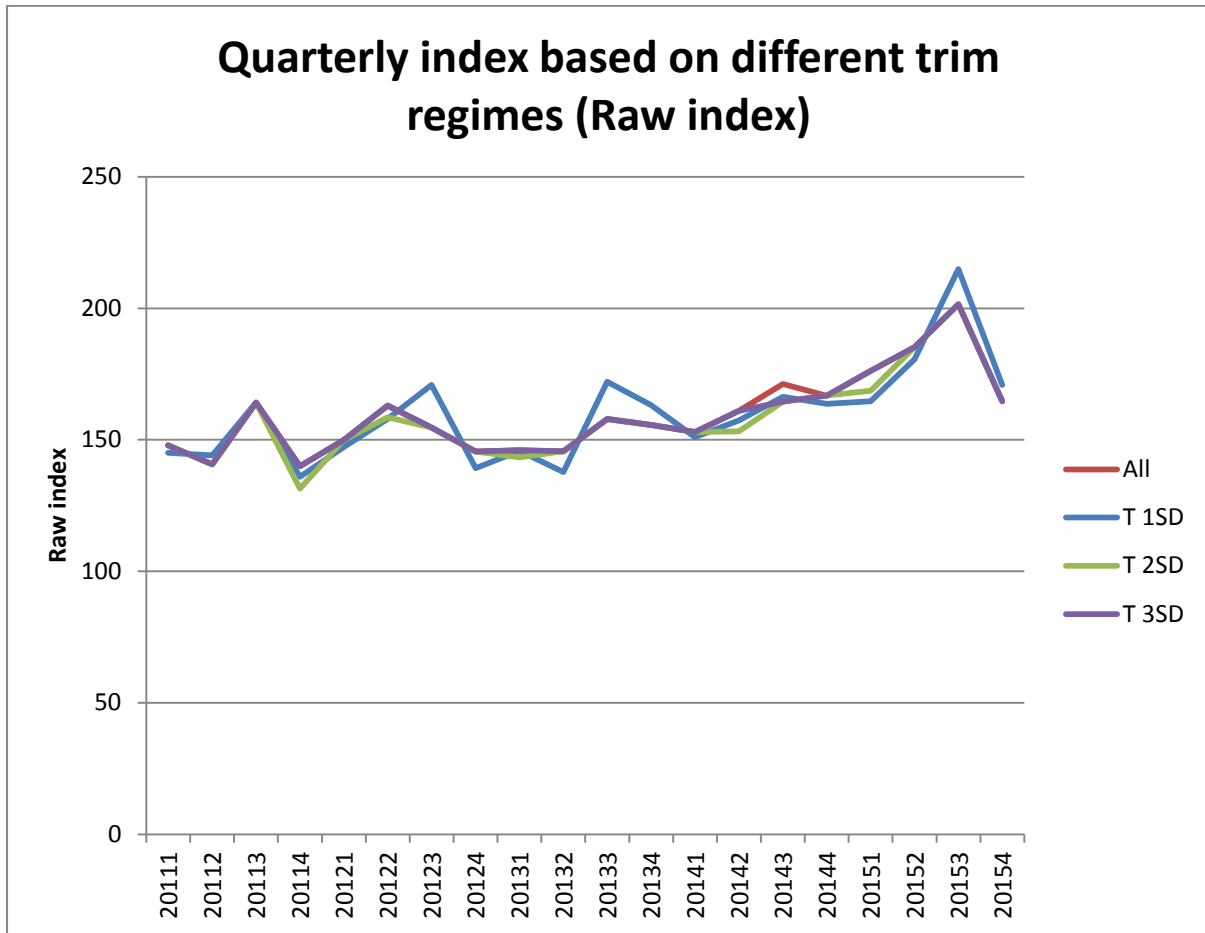
Applying a log transformation to the project indices still results in a slightly skewed distribution but it is reasonably close to symmetric. A log transformation is therefore applied (which is equivalent to using the geometric mean).

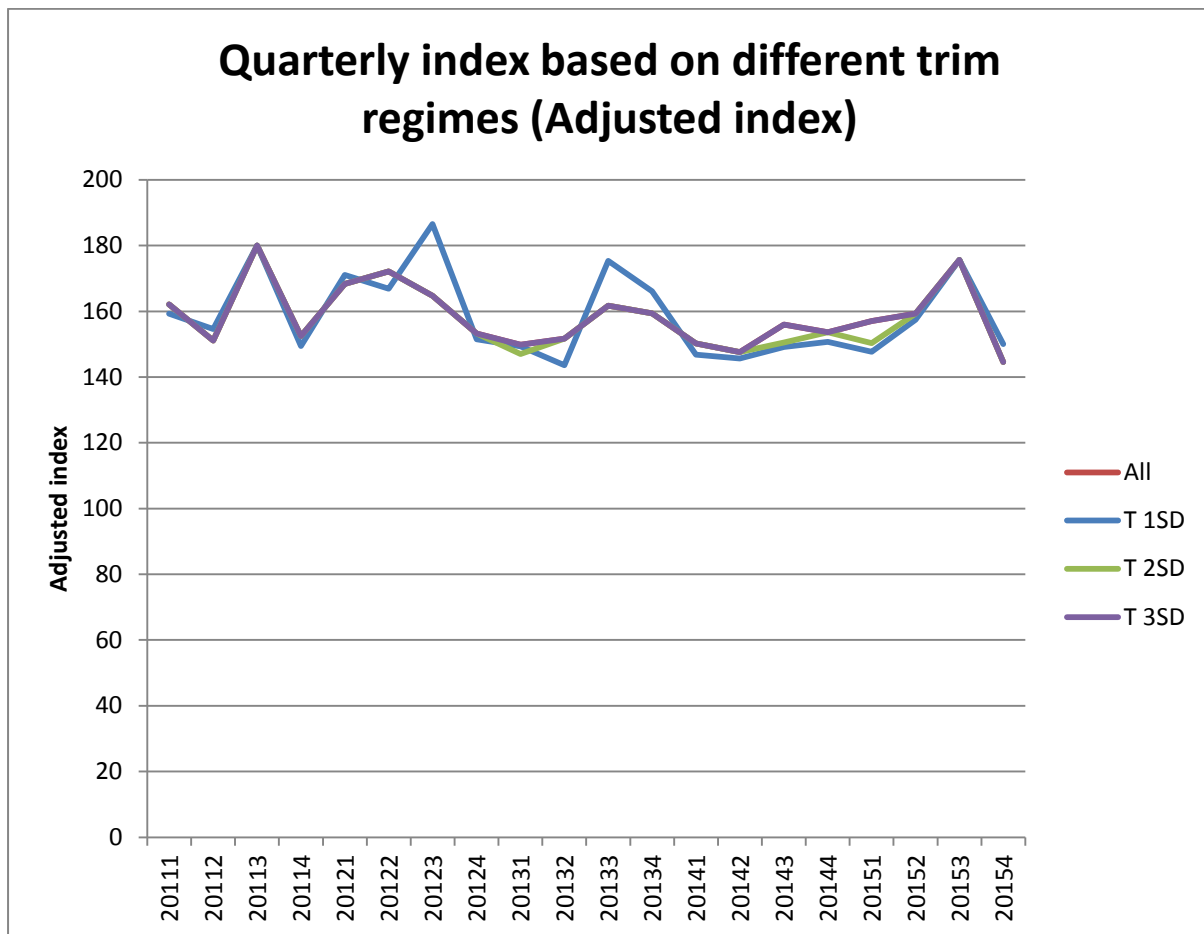




### Censoring outliers

There are a few outliers and the stability of the index when the sample is small could be improved by removing those. The suggested approach is to calculate the mean of the  $\log_{10}$  of all projects in a quarter and exclude any which are more than 0.16 from the mean. 0.16 has been calculated as being approximately two standard deviations. This figure was obtained empirically as a compromise between tight limits which result in a smaller sample size (blue line) and wide limits which have little impact (purple line).





The limits will be applied to the adjusted index (see below). Since the adjustments will not be known until after the calculation is complete, the adjustments used will be from the previous quarter's adjustments. If an adjustment is not available for any reason then the unadjusted index will be used.

The main drawback of trimming the sample in this project is that the high extreme values are likely to be island projects where access was very expensive. While these projects will distort the trend, omitting them will tend to underestimate the potential premium for island schemes. Users of the data should be made aware of this.

### Smoothing

There are several different smoothing techniques but in order to maintain the transparency of the calculation method a simple three quarter moving average weighted (1-2-1) is applied. Where the most recent quarter is being calculated the following quarter needed for the smoothing will be based on an unpublished forecast. This approach does not take any account of sample size which means there is a risk that an adjacent quarter with a very low sample size could unduly influence the index.

### Removing variation due to mix

Some adjustment of the raw indices will be made in order to remove some of the explainable project variation.

#### Contract value

There is a definite but weak Contract value effect (larger contracts attract a keener price). The exact value of the adjustment is uncertain because the relationship is not particularly strong and the sample size is relatively small. It would not be appropriate to estimate a factor over a reduced period given current information. An adjustment for contract value will be made based on the following fixed formula:

$$\text{Log}_e(\text{Contract sum adjustment}) = 0.2376 - 0.04063 \times \text{Log}_{10}(\text{Contract sum at 1985 prices})$$

This can more easily be expressed as follows:

- Calculate Contract Sum at 1985 prices
- Raise this figure to the power -0.01764
- Multiply by 1.268

When deflating the Contract sum to 1985 prices the BCIS All-in TPI is used.

These factors are based on the projects indexed under the current contract.

#### Location

Because of the requirements to firm index figures after two provisional quarters and publish the location factors used to adjust the project indices, a methodology similar to the one adopted by the PUBSEC index was adopted. This calculates location factors for each quarter based on a rolling sample.

There is a requirement for location factors to be produced for all the Scottish Government location codes where the sample supports this. To avoid disclosing potentially commercially sensitive project information any location where the sample is less than 4 will not be reported.

Even where the sample size reaches 4 the answer will not be reliable due to the inherent variability in project indices. It is proposed that adjustments be applied at level 2 of the location code hierarchy only.

#### Calculation process

For clarity the current quarter will be referred to as Q0. In this quarter updated indices will be reported for:

- The previous quarter (Q-1) - the first provisional index
- The quarter before that (Q-2) - a revised provisional index
- The quarter before that (Q-3) - the firm index

While project data from previous quarters will be needed to support these calculations, any results will not be reported even if additional projects were indexed. The number of quarters to include in the recalculation of any one quarter (referred to as  $w$  below) will be set to 15. This can be reviewed at intervals.

Because the location factors will be based on 15 quarters' data it will be necessary to process projects from Q-18 to Q-1 inclusive. If any projects have been indexed from Q0 these will be excluded on the assumption that there would be so few schemes that the uncertainty about the quarterly price level would dominate.

### **Apply censorship**

Adjust all project indices using the Contract sum adjustment and location factor at level 2 for the quarter as last reported (or for the last reported index for the previous quarter when the project is in Q-1). Exclude from all subsequent calculations the projects where the  $\log_{10}$  of the adjusted project index is more than 0.16 from the mean of all log project indices for the quarter.

### **Initial quarterly index**

Calculate a quarterly index as the geometric mean of project indices in a quarter adjusted for contract value and location factor at level 2 as last reported (or for the last reported index for the previous quarter when the project is in Q-1). Exclude quarters where sample is less than 4.

### **Location factors (all levels)**

Calculate a project factor by dividing the project index by the quarterly index for the appropriate quarter and by the contract value adjustment as calculated above.

For any quarter Q-x calculate the weighted geometric mean of project factors for each location using projects from quarters from Q-x to Q-(w+x). The objective being to give more weight to recent projects but allow older projects to be included in case the sample size is low. Weights are calculated as  $d^q$  where  $d$  is 0.6 and  $q$  is the period in quarters between the project quarter and Q-x. The value of 0.6 was chosen empirically to give significant emphasis to recent projects but without excluding older schemes (especially where sample size is small). This can be reviewed from time to time.

### **Reported quarterly index**

Calculate a quarterly index as the geometric mean of project indices in a quarter adjusted for contract value and location factor at level 2 for the quarter in question and smoothed as described above.