FACT SHEET

Guide to IPART's Uncertainty Index Model

February 2016

This Fact Sheet is a guide to IPART's uncertainty index model, which is now available on our website.[1] Stakeholders can use this guide to replicate IPART's uncertainty index which is used as a basis for determining an appropriate WACC in our various price reviews.

1 What is IPART's uncertainty index?

As part of the 2012 review of WACC methodology, Independent Pricing and Regulatory Tribunal of NSW (IPART) developed a WACC decision-making framework to improve the transparency and predictability of our WACC decisions. As part of this framework, we decided to construct a monthly uncertainty index, which measures the level of economic uncertainty, and use it as a basis for determining an appropriate WACC in our price reviews. Our WACC decision making rule is that:

- If the uncertainty index is within or at one standard deviation from the long-term average of 0, we will select the midpoint WACC.
- If the uncertainty index is more than one standard deviation from the long-term average of 0, we will consider moving away from the midpoint WACC.

Our methodology for constructing the uncertainty index closely follows the approach taken by the Bank of England in its study of macroeconomic uncertainty.[2] For more details on the analysis of IPART's uncertainty index and WACC decision making process, please refer to our WACC methodology paper.[3]

1 www.ipart.nsw.gov.au

2 Bank of England, *Macroeconomic uncertainty: what is it, how can we measure it and why does it matter?*, 2013, pp 100-109.

3 IPART, *Review of WACC methodology – Final Report*, December 2012.

2 How are the model and guide structured?

Constructing the uncertainty index is a two-stage process. In the first stage, we download data and create variables in Excel. We then export these variables to SPSS, a software package used for statistical analysis, to run a principal component analysis (PCA).

To follow this guide, please open the Excel spreadsheet, *IPART uncertainty index - Creating proxy variables - Public.xls,* and SPSS. Note that proprietary data from Thomson Reuters Datastream (Datastream) and Bloomberg has been removed and replaced with dummy data. Users will need to source the data.

The rest of this guide is structured as follows:

- Section 3 provides a list of input data and data sources, and explains how we manipulate the input data in Excel to create necessary variables for the uncertainty index.
- Section 4 describes steps to run a PCA in SPSS to obtain IPART's uncertainty index.

3 Creating proxy variables for economic uncertainty

IPART's uncertainty index is constructed using the following four variables which proxy for economic uncertainty in Australia:

- implied volatility
- dispersion in analysts' forecast
- credit spreads, and
- bills–overnight index swap (OIS) spread.

In this section, we describe how we create these proxy variables using the raw data listed below. Table 3.1 provides a full list of raw data and data sources.

Table 3.1 List of raw data and data sources

Proxy variable	Raw data	Data source	Series/Datatype
Implied volatility	S&P/ASX200 Volatility Index (post January 2008)	Datastream	AXVIVOL/PI
	S&P/ASX 200 Index Total Return (prior to January 2008)	Datastream	ASX200I/RI
Dispersion in Analysts' forecast	Weighted average standard deviation of EPS forecasts for calendarised FY1 fiscal period	Datastream	@:AUSP200/ AF1SDC

Proxy variable	Raw data	Data source	Series/Datatype
Credit spread	UBS Credit Yield	Datastream (prior to September 2015)	ACBALLM/RY
	AusBond Credit Index Yield	Bloomberg (post September 2015)	BATY0 Index/ YLD_YTM_MID
	UBS Treasury Yield	Datastream (prior to September 2015)	AGBALLM/RY
	AusBond Treasury Index Yield	Bloomberg (post September 2015)	BACR0 Index/ YLD_YTM_MID
Bills-OIS spread	90-day Bank Accepted Bills	Datastream	AUBAB90D
	Australian 3-month Overnight Indexed Swaps	Datastream	AUGBILL3

3.1 Volatility Index

The S&P/ASX 200 VIX is a volatility index that reflects the market's expected volatility in the S&P/ASX 200. The level of the volatility index implies the market's expectations of volatility in the S&P/ASX 200 over the next 30 days. The index value is similar to rate of return volatility with the volatility index reported as an annualised standard deviation percentage.[4]

The variable, *Volatility Index*, is created in the "*IVOL*" tab in the Excel spreadsheet on a monthly basis. We download daily S&P/ASX 200 VIX from Datastream. The S&P/ASX 200 VIX is available only from January 2008. Prior to this period, we use the Total Return Index (*TRI*) of the S&P/ASX 200 Index from Datastream and calculate the annualised standard deviation of daily returns over 90 days, where a daily return on day *t*, *r*, is calculated as:

$$r_t = \ln\left(\frac{TRI_t}{TRI_{t-1}}\right)$$

We then calculate the standard deviation of the returns over the last 90 days and annualise it by multiplying it by the square root of 252.[5]

To obtain a monthly implied volatility value, we average daily volatility index values in each month.

4 http://www.asx.com.au/products/sp-asx200-vix-index.htm accessed 10 February 2016.

5 The annualisation assumes 252 trading days.

3.2 Dispersion in Analysts' Forecast

The variable, *Dispersion in Analysts' Forecast*, is created in the "*DISP*" tab in the Excel spreadsheet. We download monthly dispersion in analysts' earnings forecasts for the companies in the S&P/ASX Index from Datastream. The dispersion in analysts' forecast is used as a proxy for the uncertainty about future earnings or the degree of consensus among analysts or market participants.

3.3 Credit Spread

The variable, *Credit Spread,* is created in the "*CS*" tab in the Excel spreadsheet on a monthly basis. Credit spreads refer to a difference in yields between different securities due to different credit quality. We calculate daily credit spreads as the difference between daily *Credit yield* and daily *Treasury yield*.

Previously, we used the daily UBS Australian all maturities credit yields and UBS Australian Treasury all maturities yield as *Credit yield* and *Treasury yield,* respectively, sourced from Datastream. However, since Thomson Reuters has ceased publishing these data series in September 2015, we have been using the AusBond Credit Index Yield and AusBond Treasury Index Yield. We note that data values from Datastream and Bloomberg are identical except that Bloomberg publishes weekend values.

To obtain a monthly credit spread, we average daily credit spreads in each month.

3.4 Bills-OIS Spread

The variable, *Bills-OIS Spread,* is created in "*BOS*" in the Excel spreadsheet. We download monthly 90-day bank accepted bills and 3-month overnight indexed swaps (OIS) from Datastream, and calculate the Bills-OIS spread as the difference between these two data series.

4 Running a Principal Component Analysis

The "Data for SPSS" tab in the Excel spreadsheet contains the monthly series of the four proxy variables. We export these variables to SPSS for a PCA.

A PCA is a way of identifying patterns in data and expressing the data in a way which highlights their similarities and differences.[6] Using this method, we can combine the four variables, which we identified as proxies for economic uncertainty, and extract a single variable, called a principal component, which explains most of the variation in the original set of the four proxy variables.

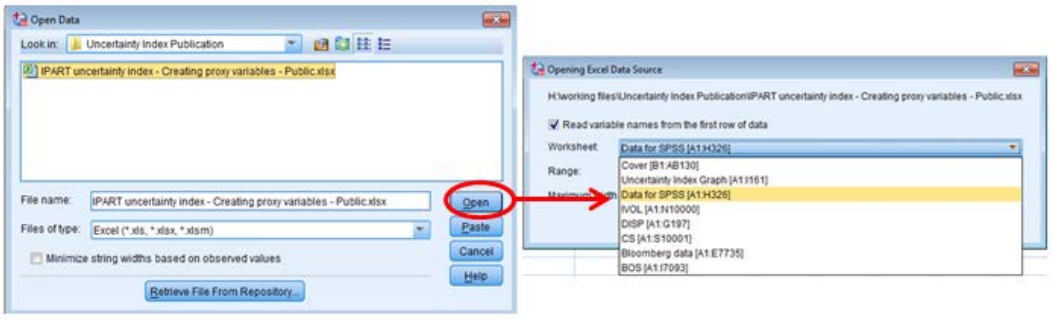
In this section, we explain steps to run a PCA in SPSS, focusing on:

- how to import the Excel data, which contains the four proxy variables, into SPSS (Section 4.1)
- how to extract a principal component (ie, the uncertainty index value) (Section 4.2), and
- how to obtain the principal component (Section 4.3).

4.1 Importing data

To import the excel data, from the SPSS menu select **File > Open > Data.** In the Open Data box, navigate directories to find the Excel spreadsheet, *IPART uncertainty index - Creating proxy variables - Public.xls*. Then select the Open button in the Open Data box, and select the worksheet "Data for SPSS" from the worksheet drop down list (Figure 4.1).

Figure 4.1 Importing the Excel data to SPSS



6 For more information on principal component analysis including derivation of principal components, see for example, Jolliffee, I.T., *Principal Component Analysis Second Edition*, Springer.

4.2 Extracting the uncertainty index

To extract the principal component (ie, the uncertainty index value), from the menu select **Analyse > Dimension Reduction > Factor**, and move the four proxy variables over to the Variables box (Figure 4.2). Then select the **Extraction** button in the Factor Analysis box and select **Principal components** from the Method drop down list in SPSS (Figure 4.3).

Figure 4.2 Selecting variables for a Principal Component Analysis

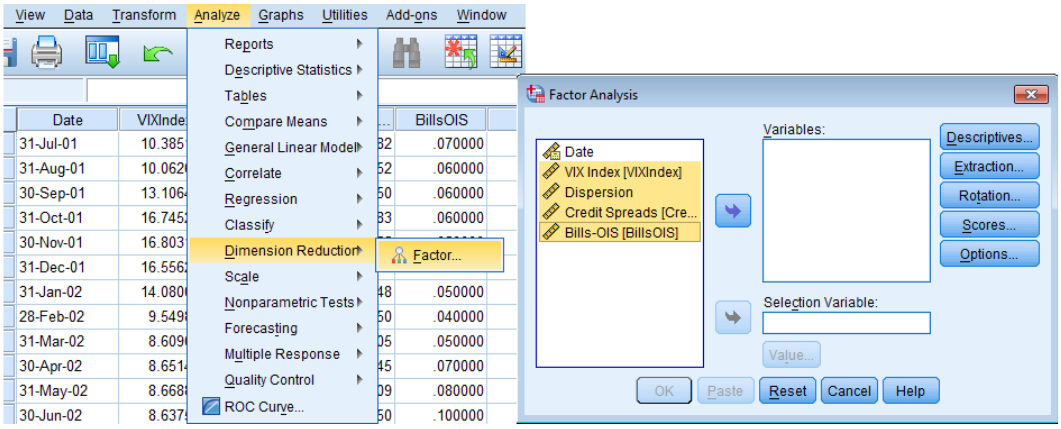
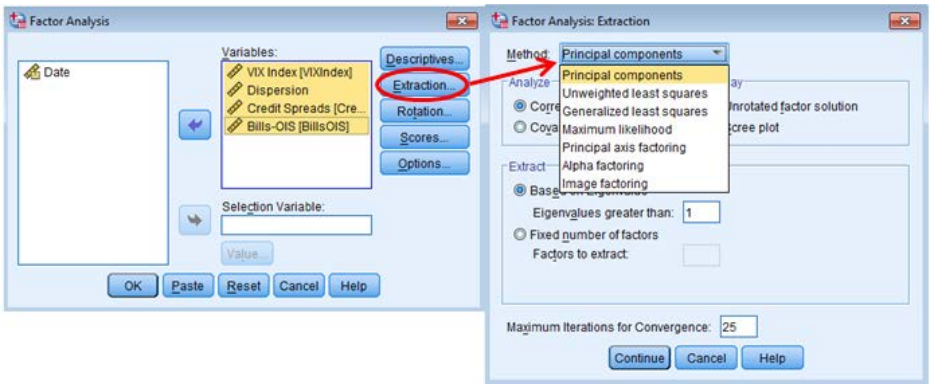


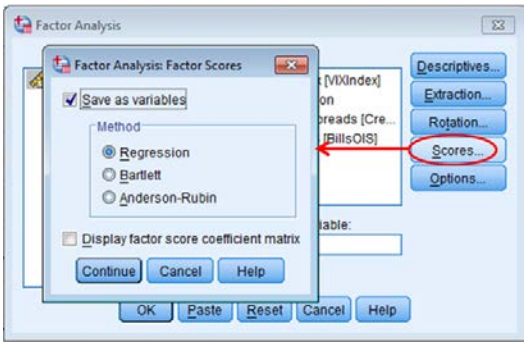
Figure 4.3 Extracting a principal component



4.3 Saving the uncertainty index values

To obtain the principal component scores (ie, the value of the uncertainty index), select the **Score** button in the Factor Analysis box as shown in Figure 4.4.

Figure 4.4 Saving the principal component score



The result is that one additional column (**FAC1_1** in Figure 4.5) is added to the dataset representing the factor score for the first principal component (ie, the value of the uncertainty index). The values are exported to the "Uncertainty index graph" tab in the Excel spreadsheet.

Figure 4.5 Dataset after saving the principal component score

	Date	VIXIndex	Dispersion	CreditSpre...	BillsOIS	FAC1_1
1	31-Jul-01	10.385160	18.249000	.298182	.070000	-1.01924
2	31-Aug-01	10.062624	23.230000	.306652	.060000	-.84450
3	30-Sep-01	13.106494	22.615000	.253850	.060000	-.77387
4	31-Oct-01	16.745220	22.571000	.195783	.060000	-.65978
5	30-Nov-01	16.803112	22.300000	.117955	.050000	-.70638
6	31-Dec-01	16.556279	19.307000	.103905	.060000	-.81964
7	31-Jan-02	14.080057	19.047000	.085348	.050000	-.94285