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IFRS 9: Developing Point-in-Time Probability of Default

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1. Introduction

This document outlines requirements of determining 12-month Probability of Default and then outlines modelling details for retail and non-retail Probability of Default using top-down approach.

The objective of this document is to:
- identify IFRS 9 Probability of Default (PD) modelling requirements
- identify data requirements
- develop approach for IFRS 9 Stage 1 PD model (12-month PDs)

This PD can then be used as input in the following model:

Stage 1 PDs are used in the following formula:

\[ ECL_{12} = \nu \times PD_{12}^F \times LGD_{12}^F \times EAD_{12} \]

Where,

\[ \nu = \text{discount factor at the effective interest rate of the portfolio} \]

\[ PD_{12}^F = \text{Forward looking 12-month PD} \]

\[ LGD_{12}^F = \text{Forward looking 12-month LGD} \]

\[ EAD_{12} = \text{12-month EAD in dollars} \]

Additional application includes using the PD for calibration of rating grades with PDs.

The scope of this document is limited to IFRS 9 Stage 1 PIT PD.

2. Background

IFRS 9 is a principles-based standard. It uses a single classification and measurement approach for all types of financial assets that reflects a reporting entity’s business model and the manner in which contractual cash flows are managed.

2.1. In scope portfolios

IFRS 9 applies one classification approach for all types of financial assets based on two criteria:

1. The business model for managing the financial assets
2. The contractual cash flow characteristics of the financial assets

A business model refers to the way an entity manages its financial assets in order to generate cash flows. A business model is a matter of fact rather than an assertion and is generally observable through activities that an entity undertakes to achieve its business
objectives. The standard envisages two distinct business models within which financial assets can be managed—held-to-collect and collecting-and-selling—and a third residual category. Under both the held-to-collect and collecting-and-selling models, contractual cash flows from the financial assets must be solely payments of principal and interest (SPPI).

Financial instruments that consist of SPPI-type cash flows are usually simple-debt financial assets, including money market instruments.

After considering the classification criteria and performing the SPPI tests, financial assets that are held-to-collect cash flows and whose contractual cash flows are SPPI will be classified and measured at amortized cost. On the other hand, financial assets that are held for collecting-and-selling when generating cash flows and where contractual cash flows are SPPI will be classified and measured at fair value through other comprehensive income (FVOCI).

All other financial assets that do not meet the business model or SPPI tests are classified and measured in the residual category, fair value through profit and loss (FVTPL). Derivatives and equity investments do not meet the SPPI test, and are classified and measured at FVTPL.

2.2. General steps to consider in applying IFRS 9 Impairment
The following diagram illustrates the general steps to consider when implementing IFRS 9 Impairment. Please note that this is not intended to be a definitive checklist of all the steps a reporting entity needs to undertake to comply with IFRS 9.
1. Establish the appropriate definition of default

2. Determine the level of assessment (individual vs. collective assessment)

3. Determine indicators/measures of significant increase in credit risk

4. Define the thresholds for significant increase in credit

5. Determine whether the “low credit risk assumption” will be applied to certain loans

6. Identify relevant forward-looking information and macro-economic factors

7. Identify appropriate sources of relevant forward-looking information and macro-economic factors

8. Incorporate forward-looking information and multiple scenarios in staging assessments of loans

9. Stage loans based on the forward-looking assessment of significant increase in credit risk

10. Determine the method to be used for measuring Expected Credit Loss
11. Determine the estimation period – the expected lifetime of the financial instrument

12. Establish the respective Probability of Default for loans in Stage 1 and Stage 2

13. Estimate the Exposure at Default

14. Identify relevant collateral and credit enhancements

15. Develop estimates of Loss Given Default (incorporating collateral and credit enhancements)

16. Incorporate forward-looking information and multiple scenarios in the measurement of Expected Credit Loss

17. Consider the time value of money and calculate the Expected Credit Loss

18. Identify modifications that occurred during the period and determine if each modification results in derecognition or no derecognition

19. Calculate the modification gain or loss and include the modified loan (or new loan) in Steps 9 to 17

20. Establish and document the appropriate processes, internal controls and governance for estimating Expected Credit Loss
3. **Key terms and concepts**

- **Definition of Default** – IFRS 9 does not define default. It is based on internal credit risk management practices and/or policies and is usually considered to be consistent with the definition of default used for measuring probability of default.

- **Forward-looking factors** – macro-economic variables and their forecasts used in the calculation of impairment under IFRS 9. FLF should be used for both stage migration decisions and in measuring the expected credit losses components.

- **Probability of Default (PD)** – an estimate of the likelihood of default over a given time horizon.

- **Expected Credit Losses (ECL)** – the difference between the present value of the expected cash flows (principal and interest) that are contractually due and the present value of the cash flows the bank expects to receive taking into consideration the estimates of probability of default.

- **Exposure at Default (EAD)** – an estimate of the loan exposure amount at a future default date, taking into account changes in the exposure after the reporting date, including repayments of principal and payments of interest, any prepayments or liquidations, expected drawdowns on committed facilities or any other term or condition in favour of the obligor that may alter the cash flow characteristics of the loan.

- **Expected Life (EL)** – the maximum period over which expected credit losses are measured and which should not exceed the contractual period or term of the financial instrument (e.g. a loan). For certain financial instruments with both a loan and an undrawn commitment component that meet the narrow exception in IFRS 9/5.5.20, the expected life will need to be estimated while considering the following factors: the period the bank is exposed to credit risk on similar loans, the length of time for defaults to occur on similar loans and the credit risk actions that would be taken if the credit risk on these loans increased.

- **Loss Given Default (LGD)** - an estimate of the loss arising on default. It is based on the difference between the contractual cash flows due and those that the lender would expect to receive, including from any collateral. It is usually expressed as a percentage of the EAD.

- **Loss Rate (LR)** – the ratio between the amount of total losses experienced on the default of a loan or group of loans to either: the total amount of the loan or group of loans or the total amount of the loans or group of loans in default.

- **Discount Rate (DR)** – used to discount an expected loss or recovery to a present value (PV) at the reporting date using the effective interest rate (EIR) at initial recognition. The EIR takes the stated rate on the original loan and factors in any fees, transactions costs, expected prepayments and discounts or premiums.

### 3.1. GPPC Guidance

Note: This Guide contains guidance taken from the paper published by the Global Public Policy Committee (GPPC) titled *The implementation of IFRS 9 impairment requirements by banks: Considerations for those charged with governance of systemically important banks*. The GPPC consists of representatives from the world's six
largest accounting networks and it published this paper to promote the implementation of accounting for expected credit losses to a high standard. While the guidance from this paper is not authoritative guidance and does not intend to amend or interpret IFRSs, it does contain very useful information in respect of considerations for IFRS implementation and hence it has been reproduced in this Guide to provide useful implementation reference material for reporting entities. As noted in the title of this GPPC paper, it is intended primarily for systemically important banks and hence the guidance from this paper, including distinction between sophisticated and simpler approaches, should be read in that context.

3.1.1. Default

- The concept of “default” is critical to the implementation of IFRS 9. IFRS 9 requires that when making the assessment of whether there has been a significant increase in credit risk since initial recognition, an entity uses the change in the risk of default occurring over the expected life of the financial instrument. For financial instruments for which there has not been a significant increase in credit risk, ECLs are recognized only in respect of default events that are possible within the next 12 months. Furthermore, IFRS requires that assets meeting the definition of credit impaired (“Stage 3 assets”) should be disclosed and the definition of credit impaired includes references to defaults, as well as other events that have a detrimental impact on estimated future cash flows. [IFRS 9.5.5.9, IFRS 9.A, IFRS 7.35G(a)(iii)]

- IFRS 9 does not define the term “default” but instead requires each entity to do so. The definition used should be consistent with the definition used for internal credit risk management purposes and consider qualitative indicators (for example financial covenants) when appropriate. There is a rebuttable presumption that default takes place no later than 90 days past due. However, IFRS 9 contains no further guidance on how to define default. [IFRS 9.B5.5.37]

- Regulatory literature, such as the Basel Capital Accord rules, provides examples in addition to the 90 days past due backstop which are known as unlikeliness to pay indicators (UTP). These UTPs form part of the regulatory definition of default. UTPs are similar, but not identical to, the events described in the definition of “credit-impaired financial asset” under IFRS 9. In addition, the Basel Committee has recommended that the definition of default adopted for IFRS 9 accounting purposes is guided by the definition used for regulatory purposes. [IFRS 9.A, GCRAECL.A4]

- The definition of default used — e.g., using the IFRS 9 definition of credit-impaired indicators as the definition of default or using the definition of default from Basel Committee rules — affects the calculation of PDs, LGDs and EADs. Different definitions can lead to different ECL results. Accordingly, amending the definition of default used in a bank’s models as part of the transition to IFRS 9 requires a recalibration of those models.

- This section sets out how a bank could approach defining default for IFRS 9 purposes and could deal with these differences.

A sophisticated approach

- The bank analyses the regulatory definition of default and the definition of default in IFRS 9 and maintains and applies (subject to discussion below) a
consistent, single definition of default for both regulatory and financial reporting purposes, or documents good reasons why not.

- For particular financial instruments, the same definition of default is applied uniformly in all aspects of modelling ECLs (e.g., in estimating PD, EAD and LGD). All indicators of credit impaired within IFRS 9 and all UTPs in the applicable regulatory definitions are considered in defining default for IFRS 9 purposes.

- The definition of default and its application to different types of financial instruments is appropriately tailored to reflect their differing characteristics.

- In exceptional cases where the definitions of default for regulatory purposes and accounting purposes continue to differ, this may result in two principal outcomes:
  - Assets recorded in “Stage 2” under IFRS 9 (because they have not yet reached the accounting definition of credit impaired) but are in regulatory default.
  - Assets recorded in “Stage 3” under IFRS 9 (because they have met the accounting definition of credit impaired) but are not yet in regulatory default.

- If such outcomes occur because of different definitions, the bank, in accordance with a documented policy, explains and justifies why a credit-impaired financial asset is not in regulatory default and vice versa. The objectives of both definitions are similar so, for example, if there are cases where an exposure could be deemed “unlikely to pay” while at the same time not credit impaired, this would have to be explained.

- The bank has processes to update both regulatory and accounting definitions for further changes in either regulatory requirements (such as local regulatory definitions) or emerging practice.

**Considerations for a simpler approach**

- A bank may be able to use models that were developed for regulatory purposes without amending the definition of default used in the models and then adjust the model output for the effect of differences between the regulatory and accounting definitions. If the difference is believed to lead to only an immaterial difference in outcome, the bank has processes and controls in place to support this view.

**What is not compliant**

- Using a definition of default when modelling the probability of default for IFRS 9 purposes that results in fewer default events being captured than are actually monitored and observed in the credit risk management of the business. [IFRS 9.B5.5.37]

- Using information that was designed for regulatory purposes without assessing whether any adjustments are required for the information to be fit for use under IFRS 9. The bank should investigate the differences and assess their impact on the staging of its assets and ECL calculations. [IFRS 9.B5.5.37, GCRAECL.A4-5]
• Not applying the 90 days past due backstop unless the bank has documented reasonable and supportable information to demonstrate that a more lagging default criterion is more appropriate. [IFRS 9.B5.5.37, GCRAECL.A5]

Probability of default

• Many banks plan to use PDs as a key component both in calculating ECLs and in assessing whether a significant increase in credit risk has occurred. A PD used for IFRS 9 should reflect management’s current view of the future and should be unbiased (i.e., it should not include any conservatism or optimism). Consideration of forward-looking information is discussed in Section 4 of this Guide.

• This section discusses how PDs may be calculated for IFRS 9 purposes and the relationship with regulatory PD measures.

• Two types of PDs are used for calculating ECLs:
  o 12-month PDs – This is the estimated probability of default occurring within the next 12 months (or over the remaining life of the financial instrument if that is less than 12 months). This is used to calculate 12-month ECLs.
  o Lifetime PDs – This is the estimated probability of a default occurring over the remaining life of the financial instrument. This is used to calculate lifetime ECLs for “Stage 2” and “Stage 3” exposures. PDs may be broken down further into marginal probabilities for sub-periods within the remaining life. Please note Lifetime PDs and their methodology is out of the scope of this document.

A sophisticated approach

• PDs are limited to the maximum period of exposure required by IFRS 9.

12-month PDs

• If a bank uses Internal Ratings Based (IRB) models for regulatory purposes, the bank may use the outputs from its IRB models as a starting point for calculating IFRS 9 PDs. However, the PDs from these IRB models may in some organizations be determined using a through the cycle (TTC) rating philosophy (or hybrid point-in-time approach) or may include certain conservative adjustments (such as floors). Therefore, these PDs are appropriately adjusted if they are to be used for IFRS 9 purposes. Examples of adjustments include:
  o Conversion to an unbiased (rather than conservative) estimate.
  o Removal of any bias towards historical data (for example, TTC) that does not reflect management’s current view of the future. Aligning the definition of default used in the model with that used for IFRS 9 purposes.
  o Incorporating forward-looking information.

• If a bank does not have IRB models, new models are developed to produce 12-month PDs for IFRS 9 purposes. All key risk drivers and their predictive power are identified and calibrated based on historical data over a suitable time period. This could take the form of a scorecard approach. A scorecard approach uses a
set of loan-specific or borrower-specific factors which are weighted to produce an assessment of credit risk.

**Lifetime PDs**

- To determine lifetime PDs, the bank either builds from the 12-month PD model or develops a lifetime PD model separately.
- If the bank builds from the 12-month PD model, it develops lifetime PD curves or term structures to reflect expected movements in default risk over the lifetime of the exposure. This involves:
  - Sourcing historical default data for the portfolio.
  - Performing vintage analysis to understand how default rates change over time.
- Extrapolating trends to longer periods where default data are not available for the maximum period of exposure.
- Performing analysis at an appropriately segmented level, such that groups of loans with historically different lifetime default profiles are modelled using different lifetime default curves.
- If the bank is able to incorporate detailed forecasts of future conditions in developing PD estimates only for a period that is shorter than the entire expected life, it applies a documented policy for determining the longer-term trend in rates of default based on historical and other available reasonable and supportable information. [IFRS 9.B.5.50, 52]
- If the bank develops a new model to produce lifetime PDs, it will be necessary to ensure all key risk drivers and their predictive power are identified and calibrated based on historical data over a suitable time period. This could take the form of a scorecard approach.

**Considerations for a simpler approach**

**12-month PDs**

- Where there is insufficient default history for a particular portfolio (e.g., a portfolio of new products), the bank uses internal benchmarking to a similar risk portfolio, or a reduced level of risk segmentation (i.e., grouping similar risks/portfolios to increase data credibility) and, where relevant, uses external ratings and external benchmarking.
- There may be simpler alternatives to a scorecard approach available to a bank. For example, adaptations of collective methodologies such as roll/transition rates may be possible. Roll/transition rate methods are commonly used under IAS39 to assess credit losses by analyzing the movement of exposures between different risk buckets (e.g., delinquency states) over time. Such methods use historical observed rates to estimate the amounts of exposure that are expected to roll into default over a specified period.
- When a bank relies on external ratings, internal benchmarking or grouping risks together, the bank should perform adequate analysis to justify this approach and consider and document its limitations. For example, grouping risks together may mask underlying credit losses or increases in credit risks, if the segments are not sufficiently homogeneous. Therefore, the bank should support the suitability of
any groupings of risks with sufficient evidence.

**Lifetime PDs**

- A bank may apply simpler extrapolation techniques to the 12-month PD. For example, the bank may assume that the default rate does not change during the lifetime of the loan or use less segmentation than under a more sophisticated approach. This may be more common for shorter-term products. The bank should justify this approach with analysis evidencing that the PD profiles are appropriately similar.

- If a bank uses an extrapolation approach to determine lifetime PDs, then it may combine different risk segments if they are considered to have similar lifetime PD profiles. This will simplify the modelling required and reduce the number of explicit PD profiles to be calculated at each reporting date. The bank should justify this approach with analysis supporting the assertion that the underlying PD profiles are appropriately similar.

**What is not compliant**

- Leveraging existing models without, based on reasonable and supportable information, validating that these models are fit for purpose under IFRS 9 and/or making and documenting appropriate adjustments. [IFRS 9.5.5.17(c), B5.5.49-54, BC5.283]

- Assuming a constant marginal rate of default over the remaining lifetime of a product without appropriate supporting analysis. [IFRS 9.5.5.17(c), B5.5.49-54]

- Grouping together exposures that are not sufficiently similar. [IFRS 9.B5.5.5]

### 3.2. Data Requirements

The goal of this document is to provide data requirements and methodology for the development of IFRS 9 PIT PD using top-down approach for Stage 1 PDs. It is with this as the background that we outline the requirement of data below.

The data requirements are organized as follows:

**4. Internal data**

**4.1. Default rate modelling**

- Total outstanding loans by segment
- Total non-performing loans by segment
- Total non-performing loans by classification (total book)
- Breakdown of non-performing loans by classification (by segment)
- New non-performing loans by segment
- Specific provision (charge-off) during each historical year (stock and flow)
- General provision and reserved interest
- Behaviour of loans post-default (evidence of cure, if any)
4.1.1. Retail roll-rates modelling
Data on a month-by-month or quarter-by-quarter basis for the amount of loans that are 30-60 days past due and 60-90 days past due.

5. Model Structure and Approach

5.1. Definition of Default
As mentioned above, IFRS 9 does not provide an explicit definition of default, however the Basel Committee of Banking Supervision (BCBS) recommends the adoption of the definition of default applied in the Basel capital framework; it is included below:

- An obligor is considered to be in default by a credit union when one of the following two conditions are satisfied:
  o The obligor is more than 90 days past due on any material credit obligation to the credit union, or
  o The bank considers the obligor to be unlikely to pay its credit obligations to the credit union in full, without recourse by the credit union to actions such as realizing security (if held).

- Unlikely to pay criteria include any of the following:
  o Obligation/cross default, which means the occurrence of a default (other than failure to make a payment) on any other similar obligation.
  o Obligation/cross acceleration, which means the occurrence of a default (other than failure to make a payment) on any other similar obligation, resulting in the obligation becoming due immediately.
  o Repudiation/moratorium, which means that the counterparty is rejecting, or challenging, the validity of the obligation.
  o Restructuring, which means a waiver, deferral, or rescheduling of the obligation with the effect that the terms are less favourable than before.

- Bankruptcy, which is defined as a situation involving any of the following:
  o The dissolution of the obligor (other than merger)
  o The insolvency, or inability to pay its debt
  o The assignment of claims
  o The institution of bankruptcy proceeding
  o The appointment of receivership
  o The attachment of substantially all assets by a third party

This is the definition of default that banks typically employ for exposures to non-retail and retail clients.

5.2. 12-month Probability of Default
Probability of default is a forward-looking estimate of the realized default rate over either a 12-month or lifetime time horizon. It determines the probability an account will default over the period considered. The realized default rate is calculated based on past data to determine default rates, by following the steps described below:

- First, accounts that are not in default at the time of observation are monitored over the performance period. Accounts are defined as realized defaults if they have defaulted at any point during this period. For example, if an account defaults in year 1, cures and then defaults again in year 3, only the last instance of default is counted as having occurred in year 3. PD (PD) is therefore the cumulative default rate after the time of observation.
- For 12-month PD (PD\(_{12}\)):

\[
DR_{t,s} = \sum_{i=1}^{N_{t,s}} \max_{j=t+1 \ldots t+12} \{I_{DJ,ij,s}\} / N_{t,s}
\]

Where,

\(N_{t,s}\) – Number of accounts not in default at time \(t\) for segment \(s\),

\(I_{DJ,ij,s}\) – Default indicator (1=default; 0 = no default) for each account \(i\) at time \(j\) segment \(s\).

5.3. Probability of Default - Corporate

12-month Corporate (non-retail) PD is calculated using an estimate of average annual performing loans and new NPAs in each year preferably covering the entire economic cycle, say for example, from 2008 to 2017.

\[
Performing\ loans = (Total\ Outstanding - Total\ NPAs)
\]

In order to gain a more accurate estimate of the performing loans during each period, we took the average of the year-end figure for that year’s performing loans and the previous year’s performing loans. This process provides a more realistic year average value. For example, the estimated average performing for 2017 would be:

\[
Est.\ avg.\ Performing\ 2017 = \frac{Performing\ 2016 + Performing\ 2017}{2}
\]

Probability of default on a per year basis can subsequently be calculated by dividing the new NPAs in a given year by the estimated average performing loans.

\[
PD = \frac{\text{new NPAs}}{(Est.\ avg.\ Performing)}
\]

The PD can be calculated for the previous 7 years, in line with the assumption of a seven-year economic cycle.

5.4. Point in Time (PIT) Probability of Default - Corporate

Once we have historical 12-month PDs, we can use business cycle adjustment to make them unbiased and current. For example, we assume that two years in the seven have significantly larger PD’s than the rest of the years on record, and are therefore classified as ‘bad’ years. Because there are already two bad years within the 7-year cycle, a straight average of the past 7 years serves as an appropriate benchmark for future PD’s.

\[
PD_{corporate} = \frac{\sum_{Years} \{NPA_{new}\} / (Balance_{ave})}{\#Years}
\]
5.5. Cycle adjustment

If the available data set did not correspond to a typical seven-year cycle, it would be necessary to reweight the data to simulate such a cycle. This can be done by finding two sets of average PDs corresponding to good and bad years. The average PD is then a weighted average of these values in a 5 to 2 ratio. This ratio can be modified to adjust for a more conservative approach.

5.6. 12-month Probability of Default – Retail

5.6.1. Roll Rate analysis

Retail or Personal loans 12-month PD can be calculated using a model based on the ‘roll rates’ of performing loans. In this case, let’s assume data is available from Dec-2015 to Dec-2017 for loans 30-60 days past due and 60-90 days past due on a monthly basis. Furthermore, once a loan is 90 days past due it becomes officially non-performing. Therefore, we could study the movement of loan classifications in different stages of their delinquency. ‘Roll Rates’ could be calculated for the percentage of loans that were demoted every month.

Example for the month of May:

\[
\text{‘30-60 day past due’ Roll Rate} = \frac{(60-90 \text{ days})_{\text{MAY}}}{(30-60 \text{ days})_{\text{APRIL}}}
\]

Following from this concept, an average roll rate can be calculated for 2015 and 2017.

The 0-30 days past due figure is generated rate by dividing the total sum of new 0-30 days past due classification in a given year by the total amount of performing assets. The 60-90 days past due rate can be calculated by dividing the new NPAs by the total 60-90 day balance.

The segmentation of loans into these categories allows for greater granularity – it allows better understanding of how many loans in each stage of delinquency were at risk of default. For example, for a loan that is currently fully performing to default, it must first pass through the 30-day and 60-day past default stages before defaulting. The probability of deteriorating all the way to default is the product of the 0-30, 30-60, and 60-90 day roll rates.

Using this framework, we can develop PDs specifically tailored to loans past due by 0-30 days, 30-60 days, and 60-90 days. The exposure-weighted average of these PDs is the average PD for the entire portfolio.

5.6.2. PIT Adjustment

Using the roll rate cycle average, the model essentially follows the methodology used in the Corporate PD model with slightly more detail. The average PD is calculated using the same formula:
However, our roll rate analysis only uses data from 2015 and 2017. An adjustment factor is introduced into our calculations to project the 2015 and 2017 values into the average 7-year cycle previously discussed. This adjustment factor essentially compensates for the potential for 2015 and 2017 to be uncharacteristically ‘good’ years for the bank.

\[
PD_{\text{personal}} = \frac{\sum (NPA_{\text{new}})/(Balance_{\text{ave}})}{\#\text{Years}} 
\]

This cycle adjustment can now act as a coefficient to reflect the true performance of the bank.

Furthermore, a ‘Top-up’ adjustment factor can also be employed to better reflect default risk and performance. This Top-up factor was put in place to account for performing personal loans that only remain performing because of further debt incurred by the customer. Essentially, some customers go into debt to pay off their debt. While these accounts remain performing assets, they are much riskier than other performing assets. The ‘Top-up’ adjustment factor is an estimated coefficient derived using regional benchmarks.

6. Key assumptions

6.1. Segmentation

We assume only two segments but the above analysis can be applied to remaining segments of the bank to determine PIT PDs, e.g., Small Business and even Low Default Portfolios.

6.2. Economic cycle

6.2.1. Length of cycle

We hypothesize that the length of one economic cycle in Taiwan is approximately 7 years. Obviously, this number is variable given a number of internal and external factors. We are not claiming to be able to predict the exact pattern of the Taiwan economy, however, we assume that by examining past historical trends we are comfortable with a cycle length average of 7 years in which two of those years will perform considerably lower than the other two.

We also assume that in the case of Taiwan, the future of exports plays a significant factor in the robustness of the economy, and if exports do not decline, Taiwan will likely see a period of great prosperity.
The average GDP growth in Taiwan over the last 55 years is 6.83%, which is reflective of increasing prosperity and sound economic management in the region. The GDP growth is nonetheless incredibly volatile, with an assumed standard deviation of 9.5%. Despite the upward slope of the growth, Taiwan is subject to steep up and down turns, in part due to internal and external economic conditions, and in part due to the relatively small scale within the country – i.e. large single domestic event is capable of tipping the scales in either direction.

The prosperity of the country is intrinsically linked to exporting activities. However, the growth of non-export activities is a very positive trend and could be a mitigating factor for the future volatility of GDP growth in the coming years.

As a percent of total GDP at market prices, non-export activities are assumed to have risen from 40% to 50%.

In order to gain a better perspective of the economic cycle, we can also normalize both GDP growth and contribution of exports. The correlation between the two factors can then be tested.

From the analysis of macroeconomic data and from internal discussion, we are comfortable with the assumption that the average economic cycle is approximately 7 years. A representative 7-year pool of data should be able to provide enough variation to encompass the full economic swing of both ‘good’ years and ‘bad’ years in an average cycle. In the model, we can find separate historical PDs for good and bad years.

6.3. Composition of cycle

In its simplest form, we can group economic data into ‘good’ and ‘bad’ years. From our analysis of macro level data as well as historical lending data, it can be discovered that within a typical economic cycle, 2 years will be ‘bad’ and 5 years will be ‘good.’ How ‘good’ and how ‘bad’ is clearly dependant on a number of domestic and international factors which can take on the form of economy, geopolitics, society, or otherwise. The two ‘bad years’ cannot be ignored in the bank’s loan loss provisions.

6.3.1. Personal loans

In line with the 7-year economic cycle, 2010 and 2011 can be assumed as particularly ‘bad’ years in the period. However, in the absence of simple adjustment, due to short term nature of retail loans an average default rate can be used as a proxy for PIT PDs.

6.3.2. Non-retail loans

Commercial loan default rates are largely dependent on the domestic economy. Consumer spending, exchange rates, etc. are key drivers of business. The factors that affect each business are industry specific. Commercial loans, therefore, exist within the 7-year cycle. In the past 7 years 2010 and 2011 saw particularly high default rates and therefore losses.
6.3.3. ‘Top-up' factor for retail loans

We assume that certain Personal loan customers maintain performing status by taking on further debt either in-house or with other financial institutions. Although these assets appear to be performing, they are at a higher risk than standard performing assets because the customer is highly leveraged. A regional benchmark indicates a factor of approximately $\frac{3}{2}$ is standard. However, of bank has effective processes in place to monitor such activities, a haircut to the benchmarked adjustment factor was administered. A factor of $\frac{4}{3}$ can be used to compensate for these invisible but high risk performing loans.