NUS-RMI Credit Research Initiative Technical Report

Version: 2018 update 1

Credit Research Initiative†
Risk Management Institute
National University of Singapore

This document describes the implementation of the system which the Credit Research Initiative (CRI) at the Risk Management Institute (RMI) of the National University of Singapore (NUS) uses to produce probabilities of default (PD) and actuarial spread (AS). As of this version of the technical report, RMI-CRI covers around 67,000 exchange-listed firms (including delisted ones) in 128 economies around the world (see Table A.1). Of them, over 34,000 firms have sufficient data to release daily updated PD and AS. The PD and AS for all firms are freely available to users who can provide evidence of their professional qualifications to ensure that they will not misuse the data. General users who do not request global access are restricted to a list of 5,000 firms. The individual company PD/AS data, along with aggregate PD/AS at the economy and sector level, can be accessed at `http://rmicri.org`.

The primary goal of this initiative is to drive research and development in the critical area of credit rating systems. As such, a transparent methodology is essential to this initiative. Having the details of the methodology available to everybody means that there is a base from which suggestions and improvements can be made. The objective of this technical report is to provide a full exposition of the CRI system. Readers of this document who have access to the necessary data and who have a sufficient level of technical expertise will be able to implement a similar system on their own. For a full exposition of the conceptual framework of the CRI, see Duan and Van Laere [2012].

The system used by the CRI will evolve as new innovations and enhancements are applied. The main changes to the 2018 technical report and operational implementation of our model are: (1) New smart data launch of the CRI Systematically Important Financial Institution (CriSIFI), (2) New common covariates and some changes in covariates, and (3) Changes in parameter estimation. This version of the technical report provides an update on the operational implementation of the CRI and includes all changes to the system that had been implemented by March 2018. The latest version of the technical report and addenda are available via the web portal and will include any changes to the system that have been implemented since the publication of this version.

In the remainder of this technical report, the PD model and its computational details will be explained in thorough details. As an application of the model, the computation of AS and CVI will be discussed in a much concise manner. Wherever no confusion is caused, "the model" refers to the PD model. The sections are organized as follows. Section 1 describes the quantitative model that is currently used to compute the PDs. The model was first described

† For any questions or comments on this article, please contact the CRI Team at rmicri@nus.edu.sg.

in Duan et al. [2012]. The description includes calibration procedures, which are performed on a monthly basis, and individual firm's PD computations, which are performed on a daily basis.

Section 2 describes the input variables of the model as well as the data used to produce these inputs. This model uses both input variables that are common to all firms in an economy and input variables that are firm-specific. Another critical component in the estimation system is the default data, and this is also described in this section.

While Section 1 provides a broader description of the model, Section 3 describes the implementation details that are necessary for application, given real world issues of, for example, bad or missing data. The specific technical details needed to develop an operational system are also given, including details on the monthly calibration, daily computation of individual firm's PDs and aggregation of the individual firm's PDs. Distance-to-default (DTD) in a Merton-type model is one of the firm-specific variables. The calculation for DTD is not the standard one, and has been modified to allow a meaningful computation of the DTD for financial firms. While most academic studies on default prediction exclude financial firms from consideration, it is important to include them given that the financial sector is a critical component in every economy. The calculation for DTD is detailed in this section.

Section 4 shows an empirical analysis for those economies that are currently covered. While the analysis shows excellent results in several economies, there is room for improvement in a few others. Basically, all the economies adopt the variables used in the academic study of US firms in Duan et al. [2012]. Going beyond that, as of May 2018, we design new variables to improve default prediction and also start applying variable selection specific to different economies (e.g., China). For details, refer to Subsection 2.1. Sections 5 and 6 explain how the CVI and AS are formulated. A detailed theoretical background can be found in Duan [2014]. Section 7 introduces the new CRI product "CriSIFI" aimed at identifying systemic risks of all banks and insurers under the CRI coverage. Section 8 discusses future developments.

1 Model Description

The quantitative model that is currently being used by the CRI is a forward intensity model that was introduced in Duan et al. [2012]. Certain aspects of the model are taken from Duan and Fulop [2013]. This model allows PD forecasts to be made at a range of horizons. In the current CRI implementation of this model, PDs are forecasted from a horizon of one month up to a horizon of five years. At the RMI-CRI website, for every firm, the probability of that firm defaulting within one month, three months, six months, one year, two years, three years, and five years is given. The ability to assess credit quality for different horizons is a useful tool for risk management, credit portfolio management, policy setting, and regulatory purposes, since short- and long-term credit risk profiles can differ greatly depending on a firm's liquidity, debt structures, and other factors.

The forward intensity model is a reduced form model in which the PD is computed as a function of different input variables. These can be firm-specific or common to all firms within an economy. The other category of the default prediction model is the structural model, whereby the corporate structure of a firm is modeled in order to assess the firm's PD.

A similar reduced form model by Duffie et al. [2007] relies on modeling the time series dynamics of the input variables in order to make PD forecasts for different horizons. However, there is little consensus on assumptions for the dynamics of variables such as accounting ratios, and the model output will be highly dependent on these assumptions. In addition, the time series dynamics will be of very high dimension. For example, with the two common variables and two firm-specific variables that Duffie et al. [2007] use a sample of 10,000 firms gives a dimension of the state variables of 20,002.

Given the complexity in modeling the dynamics of variables such as accounting ratios, this model will be difficult to implement if different forecast horizons are required. The key innovation of the forward intensity model is that PD for different horizons can be consistently and efficiently computed based only on the value of the input variables at the time the prediction is made. Thus, the model specification becomes far more tractable.

Fully specifying a reduced form model includes the specification of the function that computes a PD from the input variables. This function is parameterized, and finding appropriate parameter values is called calibrating the model. The forward intensity model can be calibrated by maximizing a pseudo-likelihood function. The calibration is carried out by groups of economies and all firms within a group of economies will use the same parameter values along with each firm's variables in order to compute the firm's PD.

Subsection 1.1 will describe the modeling framework, including the way PDs are computed based on a set of parameter values for the economy and a set of input variables for a firm. Subsection 1.2 explains how the model can be calibrated. Subsection 1.3 details the way parameters are estimated based on the Sequential Monte Carlo (SMC) technique.

1.1 Modeling Framework

While the model can be formulated in a continuous time framework, as done in Duan et al. [2012], an operational implementation requires discretization in time. Since the model is more easily understood in discrete time, the following exposition of the model will begin in a discrete time framework.

Variables for default prediction can have vastly different update frequencies. Financial statement data is updated only once a quarter or even once a year, while market data like stock prices are available at frequencies of seconds. A way of compromising between these two extremes is to have a fundamental time period Δt of one month in the modeling framework. As will be seen later, this does not preclude updating the PD forecasts on a daily basis. This is important since, for example, large daily changes in a firm's stock price can signal changes in credit quality even when there is no change in FS data.

Thus, for the purposes of calibration and subsequently for computing time series of PD, the input variables at the end of each month will be kept for each firm. The input variables associated with the i^{th} firm at the end of the n^{th} month (at time $t = n\Delta t$) is denoted by $X_i(n)$. This is a vector consisting of two parts: $X_i(n) = (W(n), U_i(n))$. Here, $W(n)$ is a vector of variables at the end of month n that is common to all firms in the economy and $U_i(n)$ is a vector of variables specific to firm i.

In the forward intensity model, a firm's default is signaled by a jump in a Poisson process. The probability of a jump in the Poisson process is determined by the intensity of the Poisson process. The forward intensity model draws an explicit dependence of intensities at time periods in the future (that is, forward intensities) to the values of input variables at the time of prediction. With forward intensities, PDs for any forecast horizon can be computed knowing only the values of the input variables at the time of prediction, without needing to simulate future values of the input variables.

There is a direct analogy in interest rate modeling. In spot rate models where dynamics on a short-term spot rate are specified, bond pricing requires expectations on realizations of the short rate. Alternatively, bond prices can be computed directly if the forward rate curve is known.

One issue in default prediction is that firms can exit public exchanges for reasons other than default, such as merge and acquisition (M&A) and OTC. In order to take these other exits into account, defaults and other exits are modeled as two independent Poisson processes, each with their own intensity. While defaults and exits classified as non-defaults are mutually exclusive by definition, the assumption of independent Poisson processes does not pose a problem since the probability of a simultaneous jump in the two Poisson processes is negligible. In the discrete time framework, the probability of simultaneous jumps in the same time interval is non-zero. As a modeling assumption, a simultaneous jump in the same time interval by both the default Poisson process and the non-default type exit Poisson process is considered as a default. In this way, there are three mutually exclusive possibilities during each time interval: survival, default and non-default exit. As with defaults, the forward intensity of the Poisson process for other exits is a function of the input variables. The parameters of this function can also be calibrated.

To further illustrate the discrete framework, the three possibilities for a firm at each time point are diagrammed. Either the firm survives for the next time period Δt, or it defaults within Δt, or it has a non-default exit within Δt. This setup is pictured in Fig. 1. Information about firm i is known up until time $t = m\Delta t$ and the figure illustrates possibilities in the future between $t = (n-1)\Delta t$ and $(n+1)\Delta t$. Here, m and n are integers with $m < n$.

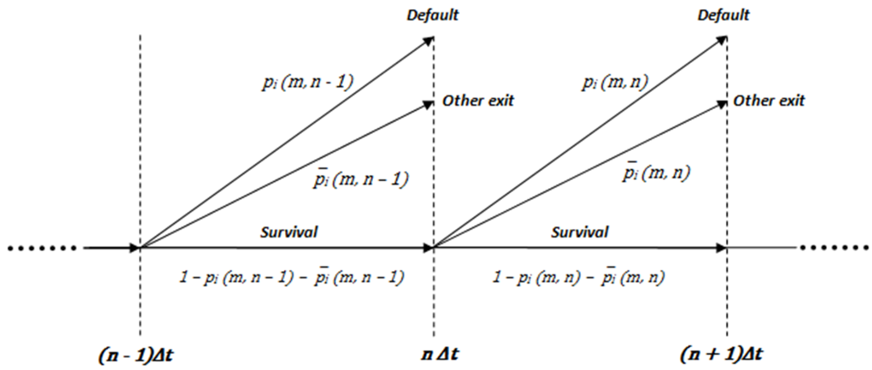


Figure 1: Default-other exit-survival tree for firm i, viewed from time $t = m\Delta t$.

The probabilities of each branch are, for example: $p_i(m, n)$ the conditional probability viewed from $t = m\Delta t$ that firm i will default before $(n+1)\Delta t$, conditioned on firm i surviving up until $n\Delta t$. Likewise, $\bar{p}_i(m, n)$ is the conditional probability viewed from $t = m\Delta t$ that firm i will have a non-default exit before $(n+1)\Delta t$, conditioned on firm i surviving up until $n\Delta t$. It is the modeler's objective to determine $p_i(m, n)$ and $\bar{p}_i(m, n)$, but for now it is assumed that these quantities are known. With the conditional default and other exit probabilities known, the corresponding conditional survival probability of firm i is $1 - p_i(m, n) - \bar{p}_i(m, n)$.

With this diagram in mind, the probability that a particular path will be followed is the product of the conditional probabilities along the path. For example, the probability at time $t = m\Delta t$ of firm i surviving until $(n-1)\Delta t$ and then defaulting between $(n-1)\Delta t$ and $n\Delta t$ is:

$$\mathrm{Prob}_{t=m\Delta t}[\tau_i = n, \tau_i < \bar{\tau}_i] = p_i(m, n-1) \prod_{j=m}^{n-2} [1 - p_i(m, j) - \bar{p}_i(m, j)] \,. \tag{1}$$

Here, τ_i is the default time for firm i measured in units of months, $\bar{\tau}_i$ is the other exit time measured in units of months, and the product is equal to 1 if there is no term in the product. The condition $\tau_i < \bar{\tau}_i$ is the requirement that the firm defaults before it has a non-default type of exit. Note that by measuring exits in units of months, if, for example, a default occurs at any time in the interval $[(n-1)\Delta t, n\Delta t]$, then $\tau_i = n$.

Using Eq. (1), cumulative default probabilities can be computed. At $m\Delta t$ the probability of firm i defaulting at or before $n\Delta t$ and not having an other exit before $t = n\Delta t$ is obtained by taking the sum of all of the paths that lead to default at or before $n\Delta t$:

$$\mathrm{Prob}_{\;t=m\Delta t}[m < \tau_i \le n, \tau_i < \bar{\tau}_i] = \sum_{k=m}^{n-1} \left\{ p_i(m, k) \prod_{j=m}^{k-1} [1 - p_i(m, j) - \bar{p}_i(m, j)] \right\} . \tag{2}$$

While it is convenient to derive the probabilities given in Eqs. (1) and (2) in terms of the conditional probabilities, expressions for these in terms of the forward intensities need to be found, since the forward intensities will be functions of the input variable $X_i(m)$. The forward intensity for the default of firm i that is observed at time $t = m\Delta t$ for the forward time interval from $t = n\Delta t$ to $(n+1)\Delta t$, is denoted by $h_i(m,n)$, where $m \leq n$. The corresponding forward intensity for a non-default exit is denoted by $\bar{h}_i(m,n)$. Because default is signaled by a jump in a Poisson process, its conditional probability is a simple function of its forward intensity:

$$p_i(m,n) = 1 - \exp[-\Delta t\ h_i(m,n)]. \tag{3}$$

Since joint jumps in the same time interval are assigned as defaults, the conditional other exit probability needs to take this into account:

$$\bar{p}_i(m,n) = \exp[-\Delta t\ h_i(m,n)] \times \{1 - \exp[-\Delta t\ \bar{h}_i(m,n)]\}. \tag{4}$$

The conditional survival probabilities in Eqs. (1) and (2) are computed as the conditional probability that the firm does not default in the period and the firm does not have a non-default exit either:

$$\text{Prob}_{\,t=m\Delta t}[\tau_i, \bar{\tau}_i > n+1 |\ \tau_i, \bar{\tau}_i > n] = \exp\{-\Delta t[h_i(m,n) + \bar{h}_i(m,n)]\}. \tag{5}$$

It remains to be specified the dependence of the forward intensities on the input variable $X_i(m)$. The forward intensities need to be positive so that the conditional probabilities are non-negative. A standard way to impose this constraint is to specify the forward intensities as exponentials of a linear combination of the input variables:

$$\begin{aligned} h_i(m,n) &= \exp[\beta(n-m) \cdot Y_i(m)], \\ \bar{h}_i(m,n) &= \exp[\bar{\beta}(n-m) \cdot Y_i(m)]. \end{aligned} \tag{6}$$

Here, β and $\bar{\beta}$ are coefficient vectors that are functions of the number of months between the observation date and the beginning of the forward period $(n-m)$, and $Y_i(m)$ is simply the vector $X_i(m)$ augmented by a preceding unit element: $Y_i(m) = (1, X_i(m))$. The unit element allows the linear combination in the argument of the exponentials in Eq. (6) to have a non-zero intercept.

In the current implementation of the forward intensity model in the CRI, the maximum forecast horizon is 60 months (5 years) and there are in general 16 input variables plus the intercept, so there are 60 sets of β and $\bar{\beta}$. While this is a large set of parameters, as will be seen in Subsections 1.2 and 1.3, the calibration is tractable because the default parameters can be calibrated separately from the other exit parameters, and the total number of parameters are greatly reduced after constraining the term-structure of the parameter estimates to be Nelson-Siegel functions.

Before expressing the probabilities in Eqs. (1) and (2) in terms of the forward intensities, a notation H is introduced for the forward intensities so that it becomes clear which parameters the forward intensity depends on:

$$H(\beta(n-m), X_i(m)) = \exp[\beta(n-m) \cdot Y_i(m)]. \tag{7}$$

This is the forward default intensity. The corresponding notation for other exit forward intensities is then just $H(\bar{\beta}(n-m), X_i(m))$. So, the probability in Eq. (1) is expressed in terms of the forward intensities, using Eq. (3) as the conditional default probability and Eq. (5) as the conditional survival probability:

$$
\begin{aligned}
&\text{Prob}_{\,t=m\Delta t}[\tau_i = n, \tau_i < \bar{\tau}_i] \\
&= \{1 - \exp[-\Delta t\ H(\beta(n-1-m), X_i(m))]\} \\
&\quad \times \prod_{j=m}^{n-2} \exp\left\{-\Delta t\ [H(\beta(j-m), X_i(m)) + H(\bar{\beta}(j-m), X_i(m))]\right\} \\
&= \{1 - \exp[-\Delta t\ H(\beta(n-m-1), X_i(m))]\} \\
&\quad \times \exp\left\{ -\Delta t \sum_{j=m}^{n-2} \left[H(\beta(j-m), X_i(m)) + H(\bar{\beta}(j-m), X_i(m))\right] \right\}. \qquad (8)
\end{aligned}
$$

This probability will be relevant in the next part during the calibration. The cumulative default probability given in Eq. (2) in terms of the forward intensities is then:

$$
\begin{aligned}
&\text{Prob}_{\,t=m\Delta t}[m < \tau_i \le n, \tau_i < \bar{\tau}_i] \\
&= \sum_{k=m}^{n-1} \Bigg\{ \{1 - \exp[-\Delta t\ H(\beta(k-m), X_i(m))]\} \\
&\quad \times \exp\left\{ -\Delta t \sum_{j=m}^{k-1} [H(\beta(j-m), X_i(m)) + H(\bar{\beta}(j-m), X_i(m))] \right\} \Bigg\}. \qquad (9)
\end{aligned}
$$

This formula is used to compute the main output of the CRI: an individual firm's PD within various time horizons. The β and $\bar{\beta}$ parameters are obtained when the firm's economy is calibrated, and using those together with the firm's input variables yields the firm's PD.

1.2 Pseudo-Likelihood Function

The empirical data set used for calibration can be described as follows. For the economy as a whole, there are N end of month observations, indexed as $n = 1, \ldots, N$. Of course, not all firms will have observations for each of the N months as they may start later than the start of the economy's data set or they may exit before the end of the economy's data set. There are a total of I firms in the economy, and they are indexed as $i = 1, \ldots, I$. As before, the input variables for the i^{th} firm in the n^{th} month is $X_i(n)$. The set of all observations for all firms is denoted by X.

In addition, the default times τ_i and non-default exit times $\bar{\tau}_i$ for the i^{th} firm are known if the default or other exit occurs after time $t = \Delta t$ and at or before $t = N\Delta t$. The possible values for τ_i and $\bar{\tau}_i$ are integers between 2 and N, inclusive. If a firm exits before the month end, then the exit time is recorded as the first month end after the exit. If the firm does not exit before $t = N\Delta t$, then the convention can be used that both of these values are infinite. If the firm has a default type of exit within the data set, then $\bar{\tau}_i$ can be considered as infinite. If instead the firm has a non-default type of exit within the data set, then τ_i can be considered as infinite. The set of all default times and non-default exit times for all firms is denoted by τ and $\bar{\tau}$, respectively. The first month in which firm i has an observation is denoted by t_{0i}. Except for cases of missing data, these observations continue until the end of the data set if the firm never exits. If the firm does exit, the last needed input variable $X_i(n)$ is for $n = \min(\tau_i, \bar{\tau}_i) - 1$.

The calibration of the β and $\bar{\beta}$ parameters is done by maximizing a pseudo-likelihood function. The function to be maximized violates the standard assumptions of likelihood functions, but Appendix A in Duan et al. [2012] derives the large sample properties of the pseudo-likelihood function.

In formulating the pseudo-likelihood function, the assumption is made that the firms are conditionally independent of each other. In other words, correlations arise naturally from shared common factors $W(n)$ and any correlations between different firms' firm-specific variables. With this assumption, the pseudo-likelihood function for the horizon of ℓ months, a set of parameters β and $\bar{\beta}$ and the data set $(\tau, \bar{\tau}, X)$ is:

$$\mathcal{L}_\ell(\beta, \bar{\beta}; \tau, \bar{\tau}, X) = \prod_{m=1}^{N-1} \prod_{i=1}^{I} P_{\min(N-m,\ell)}(\beta, \bar{\beta}; \tau_i, \bar{\tau}_i, X_i(m)). \tag{10}$$

Here, $P_{\min(N-m,\ell)}(\beta, \bar{\beta}; \tau_i, \bar{\tau}_i, X_i(m))$ is a probability for the i^{th} firm, with the nature of the probability depending on what happens to the firm during the period from month m to month $m + \min(N - m, \ell)$. This is defined as:

$$\begin{aligned}
&P_\ell(\beta, \bar{\beta}; \tau_i, \bar{\tau}_i, X_i(m)) \\
&\quad = 1_{\{t_{0i} \le m, \min(\tau_i, \bar{\tau}_i) > m+\ell\}} \\
&\qquad \times \exp\left\{ -\Delta t \sum_{j=0}^{\ell-1} [H(\beta(j), X_i(m)) + H(\bar{\beta}(j), X_i(m))] \right\} \\
&\quad + 1_{\{t_{0i} \le m, \tau_i \le \bar{\tau}_i, \tau_i \le m+\ell\}} \times \{1 - \exp[-\Delta t\, H(\beta(\tau_i - m - 1), X_i(m))]\} \\
&\qquad \times \exp\left\{ -\Delta t \sum_{j=0}^{\tau_i - m-2} [H(\beta(j), X_i(m)) + H(\bar{\beta}(j), X_i(m))] \right\} \\
&\quad + 1_{\{t_{0i} \le m, \bar{\tau}_i \le \tau_i, \bar{\tau}_i \le m+\ell\}} \times \{1 - \exp[-\Delta t\, H(\bar{\beta}(\bar{\tau}_i - m - 1), X_i(m))]\} \\
&\qquad \times \exp[-\Delta t H(\beta(\tau_i - m - 1), X_i(m))] \\
&\qquad \times \exp\left\{ -\Delta t \sum_{j=0}^{\bar{\tau}_i - m-2} [H(\beta(j), X_i(m)) + H(\bar{\beta}(j), X_i(m))] \right\} \\
&\quad + 1_{\{t_{0i} > m\}} + 1_{\{\min(\tau_i, \bar{\tau}_i) \le m\}}.
\end{aligned} \tag{11}$$

In other words, if the i^{th} firm survives from the observation time at month m for the full horizon ℓ until at least $m + \ell$, then the probability is the model-based survival probability for this period. This is the first term in Eq. (11). The second term handles the cases where the firm has a default within the horizon, in which case the probability is the model-based probability of the firm defaulting at the month that it ends up defaulting, as given in Eq. (8). The third term handles the cases where the firm has a non-default exit within the horizon, in which case the probability is the model-based probability of the firm having a non-default type exit at the month that the exit actually does occur. The expression for this probability uses the conditional non-default type exit probability given in Eq. (4). The final two terms handle the cases where the firm is not in the data set at month m - either the first observation for the firm is after m or the firm has already exited. A constant value is assigned in this case so that this firm will not affect the maximization at this time point.

The pseudo-likelihood function given in Eq. (10) can be numerically maximized to give estimates for the coefficients β and $\bar{\beta}$. Notice though that the sample observations for the pseudo-likelihood function are overlapping if the horizon is longer than one month. For example, when $\ell = 2$, default over the next two periods from month m is correlated to default over the next two periods from month $m + 1$ due to the common month in the two sample observations. However, in Appendix A of Duan et al. [2012], the maximum pseudo-likelihood estimator is shown to be consistent, in the sense that the estimators converge to the "true" parameter value in the large sample limit.

Notice though that each of the terms in Eq. (11) can be written as a product of terms containing only β and terms containing only $\bar{\beta}$. This will allow separate maximizations with respect to β and with respect to $\bar{\beta}$, that is, the defaults and other exits.

The β and $\bar{\beta}$ specific versions of Eq. (11) are:

$$
\begin{aligned}
&P_\ell^\beta(\beta;\tau_i,\bar{\tau}_i,X_i(m)) \\
&\quad = 1_{\{t_{0i}\le m,\min(\tau_i,\bar{\tau}_i)>m+\ell\}} \exp\left\{-\Delta t \sum_{j=0}^{\ell-1} H(\beta(j),X_i(m))\right\} \\
&\qquad + 1_{\{t_{0i}\le m,\tau_i\le\bar{\tau}_i,\tau_i\le m+\ell\}} \exp\left\{-\Delta t \sum_{j=0}^{\tau_i-m-2} H(\beta(j),X_i(m))\right\} \\
&\qquad\quad \times \{1-\exp[-\Delta t\, H(\beta(\tau_i-m-1),X_i(m))]\} \\
&\qquad + 1_{\{t_{0i}\le m,\bar{\tau}_i\le\tau_i,\bar{\tau}_i\le m+\ell\}} \exp\left\{-\Delta t \sum_{j=0}^{\bar{\tau}_i-m-2} H(\beta(j),X_i(m))\right\} \\
&\qquad\quad \times \exp[-\Delta t\, H(\beta(\tau_i-m-1),X_i(m))] \\
&\qquad + 1_{\{t_{0i}>m\}} + 1_{\{\min(\tau_i,\bar{\tau}_i)\le m\}},
\end{aligned}
$$

$$
\begin{aligned}
&P_\ell^{\bar{\beta}}(\bar{\beta};\tau_i,\bar{\tau}_i,X_i(m)) \\
&\quad = 1_{\{t_{0i}\le m,\min(\tau_i,\bar{\tau}_i)>m+\ell\}} \exp\left\{-\Delta t \sum_{j=0}^{\ell-1} H(\bar{\beta}(j),X_i(m))\right\} \\
&\qquad + 1_{\{t_{0i}\le m,\tau_i\le\bar{\tau}_i,\tau_i\le m+\ell\}} \exp\left\{-\Delta t \sum_{j=0}^{\tau_i-m-2} H(\bar{\beta}(j),X_i(m))\right\} \\
&\qquad + 1_{\{t_{0i}\le m,\bar{\tau}_i\le\tau_i,\bar{\tau}_i\le m+\ell\}} \exp\left\{-\Delta t \sum_{j=0}^{\bar{\tau}_i-m-2} H(\bar{\beta}(j),X_i(m))\right\} \\
&\qquad\quad \times \{1-\exp[-\Delta t\, H(\bar{\beta}(\bar{\tau}_i-m-1),X_i(m))]\} \\
&\quad + 1_{\{t_{0i}>m\}} + 1_{\{\min(\tau_i,\bar{\tau}_i)\le m\}}.
\end{aligned} \tag{12}
$$

Then, the β and $\bar{\beta}$ specific versions of the pseudo-likelihood function are given by:

$$
\begin{aligned}
\mathcal{L}_\ell^\beta(\beta;\tau,\bar{\tau},X) &= \prod_{m=1}^{N-\ell}\prod_{i=1}^{I} P_\ell^\beta(\beta;\tau_i,\bar{\tau}_i,X_i(m)) \\
\mathcal{L}_\ell^{\bar{\beta}}(\bar{\beta};\tau,\bar{\tau},X) &= \prod_{m=1}^{N-\ell}\prod_{i=1}^{I} P_\ell^{\bar{\beta}}(\bar{\beta};\tau_i,\bar{\tau}_i,X_i(m)).
\end{aligned} \tag{13}
$$

With the definitions given in Eqs. (12) and (13), it can be seen that:

$$
\mathcal{L}_\ell(\beta,\bar{\beta};\tau,\bar{\tau},X) = \mathcal{L}_\ell^\beta(\beta;\tau,\bar{\tau},X)\mathcal{L}_\ell^{\bar{\beta}}(\bar{\beta};\tau,\bar{\tau},X). \tag{14}
$$

Thus, $\mathcal{L}_\ell^\beta$ and $\mathcal{L}_\ell^{\bar{\beta}}$ can be separately maximized to find their respective parameters. Subsection 1.3 will further explain how the optimum parameters can be estimated.

1.3 Parameter Estimation

Previously, the CRI system produced default predictions to a horizon of two years (CRI [2012]). An extension of the forecast horizon has been implemented as of the PD released on 1 April 2013. With this update, horizons of up to five years are now being computed. Technically speaking, horizons of arbitrary length can be calculated.

This extension to a five-year horizon is done by constraining the term-structure of the parameter estimates to be Nelson-Siegel (Nelson and Siegel [1987]; hereafter NS) functions of the forward-starting time. Horizon-specific parameters β and $\bar{\beta}$ can be obtained from the continuous NS function by using the forward prediction horizon as an input. The term-structures are further constrained so that the effect of risk factors on the forward intensity goes to zero as the horizon increases. This allows tractable and parsimonious extrapolations for horizons beyond five years.

The parameter estimation for the NS functions is based on a new numerical method (a pseudo-Bayesian SMC technique) developed by Duan and Fulop [2013]. The remainder of this section details the new parameter estimation. Subsection 1.3.1 describes the parameterization of the parameters by NS functions. Subsection 1.3.2 explains how a structural break applies to the parameter estimation for the North America calibration group and Chinese firms. Subsection 1.3.3 gives an overview of the SMC method that is used to estimate the NS functions. Subsection 1.3.4 details the calculation of the confidence intervals for the parameter estimation, and Subsection 1.3.5 describes how the parameters can be re-estimated given new data or updates of old data.

1.3.1 Smoothed parameters

Duan et al. [2012] formulate the forward intensity model in which the forward default intensity for a firm is a function of a number of covariates. The forward default intensities for different forward starting periods are computed using different sets of parameters.

In Duan et al. [2012], the sets of parameters are estimated separately for each forward starting time. Parameters at different forward starting times that are associated with each covariate can be approximated by a function of the forward starting time using NS type term structure functions. Duan et al. [2012] show that this approximation by NS functions does not negatively affect prediction performance. The CRI implementation follows Duan and Fulop [2013] to impose the functional restriction during the estimation as opposed to the method used in Duan et al. [2012] of fitting the curve after parameter estimates have been obtained. This is done for two reasons.

First, it will significantly reduce the number of parameters. For example, using 16 covariates for forward default intensities up to 60 months would require a joint estimation of $17 \times 60 = 1020$ parameters. Here, 17 comes from adding an intercept to the intensity function with 16 covariates. If the coefficients corresponding to each covariate are represented by the NS function of 4 parameters, there will be at most $17 \times 4 = 68$ parameters. In fact, there will be fewer parameters as some of the NS parameters will be constrained to zero.

Second, the NS function will allow extrapolation. For example, the 17 NS functions estimated with predictions up to 60 months can be used for prediction, say, over 72 months.

The NS function with four free parameters is:

$$r(t; \varrho_0, \varrho_1, \varrho_2, d) = \varrho_0 + \varrho_1 \frac{1 - \exp(-t/d)}{t/d} + \varrho_2 \left[\frac{1 - \exp(-t/d)}{t/d} - \exp(-t/d) \right], \tag{15}$$

where t is the forecast horizon (measured in years). In the CRI implementation, the horizon is 60 months (5 years) so that t ranges from 0 to 59/12. Once the four NS parameters are estimated, individual horizon-specific parameters β and $\bar{\beta}$ are obtained from the NS function r using the forecast horizon as input to the NS function. In our current implementation with forecast horizons extending to 60 months (5 years), 120 sets of month specific β and $\bar{\beta}$ are obtained. For all covariates, the restriction $d > 0$ is imposed so that the functions converge to a value for large t. This formulation will be used for forward intensities for both defaults and other types of exit.

For the coefficients of all stochastic covariates, the long-run level ϱ_0 is restricted to zero, because the current value of a stochastic covariate should be uninformative of default or other exits when the forward starting time goes to infinity. In other words, the coefficient of such a stochastic covariate should approach zero when t goes to infinity.

The intercept of the forward intensity function is of course non-stochastic. Thus, ϱ_0 can have non-zero values for the intercept. With these restrictions on the NS parameters, take the example of 16 covariates and an intercept, there will be a total of $16 \times 3 + 1 \times 4 = 52$ parameters, provided that the calibration group does not carry a structural break.

In the CRI implementation, the NS function is further constrained to be non-positive for certain covariates: liquidity level and trend, and profitability level and trend. Refer to Section 2 for descriptions of these covariates.

For China, we have 15 input variables (an intercept plus 14 covariates) due to the different variable selection specific to the economy (see Subsection 2.1). In addition, we further revise the parameter estimation for the North America calibration group and Chinese firms. For details, refer to Subsection 1.3.2.

1.3.2 Structural break

The North America calibration group (the US and Canada) has incorporated the following two specific changes. First, we include a dummy variable on the intercept for financial firms to account for differences that have not been duly reflected through other covariates. Second, we apply a structural break to this financial-sector intercept dummy to address the change in September 2008 after Lehman Brothers defaulted.

The structural break for the North America calibration group is treated as an impulse response. The key is to allow the different rates of transition, characterized by $\widetilde{\alpha}_1(\tau) > 0$ and $\widetilde{\alpha}_2(\tau) > 0$, before and after the break point t_0 (September 2008), respectively. Before t_0, for example, the coefficient for the financial–sector intercept dummy, $\beta(t, \tau; t_0)$, has the form:

$$\beta(t, \tau; t_0) = \widetilde{\beta}(\tau) + \widetilde{\gamma}(\tau) \times \frac{1}{1 + e^{-\widetilde{\alpha}_1(\tau)(t - t_0)}},$$

where t denotes the default prediction time, and τ denotes a forward starting time ranging from 0 (1 month) to 59/12 (5 years). $\widetilde{\alpha}_1(\tau)$, $\widetilde{\beta}(\tau)$, and $\widetilde{\gamma}(\tau)$ are characterized by the NS function in Eq. (15). After t_0, the coefficient for the financial–sector intercept dummy is governed by $\widetilde{\alpha}_2(\tau)$ instead of $\widetilde{\alpha}_1(\tau)$:

$$\beta(t, \tau; t_0) = \widetilde{\beta}(\tau) + \widetilde{\gamma}(\tau) \times \frac{1}{1 + e^{-\widetilde{\alpha}_2(\tau)(t_0 - t)}}.$$

Therefore, $\beta(t, \tau; t_0)$ moves from $\widetilde{\beta}(\tau)$ to $\widetilde{\beta}(\tau) + 1/2\widetilde{\gamma}(\tau)$ as t advances toward t_0, and reverts back to $\widetilde{\beta}(\tau)$ as t goes past t_0.

Our treatment on Chinese firms differs from that for the North American calibration group in two aspects. First, we apply a structural break to both the intercept and the DTD level. Second, we model the structural break by a step function allowing for different rates of transition to and away from the break point. As implemented earlier, the treatment is the same for intercept term and the coefficient for the DTD level, but the transition rates are different. Here, we describe generically for one of these two structural breaks. Before t_0 (December 2004), $\beta(t, \tau; t_0)$ has the following form:

$$\beta(t, \tau; t_0) = \widetilde{\beta}(\tau) + \widetilde{\gamma}(\tau) \times \frac{1}{1 + e^{-\widetilde{\alpha}_1(\tau)(t - t_0)}},$$

After t_0, the two variables are governed by $\widetilde{\alpha}_2(\tau)$:

$$\beta(t, \tau; t_0) = \widetilde{\beta}(\tau) + \widetilde{\gamma}(\tau) \times \frac{1}{1 + e^{-\widetilde{\alpha}_2(\tau)(t - t_0)}}.$$

Therefore, $\beta(t,\tau;t_0)$ smoothly transits from $\widetilde{\beta}(\tau)$ to $\widetilde{\beta}(\tau)+1/2\widetilde{\gamma}(\tau)$ as t moves toward t_0, and then continues to $\widetilde{\beta}(\tau)+\widetilde{\gamma}(\tau)$ as t moves beyond t_0.

1.3.3 Parameter estimation by SMC

Reliably estimating a system involving 52 parameters for 16 covariates and an intercept presents a numerical challenge. Moreover, the number of parameters can be greater than 52 if there are more than 16 covariates or structural breaks. The CRI implementation follows Duan and Fulop [2013] who use the SMC pseudo-Bayesian method for estimation and self-normalized statistics for inference.

Due to decomposability, the analysis can be performed separately on the forward default and other exit intensities. The data in the CRI implementation are refreshed with monthly frequency, and the sample likelihood used in estimation relies on default predictions running from 1 month to 60 months with a one month increment. Naturally, default prediction is subject to data availability. Towards the end of the period with available data, the prediction horizon naturally decreases and stops at one-month predictions.

The following exposition closely follows the appendix in Duan and Fulop [2013]. It is important to note that the CRI implementation uses the model described in Duan and Fulop [2013], which does not contain any latent frailty or partial conditioning variable, and hence is technically much simpler in parameter estimation. For example, there is no nonlinear filtering problem.

According to the current modeling framework, where for a particular economy there are N end of month observations, the input variables of the ith firm in the mth month is given by $X_i(m)$. Let θ denote a set of NS parameters and ℓ denote the forecast horizon ($\ell = 60$). Then the pseudo-likelihood function at step m, denoted by $\mathcal{L}_{m,\min(N-m,\ell)}(\theta)$, takes the form:

$$\mathcal{L}_{m,\min(N-m,\ell)}(\theta) = \prod_{i=1}^{I} P_{\min(N-m,\ell)}(\beta(\theta), \bar{\beta}(\theta); \tau_i, \bar{\tau}_i, X_i(m)), \tag{16}$$

where I is the number of firms, $\beta(\theta)$ and $\bar{\beta}(\theta)$ are the default and other exit coefficient vectors from Eq. (6) generated from the NS functions with parameter θ, respectively. One may notice that $\mathcal{L}_{m,\min(N-m,\ell)}(\theta)$ is one of the terms in the outer-most product in Eq. (10).

Let $\pi(\theta)$ denote the prior. Following the notation from Section 1.1, consider the following pseudo-posterior distribution at time n after one makes the ℓ-period prediction:

$$\gamma_n(\theta) \propto \prod_{m=1}^{n-1} \mathcal{L}_{m,\min(N-m,\ell)}(\theta)\pi(\theta), \text{ for } n = 2, \ldots, N, \tag{17}$$

In the CRI implementation, $\pi(\theta)$ is set to 1, i.e., a uniform or improper prior instead of the previous normal/truncated normal priors. This revision frees the estimation algorithm from needing an ad hoc prior belief to start the process. Despite this change, the estimation results remain qualitatively similar, reflecting the fact that our dataset is quite large and the prior's effect is only marginal.

One can apply the sequential batch-resampling routine of Chopin [2002] together with tempering steps as in Del Moral et al. [2006] to advance the system. For each n, this procedure yields a weighted sample of K particles, $(\theta^{(k,n)}, w^{(k,n)})$ for $k = 1, \ldots, K$, whose empirical distribution function will converge to $\gamma_n(\theta)$ as K increases. In the following paragraphs, the superscript k denotes the particle index. Note that in the CRI implementation, K=1,000.

***Initialization*:** To provide the initial particle cloud from which the algorithm can start, an initial random sample from the normal distribution is drawn ($\theta^{(k,0)} \sim \mathcal{N}(\boldsymbol{\mu}, \Sigma)$, $w^{(k,0)} = 1/K$). Of course, the support of the normal distribution must contain the true parameter value θ_0. In the CRI implementation, μ and σ are chosen based on cumulative knowledge on parameters' locations and dispersions to speed up optimization.

Recursions and defining the tempering sequence: Assume there is a particle cloud $\left(\theta^{(k,n)}, w^{(k,n)}\right)$ whose empirical distribution represents $\gamma_n(\theta)$. Then, a cloud representing $\gamma_{n+1}(\theta)$ will be reached by combining importance sampling and the Markov Chain Monte Carlo (MCMC) steps. Sometimes moving directly from $\gamma_n(\theta)$ to $\gamma_{n+1}(\theta)$ is too ambitious as the two distributions are too far from each other. This will be reflected in highly variable importance weights if one resorts to direct importance sampling. Hence, following Duan and Fulop [2013] which in turn followed Del Moral et al. [2006], a tempered bridge is built between the two densities and the particles are evolved through the resulting sequence of densities. In particular, assume that at time $n+1$, there are P_{n+1} intermediate densities:

$$\overline{\gamma}_{n+1,p}(\theta) \propto \gamma_n(\theta)\mathcal{L}^{\xi_p}_{n,\min(N-n,\ell)}(\theta), \text{ for } p = 0, \ldots, P_{n+1}. \tag{18}$$

This construction defines an appropriate bridge: $\xi_0 = 0$ so that $\overline{\gamma}_{n+1,0}(\theta) = \gamma_n(\theta)$, and $\xi_{P_{n+1}} = 1$ so that $\overline{\gamma}_{n+1,P_{n+1}}(\theta) = \gamma_{n+1}(\theta)$. For p between 0 and P_{n+1}, ξ_p is chosen from a grid of points to evenly distribute the weights, as described below. A particle cloud representing $\overline{\gamma}_{n+1,0}(\theta)$ can be initialized as $(\overline{\theta}^{(k,n+1,0)}, \overline{w}^{(k,n+1,0)}) = (\theta^{(k,n)}, w^{(k,n)})$. Then, for $p = 1, \ldots, P_{n+1}$ the sequence proceeds as follows:

- *Reweighting Step:* At the beginning of each tempering step, p, a reweighting procedure is run:
$$\overline{w}^{(k,n+1,p-1)} \times \mathcal{L}^{\xi_p - \xi_{p-1}}_{n,\min(N-n,\ell)}(\overline{\theta}^{(k,n+1,p)}), \tag{19}$$
where ξ_p is chosen to ensure that a minimum effective sample size (ESS) is maintained, where ESS is defined as
$$\text{ESS} = \frac{\left(\sum_{k=1}^{K} \overline{w}^{(k,n+1,p)}\right)^2}{\sum_{k=1}^{K}\left(\overline{w}^{(k,n+1,p)}\right)^2}. \tag{20}$$
The newly adopted minimum ESS is 25% of the sample size, which equals 250 with the CRI's use of the SMC sample for 1,000 parameter particles. This is done by a grid search, where the ESS is evaluated at a grid of candidate values for ξ_p. The one that produces the ESS that is larger than and closest to 250 is chosen. By changing the criterion from 500 to 250, bigger steps for ξ_p are taken to speed the algorithm without adversely affecting the quality of the estimation result.

  In order to arrive at a representation of $\overline{\gamma}_{n+1,p}(\theta)$, the particles representing $\overline{\gamma}_{n+1,p-1}(\theta)$ and the importance sampling principle can be used. This leads to:
$$\overline{\theta}^{(k,n+1,p)} = \overline{\theta}^{(k,n+1,p-1)}, \tag{21}$$
$$\begin{aligned}\overline{w}^{(k,n+1,p)} &= \overline{w}^{(k,n+1,p-1)} \times \frac{\overline{\gamma}_{n+1,p}(\overline{\theta}^{(k,n+1,p)})}{\overline{\gamma}_{n+1,p-1}(\overline{\theta}^{(k,n+1,p)})} \\ &= \overline{w}^{(k,n+1,p-1)} \times \mathcal{L}^{\xi_p - \xi_{p-1}}_{n,\min(N-n,\ell)}(\overline{\theta}^{(k,n+1,p)}).\end{aligned} \tag{22}$$

  To avoid particle impoverishment in sequential importance sampling where most of the weights are concentrated in a small number of particles, a resample-move step is run.

- *Resampling Step:* The particles are resampled proportional to their weights. If $I^{(k,n+1,p)} \in (1, \ldots, K)$ are particle indices sampled proportional to $\overline{w}^{(k,n+1,p)}$, the equally weighted particles are obtained as

$$\overline{\theta}^{(k,n+1,p)} = \overline{\theta}^{(I^{(k,n+1,p)},n+1,p)}, \tag{23}$$

$$\overline{w}^{(k,n+1,p)} = \frac{1}{K}. \tag{24}$$

- *Move Step:* Each particle is passed through a Markov kernel $\mathcal{K}_{n+1,p}(\overline{\theta}^{(k,n+1,p)}, \cdot)$ that leaves $\overline{\gamma}_{n+1,p}(\theta)$ invariant, typically a Metropolis-Hastings kernel:

  1. Propose $\theta^{*(k)} \sim \mathcal{Q}_{n+1,p}\left(\cdot \;\middle|\overline{\theta}^{(k,n+1,p)}\right)$.
  2. Compute the acceptance rate α, where:

  $$\alpha = \min\left(1, \frac{\overline{\gamma}_{n+1,p}(\theta^{*(k)})\mathcal{Q}_{n+1,p}(\overline{\theta}^{(k,n+1,p)} \mid \theta^{*(k)})}{\overline{\gamma}_{n+1,p}(\overline{\theta}^{(k,n+1,p)})\mathcal{Q}_{n+1,p}(\theta^{*(k)} \mid \overline{\theta}^{(k,n+1,p)})}\right). \tag{25}$$

  3. With probability α, set $\overline{\theta}^{(k,n+1,p)} = \theta^{*(k)}$, otherwise keep the old particle.

This step will enrich the support of the particle cloud while conserving its distribution. If the particle set is a poor representation of the target distribution, the move step can also help adjust the location of the support. Crucially, given the importance of the sampling setup, the proposal distribution $Q_{n+1,p}(\cdot \mid \overline{\theta}^{(k,n+1,p)})$ can be adapted using the existing particle cloud.

In the CRI implementation, we define three (or four) NS parameters corresponding to each covariate as one block. A mixture distribution is designed to combine with equal probabilities: (1) a block independent normal distribution using the means and the standard deviations derived from the existing particle set, and (2) a random walk proposal based on a scaled-down covariance matrix used in the block independent proposal; that is,

$$\theta^{*(k)} \sim \frac{1}{2}\mathcal{N}(\boldsymbol{\mu}, \Sigma) + \frac{1}{2}\mathcal{N}\left(\overline{\theta}^{(k,n+1,p)}, \Sigma^*\right),$$

where $\boldsymbol{\mu}$ is the sample mean vector of $\overline{\theta}^{(k,n+1,p)}$ and Σ is the covariance matrix with a block diagonal structure, i.e., the covariances across blocks are all zero. $\sigma^{*2}_{i,j}$, which is the (i,j)–th element of Σ^*, is set to be $(0.2\sigma_{i,j})^2$ (the (i,j)–th element of Σ), to propose around the original values. Mixing the independent and random walk proposals can effectively boost the support (i.e., a higher ESS) by offering local alternatives to those parameters with already high likelihood, especially when there exists discrepancies between the true distribution and its approximating normal distribution.

Moreover, we do not propose to replace an entire parameter particle, and implement a random block proposal. For each particle, say, comprising sixteen blocks (i.e., covariates), we randomly select a random number of blocks (from five to ten) and only propose new values for the selected blocks, while keeping the remaining blocks at their original values. This design can increase the acceptance rate and still offer rich enough replacements. To ensure a good replacement for every block, we perform multiple such Metropolis-Hastings steps each time until the accumulated acceptance rate exceeds 100% and the ESS reaches at least 75% of sample size.

Finally, proposed particles must satisfy some pre-defined constraints. First, the NS parameter d must be positive. Second, particles must produce an increasing or decreasing structure of the NS function for the first five months in order to ensure the smoothness of the term structure of the forward intensity parameters. Third, the coefficients for some covariates, such as the level and trend of liquidity, are required to be non–positive over all forward starting times.

Using the mixture proposal creates a minor complication. The sampler for the truncated values does not carry the same norming constant due to the inclusion of the random walk proposal so that it cannot be ignored in the importance weight. To address the issue, we treat those sampled parameters violating the above mentioned constraints as if there were legitimate particles, but assign the likelihood $\overline{\gamma}_{n+1,p}(\theta^{*(k)})$ of any such proposed particle a value of 0. In short, such particles will never be accepted.

Final tempering step: When $p = P_{n+1}$ is reached (i.e., ξ_p reaches 1), a representation of $\gamma_{n+1}(\theta)$ is:

$$(\theta^{(k,n+1)}, w^{(k,n+1)}) = (\overline{\theta}^{(k,n+1,P_{n+1})}, \overline{w}^{(k,n+1,P_{n+1})}). \tag{26}$$

Additional Metropolis–Hastings moves are performed until the accumulated acceptance rate exceeds 200% instead of 100% at the prior steps. This is to improve the final quality of the SMC sample of parameter particles in representing the target distribution.

Re–initialization: Recall that our SMC approach is the expanding–data SMC technique according to the classification in Duan and Fulop [2013]. Although the expanding data approach is more computationally efficient, we noticed that approximation errors may sometimes get accumulated after repeatedly updating the SMC parameter particle set by adding data one month at a time. We thus introduce a parameter re-initialization every 10 sequential updating time steps to remove the potentially accumulated approximation errors. Re-initialization is the same as the initialization at the beginning of the SMC, except that the relevant means and variances-covariances are computed with the updated SMC parameter particle set so that re-initialization can take advantage of updated information on the sampling distribution.

1.3.4 Statistical inference

The full sample size has N time series data points, but one can only make default prediction at $N-1$ time points; for example, at time point 2, the data is only available for making one-period default prediction at time point 1. Denote the pseudo-posterior mean of the parameter of the whole sample by $\hat{\theta}_N$. And for $n = 2, \cdots, N$,

$$\hat{\theta}_n = \frac{1}{\sum_{k=1}^{K} w^{(k,n)}} \sum_{k=1}^{K} w^{(k,n)} \theta^{(k,n)}. \tag{27}$$

Note that $(\overline{\theta}^{(k,n+1,0)}, \overline{\omega}^{(k,n+1,0)}) = (\theta^{(k,n)}, \omega^{(k,n)})$ is not a true posterior because the likelihood function in Eq. (17) is not a true likelihood function. Thus, it cannot directly provide valid Bayesian inference. But following Duan and Fulop [2013] - which is in turn based on Shao's self-normalized statistic (Shao [2010]) - inference can be performed using the t-like statistic in the full-sample run. To test, for example, the hypothesis of the kth element of $\overline{\theta}^{(k,n+1,p)} = \overline{\theta}^{(I^{(k,n+1,p)},n+1,p)}$, denoted by $\overline{\omega}^{(k,n+1,p)} = \frac{1}{K}$, equal to a, one has:

$$t^* = \frac{\sqrt{N-1}\left(\hat{\theta}_N^{(k)} - a\right)}{\sqrt{\hat{\delta}_{k,N}}} \xrightarrow{d} \frac{W(1)}{\left[\int_0^1 (W(r) - rW(1))^2 dr\right]^{1/2}}, \tag{28}$$

where $W(r)$ is a Wiener process, $\hat{\delta}_{k,N}$ is the kth diagonal element of $\hat{C}_N$, and

$$\hat{C}_N = \frac{1}{(N-1)^2} \sum_{n=2}^{N} n^2 (\hat{\theta}_n - \hat{\theta}_N)(\hat{\theta}_n - \hat{\theta}_N)'. \tag{29}$$

The statistical inference on the structural break parameters are again based on Shao's self-normalized statistic (see Subsection 1.3.2). Since the parameters in connection with the structural break cannot be identified using the data before the break point, the sequence of parameter estimates used in Shao's self-normalized statistic can only start from the break point onward. In the CRI implementation, all parameter estimates, break or non-break related, start from the break point. Denote by T the endpoint of the data set and t_0 again the structural break point. The number of points in the sequence, N, used to compute the norming matrix and the confidence intervals (see Eq. (29)) therefore equals $T - t_0 + 1$.

The right-hand-side random variable for t^* in Eq. (28) does not have a known distribution, but can be easily simulated. Kiefer et al. [2000] reported that the 95% quantile is 5.374 and the 97.5% quantile is 6.811. These values can also be used to set up confidence intervals.

1.3.5 Periodic updating

In reality, portfolio credit risk models need to be updated periodically as new data arrive and/or old data are revised. With one new month of data, this means that the final date index N is increased to $N + 1$. For this monthly real-time updating procedure, we always apply re-initialization as described in Subsection 1.3.3, where the relevant means and variances–covariances used to generate the initial particle cloud are computed with the updated SMC parameter particle set from the previous run up to time N. Then one can apply the same recursive procedure described earlier. Furthermore, one can update all self-normalized statistics in the way as described earlier to reflect the additional one more pseudo-posterior means to the sequence.

As for this technical report, the initial parameter estimation is carried out for all calibration groups using the data up to the end of March 2018. Additional implementation details on the calibration are given in Section 3.

2 Input Variables and Data

Subsection 2.1 describes the input variables used in the quantitative model. In principle, the same set of input variables is common to most of the economies under the CRI's coverage. Going further, the CRI system starts to apply different input variables to different economies (e.g., China). The effect of each of the variables on the PD output will be discussed in the empirical analysis of Section 4.

Subsection 2.2 gives the data sources and relevant details of the data sources. There are two categories of data sources: current and historical. Data sources used for current data need to be updated in a timely manner so that daily updates of PD forecasts are meaningful. They also need to be comprehensive in their current coverage of firms. Data sources that are comprehensive for current data may not necessarily have comprehensive historical coverage for different economies. Thus, other data sources are merged in order to obtain comprehensive coverage of historical and current data.

Subsection 2.3 indicates the fields from the data sources that are used to construct the input variables. For some of the fields, proxies need to be used for a firm if the preferred field is not available for that firm.

Subsection 2.4 discusses the definition and sources of defaults and of other exits used in the CRI.

2.1 Input Variables

Following the notation that was introduced in Section 1, firm i's input variables at time $t = n\Delta t$ are represented by the vector $X_i(n) = (W(n), U_i(n))$ consisting of a vector $W(n)$ that is common to all firms in the same economy, and a firm-specific vector $U_i(n)$ which is observable from the date the firm's first FS is released, until the month end before the month in which the firm exits, if it does exit.

In Duan et al. [2012], different variables that are commonly used in the literature were tested as candidates for the elements of $W(n)$ and $U_i(n)$: the 2 common variables and 10 firm-specific variables were selected as having the greatest predictive power for corporate defaults in the United States. In the current stage of development, the set of 16 covariates beyond the past 12 variables, as described below, is generally used for all economies but China. In this way, future development will include variable selection for firms in different economies.

- Common variables

  The vector $W(n)$ contains four elements, which are:

  1. Stock index return: the trailing one-year simple return on a major stock index of the economy;
  2. Interest rate: a representative 3-month short-term interest rate standardized from the data available point until now;
  3. Financial Aggregate DTD: median DTD of financial firms in each economy/country inclusive of those foreign financial firms whose primary shock exchange is in this economy/country;
  4. Non–financial Aggregate DTD: median DTD of non–financial firms in each economy/country inclusive of those foreign financial firms whose primary shock exchange is in this economy/country.

Stock index return incorporates the following two treatments. First, we use unified currencies for 6 groups of economies: China (CNY), India (INR), Asia Pacific Developed (USD), Emerging Market (USD), Europe (EUR), and North America (USD). Second, we winsorize the unified return over the range of $[5\%, 95\%]$ for 3 groups of economies: Asia Pacific Developed, Emerging Market, and Europe.

Interest rate is standardized in the way of demeaning each series and then scaling the demeaned values so that the standard deviation equals one, except for China and India. The treatment specific to the Eurozone is detailed in Subsection 3.3.

Each of the aggregate DTDs is only applicable to firms in the corresponding category. In short, the number of covariates used for default prediction is 16 including 12 firm–specific variables, as will be discussed below. China, however, differs from other economies/countries where the two aggregate DTDs are not applicable, because they offer no informational value above and beyond what have already been captured. The number of covariates for China is thus still 14.

- Firm-specific variables

  The 12 firm-specific input variables are transformations of measures of 6 different firm characteristics. The 6 firm characteristics are:

  1. volatility-adjusted leverage;
  2. liquidity;
  3. profitability;
  4. relative size;
  5. market mis-valuation/future growth opportunities; and
  6. idiosyncratic volatility.

Volatility-adjusted leverage is measured as the DTD in a Merton-type model. The calculation of DTD used by the CRI allows a meaningful DTD for financial firms, a critical sector that must be excluded from most DTD computations. This calculation is detailed in Section 3.

Liquidity is measured as a log ratio of cash and short-term investments to total assets for financial firms and a log ratio of current assets to current liabilities for non–financial firms. Profitability is measured as a ratio of net income to total assets. Relative size is measured as the logarithm of the ratio of market capitalization to the economy's median market capitalization.

Duan et al. [2012] transformed these first four characteristics into level and trend versions of the measures. For each of these characteristics, the level is computed as the one-year average of the measure, and the trend is computed as the current value of the measure minus the one-year average of the measure. The level and trend of a measure have seldom been used in the academic or industry literature for default prediction, and Duan et al. [2012] found that using the level and trend significantly improves the predictive power of the model for short-term horizons.

To understand the intuition behind using level and trend of a measure as opposed to using just the current value, consider the case of two firms with the same current value for all measures. If the level and trend transformations were not performed, only the current values would be used and the two firms would have identical PD. Suppose that for the first firm the DTD had reached its current level from a high level, and for the second firm the DTD had reached its current level from a lower level (see Fig. 2). The first firm's leverage is increasing (worsening) and the second firm's leverage is decreasing (improving). If there is a momentum effect in DTD, then firm 1 should have a higher PD than firm 2.

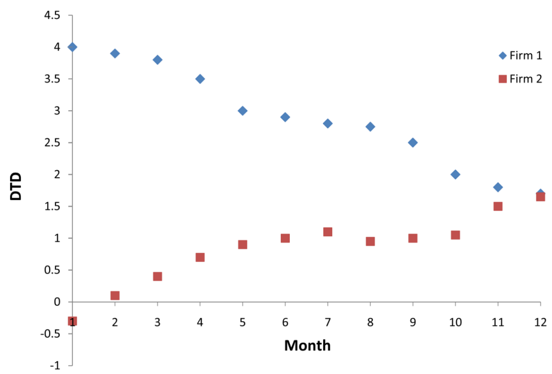


Figure 2: Two firms with all current values equal to each other, but DTD trending in the opposite direction.

Duan et al. [2012] found evidence of the momentum effect in DTD, liquidity, profitability and size. For the other two firm characteristics, applying the level and trend transformation did not improve the predictive power of the model.

As of this technical report, we further conduct additional treatments on liquidity and size. First, the level and trend of liquidity are respectively allowed to be sector–specific: financial firms, and non–financial firms. For financial firms, we take natural logarithm on the existing liquidity definition: log[(Cash + Short–term investments) / Total assets]. For non–financial firms, we refine liquidity as log(Current assets / Current liabilities) with the two current items in their financial statements. Second, size is redefined through the unified currency discussed above and then divided by the economy's median market capitalization over the past one year.

One of the remaining two firm characteristics is the market mis-valuation/future growth opportunities characteristic, which is taken as the "relative" market–to–book asset ratio (M/B) and measured as Individual firm's M/B divided by Economy M/B median. One can see whether the market mis-valuation effect or the future growth opportunities effect dominates this measure by looking at whether the parameter for this variable is positive or negative. This will be further discussed in the empirical analysis of Section 4.

The last firm characteristic is the idiosyncratic volatility which is taken as SIGMA, following Shumway [2001]. SIGMA is computed by regressing the daily returns of the firm's market capitalization against the daily returns of the economy's stock index, for the previous 250 days. SIGMA is defined to be the standard deviation of the residuals of this regression. Using daily returns is to ensure that SIGMA provides an accurate and timely measure of idiosyncratic risk of individual companies. Shumway [2001] reasons that SIGMA should be logically related to bankruptcy since firms with more variable cash flows and therefore more variable stock returns relative to a market index are likely to have a higher probability of bankruptcy.

Finally, the vector $U_i(n)$ contains 12 elements, consisting of:

1. Level of DTD.
2. Trend of DTD.
3. Level of log[(Cash + Short–term investments) / Total assets] for financial firms, abbreviated as CASH/TA.
4. Trend of CASH/TA for financial firms.
5. Level of log(Current assets / Current liabilities) for non–financial firms, abbreviated as CA/CL.
6. Trend of CA/CL for non–financial firms
7. Level of Net income / Total assets, abbreviated as NI/TA.
8. Trend of NI/TA.
9. Level of log (Firm market capitalization / Economy's median market capitalization over the past one year), abbreviated as SIZE.
10. Trend of SIZE.
11. Current value of Relative M/B displayed above, abbreviated as M/B.
12. Current value of SIGMA.

Note that every firm should belong to either a financial sector or a non–financial sector, determining which liquidity ratio between CASH/TA and CA/CL is used. When it comes to one financial firm, for example, we cannot use CA/CL level and trend among the 12 elements. Therefore, default prediction of each firm should depend on the rest of the 10 firm–specific variables. The data fields that are needed to compute DTD and short-term investments are described in Subsection 2.3. The remaining data fields required are straightforward and standard. The computation for DTD is explained in Section 3.

2.2 Data Sources

There are two data sources that are used for the daily PD forecast updates: Thomson Reuters Datastream and the Bloomberg Data License Back Office Product. Many of the common factors such as short-term interest rates and macroeconomic data are retrieved from Datastream.

Firm-specific data come from Bloomberg's Back Office Product which delivers daily update files by region via FTP after respective market closes. All relevant data is extracted from the FTP files and uploaded into the CRI database for storage. From this, the necessary fields are extracted and joined with previous months of data.

The Back Office Product includes daily market capitalization data based on closing share prices and also includes new FSes as companies release them. Firms will often have multiple versions of FSes within the same period, with different accounting standards, filing statuses (most recent, preliminary, original, reclassified or restated), currencies or consolidated/unconsolidated indicators. A major challenge lies in prioritizing these FSes to decide which data should be used. The priority rules are described in section 3.

The firm coverage of the Back Office Product is of sufficient quality that over 34,000 firms can be updated on a daily basis in the 128 economies under the CRI's coverage. While the current coverage is quite comprehensive, historical data from the Back Office Product can be sparse for certain economies. For this reason, various other databases are merged in order to fill out the historical data. The other databases used for historical data are: a database from the Taiwan Economics Journal (TEJ) for Taiwanese firms; a database provided by Korea University for South Korean firms; data from Prowess for Indian firms; and the Compustat for United States.

With all of the databases merged together and for the 128 economies under CRI's coverage, around 67,000 exchange-listed firms are in the CRI database. The historical coverage of the firm data goes back to the early 1990s. In order to be included in our coverage, a company needs to have common equity traded on a stock exchange. Of these 128 economies, 87 economies have their own stock exchange (see Table A.2). For the other 41 economies under the CRI coverage, we cover companies domiciled in the economy that are quoted on a foreign exchange, either because those economies do not have a stock exchange or because data issues are preventing us from including the companies listed on the local exchange (see Table A.3). For these reasons, we exclude two economies for the CRI products calibrated in April 2018: Dominican Republic and Niger Republic.

2.3 Constructing Input Variables

The chosen stock indices and short-term interest rates for the 87 economies with their own stock exchanges under the CRI's current coverage are listed in Tables A.5 and A.6, respectively. All economies are listed by their three letter ISO code given in Table A.4.

Most of the firm-specific variables can be readily constructed from standard fields from firms' FSes in addition to daily market capitalization values. The only two exceptions are the DTD and the liquidity measure.

The calculation for DTD is explained in section 3. In the calculation, several variables are required. One variable is a proxy for a one-year risk-free interest rate, and the choices for each of the 87 economies are listed in Table A.7. Total assets, long-term borrowing and total liabilities are also required, but can be obtained from standard FS fields easily.

Total current liabilities are also required, and due to the relatively large numbers of firms that are missing this value, proxies have to be found. The preferred Bloomberg field for this is BS_CUR_LIAB. If this is missing, then the sum of BS_ST_BORROW, BS_OTHER_ST_LIAB, BS_CUST_ACCPT_LIAB_CUSTDY_SEC (customers' acceptance and liabilities/custody securities) and BS_SEC_SOLD_REPO_AGRMNT is used. If one, two or three of these are missing, zero is inserted into those fields, but at least one of the four fields is required.

The liquidity measure requires different fields for financial and non-financial firms. For financial firms, the numerator of "CASH/TA", (Cash + Short-term investments), is taken as the sum of BS_CASH_NEAR_CASH_ITEM and BS_MKT_SEC_OTHER_ST_INVEST (marketable securities and other short-term investments). If BS_MKT_SEC_OTHER_ST_INVEST is missing, substitute zero (but BS_CASH_NEAR_CASH_ITEM is required). For non–financial firms, the two elements of "CA/CL" come from BS_CUR_ASSET_REPORT and BS_CUR_LIAB, respectively: log(Current assets / Current liabilities).

It was found that this sum frequently overstated the liquidity for financial firms. In place of BS_MKT_SEC_OTHER_ST_INVEST, financial firms use the sum of ARD_SEC_PURC_UNDER_AGR_TO_RESELL (securities purchased under agreement to re-sell), ARD_ST_INVEST and BS_INTERBANK_ASSET. If one or two of these are missing, zero is inserted for those fields, but at least one field is required. The "ARD" prefix indicates that these are "as reported" numbers directly from the FSes. As such, for some firms these fields may need to be adjusted to the same units before adding them to other fields.

To summarize, the firm-specific variables include: DTD, Cash/TA, CA/CL, NI/TA, SIZE, M/B, and SIGMA, and the statistics grouped by economy are listed in Table A.8.

2.4 Data for Corporate Events

The CRI database contains 11,557 default events and 56,668 other exits events from 1990 to the present. The corporate events come from numerous sources, including Bloomberg, Compustat, CRSP, Moodys reports, TEJ, exchange websites and news sources. Moreover, in order to enhance default coverage, from December 2015, the CRI team has started to use "defaults" reported by major credit rating agencies as an additional data source.

The default events that are recognized by the CRI can be classified under one of the following events:

(1) Bankruptcy filing, receivership, administration, liquidation or any other legal impasse to the timely settlement of interest and/or principal payments;

(2) A missed or delayed payment of interest and/or principal, excluding delayed payments made within a grace period;

(3) Debt restructuring/distressed exchange, in which debt holders are offered a new security or package of securities that result in a diminished financial obligation (e.g., a conversion of debt to equity, debt with lower coupon or par amount, debt with lower seniority, debt with longer maturity).

The more precise sub-categories of default corporate actions are listed in Table A.9.

Delisting due to other reasons such as failure to meet listing requirements, inactive stock prices or M&A are counted as "other exits" and are not considered as default. Especially, if a firm has stale stock price for more than a year but has no record on experiencing any credit events, we will assume that it has been suspended and exited from its stock exchange. If two credit events of the same type happen in a row or a default event happens followed by another event of either type, we only keep the first event assuming that the series of events arise from the same source of financial distress. However, if firms are delisted from an exchange and then experience a default event within 365 calendar days of the delisting, we will only keep the default event, and any information between the two dates won't be used. Technical defaults such as covenant violations are not included in our definition of default. The exit events that are not considered as defaults in the CRI system are listed in Table A.10.

In addition to the aforementioned events, there are still cases that require special attention and will be assessed on a case-by-case basis, e.g., subsidiary default. As a general rule, the CRI does not consider related party-default (e.g., subsidiary bankruptcy) as a default event. However, when a non-operating holding parent company relies heavily on its subsidiary, bankruptcy by the subsidiary will cause a considerable economic impact on the parent company. Such cases will be reviewed, and final classifications will be made.

Complete statistics of the total number of firms, number of defaults, and number of other exits in each of the 87 economies from 1990 to 2017 are listed in Table A.11.

3 Implementation Details

Section 1 described the modeling framework underlying the current implementation of the CRI system. It focused on theory rather than the details encountered in an operational implementation. The present section describes how the CRI system handles more specific issues.

Subsection 3.1 describes implementation details related to data, mainly dealing with data cleaning and missing data. Subsection 3.2 describes the specific computation of DTD used by the CRI system that leads to meaningful DTD for financial firms. Subsection 3.3 explains how the calibration previously described in Subsection 1.2 can be implemented. Subsection 3.4 gives the implementation details relevant to the daily output. This includes an explanation of the various modifications needed to compute daily PDs so that the daily PDs are consistent with the usual month end PD and a description of the computation of the aggregate PDs provided by the CRI.

3.1 Data Treatment for Calibration

Fitting data to monthly frequency: Historical end of month data for every firm in an economy is required to calibrate the model. For daily data such as market capitalization, interest rates and stock index values, the last day of the month for which there is valid data is used.

Up to the October 2012 calibration, FS variables data were used, starting from the period end of the statement lagged by 3 months. This is to ensure that predictions are made based on information that was available at the time the prediction was made. However, this treatment can be over-conservative, and many companies actually release their FSes quicker than 3 months. Therefore, we implement a new logic, and we start using the values in an FS as soon as its latest revision was put into the CRI database, unless the FS' release was delayed for more than 3 months. If there was no revision to an FS, the originally released FS is used. Whenever the latest revision is available more than 3 months after the period end, we revert to the previous logic. We start including the FS before the latest revision is actually available as a compromise, to avoid situations like later minor revisions of the FS holding back more up-to-date information. It should be noted that the new approach was only applied for FS input into the CRI database after February 2011, as the revision dates were not accurately recorded before this date. The CRI considers FS variables to be valid for one year without restriction, after they were first used.

Priority of FSes with the same period end: As described in Subsection 2.2, data provided in Bloomberg's Back Office Product can include numerous versions of FSes within the same period. If there are multiple FSes with the same period end, priority rules must be followed in order to determine which to use. The formulation and implementation of these rules are major challenges and areas of continuing development.

The first rule is to prioritize by consolidated/unconsolidated status. This rule applies to all economies, however, special treatment is imposed on firms in the "diversified financial services" sector in South Korea and Taiwan. In this sector of the two economies, firms issue unconsolidated FSes more frequently than consolidated ones. As a result, this prioritization rule can lead to cases where the FSes chosen switch between unconsolidated and consolidated ones on a regular basis. In South Korea and Taiwan, where corporate structures are biased toward large holding companies, this switching may substantially distort the DTD calculation for these holding companies. Therefore, as of October 2013 calibration, in the case of South Korea, and November 2013 calibration, in the case of Taiwan, if a company has released at least one consolidated FS over the last 12 months, all unconsolidated FS will be ignored.

If, after the first prioritization rule has been applied, there are still multiple FSes, the second rule is applied. This is prioritization by fiscal period. In most economies, annual statements are required to be audited, whereas other fiscal periods are not necessarily audited. The order of priority from highest to lowest is, therefore: annual, semi-annual, quarterly, cumulative, and finally other fiscal periods. We have observed that the capital structure breakdown reported by Australian domiciled-banks differs between annual and semi-annual reports, leading to DTD calculations that are not meaningful. Because of this, as of October 2013 calibration, we only use data from annual FSes for Australian banks.

The third prioritization rule is based on filing status. The "Most Recent" statement is used before the "Original" statement, which is used before the "Preliminary" statement.

The final prioritization rule is based on the accounting standard. As more and more countries adopt the International Financial Reporting Standards (IFRS) as their mandatory accounting standard, FSes that are reported using IFRS are given higher priority than they were before. The revised rule is implemented from the 2014 October calibration and is described as follows. For the countries with mandatory IFRS adoption, FSes under IFRS are now given the highest priority after their respective mandatory adoption dates. Before the mandatory adoption dates and for countries without mandatory IFRS adoption, FSes under the Generally Accepted Accounting Principles (GAAP) have the highest priority. If an FS does not indicate its accounting standard, it will not be used.

Having all the prioritization descriptors in place, we rank all the FSes available in the database from the highest priority to the lowest. If there are FSes where all the financial information needed in our model is present, the FS with the highest ranking will be chosen. If instead there is no such FS, we will pick the values variable by variable. For example, the total liability is taken from the highest ranked FS with this information available, while the total asset can be from another FS, which ranks the highest among those bearing this information and having the same FS period end. This treatment is to get as much information as possible and to accommodate the fact that Bloomberg occasionally only revises the variables that have changed values, leaving the other fields NaN.

One variable that requires special attention is the net income. Net income is a flow variable and needs to be adjusted based on the fiscal period of the FS. More specifically, we transform the net income into a monthly net income by dividing the net income by the number of months that the FS covers. For example, the monthly net income can be computed from the annual net income divided by 12, the semi-annual net income divided by 6 and the quarterly net income divided by 3. When the monthly net income can be obtained from different sources simultaneously, the quarterly net income will have the highest priority (followed by the cumulative quarterly, semiannual, annual, and others) because it covers a more recent period of time.

Treatment of stale market capitalization prices: The market capitalization of a firm is required in a few input variables: DTD, SIZE, M/B, and SIGMA. For most firms, the market capitalization is available from Bloomberg on a daily basis.

A check on the trading volume of shares is used to remove stale prices. Specifically, if there are more than two consecutive days of identical market capitalization prices, subsequent identical prices are removed only if the trading volume is equal to zero. This is to avoid, for example, cases where the shares of a company are under a trading suspension but the market capitalization data is incorrectly carried forward.

An exception is for Indian companies, where it is common for some companies to have market capitalizations reported only once a month with several consecutive months having identical prices and positive trading volume. These prices are very likely not to be accurate reflections of the firms' value. So, the trading volume is not checked for Indian firms and market capitalizations are excluded after more than two repeated prices.

For some firms, the market capitalization data is not available for some periods. To fill in the blanks, we use the shares outstanding obtained from the previously available market capitalization divided by the price on that day as a proxy. If the market capitalization data is missing for more than a year, we use the share price multiplied by the shares outstanding listed on the balance sheet and then multiplied again by the adjustment factor that Bloomberg provides to account for splits, dividends, etc. If there is still market capitalization missing in the data, then shares outstanding from other data sources including Compustat and Korean University Database are used.

Currency conversion: Currency conversions are required if the market capitalization or any of the FS variables are reported in a currency different than the currency of the economy.

If a currency conversion is required, the foreign exchange rate used is the one reported at the relevant market close. For firms traded in most of the Asian economies and Asia-Pacific, the Tokyo closing rate is used; for firms traded in Europe, Africa, and Middle East, the London closing rate is used; and for firms traded in North and Latin America, the New York closing rate is used. For market capitalizations, the FX rate used is for the date that the market capitalization is reported. For FS variables, the FX rate used is for the date of the period end of the statement.

As of December 2017, we proceed with the unified currency about stock index return for each calibration group of economies: China (CNY), India (INR), Asia Pacific Developed (USD), Emerging Market (USD), Europe (EUR), and North America (USD). This attempt is made to prevent currency distortion in assessing default prediction. In this way, we apply the currency adjustment to market capitalization, total liabilities, and total assets, all of which are used to compute the M/B ratio.

Treatment for mergers and acquisitions (M&A): M&A events are common occurrences in the economic world. For our purpose, we define the M&A events as the cases where a firm ("acquirer") acquires partial or full ownership of another firm ("target"). Once an M&A deal is completed, the market capitalization of the acquirer changes immediately, reflecting the restructure of the acquirer. However, its FSes do not usually immediately reflect the new situation due to the fact that they are only released on a periodic basis. As a result, the DTD and market-to-book ratio, which are important inputs for the PD computation, will be distorted due to a mismatch in the market capitalization and the FS variables. In order to ensure the accuracy and reliability of our PD estimates, some special treatments are taken for PD calculations to companies whose financials are presumably significantly affected by the M&A events. The treatments are only applied to the acquirers.

The treatment starts with the screening of the important M&A deals. Only the important M&A deals are treated, assuming that the unimportant ones would not significantly affect a firm's corporate structure. An M&A deal is considered important if it satisfies the following three criteria :

1. Upon the deal's completion, the acquirer owns 20% or more of the target company.
2. The size of the deal is material to the acquirer. This is measured in terms of total assets. If α is the percentage of the target that is being acquired, the size is considered material if the product of α and the total assets of the target is greater than or equal to 20% of the total assets of the acquirer.
3. The change in market capitalization is material, with the largest absolute daily market capitalization return, within 20 days of the M&A completion day, larger than or equal to 5%.

One thing to note in implementation is that some targets stopped producing financial statements years before the M&A events. As a result, they may not have a valid value of total asset (needed for testing criterion 2) on the deal completion date. In this case, we use their last available value within 2 years before the deal completion as a substitute. If the last available value is beyond the 2-year range, we think that the data is not informative enough to reflect the financial situation upon deal completion and thus skip this particular case.

In order to mitigate the mismatching problem between the market capitalization and FS variables, we make the simplest and most conservative treatments, which are in line with the fundamental accounting standards. The treatment period will begin on the deal completion date and end when the first financial statement that reflects the post-M&A situation becomes available, which varies across economies and can range from 3 months to a few years. After identifying the important M&A deals, which must have had an ownership level of equal or more than 20%, we treat them in two different ways:

1. If the acquirer owns 20-50% (excluding 50%) of the target upon deal completion, the

"Equity Method" is used to treat the financial statement variables. Under the "Equity Method", the total asset of the acquirer will increase by a proportion, which is the percentage of ownership acquired in this deal, of the targets equity. Its net income will increase by the same proportion of the target's net income. In contrast, other financial statement variables will stay the same.

2. If the acquirer owns 50-100% (including 50%) of the target upon deal completion, the "Acquisition Method" is used to adjust the financial statement variables. By using this method, we assume that the financial manager of the acquirer consolidates the financial statements of both entities. As a consequence, the financial statement variables, including total liability, total asset, and cash and marketable securities, take the simple sum of the values from both entities. The net income will still increase by a proportion (the percentage of ownership acquired in this deal) of the targets net income, simply because it is the profit attributed to the shareholders.

After constructing the hypothetical financial statement data in the above-mentioned way, we use them to compute the DTD and the historical monthly PDs wherever applicable. Note that we do not let the hypothetical values enter the model's calibration process. With enough data points in the database to robustly calibrate the model parameters at the economy or region level, we can afford to disregard a small portion of data for the M&A period during which we believe them to be mismatched. After getting the model parameters, however, we not only use the hypothetical values to re-calibrate the firm-specific DTD parameters and re-calculate the DTD values, we also use them to adjust other variables with financial information. This is to guarantee that the PDs during the treatment period are properly calculated.

Treatment for missing values and outliers: Missing values and outliers are dealt with by a three-step procedure. In the first step, the 10 firm-specific input variables are computed for all firms and all months. In this step, the extreme values will be calculated, and the missing values will be determined. In the second step, outliers are eliminated by winsorization. In the final step, missing values are replaced under certain conditions.

The first step is to compute the input variables and to determine which are missing. As mentioned previously, FS variables are carried forward for one year after the date that they are first used. The date that they are first used is generally three months after the period end of the statement. If no FS is available for the company within this year, then the FS variable will be missing. For market capitalization, if there is no valid market capitalization value within the calendar month, then the value is set to missing.

For illiquid stocks, if there has been no valid market capitalization value for a firm within the last 90 calendar days, then the market capitalization is deemed to not properly reflect the value of the firm. The firm is considered to have exited with a non-default event. Once the firm starts trading again and a new FS is released, the firm can enter back into the calibration. With regard to historical PDs, the PDs can be reported again once there are enough valid variables.

With regard to the level variables, their values in the current and the last 11 months are averaged to compute the level. A minimum of 6 observations in the 12-month range are required to calculate the level variables. If fewer than 6 observations exist in this case, the level variables will bear missing values. However, this condition is not enforced during the initial 6 months after the firm releases the first financial statement.

To compute the trend variables, the level is subtracted from the current month value. If the current month value is missing, the trend variable is set to be the last valid value during the previous one year.

The value of M/B is set to be missing if any of the following values are missing: market capitalization, total liabilities, or total assets of a firm. For the computation of SIGMA, at least 50 valid returns over the last 250 days of possible returns are required for the regression. If there are less than 50 valid returns, SIGMA is set to be missing.

In this way, the 8 trend and level variables as well as M/B and SIGMA are computed and identified as missing or present. Winsorization can then be performed as a second step to eliminate outliers. The volume of outliers is too large to be able to determine whether each one is valid or not, so winsorization applies a floor and a cap on each of the variables. The historical 0.1 percentile and 99.9 percentile for all firms in the economy are recorded for each of the 10 variables. Any values that exceed these levels are set to equal these boundary values.

With a winsorization level of 0.1 and 99.9 percentile, the boundary values still may not be reasonable. For example, NI/TA levels of nearly -25, meaning an annual net income -25 times larger than the total assets of a firm, has been observed at this stage. In these cases, a more aggressive winsorization level is applied, until the boundary values are reasonable. Thus, the winsorization level is economy- and variable-specific, and will depend on the data quality for that economy and variable. Winsorization levels different from the default of 0.1 percentile and 99.9 percentile are indicated in Table A.8. As for log variables log(x) such as CASH/TA and CA/CL, we should check first whether x is well defined with positive values. Otherwise, we assign the upper and lower bounds of the economy- and variable-specific winsorization level to these firms.

In addition to the special winsorization of the firm–specific variables, as of December 2017, we also apply a winsorization of 5 and 95 percentiles for stock index return used as one of the common variables to the 3 groups of economies: Asia Pacific Developed, Emerging Market, and Europe.

A third and final step can be taken to deal with missing values. If during a particular month, no variable is missing for a particular firm, the PD can then be computed. If 6 or more of these 10 variables are missing, there is deemed to be too many missing observations and no replacement shall be made.

If between 1 and 5 variables are missing out of the 10, the first step is to trace back for at most 12 months to use previous values of these variables instead. If this does not succeed in replacing all of the variables, a replacement by sector medians is done. A firm's sector during a certain month is classified as either financial or non-financial, which is based on its Bloomberg industry sector code during that month. As of January 2015, the sector median replacement is no longer implemented in the calibration process but still in the PD computation. One special case is that the sector replacement is not done if it results in a relative change in the historical PD of 10% or more when the initial PD was at or above 100 bps, or an absolute change in the historical PD of 10 bps or more when the initial PD was below 100 bps.

One thing to note is that in the initial phase of a company - 6 months or even longer after its IPO - the data availability and quality are relatively low due to, for example, the delay in the issuance of FSes or illiquid trading. As observed in our data, replacing the missing values during this period with a sector median sometimes results in extreme spikes and falls in the company's PD. These extreme values are not easily detected, because in the beginning of a company's history, there are not many previous PD values to compare to as can be done later in the company's history. In order to avoid this, as of the 2015 January calibration, we set the rule to start treating the missing values only from the month when both the DTD level and trend are available and finite. By doing so, we make the PDs in the beginning of a company's history more reflective of its true credit quality.

Inclusion/exclusion of companies for calibration: Firms are included within an economy for calibration when the primary listing of the firm is on an exchange in the economy. This ensures that all firms within the economy are subject to the same disclosure and accounting rules. There are a relatively small number of firms that are listed in multiple economies. For example, Bank of China Ltd is listed both in Hong Kong Stock Exchange and China's Shanghai Stock Exchange. Based on Bloomberg's classification of its primary listing, Bank of China Ltd is assigned to the calibration group of Asia-Pacific rather than China.

In the US, firms traded on the OTC markets or the Pink Sheets are not considered as exchange listed so are not included in calibration or in the reporting of PD forecasts. Many of these firms are small or start-up firms. Including this large group of companies would skew the calibration and the aggregate results. The TSX Venture Exchange in Canada also contains only small and start-up firms, so firms listed here are also excluded.

Other exclusions include Taiwan's Taipei Exchange, Vietnam's Hanoi UPCoM, Switzerland's OTC-X BEKB, Brazil's Soma and Romania's RASDAQ. To identify the smaller markets outside of the US and Canada is challenging due to data availability. However, continuing work is being done in the CRI system to exclude firms that are not listed on major exchanges within a country.

3.2 Distance-to-Default Computation

The DTD computation used in the CRI system is not a standard one. Standard computations exclude financial firms, which is of course a critical part of any economy. Thus, the standard DTD computation must be extended to give meaningful estimates for financial firms as well. Duan and Wang [2012] have provided a review of different DTD calculations with several examples for financial and non-financial firms.

The description of the specialized DTD computation starts with a brief description of the Merton [1974] model. Merton's model makes the simplifying assumption that firms are financed by equity and a single zero-coupon bond with maturity date T and principal L. The asset value of the firm V_t follows a geometric Brownian motion:

$$\mathrm{d}V_t = \mu V_t \mathrm{d}t + \sigma V_t \mathrm{d}B_t. \tag{30}$$

Here, B_t is the standard Brownian motion, μ is the drift of the asset value in the physical measure, and σ is the volatility of the asset value. Following the Merton [1974] model, the probability of the company's default at time T evaluated at time t is $\Pr_t(V_T \leq L)$, from Eq. (30), we can derive $\Pr_t(V_T \leq L) = N(-\mathrm{DTD}_t)$, where DTD at time t is defined as:

$$\mathrm{DTD}_t = \frac{\log\left(\frac{V_t}{L}\right) + \left(\mu - \frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}}. \tag{31}$$

The standard KMV assumptions given in Crosbie and Bohn [2003] are to set the time to maturity $T-t$ at a value of one year, and the principal of the zero-coupon bond L to a value equal to the firm's current liabilities plus one half of its long-term debt. Here, the current liabilities and long-term debt are taken from the firm's FSes. If the firm is missing the current liabilities field, then various substitutes for this field can be used, as described in Subsection 2.3.

This is a poor assumption of the debt level for financial firms, since they typically have large liabilities, such as deposit accounts, that are neither classified as current liabilities nor long-term debt. Thus, using these standard assumptions means ignoring a large part of the debt of financial firms.

To properly account for the debt of financial firms, Duan [2010] included a fraction δ of a firm's other liabilities. The other liabilities are defined as the firm's total liabilities minus both the short and long-term debt. The debt level L then becomes the current liabilities plus half of the long-term debt plus the fraction δ multiplied by the other liabilities, so that the debt level is a function of δ. The standard KMV assumptions are then a special case where $\delta = 0$.

The fraction δ can be optimized along with μ and σ in the transformed-data maximum likelihood estimation method developed in Duan [1994, 2000]. As asset value is unobservable, it has to be implied from market equity value. Note that equity holders receive the excess value of the firm above the principal of the zero-coupon bond and have limited liability, so the equity value at maturity is: $\max(V_T - L, 0)$. This is just a call option payoff on the asset value with a strike value of L. Thus, the Black-Scholes option pricing formula can be used to calculate the equity value at times t before T,

$$E_t = V_t N(d_+) - e^{-r(T-t)} L N(d_-), \tag{32}$$

where r is the risk-free rate, $N(\cdot)$ is the standard normal cumulative distribution function, and

$$d_{\pm} = \frac{\log\left(\frac{V_t}{L}\right) + \left(r \pm \frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}}. \tag{33}$$

Then we can express the likelihood function of the observed equity values by viewing the equity values as the transformed data from pricing formula in Eq. (32). It should be noted that the transformation involves the unknown asset volatility. By standard transformation theory, the likelihood of observed equity values must equal the product of the likelihood of the asset values (implied by equity values) and the Jacobian of the inverse transformation (from the equity value back to the asset value). Moreover, following Duan et al. [2012], the firm's market value of assets is standardized by its book value A_t, so that the scaling effect from a major investment or financing by the firm will not distort the time series from which the parameter values are estimated. Thus, the log-likelihood function based on equity prices is:

$$\begin{aligned} \mathcal{L}(\mu,\sigma,\delta) = & -\frac{n-1}{2}\log(2\pi) - \frac{1}{2}\sum_{t=2}^{n}\log(\sigma^2 h_t) - \sum_{t=2}^{n}\log\left(\frac{\hat{V}_t(\sigma,\delta)}{A_t}\right) \\ & - \sum_{t=2}^{n}\log[N(\hat{d}_+(\hat{V}_t(\sigma,\delta),\sigma,\delta))] \\ & - \frac{1}{2\sigma^2}\sum_{t=2}^{n}\frac{1}{h_t}\left[\log\left(\frac{\hat{V}_t(\sigma,\delta)}{A_t} \times \frac{A_{t-1}}{\hat{V}_{t-1}(\sigma,\delta)}\right) - \left(\mu - \frac{\sigma^2}{2}\right)h_t\right]^2, \end{aligned} \tag{34}$$

where n is the number of days with observations of the equity value in the sample, $\hat{V}_t$ is the implied asset value found by solving Eq. (32), $\hat{d}_+$ is computed with Eq. (33) using the implied asset value, and h_t is the number of trading days as a fraction of the year between observations $t-1$ and t. Notice that the implied asset value and $\hat{d}_+$ are dependent on δ by virtue of the dependence of L on δ.

Implementation of DTD computation: The DTD at the end of each month is needed for every firm in order to calibrate the forward intensity model. A moving window, consisting of the last one year of data before each month end is used to compute the month end DTD. Daily market capitalization data based on closing prices is used for the equity value in the implied asset value computation of Eq. (32). If there are fewer than 50 days of valid observations for the DTD input variables (market capitalization, FS variables, and interest rate), the DTD value is set to be missing. An observation is valid if there is positive trading volume that day. If the trading volume is not available, the observation is assumed to be valid if the value for the market capitalization changes often enough. The precise criterion is as follows: if the market capitalization does not change for three days or more in a row, the first day is taken as a valid observation, and the remaining days with the same value are set to be missing.

A straightforward idea for the DTD computation is to first estimate the three variables μ, σ and δ via maximizing the log-likelihood function (34) over $\sigma \geq 0$ and $0 \leq \delta \leq 1$, and then to calculate the DTD from Eq. (31). Let $(\hat{\mu}, \hat{\sigma}, \hat{\delta})$ be an optimal solution to the maximization problem. By direct calculation, it is not hard to see that

$$\hat{\mu} = \frac{\hat{\sigma}^2}{2} + \frac{1}{\sum_{t=2}^{n} h_t}\log\left(\frac{\hat{V}_n(\hat{\sigma},\hat{\delta})}{A_n} \times \frac{A_1}{\hat{V}_1(\hat{\sigma},\hat{\delta})}\right). \tag{35}$$

In view of this, maximizing the three-dimensional function $\mathcal{L}(\mu, \sigma, \delta)$ can be equivalently reduced to maximizing the two-dimensional function $\tilde{\mathcal{L}}(\sigma, \delta)$ taking the form

$$\begin{aligned}\tilde{\mathcal{L}}(\sigma, \delta) = & -\frac{n-1}{2} \log(2\pi) - \frac{1}{2} \sum_{t=2}^{n} \log(\sigma^2 h_t) - \sum_{t=2}^{n} \log\left(\frac{\hat{V}_t(\sigma, \delta)}{A_t}\right) \\ & - \sum_{t=2}^{n} \log N(d_+) - \frac{1}{2\sigma^2} \left\{ \sum_{t=2}^{n} \frac{1}{h_t} \times \left[\log\left(\frac{\hat{V}_t(\sigma, \delta)}{A_t} \times \frac{A_{t-1}}{\hat{V}_{t-1}(\sigma, \delta)} \right) \right]^2 \right. \\ & \left. - \frac{1}{\sum_{t=2}^{n} h_t} \left[\log\left(\frac{\hat{V}_n(\hat{\sigma}, \hat{\delta})}{A_n} \times \frac{A_1}{\hat{V}_1(\hat{\sigma}, \hat{\delta})} \right) \right]^2 \right\}. \end{aligned} \tag{36}$$

However, with quarterly FSes there will never be more than three changes in the corporate structure (defined in this model by L and A_t) throughout the year, leading to possibly unstable estimates of δ. This problem is mitigated by performing a two-stage optimization for σ and δ.

In the first stage, the maximization of $\tilde{\mathcal{L}}(\sigma, \delta)$ for each firm is performed over both σ and δ. For each firm, at the first month in which DTD can be computed, the maximization is constrained in $\sigma \geq 0$ and $0 \leq \delta \leq 1$. Thereafter, at month n, the maximization is still constrained in $\sigma \geq 0$ while δ is constrained in the interval $[\max(0, \hat{\delta}_{n-1} - 0.05), \min(1, \hat{\delta}_{n-1} + 0.05)]$, where $\hat{\delta}_{n-1}$ is the estimate of δ made in the previous month. In other words, a 10% band around the previous estimate of δ (where that band is floored with 0 and capped with 1) is applied so that the estimates do not fluctuate too much from month to month.

However, for many firms, the estimate of δ would frequently lie on the boundary of the constraining interval, meaning that the estimates of δ were not stable. Therefore, a second stage is implemented to impose greater stability. Within the same calibration group, all firms in the same sector (Bloomberg 10-industry sectors classification) are assumed to share the same estimate of δ, chosen to be the average of all its individual estimates. However, for some small economies, especially in their early years, the average of δ is still observed to be not stable due to some sector or even the whole calibration group has only few individual estimates of δ. To well handle such cases, a threshold rule at each time of estimation is applied under the following conditions: a) If a sector has fewer than 10 individual estimates, the shared estimate of δ will be set to the average of whole calibration group instead of the sector average; b) furthermore, if the whole calibration group still has fewer than 10 individual estimates, the shared estimate of δ is deemed not available. Accordingly, with δ being fixed to be the sector average on the calibration group level, the original maximization of $\tilde{\mathcal{L}}(\sigma, \delta)$ is reduced to a one-dimensional maximization in σ for each firm.

Since the first stage is done to obtain a stable sector-average estimate of δ, the criteria used to include a firm-month is more strict. In the first stage, a two-year window of FS variables, market capitalization, and interest rate is used instead of one year, and a minimum of 250 days of valid observations of the DTD input variables are required instead of 50. If a firm has less than 250 days of valid observations within the last two years of a particular month end, δ will not be estimated for that firm and that month end.

It was found that after applying the two-stage procedure described above, the estimate of μ was frequently unstable and could lower the explanatory power of DTD. For example, suppose a firm has a large drop in its implied asset value in January 2011, so that the estimated μ is negative for the DTD calculation at the end of December 2011. If there is little change in the company in January 2012, then the drop in implied asset value in January 2011 is no longer within the observation window for the DTD calculation at the end of January 2012. There will be a large increase in the estimated μ, resulting in a substantial improvement of the DTD just because of the moving observation window. To avoid this problem, we now set μ to be equal to $\sigma^2/2$. So in calculating DTD, the second term in the numerator of Eq. (31) is eliminated.

In summary, the DTD for each firm is computed using the sector average within a calibration group for δ in that month, and the estimate of σ based on the last year of data for the firm.

Carrying out this two-stage procedure would take about 70 hours of computation time on a single PC, given the millions of firm months that are required. However, each of the stages is parallelizable. In the first stage, the DTD can be computed independently between firms. In the second stage, once the sector averages of the δ have been computed for each month, the DTD can again be computed independently between firms. In the current CRI system, by using the NUS' high-performance computing facility, the DTD computational time has been greatly reduced thanks to the application of parallel computing.

3.3 Calibration

Implementation: As shown in Section 1, the calibration of the forward intensity model involves multiple maximum pseudo-likelihood estimations, where the pseudo-likelihood functions are given in Eq. (13). The maximizations are on the logarithm of these expressions, and the default parameters' maximization is performed independently from the non-default exit parameters. Parameter estimates for the entire horizon up to five years for the default and non-default exits can be obtained directly from the NS function.

A few input variables have an unambiguous effect on a firm's probability of default. Increments of both the level and trend of DTD, CASH/TA, CA/CL, and NI/TA should indicate that a firm is becoming more creditworthy and should lead to a decreasing PD. For large and relatively clean data sets such as the US, an unconstrained optimization leads to parameter values which mostly have the expected sign. For each of the DTD level and trend, CASH/TA level and trend, CA/CL trend, and NI/TA level, the default parameters at all horizons are negative. A negative default parameter at a horizon means that if the variable increases, the forward intensity will decrease (based on Eq. (6)), so that the conditional default probability at that horizon will decrease.

Grouping for economies: There are not enough defaults in some small economies and calibrations of these individual economies are not statistically meaningful. In order to ensure that there are enough defaults for calibration, the 87 economies are categorized into groups according to similarities in their stage of development and their geographic locations. Within these groups, the economies are combined and calibrated together.

As of January 2015, Canada and the US remain in the North America calibration group, and the developed economies of Asia-Pacific (Australia, Hong Kong, Japan, Singapore, South Korea, Taiwan and New Zealand) form another calibration group. China and India, the two major emerging economies of Asia Pacific are each calibrated as individual groups. All the European countries covered by the CRI are in a single calibration group. The other emerging economies of Asia Pacific, Latin America, Middle-East, and Africa form the "emerging markets" calibration group, which now includes 9 African economies: Botswana, Ghana, Kenya, Malawi, Mauritius, Namibia, Rwanda, Tanzania, and Uganda. Detailed grouping can be found in Table A.4.

All economies in the same calibration group share the same coefficients for all common variables except for the 3-month interest rate variable. In particular, we apply standardization to each economy's interest rate time series, except for China and India. First, we subtract the historical month-end mean from the 3-month interest rate variable in order to reflect the contemporary change relative to the historical average. We then scale the demeaned values so that the standard deviation equals one. Doing so allows to put all economies on the same scale so that the same interest rate parameter can be reasonably used on firms from different countries/economies.

We allow for a unique coefficient on the interest rate variable for each economy. However, certain treatments and exceptions apply due to various reasons. For New Zealand, it does not have enough default events to identify a separate coefficient. In this case, the actual interest rates are replaced with zeros throughout the whole time series. This is to disable the effect of interest rate in the particular calibration, but it will not induce bias based on the nature of the standardized interests. For the Eurozone economies, all of them use the standardized Germany's 3-month Bubill rate after the Eurozone was launched on January 1st, 1999. This aims to reflect more of the monetary rather than the sovereign credit conditions in those economies. Before joining the Eurozone, each of those economies except Germany uses own standardized interest rates, because none of them has enough default events before that date. Among the non-Eurozone economies, Denmark, Norway, Sweden, and UK have their own respective coefficients on the interest rate variable, but Iceland, Switzerland along with all the others share the same one. In the Emerging Markets group, only Indonesia, Malaysia, the Philippines, and Thailand have their own economy-specific coefficients on the interest rate variable. The Latin American subgroup has a universal coefficient for all the member economies, and all the others in the Emerging Markets group share the same coefficient.

One thing to note is that in addition to the unique coefficient on the interest rate variable, Indonesia also has its own coefficient for the relative size level as of October 2013.

Relative size: For the calibration data set, the median market cap of firms in an economy for each month end includes the market cap from the last trading day of each firm in the month. If a firm does not trade in a particular month, the firms market cap is not included in the median. For certain economies, many firms are illiquid and the median market cap experiences large variations due to the change in composition of firms rather than the market value of the firms. Another problem is data quality at the beginning of the historical sample: if a data provider starts including the market cap for a large number of firms in one month compared to the previous, there can be a large jump in the median market cap. Our research also reveals that debt–ridden countries (e.g., Venezuela) are usually susceptible to hyperinflation so that the market value of the firms under the severe economic turmoil is not trustworthy.

To avoid this problem, we use the economy's median market cap over the past one year as the divisor in the Relative Size variable:

1. We collect the whole market cap data of individual firms in a specific economy over the past one year.
2. We calculate the ratio of individual firm's market cap to the economy's median market cap calculated above.
3. We take a natural logarithm to reduce its variability.

3.4 Daily Output

Individual firms' PD: In computing the pseudo-log-likelihood functions in Eq. (13), only the end of month data is needed. The data needs to be extended to daily values in order to produce daily PDs.

For the level variables, the last 12 end-of-month observations (before averaging) are combined with the current value. The current value is scaled by a fraction equal to the current day of the month divided by the number of calendar days in the month. The earliest monthly value is scaled by one minus this fraction. The sum is then divided by the number of valid monthly observations, with the current value and the earliest monthly value jointly having the weight of one observation if either or both are not missing. Not performing this scaling can lead to an artificial jump in PD at the beginning of the month. When performing the scaling, the change in level is more gradual throughout the month.

SIGMA is computed by regressing the daily returns of the firm's market capitalization against the daily returns of the economy's stock index for the previous 250 days.

Aggregating PDs: The CRI provides term structures of the probability distributions for the number of defaults as well as the expected number of defaults for different groups of firms. The companies are grouped by economy (using each firm's country of domicile), by sector (using the firm's Bloomberg industrial sector code) and sectors within economies.

To compute the probability distribution of the number of defaults, we use an algorithm which was originally reported in Anderson et al. [2003]. It assumes conditional independence and uses a fast recursive scheme to compute the necessary probability distribution. With the individual firms' PDs, the expected number of defaults is trivial to compute and is simply the sum of the individual PDs within each group. Note that while this algorithm is currently used to produce the probability distribution of the number of defaults within an economy or sector, it can easily be generalized to compute loss distributions for a portfolio manager, in which case the portfolio's exposure to each firm should be aggregated.

As of 8th July 2014, the display of the aggregate PDs on the RMI-CRI website started to adopt the simple median of the individual PDs within each group. This change will mitigate the effect from extreme outliers and synchronize with the aggregate display of the AS. It should be noted that the aggregate PDs using mean values are still accessible through the data downloading section on the website.

Inclusion of firms in aggregation: As explained in Subsection 3.1, firms are included in an economy for calibration if the firms' primary listing is on an exchange in that economy. This is to ensure that all firms in an economy are subject to the same disclosure and accounting requirements. In contrast, a firm is included in an economy's aggregate results if the firm is domiciled in that economy. This is because users typically associate firms with their economy of domicile rather than the economy where their primary listing is, if they are different. For example, the Bank of China has its primary listing in Hong Kong, but its economy of domicile is China so the Bank of China is included in the aggregation forecasts for China, and is included under China when searching for the individual PDs.

Treatment of companies after a default event: When a company experiences a default event, the CRI system discontinues the PD calculation for that company. However, if the company resumes operations after some time, it will be treated as a new company, and we continue to generate PD. The new company's PDs are not affected by the FS or market cap data prior to the event. So, the PDs calculated are independent of the PDs that were generated before the default event. On our website, the PDs are however displayed on a single graph for the convenience of our users.

4 Empirical Analysis

This section presents an empirical analysis of the CRI outputs for the 87 economies with their own exchange that are currently being covered. In Subsection 4.1, an overview is given of the default parameter estimates. Subsection 4.2 explains and provides the accuracy ratios for the different countries under the CRI coverage.

4.1 Parameter Estimates

With 60 months of forecast horizons, 17 variables (16 variables plus an intercept), and 6 different groups of economies, tables of the parameter estimates occupy over 20 pages and are not included in this Technical Report. In Figs. B.1 and B.2, the parameter estimates are from calibrations performed in April 2018 using data up until the end of March 2018. As an example, plots of the default parameters for the US are given in Figs. B.1 and B.2 in Appendix B. In this part, a brief overview is given of the general traits and patterns seen in the default parameter estimations of the economies covered by the CRI.

Recall that if a default parameter for a variable at a particular horizon is estimated to be positive (negative) from the maximum pseudo-likelihood estimate, then an increasing value in the associated variable will lead to an increasing (decreasing) value of the forward intensity at that horizon, which in turn means an increasing (decreasing) value for the forward default probability at that horizon.

For the stock index one-year trailing return variable, most groups have default parameters that are slightly negative in the shorter horizons and then become positive in the longer horizons. When the equity market performs well, this is only a short-term positive for firms and in the longer term, firms are actually more likely to default. This seemingly counterintuitive result could be due to correlation between the market index and other firm-specific variables. For example, Duffie et al. [2009] suggested that a firm's DTD can overstate its creditworthiness after a strong bull market. If this is the case, then the stock index return serves as a correction to the DTD levels at these points in time.

As expected, we observe the different relationships between the short-term interest rate and default across economies. This observation possibly indicates different lead-lag relationships between credit conditions and the raising and cutting of short-term interest rates.

DTD is a measure of the volatility-adjusted leverage of a firm. Low or negative DTD indicates high leverage and high DTD indicates low leverage. Therefore, PD would be expected to increase with decreasing DTD. Indeed, the DTD level has negative default parameters across calibration groups.

Aggregate DTD can measure the overall degree of the volatility-adjusted leverage in an economy. As mentioned in Subsection 2.1, we use two kinds of sector–specific aggregate DTDs: one for financial firms, and the other for non–financial firms. In each economy, the default parameters for the two aggregate DTDs usually display different patterns. Such patterns may reflect different credit risk profile of the economy–wide business environments.

The log ratio of the sum of cash and short-term investments to total assets (CASH/TA) measures liquidity of a financial firm. Likewise, the log ratio of current assets to current liabilities (CA/CL) stands for liquidity of a non–financial firm. These two ratios indicate the availability of a firm's funds and its ability to make interest and principal payments. On the whole, almost all economies have negative default parameters for such liquidity ratios, although the short–term and long–term effects differ across each calibration group.

The ratio of net income to total assets (NI/TA) measures profitability of a firm. The relationship between PD and NI/TA is as expected: the default parameters for NI/TA level is negative for all economies and all horizons.

The logarithm of the market capitalization of a firm over the median market capitalization of firms over the past one year within the economy (SIZE) does not have a consistent effect on PD across different economies. For example, in the US the default parameters for SIZE level are positive for almost all horizons, suggesting that the complexity of larger firms outweighs the potential benefits, such as diversified business lines and funding sources. On the other hand, in China the default parameters for SIZE level are negative across almost all horizons. The lack of similarity may reflect the different business environments in such respective economies.

The default parameters associated with DTD Trend, CASH/TA Trend, CA/CL Trend, SIZE Trend and NI/TA Trend are negative across almost all economies and horizons. The trend variables reflect momentum. The momentum effect is a short-term effect, and evidence of this is seen in the lower magnitude of the default parameters at longer horizons than at shorter horizons. The exception is the NI/TA Trend, which for some calibration groups has a higher magnitude at longer horizons.

The ratio of the individual firm's M/B to the economy M/B median (M/B) can either indicate the market mis-valuation effect or the future growth effect. This default parameter is negative for the US in the shorter term, indicating that higher M/B implies lower PD, and the future growth effect dominates during this period. On the other hand, in China and in the Developed Asia-Pacific calibration group, the default parameter for M/B is positive, indicating that for these economies, the market mis-valuation effect dominates.

Shumway [2001] argued that a high level of the idiosyncratic volatility (SIGMA) indicates highly variable stock returns relative to the market index, which is equivalent to highly variable cash flows. Empirically, the sign on SIGMA is different across countries and across prediction horizons.

4.2 Prediction Accuracy

In-sample testing: Various tests are carried out to test the prediction accuracy of the RMI-CRI PD forecasts. These tests are conducted in-sample.

A single calibration is conducted for the in-sample tests, using data until the end of the data sample. As an example, one-year PD forecasts are made for 31 December, 2000 by using the data at or before 31 December, 2000 and the parameters from the calibration. These PD forecasts can be compared to actual defaults that occurred at any time in 2001.

Accuracy ratio: The accuracy ratio (AR) is one of the most popular and meaningful measures of the discriminatory power of a rating system (BCBS, 2005). The AR and the equivalent Area Under the Receiver Operating Characteristic (AUROC) are described in Duan and Shrestha [2011]. In short, if defaulting firms had been assigned among the highest PD of all firms before they defaulted, then the model has discriminated well between safe and distressed firms. This leads to higher values of AR and AUROC. The range of possible AR values is in [0,1], where 0 is a completely random rating system and 1 is a perfect rating system. The range of possible AUROC values is in [0.5, 1]. AUROC and AR values are related by: AR = 2×AUROC - 1.

The AR and AUROC values for different horizons are available in Table B.1 of this technical report. Only economies with more than 20 defaults entering into the AR and AUROC computation are listed.

The AUROC values have been provided only for the purpose of comparison, if other rating systems report their results in terms of AUROC. The discussion will focus only on AR. The model is able to achieve strong AR results mostly greater than 0.80 at the one and six-month horizons for developed economies. There is a drop in AR at one and two-year horizons, but the AR are still mostly acceptable.

The AR in some emerging market economies such as China, India, Indonesia, and the Philippines are noticeably weaker than the results in the developed economies. This can be due to a number of issues. The quality of data is worse in emerging markets, in terms of availability and data errors. This may be due to lower reporting and auditing standards. Also, variable selection is likely to play a more important role in emerging markets. The variables are selected based on the predictive power in the US. Performing variable selections specific to the calibration group are expected to improve predictive accuracy, especially in emerging market economies. Finally, there could be structural differences in how defaults and bankruptcies occur in emerging market economies. If the judicial system is weak and there are no repercussions for default, firms may be less reluctant to default.

Aggregate defaults: The time series of aggregate predicted number of defaults and actual number of defaults in each calibration group are also available in Figs. B.3 to B.8. For India in particular, these figures show that there is room for improvement in the predictive power of the model.

5 Corporate Vulnerability Index

In July 2012, CRI launched the Corporate Vulnerability Index (CVI), which is a new suite of indices to produce bottom-up measures of credit risk in economies, regions and portfolios of special interest. The suite of CVIs is available in three distinctive types:

1. Value-weighted CVI (CVI_{vw}) RMI-CRI PDs are aggregated with each firm weighted by its market capitalization so that the size of each firm is taken into account.
2. Equally-weighted CVI (CVI_{ew}) RMI-CRI PDs are aggregated with each firm equally weighted. This captures the prevalence of credit risk by focusing on the number of firms at risk.
3. Tail CVI (CVI_{tail}) In taking the 5th percentile of the highest RMI-CRI PDs, the most vulnerable firms in a group are measured.

The CVIs are a set of indicators that gauge economic and financial environments in a new dimension. They are best viewed as stress indicators that reflect heightened credit risks in the corporate sector from three different angles.

Index Construction The primary inputs to the CVI are RMI-CRI 1-year PDs for individual exchange-listed firms.

- Value-weighted CVI (CVI_{vw}) CVI_{vw} is an aggregation of individual PDs weighted by each firm's market capitalization. In other words, at time t, given an interested group or portfolio G,

$$\text{CVI}_{\text{vw}}(t) = \sum_{i=1}^{I} \omega_{it} p_i(t, 12),$$

  where $p_i(t, 12)$ is firm i's default probability within 12 months viewed from t, $i \in \{1, 2, ..I\}$. Also, the weight for firm i at time t is ω_{it}, and $\omega_{it} = \frac{MC_{it}}{\sum_{i=1}^{I} MC_{it}}$, in which, MC_{it} is firm i's market capitalization at time t. If a firm does not trade on a particular day, the market capitalization from the previous valid day (within 20 trading days) is used. The market-capitalization weighting is applied to all economies and groups of economies, but is not applied to portfolios such as the S&P 500 index. The S&P 500 index is a float-adjusted index where the shares available to investors are used instead of the total shares outstanding, and our weighting scheme of CVI_{vw}(SPP) is consistent with the S&P 500 index.

- Equally-weighted CVI (CVI_{ew}) The equally-weighted CVI is computed by aggregating each firm's PD with equal weights applied to each firm. In other words,

$$\text{CVI}_{\text{ew}} = \frac{1}{I} \sum_{i=1}^{I} p_i(t, 12).$$

- Tail CVI (CVI_{tail}) The tail CVI provides a measure of the relatively more distressed firms in a group. It is the highest 5th percentile of PDs. The tail CVI can also be interpreted as the conditional median of the 10 percent tail, which is a more robust measure of "tail average" than the conditional mean of the 10 percent tail.

Inclusion of Firms: A firm's PD is computed with the model parameters from its primary exchange. The construction of CVI, however, is based on the firm's country of domicile. In regions like the Eurozone, some of the public holidays do not coincide. In this case, the aggregation is computed by using PDs from the previous trading day for firms that are listed in countries that have a public holiday, and PDs from the current trading day for firms that are listed in countries that do not have a public holiday. And firms are included in the Eurozone CVI only if their countries of domicile are part of the Eurozone at time t. For CVI of the S&P 500 portfolio, the constituents typically coincide with the constituents of the S&P 500 index for each point in time, and missing any PD value for a company in the S&P 500 is filled in with the most recently available PD.

6 Actuarial Spread

In July 2014, CRI launched a new credit risk measure, the Actuarial Spread (AS), which are the counterparts of market credit default swap (CDS) with contract horizons ranging from 1 year to 5 years but valued based on RMI-CRI's PDs in the forward horizons. Since then, the computation and publication of the AS have been implemented on a daily basis in addition to those of the PDs. Much like the par spread in a standard credit default swap (CDS) contract, the AS leverages the term structure of the physical PDs of the CRI and is essentially the premium rate that purely reflects the actuarial present value of a default protection. It provides a new metric of credit risk that the financial practitioners are more familiar with.

The construction of the AS relies on the features of a standard CDS contract. To fulfill a CDS contract, the protection buyer pays premiums on a regular basis to the seller until the contract matures or the reference entity defaults. In exchange, the protection buyer receives at the default time a contingent lump sum payment, the amount of which is based on the recovery rate on the reference instrument. Such a CDS contract terminates on its maturity date if there is no default up to its maturity; otherwise, it ceases on a default day, if any. Note that, if a default occurs during a payment period, the premium for the protection from the first accrual day to the default day is also assumed to be paid by the CDS buyer on the default day. Considering no effect from the market liquidity and using the physical PDs that CRI generates, the AS is calculated in a way that the expected present value of the contingent claim upon default is equal to the expected present value of the series of premiums up until the stop of a CDS contract. To familiarize the details of its theoretical formulation, please refer to Duan [2014]. As opposed to the continuous model introduced in Duan [2014], this technical report provides a discrete representation of the model for implementation purpose. For easy comparison, it adopts the same notations in the journal article as much as it possibly can.

A typical CDS contract adopts one day as the fundamental period of time. For this, we abbreviate the interval $((d-1)\cdot\Delta t,\, d\cdot\Delta t]$ in a forward time axis by the term day $d \in \mathbb{N}$ where $\Delta t = 1/365$ reflects the 365 day count convention. Consider t is the trading day of a CDS contract terminating on the day $T > t$. If the reference entity defaults at a random day τ where $t+1 \leq \tau \leq T$, he will in return get a lump sum payment, which is 1 minus the recovery rate R_τ, from a unit-notional CDS and cease to make the scheduled payment beyond the default point. We assume the premiums are scheduled to be paid on the days $t_1, t_2, ..., t_k$ with $t_k = T$, where each payment period is roughly three months. Note that a payment day t_{i-1} is also the first day of the coming accrual period, which ends on the day before next payment day, denoted and defined by $t_i' = t_i - 1$. However, a trading day t may also occur after a payment day, say t_{i-1}, and we denote the exact start date of its remaining accrual period by $t_{i-1} \vee (t+1) = \max\{t_{i-1}, t+1\}$ for a general purpose.

Another actual/360 day count convention is usually adopted to define the length in year of an accrual period, for which we denote $A(s,q)$ the period length in year from the day s to the day $q > s$ (both inclusive). For example, if a quarterly accrual period from t_{i-1} to t_i' (both inclusive) has 91 days, then $A(t_{i-1}, t_i') = 91/360$ is applicable.

Compared to the risk-neutral probability measure used in the CDS pricing, the AS is essentially its counterpart based on a physical probability measure P. We denote it by $S_t^{(a)}(T-t)$ with its days to maturity $(T-t)$. Following the assumption that there is no arbitrage for CDS buyer and seller, the AS is defined to satisfy the equation:

$$
\begin{aligned}
& E_t^p\left[(1-R_\tau)D_t(\tau-t)\cdot \mathbb{1}_{\{t<\tau\le t'_k\}}\right] \\
= \quad & S_t^{(a)}(T-t)\sum_{i=1}^{k}\Big\{ \qquad A(t_{i-1}\vee(t+1),t'_i)\cdot E_t^p\left[D_t(t_i-t)\cdot \mathbb{1}_{\{t'_i<\tau\}}\right] \\
& \qquad + E_t^p\left[A(t_{i-1}\vee(t+1),\tau)\cdot D_t(\tau-t)\cdot \mathbb{1}_{\{t'_{i-1}<\tau\le t'_i\}}\right]\Big\},
\end{aligned}
$$

where E_t^P is an expectation operator with respect to the physical probability measure P, τ refers to the random default day, $D_t(\tau-t)$ is the random money market discount factor starting from the day t to another day τ and k is the number of the CDS premium payments.

The real-time LIBOR rates up to one year and Swap rates beyond are generally available from the market. With the combination, one can bootstrap the implied LIBOR rates beyond one year. As the AS is calculated based on days, a linear interpolation is further performed to obtain the implied LIBOR rates up to each forward day (in continuously compounded annualized form), which then serve the role of the discount factor $D_t(\cdot)$. Let $r_t(s,q)$ be the day-t risk-free annualized forward discount rate between the day $t+s$ and the day $t+q$ (both inclusive) with $q\ge s\ge 1$. In particular, $r_t(1,q)$ refers to the day-t risk-free spot discount rate covering the days $t+1,\ldots,t+q$. The standard term structure theory implies that

$$
r_t(1,q) = -\frac{1}{q}\ln\left(E_t^P\left[D_t(q)\right]\right).
$$

Further we let $r_t(q,q)=r_t(1,q)\cdot q - r_t(1,q-1)\cdot(q-1)$ for $q\ge 2$, which refers to the day-t instantaneous forward rate for the day $t+q$. As will be seen later, defining $r_t(s,q)$ this way is to make it consistent with the definition of the forward default/other exit intensity in terms of the day count convention. With the RMI-CRI PDs serving as the physical probability measure P and the use of a standard recovery rate of $\bar{R}_t=40\%$, the AS is rewritten as

$$
S_t^{(a)}(T-t) = \frac{(1-\bar{R}_t)\cdot E_t^p\left[e^{-r_t(1,\tau-t)(\tau-t)/365}\cdot \mathbb{1}_{\{t<\tau\le t'_k\}}\right]}{\sum_{i=1}^{k}\left\{A(t_{i-1}\vee(t+1),t'_i)\cdot e^{-r_t(1,t_i-t)(t_i-t)/365}\cdot E_t^p\left[\mathbb{1}_{\{t'_i<\tau\}}\right] \;+\; E_t^p\left[A(t_{i-1}\vee(t+1),\tau)\right]\cdot e^{-r_t(1,\tau-t)(\tau-t)/365}\cdot \mathbb{1}_{\{t'_{i-1}<\tau\le t'_i\}}\right\}}, \tag{37}
$$

where the actual/365 day count convention is used for the discount factor and integration.

To obtain the physical probability of defaults and their term structures, we apply CRI's forward intensity model. Define $f_t(u)$ to be the day-t forward default intensity over the day $t+u$, which will be used to calculate the probability of default of a firm conditioning on its survival up to the day $t+(u-1)$. The forward intensity for other exits, or $h_t(u)$, can be similarly defined. These two intensities are expressed as exponential linear functions of 17 covariates in general, including an intercept term, 4 common variables and 12 firm-specific variables, in the form of

$$
f_t(u) = \exp\{\alpha_0(u)+\alpha_1(u)x_{1,t}+\ldots+\alpha_{16}(u)x_{16,t}\},
$$

and

$$
h_t(u) = \exp\{\beta_0(u)+\beta_1(u)x_{1,t}+\ldots+\beta_{16}(u)x_{16,t}\}.
$$

In this similar way, 15 covariables for China apply to the two intensities. The coefficients $\alpha_i(u)$ and $\beta_i(u)$ are functions of forward starting time, which are further modelled by Nelson-Siegel term structure functions, such as

$$\alpha_i(u; \varrho_{i,0}, \varrho_{i,1}, \varrho_{i,2}, d_i) = \varrho_{i,0} + \varrho_{i,1} \frac{1 - \exp(-u\Delta t/d_i)}{u\Delta t/d_i} + \varrho_{i,2} \left[\frac{1 - \exp(-u\Delta t/d_i)}{u\Delta t/d_i} - \exp(-u\Delta t/d_i) \right], \quad (38)$$

for $i = 0, 1, 2, \ldots, 16$. Recall that, except for the intercept terms $\alpha_0(u)$ and $\beta_0(u)$, the other covariates are stochastic and their long-term levels are restricted to zeros; namely, $\varrho_{i,0} = 0$ for $i = 1, 2, \ldots, 16$. With $f_t(u)$ and $h_t(u)$ in place, we are ready to define $\psi_t(s,q) = \frac{\sum_{u=s}^{q}[f_t(u)+h_t(u)]}{q-(s-1)}$, for $q \geq s \geq 1$, which is a standardized forward termination intensity covering the days $t+s, \ldots, t+q$.

One important feature of the CDS is that when the reference entity ceases to exist due to reasons other than default, such as mergers and acquisitions, the CDS protection is typically shifted to the merged or acquiring entity. Naturally, we should take into account the fact that the successor entity will then face subsequent default or other exits. There indeed are a number of ways to model the relationship between the termination probability of the reference entity and the successor entity (see [Duan, 2014]). In CRI's implementation, we further assume that the successor has the forward default and other exit intensities identical to those of the original reference entity.

Let $P_t(s, q; r_t(1,u), s \leq u \leq q)$ denote the day-t discounted forward probability of the reference entity of the CDS being terminated, including successions, over the days $t+s, \ldots, t+q$. Under the assumptions above, Duan [2014] has derived its analytical solution, which can be re-written in the discrete form below

$$P_t(s, q; r_t(1,v), s \leq v \leq q) = \sum_{v=s}^{q} e^{-\sum_{u=s}^{v}[r_t(u,u)+f_t(u)]\Delta t} f_t(v)\Delta t. \quad (39)$$

By temporarily setting the forward interest rate to 0 in Eq. (39), the first term of denominator in Eq. (37) can be presented in the form of

$$E_t^P(1_{\{t_i'<\tau\}}) = 1 - P_t(1, t_i' - t; r_t(1,u) = 0 \text{ for } 1 \leq u \leq t_i' - t). \quad (40)$$

The solutions to the two remaining two terms of Eq. (37) can be expressed as

$$\begin{aligned}
& E_t^p \left[e^{-r_t(1,\tau-t)(\tau-t)/365} \cdot \mathbb{1}_{\left\{t<\tau\leq t_k'\right\}} \right] \\
= \quad & \sum_{q=1}^{t_k'-t} e^{-[r_t(1,q)+\psi_t(1,q)]\cdot(q/365)} \cdot f_t(q) \cdot \Delta t \\
+ \quad & \sum_{q=1}^{t_k'-t} e^{-[r_t(1,q)+\psi_t(1,q)]\cdot(q/365)} \cdot h_t(q) \cdot P_t(q, t_k'-t; r_t(1,v), q \leq v \leq t_k'-t) \cdot \Delta t
\end{aligned}$$

and

$$
\begin{aligned}
& E_t^p \left[A(t_{i-1} \vee (t+1), \tau)\right] \cdot e^{-r_t(1,\tau-t)(\tau-t)/365} \cdot \mathbb{1}_{\{t'_{i-1} < \tau \le t'_i\}} \\
= & \sum_{q=t_{i-1}\vee(t+1)}^{t'_i} A(t_{i-1} \vee (t+1), q) \cdot e^{-[r_t(1,q-t)+\psi_t(1,q-t)]\cdot(q-t)/365} \cdot f_t(q-t) \cdot \Delta t \\
+ & \sum_{q=t_{i-1}\vee(t+1)}^{t'_i} A(t_{i-1} \vee (t+1), q) \cdot e^{-[r_t(1,q-t)+\psi_t(1,q-t)]\cdot(q-t)/365} \cdot h_t(q-t) \\
& \cdot P_t(q-t, t'_i - t; r_t(1,v), q-t \le v \le t'_i - t) \cdot \Delta t
\end{aligned}
$$

With the formulas mentioned above, we compute the AS, or $S_t^{(a)}(T-t)$, and provide it to the public on a daily basis.

7 CriSIFI

As of 2017, CRI has launched the CRI Systemically Important Financial Institution (CriSIFI) on its website (`http://rmicri.org`). Further, we updated the system twice in September 2017 and January 2018, which enables users to assess systemic importance of exchange–listed banks and insurers globally. The CriSIFI aims to identify systemic risks of those banks and insurers by capturing their tendency to default together (i.e., too connected to fail) along with their respective asset sizes (i.e., too big to fail). For example, a financial institution with a higher ranking (e.g., 10 is a higher ranking than 20) is likely to pose a higher risk to the financial system and thus has greater systemic importance than does a lower ranked firm. In short, the CriSIFI relies on a novel way to construct a proper financial network which combines nodes and edges of a network.

- Node: firm characteristics captured by the ratio of individual financial institution's assets over the network's total assets
- Edge: network configuration reflected through partial default correlations of financial institutions

The CriSIFI data panel is monthly and starts from January 2000. The CriSIFI is updated monthly on the CRI website where all exchanged-traded banks (bank and investment bank) and insurers globally are included. For details, see Table A.1 for the CRI coverage. The CriSIFI can be used to track and monitor systemic risk of each financial institution in the global financial system. Apart from the CriSIFI, the CRI reports the CRI Systemically Important Bank (CriSIB) and the CRI Systemically Important Insurer (CriSII) globally, or within a local community such as region (e.g., North America and Asia-Pacific Developed economies) and economy (e.g., U.S. and Singapore). All three systemic importance indicators can help identify potential systemic risk via financial institutions' connectedness in the global financial network. Next, we explain how to construct the CriSIFI.

7.1 Constructing the forward-looking PD partial correlation matrix

A primary input to the CriSIFI is the forward–looking PD (probability of default) partial correlation matrix, which is used to measure connectedness between financial institutions in the network. This partial correlation matrix is generated from the forward–looking PD total correlation matrix using the model of Duan and Miao [2016], which is a factor model along with sparsely correlated residuals for PDs and POEs (probabilities of other exist) of all firms considered. It is worth noting that POE is a crucial element for properly estimating multiple–period default probabilities, because suitable survival probability of a firm in a multiperiod context cannot be determined without POE (see Duan et al. [2012]). Omitting POE is particularly troublesome when knowing that POEs are empirically many folds larger than PDs. First, we briefly explain how to obtain the forward–looking PD total correlation matrix. It is important to note that our methodology follows that of Chan-Lau et al. [2016], which is largely based on Duan and Miao [2016] except for deploying a logit transformation instead of a double–log transformation.

(a) Define one pair of predetermined global factors, ten pairs of predetermined industry factors, and one pair of predetermined economy factors for each economy of domicile (one–month, logit–transformed, median PD and POE). The logit transformation, denoted by a hat, has the following form:

$$\widehat{PD} = \log \frac{PD}{1 - PD} \text{ and } \widehat{POE} = \log \frac{POE}{1 - POE}.$$

The logit transformation is valid because PDs and POEs all fall in (0,1). A dynamic model is then constructed on these 24 $\widehat{PD}$ and $\widehat{POE}$ factors. Later, the inverse transformation will be applied to recover simulated model PD and/or POE factors:

$$PD = \frac{\exp(\widehat{PD})}{1 + \exp(\widehat{PD})} \text{ and } POE = \frac{\exp(\widehat{POE})}{1 + \exp(\widehat{POE})}.$$

(b) In particular, the predetermined economy pair should have at least 30 observations available in the domicile economy. Otherwise, we use the median PD/POE pair of aggregation groups as a substitution: Asia Pacific (Developed), Asia Pacific (Emerging), Europe, Latin America & Caribbean, Sub–Saharan Africa, or Middle East, North Africa & Central Asia. In case an economy has sufficient observations (equal or more than 30) in the history but not later on, we continue to use the economy median. If the economy has fewer observations earlier but sufficiently large later on, we allow the switch from the group median to the economy median to happen but for only once.

(c) The global pair of $\widehat{PD}$ and $\widehat{POE}$ are normalized to have mean 0 and variance 1. For each industry factor, regress $\widehat{PD}$ (or $\widehat{POE}$ factor) on the pair of the global factors to remove any shared information arising from the global factors (i.e., orthogonalization). Henceforth, the industry factors refer to the "orthogonalized regression residuals" uncorrelated with the global factors. We then normalize the 10 industry pairs of $\widehat{PD}$ and $\widehat{POE}$ residuals and the 1 predetermined pair of $\widehat{PD}$ and $\widehat{POE}$ to have a standard deviation of 1 (i.e., normalization).

(d) Model the factors with a bivariate vector autoregressive process of order one without intercept terms, i.e., VAR(1), for each of the 12 pairs of $\widehat{PD}$ and $\widehat{POE}$ factors by deploying entire historical data series up to the point of analysis. Doing so ensures that the factor dynamics are estimated with data covering different phases of a credit cycle and over several credit cycles. Note that the intercept terms are set to zero because normalization has removed the mean.

(e) Estimate the "best" factor model by regressing individual firm $\widehat{PD}$ on 12 global, industry, and economy $\widehat{PD}$ factors using a 60–month moving data window. Likewise, regress individual firm $\widehat{POE}$ on 12 global, industrial, economy $\widehat{POE}$ factors. Deploy the adaptive lasso technique of Zou [2006] with cross–validation in these regressions to avoid overfitting.

(f) Individual firm's factor model residuals (60 data points at most) are treated as an AR(1) process, and the AR residuals are then used to compute cross–firm correlations. Note that some individual firm's $\widehat{PD}$ and $\widehat{POE}$ are missing due to bankruptcies and/or mergers/acquisitions. We thus construct the AR residual correlation matrix by first computing pairwise correlations, and then apply thresholding coupled with cross–validation to identify a legitimate "sparse" AR residual total correlation matrix.

(g) Use the estimated factor model along with sparse residual correlations to simulate future PDs and POEs for all financial institutions under consideration, and with which we can apply the survival/default formula on the simulated PDs and POEs to obtain PD over any prediction horizon of interest via Monte Carlo averaging of the stochastic PD term structure for each financial institution. This theoretical PD term structure under a particular parameter value serves as the basis to recalibrate factor loadings for every financial institution via a single firm–specific scaling factor and the parameters of its residual AR(1) model. Our recalibration is implemented to fit the 5–year PD term structure provided by the CRI system. This recalibration step ensures that default correlations are obtained not at the expense of poorly matching the available PD term structure individually.

(h) Use the recalibrated model to simulate PDs and POEs for a specific horizon of interest (e.g., one year) at any future time point (e.g., one month later), and estimate the forward–looking total default correlation matrix using the simulated sample.

Importantly, we focus on the forward–looking default correlation via simulation, not on the historical average available from the time series of PDs in the CRI database. The reason is that this average measure represents backward-looking comovements, which does not represent the future when one goes through different phases of a credit cycle. In contrast, the forward-looking correlations reflect the currently available information and should better gauge the potential riskiness going forward. Readers who are interested in comparing the forward-looking and backward-looking results are referred to Chan-Lau et al. [2016]. Other practical considerations also favor forward-looking default correlations over historical default correlations. For example, considering 1–year PD correlations over a period of six months instead of one month would see a dramatic reduction in usable sample size by a factor of six.

Apart from the use of the forward–looking PDs, we focus on "partial" not "total" correlations. Partial correlation is the residual correlation after removing any indirect connections through other parties in the network. Conceptually, partial correlation rightfully captures the direct default connection between any two financial institutions. Of course, indirect connections are also of interest for network analysis, but they are already reflected through the network configuration represented by many direct bilateral linkages. We obtain the partial default correlation matrix through a regularization technique.

We use the CONCORD (CONvex CORrelation selection methoD) algorithm of Khare et al. [2015] and Oh et al. [2014]. Conceptually, it amounts to imposing zero partial correlations on pairs with weak ties. The CONCORD algorithm also ensures convergence because it preserves convexity through an appropriate selection of weights and a particular design of the penalty term on the concentration matrix rather than on the partial correlation matrix. In addition, the high dimensional data calls for regularization, simply because high dimensionality left un-regularized may deliver a highly unstable partial correlation matrix. As a result, the globally connected and regularized network will be more stable and does not generate an overwhelmingly large number of systemic firms.

Specifically, the CONCORD objective is to minimize

$$Q_{con}(\Omega) = \frac{N}{2}\left[-\ln\left[\det(\Omega_D^2)\right] + \mathrm{tr}(S_N\Omega^2) + \lambda||\Omega_X||_1\right],$$

where $\det(\cdot)$ denotes the determinant operator; $\mathrm{tr}(\cdot)$ denotes the trace operator; S_N is the sample correlation matrix computed with a sample size of N; $\Omega = \Omega_D + \Omega_X$ is the concentration matrix (i.e., the inverse of the correlation matrix); $\lambda > 0$ is the tuning parameter used to determine the shrinkage rate or how aggressively one penalizes the non–zero entries in Ω_X; $\lambda||\Omega_X||_1 = \lambda\sum_{i\neq j}|\omega_{ij}|$ is the L_1–penalty term; and ω_{ij} is the off–diagonal element in Ω_X. Here, we select a λ below which totally isolated firms in the network begin to emerge. The tolerance error for finding the optimal λ and the partial correlation precision are respectively set to 10^{-3} and 10^{-4}. For technical details, see Chan-Lau et al. [2016].

7.2 Computing the CriSIFI

The CriSIFI is a network centrality indicator used to assess the relative importance of a financial institution in the network, and is the appropriate entry in the non-negative eigenvector of $Q|\bar{P}_{X,t}|Q$ that corresponds to the largest eigenvalue. $|\bar{P}_{X,t}|$ is the absolute value of $\bar{P}_{X,t}$ and $\bar{P}_{X,t}$ denotes the 12–month moving average of $P_{X,t}$, the regularized partial correlation matrix at time t after setting its diagonal elements to 0. Deploying the 12-month moving average is to remove the excessive noise. Q is a diagonal matrix with q_i as its i–th diagonal element where q_i is the size of a financial institution over the total size of the network, measured in USD; Technically, $Q|\bar{P}_{X,t}|Q$ is a non–negative matrix, and the Perron–Frobenius theorem ensures the existence of such a non–negative eigenvector.

The CriSIFI captures both the node (the firm's asset size) and edge (the strength of connectedness reflected in the partial correlation) characteristics in the financial network. We contend that our forward-looking systematic risk ranking, combining both the edge and node characteristics, is much more comprehensive than the alternatives: (1) a backward-looking ranking measure, and (2) any measure that only factors in one of the two characteristics. Therefore, under the CriSIFI small financial institutions being connected to large ones may present significant systemic risks simply due to the feedback effect from their connected larger counter–parties. Chan-Lau et al. [2016] also compare the performance of the CriSIFI with those of other measures such as Global Systemically Important Banks (G-SIBs) released by the Financial Stability Board (FSB). They find that the G-SIBs are likely to be biased toward singling out large financial institutions in the system, and overall connectivity only plays a rather minor role.

8 Ongoing Developments

The CRI can develop a number of directions. We now comment on obvious ones that in our view are likely to bring meaningful and measurable benefits. Besides modifications to the current modeling framework of the forward intensity, a change in modeling platform will be undertaken if another model proves more promising in terms of accuracy and robustness of results. For this type of development, we also rely on the collective efforts by the worldwide credit research community to challenge and improve the existing modeling platform.

Within the current modeling framework, future developments involve, for example, the CRI plans to implement DTD estimations by a novel density-tempered expanding-data sequential Monte Carlo method. Another challenging example includes variable and structural–break selections where Artificial Intelligence automatically identifies time window, crucial risk factors, and breakpoints regarding defaults in a way that we would consider "smart". Also, we are designing a more comprehensive treatment scheme to handle missing data.

Finally, a series of new applications and tools using the RMI-CRI PDs as an input are currently being developed. More specifically, the CRI is actively working with users and exploring different possibilities of taking advantage of the world-class research infrastructure at the institute to propagate real world applications in credit rating and testing. The CRI has developed a tool for stress testing the financial stability for economies around the world. The CRI has also developed a methodology to address default correlations within a portfolio. The CRI remains committed to making its vast resources available for academic research.

Acknowledgements

The RMI Credit Research Initiative is premised on the concept of credit ratings as a "public good". Being a non-profit undertaking allows a high level of transparency and collaboration that other commercial credit rating systems cannot replicate. The research and support infrastructure is in place and researchers from around the world are invited to contribute to this initiative. Any methodological improvements that researchers develop will be incorporated into the CRI system. In essence, the initiative operates as a "selective wikipedia" where many can contribute but implementation control is retained.

If you have feedback on this technical report or wish to work with us in this endeavor, please contact us at rmicri@nus.edu.sg.

A APPENDIX: DATA

Table A.1: All economies under the CRI coverage

Region	Economy
Asia Pacific (Developed) (7)	Australia, Hong Kong, Japan, New Zealand, Singapore, South Korea, Taiwan.
Asia Pacific (Emerging) (17)	Bangladesh, Cambodia, China, India, Indonesia, Kazakhstan, Laos, Macau, Malaysia, Mongolia, Myanmar, Pakistan, Papua New Guinea, Philippines, Sri Lanka, Thailand, Vietnam.
North America (4)	Bermuda, Canada, Greenland, United States.
Western Europe (28)	Austria, Belgium, Cyprus, Denmark, Faeroe Islands, Finland, France, Germany, Gibraltar, Greece, Guernsey, Iceland, Ireland, Italy, Isle of Man, Jersey, Liechtenstein, Luxembourg, Malta, Monaco, Netherlands, Norway, Portugal, Reunion, Spain, Sweden, Switzerland, United Kingdom.
Eastern Europe (20)	Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Turkey, Ukraine.
Latin America & Caribbean (19)	Argentina, Bahamas, Belize, Brazil, British Virgin Islands, Cayman Islands, Chile, Colombia, Curacao, Dominican Republic, Falkland Islands, Jamaica, Mexico, Peru, Panama, Puerto Rico, Uruguay, U.S. Virgin Islands, Venezuela.
Middle East & Africa (33)	Angola, Bahrain, Botswana, Cameroon, Egypt, Gabon, Ghana, Iraq, Israel, Jordan, Kenya, Kuwait, Madagascar, Malawi, Mauritius, Morocco, Mozambique, Namibia, Nigeria, Niger Republic, Oman, Qatar, Rwanda, Saudi Arabia, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Tunisia, Uganda, United Arab Emirates, Zambia.

Table A.2: The 87 economies under the CRI coverage for which we cover companies listed on the exchange.

Region	**Economy**
Asia Pacific (Developed) (7)	Australia, Hong Kong, Japan, New Zealand, Singapore, South Korea, Taiwan.
Asia Pacific (Emerging) (11)	Bangladesh, China, India, Indonesia, Kazakhstan, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam.
North America (2)	Canada, United States.
Western Europe (20)	Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.
Eastern Europe (18)	Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Turkey, Ukraine.
Latin America & Caribbean (8)	Argentina, Brazil, Colombia, Chile, Jamaica, Mexico, Peru, Venezuela.
Middle East & Africa (21)	Bahrain, Botswana, Egypt, Ghana, Israel, Jordan, Kenya, Kuwait, Malawi, Mauritius, Morocco, Namibia, Nigeria, Oman, Rwanda, Saudi Arabia, South Africa, Tunisia, Uganda, United Arab Emirates, United Republic of Tanzania.

Table A.3: The 41 economies under the CRI coverage for which we cover companies domiciled in the economy but listed on a foreign exchange included in Table A.2. The gray boxes indicate that these economies also have their own local stock exchange.

Angola	Georgia	Mozambique
Azerbaijan	Gibraltar	Niger Republic
Bahamas	Greenland	Panama
Belize	Guernsey	Papua New Guinea
Bermuda	Iraq	Puerto Rico
British Virgin Islands	Isle of Man	Qatar
Cambodia	Jersey	Republic of Zambia
Cameroon	Laos	Reunion
Cayman Islands	Liechtenstein	Sierra Leone
Curacao	Macau	Sudan
Dominican Republic	Madagascar	Togolese Republic
Faeroe Islands	Myanmar	United States Virgin Islands
Falkland Islands	Monaco	Uruguay
Gabon	Mongolia	

Table A.4: The ISO codes of 87 economies covered by the CRI and the corresponding calibration groups and stock exchanges.

ISO Code	Economy	Calibration Group	Stock Exchange
ARE	United Arab Emirates	Emerging	Abu Dhabi Securities Exchange
			Dubai Financial Market
			National Association of Securities Dealers
ARG	Argentina	Emerging	Buenos Aires Stock Exchange
AUS	Australia	Developed Asia-Pacific	Australian Securities Exchange
			National Stock Exchange of Australia
			SIM Venture Securities Exchange
AUT	Austria	Europe	Vienna Stock Exchange
BEL	Belgium	Europe	Brussels Stock Exchange
BGD	Bangladesh	Emerging	Dhaka Stock Exchange
BGR	Bulgaria	Europe	Bulgarian Stock Exchange
BHR	Bahrain	Emerging	Bahrain Stock Exchange
BIH	Bosnia and Herzegovina	Europe	Banja Luka Stock Exchange
			Sarajevo Stock Exchange
BRA	Brazil	Emerging	BM&FBOVESPA
BWA	Botswana	Emerging	Botswana Domestic Companies Index
CAN	Canada	North America	Canadian Securities Exchange
			TSX Venture Exchange
			Toronto Stock Exchange
CHE	Switzerland	Europe	Berne Stock Exchange
			Six Swiss Exchange
CHL	Chile	Emerging	Santiago Stock Exchange
CHN	China	China	Shanghai Stock Exchange
			Shenzhen Stock Exchange
COL	Colombia	Emerging	Colombia Stock Exchange
CYP	Cyprus	Europe	Cyprus Stock Exchange
CZE	Czech Republic	Europe	Prague Stock Exchange
DEU	Germany	Europe	Berlin Stock Exchange
			BOAG Borsen AG
			Dusseldorf Stock Exchange
			Frankfurt Stock Exchange
			Munich Stock Exchange
			Stuttgart Stock Exchange
DNK	Denmark	Europe	Copenhagen Stock Exchange
			First North Denmark
EGY	Egypt	Emerging	Egyptian Exchange
			Nile Stock Exchange
ESP	Spain	Europe	Barcelona Stock Exchange
			Madrid Stock Exchange
EST	Estonia	Europe	Tallinn Stock Exchange
FIN	Finland	Europe	Helsinki Stock Exchange
			NASDAQ OMX NORDIC
FRA	France	Europe	Euronext Paris
GBR	United Kingdom	Europe	Icap Securities and Derivatives Exchange
			London International Financial Futures and Options Exchange
			London Stock Exchange

Continued on next page

Table A.4 – *Continued from previous page*

ISO Code	Economy	Calibration Group	Stock Exchange
			Professional Liability Underwriting Society Market Group
GHA	Ghana	Emerging	GSE Composite Index
GRC	Greece	Europe	Alternative Market of Athens Exchange
			Athens Stock Exchange
HKG	Hong Kong	Developed Asia-Pacific	Hong Kong Exchanges and Clearing Limited
HRV	Croatia	Europe	Zagreb Stock Exchange
HUN	Hungary	Europe	Budapest Stock Exchange
IDN	Indonesia	Emerging	Indonesian Stock Exchange
IND	India	India	Bombay Stock Exchange
			MCX Stock Exchange Limited
			National Stock Exchange of India Limited
IRL	Ireland	Europe	Irish Stock Exchange
ISL	Iceland	Europe	Iceland Stock Exchange
ISR	Israel	Europe	Tel Aviv Stock Exchange
ITA	Italy	Europe	Borsa Italiana S.p.A
			Hi-Multilateral Trading Facilities Sim S.p.A
JAM	Jamaica	Emerging	Jamaica Stock Exchange
JOR	Jordan	Emerging	Amman Stock Exchange
JPN	Japan	Developed Asia-Pacific	Fukuoka Stock Exchange
			JASDAQ Securities Exchange
			Nagoya Stock Exchange
			Osaka Securities Exchange
			Sapporo Stock Exchange
			Tokyo Stock Exchange
KAZ	Kazakhstan	Emerging	Kazakhstan Stock Exchange JSC
KEN	Kenya	Emerging	Kenya Nairobi Stock Exchange Index
KOR	South Korea	Developed Asia-Pacific	Korea New Exchange
			Korea Stock Exchange
			Korean Securities Dealers Automated Quotations
KWT	Kuwait	Emerging	Kuwait Stock Exchange
			Bloomberg Kuwait Premier Market Total Return Index
LKA	Sri Lanka	Emerging	Colombo Stock Exchange
LTU	Lithuania	Europe	OMX Vilnius Stock Exchange
LUX	Luxembourg	Europe	Luxembourg Stock Exchange
LVA	Latvia	Europe	OMX Riga Stock Exchange
MAR	Morocco	Emerging	Casablanca Stock Exchange
MEX	Mexico	Emerging	Mexican Stock Exchange
MKD	Macedonia	Europe	Macedonian Stock Exchange Inc.
MLT	Malta	Europe	Malta Stock Exchange
MNE	Montenegro	Europe	Montenegro Stock Exchange
MUS	Mauritius	Emerging	Mauritius Stock Exchange SEMDEX Index
MWI	Malawi	Emerging	Malawi All Share Index
MYS	Malaysia	Emerging	Kuala Lumpur Stock Exchange

Continued on next page

Table A.4 – *Continued from previous page*

ISO Code	Economy	Calibration Group	Stock Exchange
NAM	Namibia	Emerging	Namibia Overal Index
NGA	Nigeria	Emerging	Nigerian Stock Exchange
NLD	Netherlands	Europe	Euronext Amsterdam Stock Exchange
NOR	Norway	Europe	Oslo Stock Exchange
NZL	New Zealand	Developed Asia-Pacific	New Zealand Exchange
OMN	Oman	Emerging	Muscat Securities Market
PAK	Pakistan	Emerging	Karachi Stock Exchange
			Pakistan Stock Exchange
PER	Peru	Emerging	Lima Stock Exchange
PHL	Philippines	Emerging	Philippine Stock Exchange
POL	Poland	Europe	Warsaw Stock Exchange
PRT	Portugal	Europe	Euronext Lisbon Stock Exchange
ROM	Romania	Europe	Bucharest Stock Exchange
			Sibiu Stock Exchange
RUS	Russian Federation	Europe	Moscow Exchange
			Moscow Interbank Currency Exchange
			Russian Trading System
RWA	Rwanda	Emerging	Rwanda Stock Exchange All Share Index
SAU	Saudi Arabia	Emerging	Saudi Stock Exchange
SGP	Singapore	Developed Asia-Pacific	Singapore Exchange
SRB	Serbia	Europe	Belgrade Stock Exchange
SVK	Slovakia	Europe	Bratislava Stock Exchange
SVN	Slovenia	Europe	Ljubljana Stock Exchange
SWE	Sweden	Europe	AktieTorget Stock Exchange
			First North Stockholm
			Nordic Growth Market
			Stockholm Stock Exchange
THA	Thailand	Emerging	Stock Exchange of Thailand
TUN	Tunisia	Emerging	Tunis Stock Exchange
TUR	Turkey	Europe	Istanbul Stock Exchange
TWN	Taiwan	Developed Asia-Pacific	Taiwan Stock Exchange
TZA	United Republic of Tanzania	Emerging	Tanzania Share (TSI) Index
UGA	Uganda	Emerging	Uganda SE All Share Index
UKR	Ukraine	Europe	First Stock Trading System
			Russian Trading System Ukraine
USA	United States	North America	NASDAQ Capital Market
			NASDAQ Global Market
			NASDAQ Global Select Market
			New York Stock Exchange
			NYSE Arca
			NYSE MKT LLC
			Bats Stock Exchange
VEN	Venezuela	Emerging	Caracas Stock Exchange
VNM	Vietnam	Emerging	Hanoi Stock Exchange
			Ho Chi Minh City Stock Exchange
ZAF	South Africa	Emerging	Johannesburg Stock Exchange

The stock exchanges covered by the CRI database are collected from Bloomberg system and labeled as primary exchange.

Table A.5: The stock indices used for each economy in computing the first common variable.

Economy	Stock Index	Period Used*
ARE	FTSE NASDAQ DUB UAE 20	06/28/2006 - Present
ARG	Buenos Aires Stock Exchange Merval Index	
AUS	All Ordinaries Index	
AUT	Austrian Traded ATX Index	
BEL	Belgian Stk Mkt Ret Index	
BGD	DSEX Index	01/28/2013 - Present
	Dhaka Stock Exchange General I	- 01/27/2013
BGR	Bulgaria Stock Exchange Sofix Index	10/24/2000 - Present
BHR	BB All Share Index	07/08/2004 - Present
BIH	SASE Free Market 10 Index	12/31/2004 - Present
BRA	Brazil Bovespa Stock Index	
BWA	Botswana Domestic Companies Index	06/30/1989 - Present
CAN	S&PTSX Composite Index	
CHE	SPI Swiss Performance Index	
CHL	Santiago Stock Exchange IPSA Index	
CHN	Shanghai SE Composite Index	12/19/1990 - Present
COL	FTSE All World Series Colombia Local	01/01/1999 - Present
CYP	Cyprus Stock Exchange General Index	09/03/2004 - Present
	Cyprus Stock Exchange General	04/02/1996 - 09/02/2004
CZE	Prague Stock Exchange Index	04/05/1994 - Present
DEU	CDAX Performance Index	
DNK	OMX Copenhagen 20 Index	
EGY	EGX 100 Index	05/01/2006 - Present
ESP	IBEX 35 Index	
EST	OMX Tallinn OMXT	06/03/1996 - Present
FIN	OMX Helsinki Index	
FRA	CAC 40 Index	
GBR	FTSE 100 Index	
GHA	GSE Composite Index	12/31/2010 - Present
GRC	Athex Composite Share Price Index	
HKG	Hang Seng Index	
HRV	Croatia Zagreb CROBEX	06/14/2002 - Present
HUN	Budapest Stock Exchange Index	01/02/1991 - Present
IDN	Jakarta Composite Index	
IND	BSE Sensex 30 Index	
IRL	ISEQ Overall Index	
ISL	OMX Iceland All-Share PR	12/31/1992 - Present
ISR	Tel Aviv 100 Index	12/31/1991 - Present
ITA	Italy Stock Market BCI Comit Globale	
JAM	Jamaica Stock Exchange Market Index	
JOR	MSCI Jordan Index	
JPN	Nikkei 500	
KAZ	Kazakhstan Stock Exchange Index KASE	07/12/2000 - Present
KEN	Keyna Nairobi Stock Exchange Index	01/11/1990 - Present
KOR	KOSPI Index	
KWT	Bloomberg Kuwait Premier Market Total Return Index	04/01/2018 - Present
	Kuwait SE Weighted Index	01/02/2012 - 03/31/2018
	Kuwait Global General Index	- 01/01/2012
LKA	Sri Lanka Colombo Stock Exchange All-Share Index	
LTU	OMX Vilnius OMXV	01/04/2000 - Present

Continued on next page

Table A.5 – *Continued from previous page*

Economy	Stock Index	Period Used*
LUX	Luxembourg Stock Exchange Luxx Index	01/04/1999 - 01/04/1999
	Luxembourg Stock Exchange 13 'Dead'	01/02/1998 - 01/03/1999
LVA	OMX Riga OMXR	01/03/2000 - Present
MAR	MASI Free Float All Shares Index	03/31/1995 - Present
	CFG 25 CFG 25	12/31/1993 - 03/30/1995
MEX	Mexico Bolsa Index	01/19/1994 - Present
MKD	Macedonian Stock Exchange MBI 10	12/30/2004 - Present
MLT	Malta Stock Exchange	12/27/1995 - Present
MNE	Montenegro Stock Exchange Index	01/04/2015 - Present
	Montenegro Stock Exchange 20	03/03/2003 - 03/31/2015
MUS	Mauritius Stock Exchange SEMDEX Index	07/05/1989 - Present
MWI	Malawi All Share Index	11/15/1996 - Present
MYS	FTSE Bursa Malaysia KLCI	
NAM	Namibia Overall Index	12/19/2003 - Present
NGA	Nigeria Stock Exchange All Share	01/30/1998 - Present
NLD	AEX-Index	
NOR	OBX Price Index	
NZL	NZX All Index	03/30/1992 - Present
OMN	MSM30 Index	03/31/1992 - Present
PAK	Karachi All Share Index	03/11/1998 - Present
PER	S&PBVL Peru General Index TR PEN	01/05/2015 - Present
	Bolsa de Valores de Lima General Sector Index	01/02/1990 - 04/30/2015
PHL	Philippine Stock Exchange Index	
POL	WSE WIG Index	04/16/1991 - Present
PRT	PSI General Index	
ROM	Bucharest BET Plus Index	06/23/2014 - Present
	BSE Composite Index	04/17/1998 - 06/22/2014
RUS	MICEX Index	09/22/1997 - Present
RWA	Rwanda Stock Exchange All Share Index	01/10/2013 - Present
SAU	Tadawul All Share Index	01/31/1994 - Present
SGP	Straits Times Index	1/10/2008 - Present
	Straits Times Old Index	01/04/1985 - 01/09/2008
SRB	BELEXline Index	10/01/2004 - Present
SVK	Slovak Share Index	09/14/1993 - Present
SVN	HSBC Slovenia Dollar	12/29/1995 - Present
SWE	OMX Stockholm All-Share	
THA	Stock Exchange Of Thai Index	
TUN	Tunis SE TUNINDEX	04/30/1999 - Present
TUR	Istanbul Stock Exchange National 100 Index	
TWN	Taiwan Stock Exchange Weighted Index	
TZA	Tanzania Share (TSI) Index	04/03/2009 - Present
UGA	Uganda SE All Share Index	10/28/2003 - Present
UKR	Ukraine PFTS Index	01/12/1998 - Present
USA	S&P 500 Index	
VEN	Caracas Stock Exchange Stock Market Index	12/30/1993 - Present
VNM	Ho Chi Minh Stock Index	07/28/2000 - Present
ZAF	MSCI South Africa Index	12/31/1992 - Present

* A blank Period Used column indicates that there is only a single index that is used throughout the whole period.

Table A.6: The interest rates used for each economy as the second common variable.

Economy	Short-Term Interest Rate	Period Used*
ARE	UAE Ibor 3 Month	05/15/2000 - Present
ARG	Argentina Deposit Tate 90 Day	04/01/1991 - Present
AUS	Australia Dealer Bill 90 Day	
AUT	Germany 3 Month Bubill	01/01/1999 - Present
	AUSTRIA VIBOR 3 MONTH	06/10/1991 - 12/31/1998
BEL	Germany 3 Month Bubill	01/01/1999 - Present
	BELGIUM TREASURY BILL 3 MONTH	01/30/1991 - 12/31/1998
BGD	Bangladesh 3 Month Bill Auction Cut Off Yield	
BGR	Bulgaria Interbank 3 Month	02/17/2003 - Present
BHR	Bahrain Ibor 3 Month	12/14/2006 - Present
BIH	-	
BRA	Andima Brazil Govt Bond Fixed Rate 3 Months	04/03/2000 - Present
	Brazil CDB (Up To 30 Days)	10/10/1994 - 04/02/2000
BWA	Botswana, Treasury Bills, Nominal Yield, 3 Month Average	11/01/2004 - Present
CAN	Canada Treasury Bill 3 Month	01/02/1990 - Present
CHE	Swiss Interbank 3m (ZRC:SNB)	
CHL	Chile Overnight Interbank Interest Rate	05/29/1995 - Present
	Chile TAB UF Interbank Rate 90 Days	11/02/1992 - 05/28/1995
CHN	China Time Deposit Rate, 3 Month	05/17/1993 - Present
COL	Colombia CD Rate 90-Day	
CYP	Germany 3 Month Bubill	01/01/2008 - Present
	Cyprus, TREASURY BILL RATE - 13 WEEK	01/15/1993 - 12/31/2007
CZE	Czech Republic Interbank 3 Month	04/22/1992 - Present
DEU	Germany 3 Month Bubill	05/25/1993 - Present
	Germany Interbank 3 Month	01/02/1986 - 05/24/1993
DNK	Denmark Interbank 3 Month	
EGY	Egypt 91 Day T-Bill	07/06/2004 - Present
ESP	Germany 3 Month Bubill	01/01/1999 - Present
	Spain 3 Month Treasury Bill Yield	11/30/1992 - 12/31/1998
	SPAIN INTERBANK 3 MONTH	12/19/1991 - 11/29/1992
EST	Germany 3 Month Bubill	01/01/2011 - Present
	Estonia, Interest Rates, Prices, Production, & Labour, Interest Rates, DEPOSIT RATE	02/15/1993 - 12/31/2010
FIN	Germany 3 Month Bubill	01/01/1999 - Present
	FINLAND INTERBANK CLOSE 3 MONT	04/01/1992 - 12/31/1998
FRA	Germany 3 Month Bubill	01/01/1999 - Present
	France Treasury Bills 3 Month Intraday	12/29/1995 - 12/31/1998
GBR	UK Treasury Bill Tender 3 Month	01/04/1995 - Present
GHA	Ghana 3 Month Bill Auction Average Yield	11/02/2007 - Present
GRC	Germany 3 Month Bubill	01/01/2000 - Present
	GREECE TREASURY BILL 3 MONTH	01/02/1990 - 12/31/1999
HKG	Hong Kong Exchange Fund Bill 3 Month	06/10/1991 - Present
HRV	Croatia Zibor Rate 3 Month	06/02/1997 - Present
HUN	Hungary Interbank 3 Month	09/07/1995 - Present
IDN	Indonesia Interbank 3 Months	07/10/2003 - Present
	Indonesia SBI/DISC 90 Day'dead'	- 07/09/2003
IND	India Treasury Bill 3 Month	05/20/2013 - Present
	India T-Bill Secondary 91 Day	01/15/1993 - 05/19/2013
IRL	Germany 3 Month Bubill	01/01/1999 - Present
	IRELAND INTERBANK 3 MONTH	01/20/1984 - 12/31/1998

Continued on next page

Table A.6 – *Continued from previous page*

Economy	Short-Term Interest Rate	Period Used*
ISL	Iceland Interbank 3 - Month	08/04/1998 - Present
	Iceland 90 - Day Cb Notes	- 08/03/1998
ISR	Israel T-Bill Secondary 3 Mnth	05/30/1995 - Present
ITA	Germany 3 Month Bubill	01/01/1999 - Present
	Italy Bots Treasury Bill 3 Month Intraday Gross Yields	09/05/1994 - 12/31/1998
	ITALY T-BILL AUCT. GROSS 3 MONTH	01/15/1988 - 09/04/1994
JAM	Bloomberg Bank of Jamaica 3 Month Treasury Bill Yield	11/30/2010 - Present
	Jamaica 3 Months Repo Rate	07/17/2008 - 11/29/2010
JOR	Jordanian Dinar Interbank Offered Rate 3 Months	09/20/2006 - Present
	Jordan Re-discount rate	03/12/2001 - 09/19/2006
JPN	Japan Treasury Discount Bills 3 Month	07/10/1992 - Present
	Japan Government Bond Interest Rate - 1 Year	- 07/09/1992
KAZ	Kazakhstan KIBOR/KIBID 90 Days Interbank	09/29/2001 - Present
KEN	Thomson Reuters Kenya GVT BMK Bid Yield 3 Months	05/26/2009 - Present
KOR	Korea Commercial Paper 91d	06/14/1993 - Present
KWT	Kuwait Interbank 3 Month	
LKA	Sri Lanka Treasury Bill 3 Month	
LTU	Germany 3 Month Bubill	01/01/2015 - Present
	VILNIUS INTERBANK THREE MONTH	01/06/1999 - 12/31/2014
LUX	Germany 3 Month Bubill	01/01/1999 - Present
	LONG TERM GOVERNMENT BOND YIELDS - MAASTRICHT DEFINITION (AVG.)	01/15/1985 - 12/31/1998
LVA	Germany 3 Month Bubill	01/01/2014 - Present
	TREASURY BILL RATE 3 MONTH	05/11/1994 - 12/31/2013
MAR	Morocco Deposit Rate 3 Month	06/06/2003 - Present
MEX	Mexico Cetes 2nd Mkt. 90 Day	06/26/1996 - Present
	Mexico CETES 91 Day Avg.Ret.At Auc.	- 06/25/1996
MKD	Macedonia Skibor 3 Months	07/02/2007 - Present
MLT	Germany 3 Month Bubill	01/01/2008 - Present
	LONG TERM GOVERNMENT BOND YIELDS - MAASTRICHT DEFINITION (AVG.)	01/15/1985 - 12/31/2007
MNE	-	
MUS	Thomson Reuters Mauritius GVT BMK Bid Yield 1 Year	05/26/2010 - Present
MWI	Malawi 3 Month T-Bill Auction Average Yield	01/02/2009 - Present
MYS	Malaysia Deposit 3 Month	
NAM	Namibia, Treasury Bills, Effective Yield, 3 Month	05/01/1991 - Present
NGA	Nigeria Interbank Offered Rate 3 Month	01/30/2004 - Present
NLD	Germany 3 Month Bubill	01/01/1999 - Present
	Netherlands Interbank 3 Month	01/02/1979 - 12/31/1998
NOR	Norway Govt Treasury Bills 3 Month	06/27/1995 - Present
	Norway Interbank 3 Month (Effective)	- 06/26/1995
NZL	-	
OMN	OMR 3 Month Deposit	07/16/2002 - Present
PAK	Reuters Pakistan Repo 3 Month Rate	01/02/2002 - Present
	PKR 3 Month Repo	10/29/1999 - 01/01/2002
PER	Bloomberg Asbanc Peru 3 Months Nominal Rate	09/30/2002 - Present
	Peru Savings Rate	07/01/1991 - 09/29/2002
PHL	Philippine Treasury Bill 91d	
POL	Poland Interbank 3 Month (EOD)	06/04/1993 - Present
PRT	Germany 3 Month Bubill	01/01/1999 - Present
	Portugal 1–year - LISBOB - Act/365 Day convention	- 12/31/1998

Continued on next page

Table A.6 – *Continued from previous page*

Economy	Short-Term Interest Rate	Period Used*
ROM	Romanian Interbank 3 Month	08/01/1995 - Present
RUS	MosPime 3 Months Rate	04/18/2005 - Present
	Russia Moscow Interbank Non Co	08/14/2000 - 04/17/2005
	Russia Interbank 31 To 90 Day	09/01/1994 - 08/13/2000
RWA	Rwanda 3 Month Bill Auction Average Yield	04/22/2009 - Present
SAU	Saudi Interbank 3 Month	
SGP	Monetary Authority of Singapore Benchmark Govt Bill Yield 3 Month	09/20/2013 - Present
	Singapore T-Bill 3 Month	- 09/19/2013
SRB	National Bank of Serbia Belibor 3M Rate (Interbank Rate)	01/28/2005 - Present
SVK	Germany 3 Month Bubill	01/01/2009 - Present
	SLOVAK REP. INTERBANK 3 MTH	06/23/1994 - 12/31/2008
SVN	Germany 3 Month Bubill	01/01/2007 - Present
	SLOVENIA TREASURY BILL 3 MONTH'DEAD'	10/29/1998 - 12/31/2006
SWE	Sweden T Bill 3 Month	05/25/1993 - Present
	Sweden Treasury Bill 90 Day	- 05/24/1993
THA	Thailand Bibor Fixings 3 Month	05/30/2002 - Present
	Thailand Repo 3 Month (BOT)'Dead'	03/11/1994 - 05/29/2002
TUN	Tu Policy Rates: TMM (Avg.)	12/15/1994 - Present
TUR	Turkish Interbank 3 Month	08/01/2002 - Present
TWN	Taiwan Money Market 90 Day	
TZA	Tanzania 3 Month Bill Auction Average Yield	01/02/2003 - Present
UGA	Uganda 3 Month Bill Auction Average Yield	01/05/2005 - Present
UKR	Ukraine Interbank 3 Months	03/01/2001 - Present
USA	US Generic Govt 3 Month Yield	
VEN	Venezuela 90 Day Deposit Rate	01/10/1997 - Present
	Venezuela Overnight	11/28/1994 - 01/09/1997
VNM	Vietnam Interbank 3 Month	12/11/1998 - Present
ZAF	SA T-Bill 91 Days (Tender Rates)	

* A blank Period Used column indicates that there is only a single interest rate that is used throughout the whole period.

Table A.7: The interest rates used for each economy in the DTD calculation.

Economy	Interest Rate Name	Period Used*
ARE	UAE IBOR 1 Year	05/15/2000 - Present
ARG	Argentina Deposit 90 Day (PA.)	04/01/1991 - Present
AUS	Australia Govt Bonds Generic Mid Yield 1 Year	
AUT	German Government Bonds 1 Year BKO	01/01/1999 - Present
	Austria VIBOR 12 Month	06/10/1991 - 12/31/1998
BEL	German Government Bonds 1 Year BKO	01/01/1999 - Present
	Belgium Treasury Bill 1 Year	04/02/1991 - 12/31/1998
BGD	Bangladesh 12 Month Bill Auction Cut Off Yield	
BGR	Bulgaria Interbank 3 Month	02/17/2003 - Present
BHR	Bahrain IBOR 1 Year	12/14/2006 - Present
BIH	Reuters Bosnia and Herzegovina, Interest Rates, Deposite Rate	09/14/1998 - Present
	BP Real Interest Rate (%) NADJ	06/30/1998 - 09/13/1998
BRA	Andima Brazil Govt Bond Fixed Rate 1 Year	04/03/2000 - Present
	Brazil CDB (Up To 30 Days)	10/10/1994 - 04/02/2000
BWA	Thomson Reuters Botswana Pula 1 Year Deposit	07/27/2010 - Present
CAN	Canada Treasury Bill 1 Year	01/02/1990 - Present
CHE	Swiss Interbank 1 Year (ZRC:SNB)	
CHL	Chile Overnight Interbank Interest Rate	05/29/1995 - Present
	Chile Tab UF Interbank Rates 90 Days	11/02/1992 - 05/28/1995
CHN	China Household Savings Deposits 1 Year Rate	01/02/1992 - Present
COL	Colombia Government Generic Bond 1 Year Yield	01/03/2001 - Present
	Colombia CD Rate 360-Day	07/12/1993 - 01/02/2001
CYP	German Government Bonds 1 Year BKO	01/01/2008 - Present
	Cyprus, Treasury Bill Rate - 13 Week	01/15/1993 - 12/31/2007
CZE	Czech Republic Interbank 3 Month	04/22/1992 - Present
DEU	German Government Bonds 1 Year BKO	01/10/1995 - Present
	Germany Interbank 12 Month	11/02/1990 - 01/09/1995
DNK	Denmark Government Bonds 1 Year Note Generic Bid Yield	06/19/2008 - Present
	Denmark Euro-Krone 1 Year (FT/ICAP/TR)	06/14/1985 - 06/18/2008
EGY	Egypt 364 Day T-Bill	07/06/2004 - Present
ESP	German Government Bonds 1 Year BKO	01/01/1999 - Present
	Spain 12 Month Treasury Bill Yield	11/30/1992 - 12/31/1998
	Spain Interbank 12 Month	12/19/1991 - 11/29/1992
EST	German Government Bonds 1 Year BKO	01/01/2011 - Present
	Estonia, Interest Rates, Prices, Production, & LABOUR, Interest Rates, Deposit Rate	02/15/1993 - 12/31/2010
FIN	German Government Bonds 1 Year BKO	01/01/1999 - Present
	Finland Interbank Close 12 Month	04/02/1992 - 12/31/1998
FRA	German Government Bonds 1 Year BKO	01/01/1999 - Present
	France Treasury Bill 1 Year Intraday	- 12/31/1998
GBR	UK Govt Bonds 1 Year Note Gene	09/12/2001 - Present
	UK Govt. Liab. Nom. Spot Curve 12 Month	- 09/11/2001
GHA	Ghana 1YR Note Auction Average Yield	11/02/2007 - Present
GRC	German Government Bonds 1 Year BKO	01/01/2001 - Present
	Greece Treasury Bill 1 Year	01/02/1990 - 12/31/2000
HKG	HKMA Hong Kong Exchange Fund Bills 12 Month	10/28/1991 - Present
HRV	Croatia ZIBOR Rate 3 Month	06/02/1997 - Present
HUN	Hungary Central Bank Base Rate	10/15/1990 - Present
IDN	INDONESIA SBI 90 DAY	07/10/2003 - Present
	INDONESIA SBI/DISC 90 DAY'DEAD'	01/01/1985 - 07/09/2003

Continued on next page

Table A.7 – *Continued from previous page*

Economy	Interest Rate Name	Period Used*
IND	India Treasury Bill 1 Year	05/20/2013 - Present
	INDIA T-BILL SECONDARY 1 YEAR	01/01/1993 - 05/19/2013
IRL	German Government Bonds 1 Year BKO	01/01/1999 - Present
	Dublin Interbank Offered Rates	04/10/1991 - 12/31/1998
ISL	Iceland Interbank 12 - Month	02/01/2000 - Present
	Iceland Interbank 3 - Month	08/04/1998 - 01/31/2000
	Iceland 90 - Day CD Notes	- 08/03/1998
ISR	Israel T-Bill Secondary 1 Year	11/15/1994 - Present
ITA	German Government Bonds 1 Year BKO	01/01/1999 - Present
	Italy Bots Treasury Bill 12 Month Gross Yields	09/05/1994 - 12/31/1998
	Italy T-Bill Auct. Gross 12 Month	- 09/04/1994
JAM	Bloomberg Bank of Jamaica 6 Month Treasury Bill Yield	03/13/2017 - Present
	Jamaica 12 Months Repo Rate	07/17/2008 - 03/12/2017
JOR	Bllomberg Jordanian Dinar Interbank Offered Rate 1 Year	09/20/2006 - Present
	Jordan Re-Discount Rate	03/12/2001 - 09/19/2006
JPN	Japan Treasury Bills 12 Month	12/14/1999 - Present
KAZ	Kazakhstan KIBOR/KIBID 90 Days Interbank	09/29/2001 - Present
KEN	Thomson Reuters Kenya GVT BMK Bid Yield 1 Year	05/26/2009 - Present
KOR	Korea Monetary Stab. Bonds 1 Year	01/03/1992 - Present
KWT	Kuwait Interbank 1 Year	
LKA	Sri Lanka Fixed Deposit 1 Year	
LTU	German Government Bonds 1 Year BKO	01/01/2015 - Present
	Vilnius Interbank 12 Month	03/29/2000 - 12/31/2014
LUX	German Government Bonds 1 Year BKO	01/01/1999 - Present
	Long Term Government Bond Yields - Maastricht Definition (Avg.)	- 12/31/1998
LVA	German Government Bonds 1 Year BKO	01/01/2014 - Present
	Treasury Bill Rate 1 Year	04/03/1996 - 12/31/2013
MAR	Morocco Deposit Rate 1 Year	06/06/2003 - Present
MEX	Mexico Cetes 2nd Mkt. 360 Day	06/26/1996 - Present
	Mexico Cetes 91 Day Avg.Ret.At Auc.	- 06/25/1996
MKD	Macedonia SKIBOR 3 Months	07/02/2007 - Present
MLT	German Government Bonds 1 Year BKO	01/01/2008 - Present
	Long Term Government Bond Yields - Maastricht Definition (Avg.)	01/15/1985 - 12/31/2007
MNE	Treasury Bill Rate - 182-Day (EP)	07/16/2004 - Present
MUS	Thomson Reuters Mauritius GVT BMK Bid Yield 1 Year	05/26/2010 - Present
MWI	MALAWI 12 Month Bill Auction Average Accepted Yield	03/06/2012 - Present
MYS	Bank Negara Malaysia 1 Year Govt Securities Indicative YTM	06/21/2005 - Present
	Malaysia Deposit 1 Year	- 06/20/2005
NAM	Namibia 12 Month Bill Auction Average Yield	03/13/2002 - Present
NGA	Nigeria Interbank Offered Rate 12 Month	09/29/2011 - Present
	Nigeria Interbank Offered Rate 3 Month	01/30/2004 - 09/28/2011
NLD	German Government Bonds 1 Year BKO	01/01/1999 - Present
	Netherland Interbank 1 Year	- 12/31/1998
NOR	Norway Govt Treasury Bills 12 Month	07/01/1997 - Present
	Norway Interbank 1 Year	- 06/30/1997
NZL	New Zealand Dollar Deposit 1 Year	
OMN	OMR 12 Month Deposit	07/16/2002 - Present
PAK	Bloomberg State Bank of Pakistan KIBOR Fixing 12 Month Rate	04/19/2004 - Present
	PKR 12 Month Repo	10/29/2004 - 04/18/2004

Continued on next page

Table A.7 – *Continued from previous page*

Economy	Interest Rate Name	Period Used*
PER	Bloomberg Asbanc Peru 1 Year Nominal Rate	09/30/2002 - Present
	Peru Savings Rate	07/01/1991 - 09/29/2002
PHL	Philippine Treasury Bill 364d	
POL	Poland Interbank 1 Year (EOD)	10/11/1995 - Present
PRT	German Government Bonds 1 Year BKO	01/01/1999 - Present
ROM	Romanian Interbank 12 Month	08/01/1995 - Present
RUS	Mospime 3 Months Rate	04/18/2005 - Present
	Russia Moscow Interbank Non Co	08/14/2000 - 04/17/2005
	Russia Interbank 31 To 90 Day	09/01/1994 - 08/13/2000
RWA	Rwanda 12 Month Bill Auction Average Yield	05/12/2010 - Present
SAU	Saudi Interbank 1 Year	
SGP	Monetary Authority of Singapore Benchmark Govt Bill Yield 3 Month	09/20/2013 - Present
	Singapore T-Bill 3 Month	- 09/19/2013
SRB	Bloomberg National Bank of Serbia BELIBOR 6M Rate	01/28/2005 - Present
	Serbia Treasury Bill Auction Results 12 Months Average Accepted Yield	08/26/2009 - 01/27/2005
SVK	German Government Bonds 1 Year BKO	01/01/2009 - Present
	Slovak Rep. Interbank 1 Year	08/09/1994 - 12/31/2008
SVN	German Government Bonds 1 Year BKO	01/01/2007 - Present
	Slovenia Treasury Bill 3 Month'dead'	10/29/1998 - 12/31/2006
SWE	Sweden T Bill 3 Month	05/25/1993 - Present
	Sweden Treasury Bill 90 Day	- 05/24/1993
THA	Thailand Govt Bond 1 Year Note	08/07/2000 - Present
	Thailand Deposit 12 Month (KT)	01/02/1991 - 08/06/2000
TUN	TU BCT Key Interest Rate	12/15/1994 - Present
TUR	Turkish Interbank 12 Month	08/01/2002 - Present
TWN	Taiwan Deposit 12 Month	
TZA	Tanzania 12 Month Bill Auction Average Yield	01/02/2003 - Present
UGA	Uganda 12 Month Bill Auction Average Yield	01/05/2005 - Present
UKR	Ukraine Interbank 3 Months	03/01/2001 - Present
USA	US Treasury Constant Maturities 1 Year	
VEN	Venezuela Savings Deposit Rate	01/03/2000 - Present
	Venezuela Overnight	11/28/1994 - 01/02/2000
VNM	Vietnam Interbank 3 Month	12/11/1998 - Present
ZAF	South African Prime Overdraft 1 Year Rate	

* A blank Period Used column indicates that there is only a single interest rate that is used throughout the whole period.

Table A.8: Summary Statistics of input variables (based on data from January 1990 to March 2018).

DTD Level

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
Argentina	-1.69	1.14	2.49	3.98	31.67	2.83	2.49	16398
Australia	-1.40	1.74	3.00	4.57	28.18	3.46	2.51	352683
Austria	-3.01	2.02	3.53	5.69	41.69	4.90	6.22	24405
Bahrain	-1.08	1.73	3.20	6.34	25.46	4.54	4.05	2238
Bangladesh	-2.03	1.73	2.84	4.30	23.76	3.27	2.35	19452
Belgium	-3.01	2.66	4.69	7.40	41.69	5.51	4.55	36036
Bosnia and Herzegovina	-3.01	1.58	2.73	5.07	41.22	3.78	3.62	3926
Botswana	0.08	6.76	10.14	15.16	31.67	11.99	7.59	1306
Brazil	-2.10	0.63	2.12	4.05	31.67	2.66	3.02	59372
Bulgaria	-1.93	1.17	2.26	3.98	41.69	3.03	3.17	10379
Canada	-1.16	1.92	3.38	5.31	25.87	3.93	2.90	263923
Chile	-1.54	3.37	5.55	8.30	31.67	6.46	4.77	29676
China	0.07	3.16	4.30	5.90	17.39	4.77	2.34	387537
Colombia	-2.10	2.26	4.10	6.35	31.67	4.57	3.26	6569
Croatia	-2.90	1.12	2.54	4.48	23.50	3.07	2.72	13631
Cyprus	-1.40	0.88	1.72	2.99	41.69	2.42	2.76	15718
Czech Republic	-3.01	1.41	2.80	4.80	41.69	3.29	2.91	6051
Denmark	-3.01	1.89	3.43	5.42	41.69	4.11	3.69	49105
Egypt	-2.10	1.47	2.46	3.71	16.10	2.79	1.99	24744
Estonia	-0.54	1.95	3.60	6.27	21.62	4.55	3.59	3241
Finland	-3.01	2.45	3.81	5.50	41.69	4.13	2.56	35125
France	-3.01	1.94	3.38	5.24	41.69	3.95	3.33	191531
Germany	-3.01	1.68	3.14	4.97	41.69	3.67	3.16	216189
Ghana	-2.10	0.61	2.49	5.07	19.42	3.40	3.84	1407
Greece	-3.01	1.19	2.31	3.77	41.69	2.67	2.47	64395
Hong Kong	-1.40	1.78	2.91	4.50	28.18	3.47	2.62	287042
Hungary	-3.01	1.36	2.70	4.43	27.56	3.22	2.76	8627
Iceland	-1.49	2.01	3.40	5.08	17.98	3.75	2.50	4378
India	-3.40	0.82	1.87	3.25	27.11	2.41	2.68	583035
Indonesia	-2.10	0.93	2.09	3.74	31.67	2.80	3.33	81418
Ireland	-1.28	1.96	3.55	5.35	35.26	3.91	2.84	9752
Israel	-3.01	1.16	2.34	3.79	41.69	2.72	2.35	88911
Italy	-3.01	1.74	3.10	4.80	41.69	3.51	2.86	75002
Jamaica	-2.10	1.20	2.38	3.62	15.20	2.59	2.03	6599
Japan	-1.40	2.27	3.43	5.01	28.18	3.92	2.50	978991
Jordan	-1.08	2.58	3.92	5.91	24.74	4.55	2.84	29483
Kazakhstan	-2.10	0.16	1.52	3.57	31.67	2.74	4.45	1147
Kenya	-1.28	1.77	2.83	4.33	31.67	3.42	2.71	5404
Kuwait	-2.10	2.05	3.06	4.45	19.86	3.51	2.17	27455
Latvia	-1.14	1.13	2.61	4.37	37.29	3.13	2.92	2822
Lithuania	-1.30	1.48	3.31	5.70	20.72	4.02	3.50	5492
Luxembourg	-3.01	3.12	5.48	8.94	35.52	6.89	5.11	3063
Macedonia	-1.61	1.46	2.37	4.72	24.90	3.75	3.85	2722
Malawi	-1.15	0.97	2.43	4.18	14.40	3.24	3.08	385
Malaysia	-2.10	1.73	3.10	5.15	31.67	3.94	3.37	232476
Malta	-0.63	2.89	4.63	7.23	21.40	5.52	3.73	1977
Mauritius	0.59	4.36	6.51	11.19	31.67	8.83	6.74	2889
Mexico	-2.10	2.08	4.09	6.73	31.67	4.77	3.89	22980
Montenegro	-1.00	1.07	2.38	3.55	41.69	2.73	3.01	1753
Morocco	-1.04	2.51	3.76	5.65	24.85	4.30	2.82	10359
Namibia	0.75	6.32	8.13	11.16	31.67	9.87	5.96	473
Netherlands	-3.01	2.49	4.20	6.28	41.69	4.65	3.29	41182
New Zealand	-1.30	2.93	5.32	7.94	28.18	5.86	3.96	22967
Nigeria	-2.10	0.78	2.11	3.55	31.67	2.77	3.64	19338
Norway	-2.82	1.29	2.58	4.19	31.35	2.91	2.34	50894
Oman	-0.44	2.92	4.44	7.48	31.67	5.59	3.98	5018
Pakistan	-2.10	0.71	2.30	4.08	31.67	2.64	2.61	35727
Peru	-2.10	1.86	3.38	5.28	29.74	4.03	3.21	11833
Philippines	-2.10	1.42	2.85	4.79	31.67	3.47	3.10	48584
Poland	-2.86	1.38	2.53	3.84	41.69	2.81	2.14	82446
Portugal	-3.01	0.99	2.37	4.24	41.69	2.92	2.97	15258
Romania	-3.01	0.92	2.11	3.78	31.69	2.62	2.77	11975
Russian Federation	-3.01	0.56	1.76	3.36	41.69	2.27	2.88	25586
Rwanda	0.39	4.21	5.21	18.74	31.67	9.48	8.41	126
Saudi Arabia	-0.91	3.30	4.83	7.02	31.67	5.51	3.04	22960
Serbia	-2.77	0.71	1.67	2.99	41.69	2.33	3.06	8379
Singapore	-1.40	1.59	2.87	4.74	28.18	3.52	2.80	146644
Slovakia	-2.78	1.21	2.28	3.86	41.69	4.90	8.79	1478
Slovenia	-2.55	1.74	3.72	6.38	41.69	4.57	4.83	6523
South Africa	-2.10	1.30	2.95	5.21	31.67	3.68	3.53	89030
South Korea	-1.40	1.45	2.51	3.91	28.18	3.04	2.92	391813
Spain	-3.01	1.97	3.59	5.53	41.69	4.35	4.43	41816
Sri Lanka	-2.10	1.63	2.79	4.42	31.67	3.36	2.70	30037
Sweden	-3.01	1.85	3.35	5.18	41.69	3.80	2.89	107026
Switzerland	-3.01	2.73	4.48	6.65	40.70	5.00	3.37	64131
Taiwan	-1.24	3.02	4.24	5.87	28.18	4.81	3.04	183854
Tanzania	0.57	2.54	7.00	13.31	31.67	8.65	7.14	830
Thailand	-1.75	1.97	3.35	5.26	31.67	3.96	3.11	127788
Tunisia	-2.10	2.22	3.63	5.86	23.62	4.37	3.18	9769
Turkey	-3.01	1.61	2.89	4.79	41.69	3.69	3.59	62034
Uganda	0.01	1.50	2.91	4.48	31.67	4.91	6.52	522
UK	-3.01	2.28	3.96	6.33	41.69	4.81	4.00	435552
Ukraine	-3.01	0.38	1.38	2.52	28.11	1.63	2.12	4598
United Arab Emirates	-0.79	1.82	2.84	4.19	23.08	3.37	2.37	9020
US	-1.16	1.93	3.29	5.10	25.87	3.82	2.79	1696439
Venezuela	-1.80	0.69	1.51	2.75	18.63	2.38	3.19	3678
Vietnam	-1.85	1.27	2.16	3.46	31.67	2.65	2.17	62835

DTD Trend

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
Argentina	-10.29	-0.50	0.00	0.46	9.31	-0.03	1.12	16398
Australia	-7.22	-0.54	-0.02	0.45	6.43	-0.06	1.08	352683
Austria	-13.70	-0.69	-0.04	0.53	9.43	-0.20	2.28	24405
Bahrain	-10.29	-0.49	0.02	0.54	9.31	0.01	1.38	2238
Bangladesh	-9.66	-0.28	0.03	0.41	9.31	0.09	0.83	19452
Belgium	-13.70	-0.69	-0.01	0.67	9.43	-0.04	1.73	36036
Bosnia and Herzegovina	-13.70	-0.55	-0.02	0.35	9.43	-0.08	1.35	3926
Botswana	-10.29	-2.40	0.00	1.79	9.31	-0.02	4.37	1306
Brazil	-10.29	-0.42	0.00	0.43	9.31	-0.01	1.09	59372
Bulgaria	-13.70	-0.49	0.00	0.43	9.43	-0.06	1.33	10379
Canada	-7.14	-0.59	-0.02	0.49	5.69	-0.07	1.19	263923
Chile	-10.29	-0.87	0.00	0.79	9.31	-0.04	2.13	29676
China	-6.07	-0.61	0.00	0.59	5.94	-0.03	1.18	387537
Colombia	-10.29	-0.60	0.02	0.73	9.31	0.03	1.50	6569
Croatia	-7.88	-0.58	-0.04	0.40	9.43	-0.08	1.05	13631
Cyprus	-13.70	-0.41	-0.05	0.26	9.43	-0.13	1.03	15718
Czech Republic	-13.70	-0.58	-0.05	0.39	9.43	-0.14	1.30	6051
Denmark	-13.70	-0.60	-0.00	0.54	9.43	-0.04	1.49	49105
Egypt	-9.29	-0.48	-0.02	0.40	9.31	-0.05	0.92	24744
Estonia	-8.76	-0.67	0.02	0.69	9.43	-0.02	1.42	3241
Finland	-13.70	-0.50	0.05	0.62	9.38	0.04	1.12	35125
France	-13.70	-0.55	0.00	0.52	9.43	-0.03	1.32	191531
Germany	-13.70	-0.55	-0.02	0.48	9.43	-0.04	1.28	216189
Ghana	-7.78	-0.56	-0.04	0.42	9.31	-0.13	1.46	1407
Greece	-13.70	-0.52	-0.06	0.35	9.43	-0.08	1.05	64395
Hong Kong	-7.22	-0.54	0.00	0.51	6.43	-0.03	1.11	287042
Hungary	-13.70	-0.41	0.02	0.46	9.43	-0.01	1.08	8627
Iceland	-9.69	-0.77	-0.08	0.42	6.39	-0.18	1.33	4378
India	-9.29	-0.36	-0.00	0.38	6.66	-0.01	0.96	583035
Indonesia	-10.29	-0.43	0.00	0.42	9.31	-0.04	1.31	81418
Ireland	-13.70	-0.58	0.00	0.55	8.73	-0.06	1.23	9752
Israel	-13.70	-0.43	0.00	0.45	9.43	-0.00	1.03	88911
Italy	-13.70	-0.57	-0.02	0.49	9.43	-0.07	1.16	75002
Jamaica	-10.15	-0.43	0.00	0.42	9.31	0.01	1.00	6599
Japan	-7.22	-0.48	0.01	0.51	6.43	0.02	0.99	978991
Jordan	-10.29	-0.54	-0.01	0.50	9.31	-0.04	1.22	29483
Kazakhstan	-10.29	-0.51	-0.02	0.41	9.31	-0.13	1.83	1147
Kenya	-10.29	-0.51	-0.04	0.38	7.04	-0.07	1.03	5404
Kuwait	-9.05	-0.48	-0.01	0.42	9.31	-0.05	1.01	27455
Latvia	-13.70	-0.48	0.00	0.45	6.77	-0.05	1.23	2822
Lithuania	-10.52	-0.62	0.00	0.65	9.43	0.04	1.52	5492
Luxembourg	-11.05	-0.78	0.00	0.71	9.43	-0.04	1.74	3063
Macedonia	-12.69	-0.54	-0.04	0.41	6.93	-0.09	1.26	2722
Malawi	-7.39	-0.47	0.06	0.66	9.31	0.06	1.74	385
Malaysia	-10.29	-0.51	-0.00	0.48	9.31	-0.03	1.23	232476
Malta	-11.00	-0.77	0.00	0.77	9.43	0.01	1.92	1977
Mauritius	-10.29	-0.94	-0.05	0.81	9.31	-0.03	2.74	2889
Mexico	-10.29	-0.61	0.01	0.64	9.31	-0.03	1.51	22980
Montenegro	-4.27	-0.32	-0.00	0.23	9.43	-0.03	0.83	1753
Morocco	-10.29	-0.52	-0.01	0.44	9.31	-0.08	1.13	10359
Namibia	-10.29	-1.37	-0.04	1.52	9.31	0.18	3.81	473
Netherlands	-13.70	-0.69	-0.01	0.62	9.43	-0.05	1.31	41182
New Zealand	-7.22	-0.75	0.00	0.72	6.43	-0.03	1.61	22967
Nigeria	-10.29	-0.51	-0.03	0.41	9.31	-0.08	1.62	19338
Norway	-13.70	-0.52	-0.00	0.45	9.43	-0.05	1.02	50894
Oman	-10.29	-0.65	0.03	0.69	9.31	0.03	1.91	5018
Pakistan	-10.29	-0.34	0.02	0.40	9.31	0.02	0.86	35727
Peru	-10.29	-0.57	0.00	0.60	9.31	0.02	1.52	11833
Philippines	-10.29	-0.46	0.01	0.48	9.31	0.01	1.28	48584
Poland	-13.70	-0.47	-0.03	0.40	9.43	-0.06	0.92	82446
Portugal	-13.70	-0.50	-0.02	0.43	9.43	-0.04	1.09	15258
Romania	-10.08	-0.37	0.03	0.46	9.43	0.05	0.96	11975
Russian Federation	-13.70	-0.46	0.00	0.45	9.43	-0.08	1.28	25586
Rwanda	-10.29	-0.98	0.00	0.63	5.51	-0.77	3.08	126
Saudi Arabia	-10.29	-0.73	0.05	0.79	9.31	0.03	1.51	22960
Serbia	-13.70	-0.41	0.00	0.29	9.43	-0.11	1.03	8379
Singapore	-7.22	-0.52	-0.01	0.45	6.43	-0.05	1.10	146644
Slovakia	-13.70	-0.43	0.00	0.43	9.43	-0.33	2.91	1478
Slovenia	-13.70	-0.74	-0.09	0.45	9.43	-0.27	1.88	6523
South Africa	-10.29	-0.58	-0.04	0.45	9.31	-0.11	1.32	89030
South Korea	-7.22	-0.43	0.01	0.46	6.43	0.01	1.03	391813
Spain	-13.70	-0.56	0.00	0.60	9.43	-0.03	1.70	41816
Sri Lanka	-10.29	-0.41	0.00	0.46	9.31	0.02	1.12	30037
Sweden	-13.70	-0.53	-0.00	0.50	9.43	-0.02	1.14	107026
Switzerland	-13.70	-0.65	0.02	0.71	9.43	0.02	1.42	64131
Taiwan	-7.22	-0.58	0.01	0.62	6.43	0.02	1.18	183854
Tanzania	-10.29	-1.64	-0.25	0.56	9.31	-0.62	3.37	830
Thailand	-10.29	-0.56	0.00	0.56	9.31	0.00	1.22	127788
Tunisia	-10.29	-0.65	-0.08	0.49	9.31	-0.09	1.30	9769
Turkey	-13.70	-0.57	0.00	0.58	9.43	0.00	1.40	62034
Uganda	-10.29	-0.48	0.04	0.72	9.31	-0.09	3.15	522
UK	-13.70	-0.80	-0.05	0.59	9.43	-0.18	1.82	435552
Ukraine	-13.70	-0.52	-0.02	0.38	5.24	-0.12	1.07	4598
United Arab Emirates	-7.47	-0.47	-0.01	0.37	9.19	-0.09	0.94	9020
US	-7.14	-0.52	0.00	0.49	5.69	-0.03	1.05	1696439
Venezuela	-8.54	-0.40	-0.01	0.41	9.31	0.00	1.11	3678
Vietnam	-10.29	-0.38	-0.00	0.37	9.31	-0.01	0.83	62835

CASH/TA Level

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
Argentina	-3.58	-0.17	0.24	0.61	3.49	0.22	0.69	15855
Australia	-3.28	0.18	0.78	1.87	5.93	1.02	1.36	348053
Austria	-3.48	-0.02	0.25	0.53	3.52	0.26	0.61	18302
Bahrain	-1.49	0.42	0.78	1.33	5.06	0.95	0.85	1935
Bangladesh	-3.09	-0.01	0.34	0.79	4.35	0.41	0.82	14512
Belgium	-3.54	0.02	0.32	0.70	5.27	0.40	0.78	29148
Bosnia and Herzegovina	-2.70	-0.11	0.54	1.39	5.27	0.62	1.17	10407
Botswana	-0.82	0.11	0.47	0.89	4.28	0.55	0.60	1830
Brazil	-4.75	-0.15	0.28	0.68	5.06	0.18	0.97	63507
Bulgaria	-3.54	0.10	0.47	1.04	5.09	0.53	0.91	12035
Canada	-3.41	0.02	0.56	1.24	4.68	0.67	1.22	240023
Chile	-4.75	0.07	0.41	0.83	5.06	0.48	0.74	30435
China	-2.98	0.05	0.42	0.93	4.01	0.52	0.83	362610
Colombia	-4.27	-0.05	0.27	0.72	3.30	0.30	0.67	6519
Croatia	-3.54	-0.34	0.21	0.69	5.27	0.18	1.18	18532
Cyprus	-3.54	-0.33	0.25	0.79	4.00	0.23	0.92	13129
Czech Republic	-2.23	-0.11	0.16	0.64	5.27	0.33	0.78	7508
Denmark	-3.54	0.14	0.45	0.78	5.27	0.49	0.73	33852
Egypt	-2.93	0.05	0.40	0.86	4.35	0.49	0.79	17349
Estonia	-2.61	0.03	0.44	0.76	2.90	0.46	0.63	2643
Finland	-1.90	0.14	0.39	0.71	3.59	0.44	0.55	32407
France	-3.54	0.08	0.34	0.67	5.27	0.41	0.63	164453
Germany	-3.54	0.08	0.43	0.87	5.27	0.50	0.80	172550
Ghana	-3.08	-0.27	0.02	0.52	3.94	0.09	0.98	1363
Greece	-3.54	0.07	0.39	0.74	5.27	0.42	0.65	60112
Hong Kong	-3.28	0.17	0.53	1.05	5.93	0.63	0.84	219718
Hungary	-3.08	-0.04	0.36	0.81	4.10	0.45	0.74	7852
Iceland	-1.11	0.01	0.29	0.51	2.25	0.27	0.41	4724
India	-4.47	0.18	0.63	1.29	6.68	0.77	1.19	720708
Indonesia	-4.75	0.02	0.39	0.86	5.06	0.42	0.94	70124
Ireland	-3.54	0.15	0.43	0.82	4.40	0.50	0.74	8662
Israel	-3.54	0.10	0.44	0.95	5.27	0.57	1.08	64181
Italy	-2.97	0.00	0.29	0.60	5.27	0.32	0.63	57661
Jamaica	-4.75	0.30	0.72	1.12	3.76	0.71	0.77	5497
Japan	-3.28	0.08	0.41	0.84	4.87	0.48	0.66	906105
Jordan	-4.75	0.03	0.55	1.06	5.06	0.55	0.96	20434
Kazakhstan	-1.36	0.36	0.92	1.41	5.06	0.91	0.86	1024
Kenya	-2.68	0.09	0.39	0.79	4.07	0.46	0.66	6974
Kuwait	-3.44	0.10	0.57	1.24	5.04	0.66	0.97	14726
Latvia	-2.70	0.31	0.76	1.53	5.27	0.95	0.99	4936
Lithuania	-2.71	-0.12	0.30	0.68	2.61	0.28	0.70	5234
Luxembourg	-2.27	-0.01	0.25	0.65	4.33	0.32	0.94	1645
Macedonia	-2.97	-0.05	0.60	1.00	3.90	0.57	0.94	3432
Malawi	-1.13	-0.35	0.00	0.38	0.87	-0.05	0.53	436
Malaysia	-4.75	0.13	0.54	1.07	5.06	0.63	0.87	197211
Malta	-1.19	-0.05	0.26	0.49	1.23	0.18	0.52	1274
Mauritius	-2.55	-0.28	0.06	0.48	2.60	0.13	0.72	4340
Mexico	-3.85	0.10	0.47	0.92	3.82	0.51	0.73	23817
Montenegro	-3.54	-0.70	0.08	1.06	5.27	0.07	1.37	4026
Morocco	-0.95	0.16	0.47	0.78	4.96	0.49	0.58	9875
Namibia	-0.38	0.43	0.57	1.00	1.28	0.67	0.33	295
Netherlands	-3.54	0.09	0.35	0.60	5.27	0.36	0.60	34548
New Zealand	-3.28	-0.00	0.46	0.89	5.93	0.47	0.93	21384
Nigeria	-4.75	-0.29	0.11	0.49	3.99	0.01	0.93	16805
Norway	-3.54	0.14	0.50	0.93	5.27	0.61	0.86	45959
Oman	-4.06	0.03	0.32	0.81	4.52	0.42	0.78	12699
Pakistan	-4.75	-0.10	0.15	0.51	4.29	0.19	0.67	32504
Peru	-2.90	-0.05	0.34	0.74	3.39	0.35	0.73	15806
Philippines	-4.75	-0.11	0.39	1.07	5.06	0.50	1.47	36210
Poland	-3.54	0.11	0.41	0.84	5.27	0.49	0.79	70806
Portugal	-3.54	-0.40	-0.03	0.32	5.27	-0.05	0.68	14959
Romania	-2.04	0.01	0.39	0.89	5.27	0.48	0.83	14537
Russian Federation	-3.54	0.02	0.34	0.80	5.27	0.49	0.89	35956
Rwanda	-0.65	-0.60	-0.52	-0.32	-0.29	-0.48	0.13	47
Saudi Arabia	-3.65	0.15	0.51	1.00	4.68	0.58	0.74	15879
Serbia	-3.54	-0.05	0.35	0.86	3.55	0.38	0.94	18873
Singapore	-3.28	0.20	0.54	0.99	5.93	0.62	0.74	127940
Slovakia	-1.18	-0.09	0.28	0.71	4.69	0.47	0.89	2588
Slovenia	-2.27	-0.07	0.24	0.66	3.07	0.32	0.71	7225
South Africa	-4.75	0.13	0.41	0.74	5.06	0.46	0.74	75833
South Korea	-3.28	0.03	0.43	0.96	5.93	0.56	0.89	365532
Spain	-3.54	-0.04	0.20	0.51	3.47	0.23	0.58	35550
Sri Lanka	-4.37	-0.08	0.33	0.78	4.53	0.36	0.85	21734
Sweden	-3.54	0.14	0.54	0.95	5.27	0.61	0.79	95815
Switzerland	-3.54	0.30	0.58	0.94	5.27	0.64	0.64	50037
Taiwan	-3.28	0.23	0.53	0.92	5.84	0.59	0.64	161818
Tanzania	-2.12	0.05	0.58	1.05	1.81	0.46	0.71	666
Thailand	-4.75	-0.07	0.32	0.85	5.06	0.39	0.87	106671
Tunisia	-1.57	0.09	0.48	0.83	2.73	0.48	0.64	6089
Turkey	-3.54	0.06	0.40	0.79	5.27	0.44	0.80	63113
Uganda	-0.67	-0.11	0.06	1.26	2.31	0.39	0.78	346
UK	-3.54	0.01	0.37	0.85	5.27	0.50	0.94	389151
Ukraine	-3.54	-0.15	0.20	0.63	5.27	0.26	0.75	8754
United Arab Emirates	-2.49	0.18	0.59	1.16	5.06	0.72	0.95	5413
US	-3.41	0.31	0.75	1.26	4.68	0.82	0.81	1343538
Venezuela	-1.70	0.14	0.34	0.55	1.96	0.33	0.49	2656
Vietnam	-2.98	0.12	0.39	0.82	4.78	0.52	0.63	58655

CASH/TA Trend

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
Argentina	-2.19	-0.08	0.00	0.07	2.30	-0.01	0.24	15855
Australia	-2.60	-0.23	-0.00	0.13	2.58	-0.04	0.61	348053
Austria	-2.50	-0.06	0.00	0.04	2.49	-0.01	0.21	18302
Bahrain	-2.19	-0.11	0.00	0.10	1.76	-0.03	0.32	1935
Bangladesh	-2.19	-0.04	0.00	0.04	2.30	0.00	0.21	14512
Belgium	-2.51	-0.05	0.00	0.04	2.49	-0.01	0.25	29148
Bosnia and Herzegovina	-2.51	-0.06	0.00	0.05	2.49	-0.00	0.29	10407
Botswana	-2.13	-0.06	0.00	0.07	2.30	0.01	0.25	1830
Brazil	-2.19	-0.09	-0.00	0.08	2.30	-0.01	0.28	63507
Bulgaria	-2.51	-0.06	0.00	0.06	2.49	-0.00	0.25	12035
Canada	-2.32	-0.17	-0.00	0.11	2.33	-0.03	0.50	240023
Chile	-2.19	-0.09	-0.00	0.09	2.30	-0.00	0.31	30435
China	-1.55	-0.09	-0.01	0.05	1.60	-0.02	0.23	362610
Colombia	-2.19	-0.09	0.00	0.08	2.30	0.00	0.32	6519
Croatia	-2.43	-0.13	-0.00	0.09	2.49	-0.01	0.36	18532
Cyprus	-2.51	-0.08	0.00	0.03	2.49	-0.02	0.26	13129
Czech Republic	-2.51	-0.06	0.00	0.04	2.49	-0.00	0.28	7508
Denmark	-2.51	-0.08	0.00	0.05	2.49	-0.02	0.30	33852
Egypt	-2.19	-0.09	0.00	0.07	2.30	-0.00	0.26	17349
Estonia	-1.65	-0.07	0.00	0.08	2.49	0.01	0.23	2643
Finland	-2.51	-0.07	-0.00	0.05	2.49	-0.01	0.19	32407
France	-2.51	-0.04	0.00	0.03	2.49	-0.01	0.19	164453
Germany	-2.51	-0.07	0.00	0.05	2.49	-0.01	0.28	172550
Ghana	-1.90	-0.10	-0.01	0.05	1.28	-0.04	0.24	1363
Greece	-2.51	-0.10	-0.01	0.05	2.49	-0.02	0.26	60112
Hong Kong	-2.60	-0.09	0.00	0.07	2.58	-0.01	0.33	219718
Hungary	-2.51	-0.09	-0.00	0.06	2.49	-0.01	0.30	7852
Iceland	-1.01	-0.07	0.00	0.04	0.97	-0.01	0.17	4724
India	-3.08	-0.09	0.00	0.05	2.83	-0.03	0.40	720708
Indonesia	-2.19	-0.10	-0.00	0.06	2.30	-0.01	0.32	70124
Ireland	-2.51	-0.07	0.00	0.06	2.49	-0.02	0.33	8662
Israel	-2.51	-0.09	-0.00	0.07	2.49	-0.02	0.40	64181
Italy	-2.51	-0.07	-0.00	0.05	2.49	-0.01	0.25	57661
Jamaica	-2.19	-0.07	0.00	0.08	2.19	-0.00	0.26	5497
Japan	-2.60	-0.04	0.00	0.05	2.58	0.00	0.14	906105
Jordan	-2.19	-0.09	0.00	0.07	2.30	-0.01	0.31	20434
Kazakhstan	-1.47	-0.11	0.00	0.16	1.11	0.01	0.29	1024
Kenya	-2.19	-0.06	0.00	0.04	2.30	-0.00	0.24	6974
Kuwait	-2.19	-0.10	0.00	0.10	2.30	-0.01	0.35	14726
Latvia	-2.51	-0.12	0.00	0.10	2.49	-0.02	0.30	4936
Lithuania	-1.86	-0.11	0.00	0.09	1.44	-0.01	0.26	5234
Luxembourg	-2.51	-0.07	0.00	0.04	2.49	-0.01	0.36	1645
Macedonia	-2.51	-0.05	0.00	0.04	2.05	-0.01	0.28	3432
Malawi	-0.43	-0.02	0.00	0.06	0.44	0.01	0.11	436
Malaysia	-2.19	-0.08	0.00	0.07	2.30	-0.01	0.26	197211
Malta	-0.74	-0.06	0.00	0.05	1.63	-0.00	0.18	1274
Mauritius	-1.93	-0.06	0.00	0.06	2.30	-0.01	0.24	4340
Mexico	-2.19	-0.10	-0.00	0.07	2.30	-0.01	0.24	23817
Montenegro	-2.51	-0.04	0.00	0.06	2.49	-0.02	0.49	4026
Morocco	-2.14	-0.06	-0.00	0.05	2.30	-0.01	0.19	9875
Namibia	-0.35	-0.04	0.00	0.07	0.23	0.01	0.10	295
Netherlands	-2.51	-0.05	0.00	0.04	2.49	-0.01	0.23	34548
New Zealand	-2.60	-0.11	0.00	0.10	2.58	-0.01	0.39	21384
Nigeria	-2.19	-0.08	0.00	0.06	2.30	-0.01	0.34	16805
Norway	-2.51	-0.12	-0.00	0.08	2.49	-0.02	0.38	45959
Oman	-2.19	-0.08	0.00	0.08	2.30	0.00	0.26	12699
Pakistan	-2.19	-0.04	0.00	0.04	2.30	0.00	0.18	32504
Peru	-2.19	-0.09	0.00	0.08	2.30	0.00	0.25	15806
Philippines	-2.19	-0.12	-0.00	0.09	2.30	-0.01	0.47	36210
Poland	-2.51	-0.09	-0.00	0.05	2.49	-0.02	0.30	70806
Portugal	-2.51	-0.07	0.00	0.06	2.22	-0.00	0.24	14959
Romania	-2.51	-0.08	0.00	0.07	2.49	0.00	0.28	14537
Russian Federation	-2.51	-0.10	0.00	0.11	2.49	0.01	0.45	35956
Rwanda	-0.26	-0.03	0.00	0.05	0.10	-0.02	0.10	47
Saudi Arabia	-2.19	-0.10	0.00	0.09	2.30	-0.01	0.28	15879
Serbia	-2.51	-0.03	0.00	0.01	2.49	-0.00	0.24	18873
Singapore	-2.60	-0.08	0.00	0.07	2.58	-0.01	0.29	127940
Slovakia	-2.08	-0.06	0.00	0.04	2.49	0.00	0.32	2588
Slovenia	-1.97	-0.06	0.00	0.05	2.05	-0.01	0.22	7225
South Africa	-2.19	-0.06	0.00	0.05	2.30	-0.01	0.31	75833
South Korea	-2.60	-0.10	0.00	0.08	2.58	-0.01	0.32	365532
Spain	-2.51	-0.06	0.00	0.05	2.49	-0.00	0.22	35550
Sri Lanka	-2.19	-0.09	0.00	0.09	2.30	-0.00	0.32	21734
Sweden	-2.51	-0.10	0.00	0.07	2.49	-0.02	0.36	95815
Switzerland	-2.51	-0.06	0.00	0.06	2.49	-0.01	0.23	50037
Taiwan	-2.60	-0.08	0.00	0.08	2.58	0.00	0.21	161818
Tanzania	-1.45	-0.08	0.00	0.08	2.30	0.02	0.29	666
Thailand	-2.19	-0.09	0.00	0.08	2.30	-0.00	0.27	106671
Tunisia	-1.83	-0.06	-0.00	0.03	1.34	-0.02	0.17	6089
Turkey	-2.51	-0.11	-0.00	0.08	2.49	-0.01	0.29	63113
Uganda	-0.97	-0.03	0.00	0.03	1.02	0.01	0.20	346
UK	-2.51	-0.09	0.00	0.06	2.49	-0.02	0.36	389151
Ukraine	-2.51	-0.06	0.00	0.05	2.49	-0.00	0.28	8754
United Arab Emirates	-2.19	-0.12	-0.01	0.07	2.30	-0.04	0.32	5413
US	-2.32	-0.11	-0.00	0.08	2.33	-0.02	0.29	1343538
Venezuela	-2.19	-0.06	0.00	0.04	1.46	-0.01	0.22	2656
Vietnam	-2.19	-0.07	0.00	0.07	2.30	-0.00	0.24	58655

NI/TA Level

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
Argentina	-0.04	-0.00	0.00	0.01	0.03	0.00	0.01	18563
Australia	-0.72	-0.02	-0.00	0.00	0.13	-0.02	0.08	391381
Austria	-0.64	0.00	0.00	0.00	0.10	-0.00	0.02	26734
Bahrain	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	5474
Bangladesh	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	23718
Belgium	-0.68	0.00	0.00	0.01	0.10	0.00	0.02	40310
Bosnia and Herzegovina	-0.13	-0.00	0.00	0.00	0.09	0.00	0.01	11789
Botswana	-0.04	0.00	0.01	0.01	0.03	0.01	0.01	4099
Brazil	-0.04	-0.00	0.00	0.01	0.03	0.00	0.01	75259
Bulgaria	-0.32	-0.00	0.00	0.01	0.10	0.00	0.02	16454
Canada	-0.62	-0.01	0.00	0.00	0.19	-0.01	0.06	275735
Chile	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	41700
China	-0.06	0.00	0.00	0.01	0.12	0.00	0.01	395813
Colombia	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	9426
Croatia	-0.27	-0.00	0.00	0.00	0.10	0.00	0.01	21226
Cyprus	-0.95	-0.01	0.00	0.00	0.10	-0.01	0.04	20662
Czech Republic	-0.29	0.00	0.00	0.00	0.04	0.00	0.01	8388
Denmark	-0.95	-0.00	0.00	0.00	0.10	-0.00	0.04	55732
Egypt	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	26516
Estonia	-0.09	-0.00	0.00	0.01	0.05	0.00	0.01	3292
Finland	-0.48	0.00	0.00	0.01	0.10	0.00	0.02	37299
France	-0.95	0.00	0.00	0.00	0.10	-0.00	0.03	203140
Germany	-0.95	-0.00	0.00	0.00	0.10	-0.00	0.03	229277
Ghana	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	2112
Greece	-0.95	-0.00	0.00	0.01	0.10	0.00	0.02	67500
Hong Kong	-0.72	-0.00	0.00	0.01	0.13	-0.00	0.03	295167
Hungary	-0.95	-0.00	0.00	0.01	0.04	-0.00	0.06	9800
Iceland	-0.07	0.00	0.00	0.01	0.02	0.00	0.01	5815
India	-0.04	-0.00	0.00	0.01	0.03	0.00	0.01	831992
Indonesia	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	96476
Ireland	-0.81	-0.00	0.00	0.01	0.10	-0.00	0.03	10904
Israel	-0.95	-0.00	0.00	0.00	0.10	-0.01	0.08	96500
Italy	-0.24	-0.00	0.00	0.00	0.10	0.00	0.01	77991
Jamaica	-0.04	0.00	0.00	0.01	0.03	0.01	0.01	7994
Japan	-0.72	0.00	0.00	0.00	0.13	0.00	0.01	999024
Jordan	-0.04	-0.00	0.00	0.00	0.03	0.00	0.01	39928
Kazakhstan	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	2303
Kenya	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	10460
Kuwait	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	33661
Latvia	-0.12	-0.00	0.00	0.01	0.10	0.00	0.01	5231
Lithuania	-0.04	0.00	0.00	0.01	0.04	0.00	0.01	5955
Luxembourg	-0.04	0.00	0.00	0.01	0.10	0.00	0.01	4093
Macedonia	-0.50	0.00	0.00	0.00	0.04	-0.00	0.03	4453
Malawi	-0.01	0.00	0.00	0.01	0.03	0.01	0.01	1108
Malaysia	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	238645
Malta	-0.02	0.00	0.00	0.00	0.04	0.00	0.00	2603
Mauritius	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	7465
Mexico	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	28665
Montenegro	-0.06	-0.00	0.00	0.00	0.02	-0.00	0.01	4411
Morocco	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	14832
Namibia	0.00	0.00	0.01	0.01	0.03	0.01	0.01	864
Netherlands	-0.95	0.00	0.00	0.01	0.10	-0.00	0.05	42365
New Zealand	-0.72	-0.00	0.00	0.01	0.13	-0.01	0.06	25405
Nigeria	-0.04	-0.00	0.00	0.01	0.03	0.00	0.01	24925
Norway	-0.95	-0.00	0.00	0.00	0.10	-0.00	0.03	57038
Oman	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	19102
Pakistan	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	41187
Peru	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	18813
Philippines	-0.04	-0.00	0.00	0.01	0.03	0.00	0.01	56972
Poland	-0.95	-0.00	0.00	0.01	0.10	-0.00	0.04	86085
Portugal	-0.21	-0.00	0.00	0.00	0.10	0.00	0.01	18536
Romania	-0.95	-0.00	0.00	0.01	0.10	0.00	0.04	16006
Russian Federation	-0.23	0.00	0.00	0.01	0.10	0.00	0.01	39097
Rwanda	0.00	0.00	0.00	0.00	0.01	0.00	0.00	131
Saudi Arabia	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	23855
Serbia	-0.12	-0.00	0.00	0.01	0.07	0.00	0.01	20943
Singapore	-0.72	-0.00	0.00	0.01	0.13	0.00	0.03	155869
Slovakia	-0.03	-0.00	0.00	0.00	0.05	0.00	0.01	3586
Slovenia	-0.07	-0.00	0.00	0.00	0.02	0.00	0.01	9632
South Africa	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	96583
South Korea	-0.72	-0.00	0.00	0.01	0.13	-0.00	0.02	399839
Spain	-0.95	0.00	0.00	0.00	0.10	0.00	0.02	50339
Sri Lanka	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	31688
Sweden	-0.95	-0.01	0.00	0.01	0.10	-0.01	0.04	113440
Switzerland	-0.95	0.00	0.00	0.01	0.10	0.00	0.02	68614
Taiwan	-0.37	0.00	0.00	0.01	0.06	0.00	0.01	185495
Tanzania	-0.04	0.00	0.01	0.02	0.03	0.01	0.01	987
Thailand	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	134715
Tunisia	-0.04	0.00	0.00	0.00	0.02	0.00	0.01	10674
Turkey	-0.95	-0.00	0.00	0.01	0.10	0.00	0.03	82488
Uganda	-0.01	0.00	0.00	0.00	0.02	0.00	0.00	735
UK	-0.95	-0.01	0.00	0.01	0.10	-0.01	0.06	476054
Ukraine	-0.10	-0.00	0.00	0.01	0.10	0.00	0.01	9647
United Arab Emirates	-0.04	0.00	0.00	0.01	0.03	0.00	0.01	12729
US	-0.62	-0.00	0.00	0.01	0.19	-0.00	0.03	1790743
Venezuela	-0.04	0.00	0.00	0.00	0.03	0.00	0.01	5300
Vietnam	-0.04	0.00	0.00	0.01	0.03	0.01	0.01	66898

NI/TA Trend

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
Argentina	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	18563
Australia	-0.55	-0.00	0.00	0.00	0.44	-0.00	0.07	391381
Austria	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.02	26734
Bahrain	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.00	5474
Bangladesh	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.00	23718
Belgium	-0.27	-0.00	0.00	0.00	0.45	0.00	0.01	40310
Bosnia and Herzegovina	-0.19	-0.00	0.00	0.00	0.13	-0.00	0.01	11789
Botswana	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.00	4099
Brazil	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	75259
Bulgaria	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.02	16454
Canada	-0.39	-0.00	0.00	0.00	0.33	0.00	0.04	275735
Chile	-0.03	-0.00	-0.00	0.00	0.03	-0.00	0.01	41700
China	-0.11	-0.00	-0.00	0.00	0.09	-0.00	0.01	395813
Colombia	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.00	9426
Croatia	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.02	21226
Cyprus	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.03	20662
Czech Republic	-0.27	-0.00	0.00	0.00	0.26	0.00	0.01	8388
Denmark	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.02	55732
Egypt	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	26516
Estonia	-0.31	-0.00	0.00	0.00	0.11	0.00	0.02	3292
Finland	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.02	37299
France	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.02	203140
Germany	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.02	229277
Ghana	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	2112
Greece	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.02	67500
Hong Kong	-0.55	-0.00	0.00	0.00	0.44	-0.00	0.03	295167
Hungary	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.03	9800
Iceland	-0.08	-0.00	0.00	0.00	0.05	-0.00	0.01	5815
India	-0.14	-0.00	0.00	0.00	0.13	-0.00	0.01	831992
Indonesia	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	96476
Ireland	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.03	10904
Israel	-0.49	-0.00	-0.00	0.00	0.45	-0.00	0.06	96500
Italy	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.01	77991
Jamaica	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	7994
Japan	-0.55	-0.00	0.00	0.00	0.44	-0.00	0.01	999024
Jordan	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	39928
Kazakhstan	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	2303
Kenya	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.00	10460
Kuwait	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	33661
Latvia	-0.29	-0.00	0.00	0.00	0.45	-0.00	0.02	5231
Lithuania	-0.12	-0.00	0.00	0.00	0.12	0.00	0.01	5955
Luxembourg	-0.12	-0.00	0.00	0.00	0.15	0.00	0.01	4093
Macedonia	-0.43	-0.00	0.00	0.00	0.34	-0.00	0.02	4453
Malawi	-0.03	-0.00	0.00	0.00	0.03	0.00	0.00	1108
Malaysia	-0.03	-0.00	-0.00	0.00	0.03	-0.00	0.01	238645
Malta	-0.05	-0.00	0.00	0.00	0.03	-0.00	0.00	2603
Mauritius	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	7465
Mexico	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	28665
Montenegro	-0.05	-0.00	0.00	0.00	0.06	0.00	0.00	4411
Morocco	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.00	14832
Namibia	-0.01	-0.00	0.00	0.00	0.01	-0.00	0.00	864
Netherlands	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.03	42365
New Zealand	-0.55	-0.00	0.00	0.00	0.44	0.00	0.05	25405
Nigeria	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	24925
Norway	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.03	57038
Oman	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	19102
Pakistan	-0.03	-0.00	0.00	0.00	0.03	0.00	0.00	41187
Peru	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	18813
Philippines	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	56972
Poland	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.03	86085
Portugal	-0.49	-0.00	0.00	0.00	0.21	-0.00	0.01	18536
Romania	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.03	16006
Russian Federation	-0.49	-0.00	0.00	0.00	0.23	-0.00	0.01	39097
Rwanda	-0.01	-0.00	-0.00	0.00	0.00	-0.00	0.00	131
Saudi Arabia	-0.03	-0.00	0.00	0.00	0.03	0.00	0.01	23855
Serbia	-0.13	-0.00	0.00	0.00	0.10	-0.00	0.01	20943
Singapore	-0.55	-0.00	-0.00	0.00	0.44	-0.00	0.03	155869
Slovakia	-0.06	-0.00	0.00	0.00	0.07	-0.00	0.01	3586
Slovenia	-0.07	-0.00	0.00	0.00	0.06	-0.00	0.01	9632
South Africa	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	96583
South Korea	-0.55	-0.00	0.00	0.00	0.44	-0.00	0.02	399839
Spain	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.02	50339
Sri Lanka	-0.03	-0.00	-0.00	0.00	0.03	-0.00	0.01	31688
Sweden	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.03	113440
Switzerland	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.02	68614
Taiwan	-0.55	-0.00	-0.00	0.00	0.37	-0.00	0.01	185495
Tanzania	-0.01	-0.00	0.00	0.00	0.03	0.00	0.00	987
Thailand	-0.03	-0.00	-0.00	0.00	0.03	-0.00	0.01	134715
Tunisia	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.00	10674
Turkey	-0.49	-0.00	-0.00	0.00	0.45	-0.00	0.02	82488
Uganda	-0.02	-0.00	0.00	0.00	0.02	0.00	0.00	735
UK	-0.49	-0.00	0.00	0.00	0.45	-0.00	0.04	476054
Ukraine	-0.20	-0.00	0.00	0.00	0.16	-0.00	0.01	9647
United Arab Emirates	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.01	12729
US	-0.39	-0.00	0.00	0.00	0.33	-0.00	0.02	1790743
Venezuela	-0.03	-0.00	0.00	0.00	0.03	-0.00	0.00	5300
Vietnam	-0.03	-0.00	-0.00	0.00	0.03	-0.00	0.01	66898

SIZE Level

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
Argentina	-5.99	-1.54	-0.01	1.42	6.10	-0.03	1.99	18796
Australia	-4.28	-1.17	-0.03	1.62	7.17	0.38	2.09	412172
Austria	-6.95	-1.27	0.00	1.48	4.83	0.04	2.02	29290
Bahrain	-3.62	-0.77	0.04	1.36	3.42	0.22	1.38	4601
Bangladesh	-4.39	-0.94	0.07	1.45	6.27	0.22	1.72	27903
Belgium	-6.95	-1.42	0.01	1.65	7.58	0.06	2.28	48174
Bosnia and Herzegovina	-6.95	-1.19	-0.04	1.06	5.66	0.02	1.85	14289
Botswana	-5.99	-0.96	0.04	1.19	5.45	0.12	1.50	4019
Brazil	-5.99	-1.68	0.01	1.39	6.27	-0.14	2.37	76729
Bulgaria	-6.95	-1.37	-0.01	1.20	7.58	-0.08	1.83	24128
Canada	-5.87	-1.39	-0.02	1.51	6.63	0.07	2.21	308707
Chile	-5.99	-1.16	-0.02	1.24	6.22	-0.02	1.80	40327
China	-2.11	-0.42	0.02	0.60	4.35	0.16	0.85	432156
Colombia	-5.61	-1.39	0.04	1.11	4.45	-0.21	1.69	9228
Croatia	-6.95	-1.16	-0.04	1.14	5.74	0.02	1.78	20377
Cyprus	-6.28	-1.03	-0.08	0.96	6.58	-0.00	1.55	22284
Czech Republic	-6.53	-1.23	-0.09	1.11	5.43	-0.03	1.87	9034
Denmark	-6.95	-1.14	-0.00	1.35	7.58	0.23	1.99	57895
Egypt	-5.54	-1.22	-0.11	1.41	5.74	0.10	1.83	28561
Estonia	-3.56	-0.87	0.01	1.17	4.79	0.15	1.66	3576
Finland	-6.22	-1.33	-0.03	1.46	7.43	0.07	1.96	38845
France	-6.95	-1.44	-0.05	1.70	7.58	0.23	2.34	237811
Germany	-6.95	-1.57	-0.05	1.52	7.58	0.02	2.52	277393
Ghana	-5.57	-1.20	-0.04	1.35	3.33	-0.19	1.96	2030
Greece	-6.95	-0.92	-0.03	1.17	7.41	0.24	1.72	69850
Hong Kong	-4.28	-0.98	-0.01	1.36	7.17	0.31	1.81	329476
Hungary	-6.95	-1.69	-0.01	1.48	6.20	0.07	2.33	10442
Iceland	-6.41	-0.69	0.07	0.82	3.64	0.02	1.30	6253
India	-4.87	-1.41	0.02	1.87	8.37	0.37	2.35	716601
Indonesia	-5.99	-1.22	0.01	1.32	6.27	0.12	1.86	95137
Ireland	-5.87	-1.20	-0.00	1.55	5.42	0.16	2.01	11996
Israel	-6.95	-1.07	-0.04	1.22	7.58	0.14	1.81	114556
Italy	-6.95	-1.16	-0.02	1.49	6.47	0.20	1.96	83346
Jamaica	-5.99	-1.40	-0.03	1.04	4.24	-0.17	1.77	8597
Japan	-4.28	-1.04	-0.05	1.21	7.17	0.20	1.71	1047644
Jordan	-3.81	-0.85	-0.01	1.14	6.27	0.24	1.53	39583
Kazakhstan	-4.87	-1.56	0.04	1.28	4.20	-0.11	1.83	2105
Kenya	-5.99	-1.21	0.00	1.12	5.31	-0.09	1.76	11522
Kuwait	-5.99	-0.80	-0.04	0.80	5.07	0.12	1.35	33066
Latvia	-6.25	-1.13	-0.06	2.33	5.86	0.50	2.20	5343
Lithuania	-4.88	-1.10	0.04	1.08	3.97	0.00	1.57	7301
Luxembourg	-6.95	-1.54	0.02	0.78	5.62	-0.15	2.10	4727
Macedonia	-6.95	-1.36	-0.04	1.07	4.89	-0.11	1.79	6410
Malawi	-5.51	-1.61	-0.01	0.66	3.07	-0.42	1.59	1214
Malaysia	-5.48	-0.86	-0.02	1.08	6.27	0.23	1.55	253287
Malta	-4.20	-0.97	-0.06	0.97	2.49	-0.06	1.32	2920
Mauritius	-4.78	-0.73	0.06	0.82	3.54	0.02	1.28	7874
Mexico	-5.99	-1.30	-0.03	1.24	5.00	-0.07	1.90	28704
Montenegro	-6.95	-1.50	-0.06	1.06	4.52	-0.17	1.91	4627
Morocco	-5.99	-1.31	-0.02	1.55	5.16	0.08	1.86	15218
Namibia	-5.99	-1.21	0.01	0.69	1.90	-0.59	1.76	831
Netherlands	-6.95	-1.59	0.04	1.60	6.59	0.09	2.30	45225
New Zealand	-4.28	-1.40	0.01	1.22	5.11	-0.07	1.91	26695
Nigeria	-5.99	-1.10	-0.04	1.75	6.27	0.29	2.09	26924
Norway	-6.95	-1.13	-0.01	1.26	6.74	0.12	1.78	60088
Oman	-5.52	-0.97	0.02	1.12	4.99	0.04	1.57	17076
Pakistan	-5.99	-1.46	-0.04	1.72	6.27	0.12	2.27	71226
Peru	-5.99	-1.30	-0.02	1.59	5.01	0.06	1.94	17758
Philippines	-5.99	-1.16	0.01	1.52	5.68	0.25	1.86	56656
Poland	-6.84	-1.31	-0.10	1.42	7.58	0.14	2.05	113126
Portugal	-6.95	-1.56	0.03	1.77	5.32	-0.01	2.46	19403
Romania	-6.95	-1.26	-0.07	1.17	7.58	0.05	2.04	23406
Russian Federation	-6.95	-1.63	-0.02	1.64	7.58	0.04	2.41	36561
Rwanda	-2.71	-1.21	-0.12	0.17	0.66	-0.51	0.92	161
Saudi Arabia	-4.55	-0.92	-0.02	1.33	5.52	0.28	1.57	25591
Serbia	-6.51	-1.30	-0.08	1.20	6.31	0.02	1.84	20784
Singapore	-4.28	-0.94	-0.02	1.17	6.72	0.26	1.69	162646
Slovakia	-5.93	-1.30	0.00	2.16	6.28	0.50	2.47	4359
Slovenia	-6.95	-1.16	-0.03	1.59	7.58	0.36	2.40	12271
South Africa	-5.99	-1.63	-0.02	1.67	6.27	0.02	2.27	104232
South Korea	-4.28	-0.72	0.01	0.99	7.17	0.25	1.51	458344
Spain	-6.95	-1.43	-0.01	1.51	6.07	0.01	2.15	50860
Sri Lanka	-5.99	-0.97	-0.06	1.00	4.86	0.07	1.53	34397
Sweden	-6.95	-1.53	-0.09	1.64	7.58	0.17	2.32	122391
Switzerland	-6.95	-1.25	0.02	1.27	7.58	0.10	1.96	71146
Taiwan	-4.28	-0.79	-0.01	0.88	6.94	0.14	1.40	200740
Tanzania	-5.93	-2.11	0.00	0.78	3.56	-0.49	1.75	1085
Thailand	-5.26	-0.93	0.00	1.15	6.27	0.22	1.59	142345
Tunisia	-3.93	-0.96	-0.04	1.16	3.51	0.08	1.31	11535
Turkey	-5.27	-1.18	-0.01	1.35	6.46	0.15	1.88	87525
Uganda	-3.49	-1.18	0.00	0.82	3.06	-0.22	1.53	783
UK	-6.95	-1.42	-0.05	1.59	7.58	0.20	2.24	509010
Ukraine	-6.95	-1.01	-0.01	0.83	3.87	-0.11	1.52	8836
United Arab Emirates	-4.27	-1.06	-0.03	1.06	4.55	0.08	1.58	11614
US	-5.87	-1.28	0.02	1.45	6.63	0.15	1.98	1867899
Venezuela	-5.99	-1.30	-0.03	1.20	6.27	-0.02	2.01	6013
Vietnam	-4.55	-0.91	-0.00	1.15	6.27	0.21	1.68	70128

SIZE Trend

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
Argentina	-1.78	-0.18	-0.00	0.18	1.99	0.01	0.40	18796
Australia	-1.61	-0.21	-0.01	0.21	1.88	0.01	0.42	412172
Austria	-2.10	-0.14	-0.02	0.11	2.24	-0.02	0.30	29290
Bahrain	-1.24	-0.10	-0.02	0.07	1.99	-0.02	0.19	4601
Bangladesh	-1.78	-0.16	-0.02	0.10	1.84	-0.04	0.28	27903
Belgium	-2.10	-0.11	-0.01	0.10	2.24	-0.01	0.29	48174
Bosnia and Herzegovina	-2.10	-0.13	0.00	0.12	2.24	0.01	0.30	14289
Botswana	-1.78	-0.13	-0.02	0.10	1.99	-0.01	0.28	4019
Brazil	-1.78	-0.20	-0.02	0.18	1.99	-0.00	0.38	76729
Bulgaria	-2.10	-0.16	-0.01	0.15	2.24	-0.01	0.39	24128
Canada	-1.93	-0.17	0.01	0.20	1.88	0.02	0.40	308707
Chile	-1.78	-0.11	0.00	0.13	1.99	0.02	0.26	40327
China	-0.95	-0.14	-0.01	0.12	1.23	0.00	0.25	432156
Colombia	-1.78	-0.13	-0.00	0.13	1.99	0.00	0.26	9228
Croatia	-2.10	-0.14	0.00	0.17	2.24	0.01	0.33	20377
Cyprus	-2.10	-0.18	0.00	0.16	2.24	-0.01	0.34	22284
Czech Republic	-2.10	-0.13	0.03	0.20	2.24	0.04	0.30	9034
Denmark	-2.10	-0.11	0.00	0.12	2.24	0.00	0.28	57895
Egypt	-1.78	-0.13	0.02	0.19	1.99	0.04	0.32	28561
Estonia	-1.99	-0.17	-0.02	0.12	2.24	-0.02	0.33	3576
Finland	-2.10	-0.13	0.01	0.15	2.24	0.02	0.28	38845
France	-2.10	-0.11	0.02	0.15	2.24	0.02	0.30	237811
Germany	-2.10	-0.14	0.00	0.16	2.24	-0.00	0.37	277393
Ghana	-1.29	-0.17	0.04	0.23	1.99	0.02	0.33	2030
Greece	-2.10	-0.18	-0.00	0.18	2.24	-0.00	0.35	69850
Hong Kong	-1.61	-0.19	-0.01	0.17	1.88	0.01	0.37	329476
Hungary	-2.10	-0.17	-0.00	0.16	2.24	0.00	0.33	10442
Iceland	-2.10	-0.18	-0.03	0.11	2.24	-0.03	0.32	6253
India	-1.71	-0.22	-0.02	0.20	2.04	0.00	0.40	716601
Indonesia	-1.78	-0.20	-0.03	0.16	1.99	-0.01	0.40	95137
Ireland	-2.10	-0.16	0.00	0.17	2.24	0.00	0.35	11996
Israel	-2.10	-0.15	-0.00	0.17	2.24	0.02	0.35	114556
Italy	-2.10	-0.12	0.00	0.12	2.24	0.01	0.25	83346
Jamaica	-1.78	-0.14	0.02	0.21	1.99	0.05	0.35	8597
Japan	-1.61	-0.10	0.01	0.13	1.88	0.02	0.23	1047644
Jordan	-1.78	-0.12	-0.01	0.10	1.99	0.00	0.24	39583
Kazakhstan	-1.78	-0.26	0.00	0.26	1.99	-0.01	0.53	2105
Kenya	-1.78	-0.14	0.01	0.16	1.99	0.02	0.27	11522
Kuwait	-1.78	-0.11	0.01	0.13	1.99	0.02	0.26	33066
Latvia	-2.10	-0.16	0.02	0.23	2.24	0.05	0.36	5343
Lithuania	-2.10	-0.17	-0.01	0.15	2.24	0.00	0.34	7301
Luxembourg	-2.10	-0.12	0.00	0.12	2.24	-0.01	0.31	4727
Macedonia	-2.10	-0.15	-0.00	0.15	2.07	0.03	0.34	6410
Malawi	-1.78	-0.14	-0.00	0.17	1.99	0.04	0.43	1214
Malaysia	-1.78	-0.14	-0.01	0.14	1.99	0.01	0.30	253287
Malta	-1.49	-0.08	0.03	0.15	1.99	0.05	0.27	2920
Mauritius	-1.78	-0.11	-0.01	0.08	1.99	-0.01	0.21	7874
Mexico	-1.78	-0.13	0.00	0.14	1.99	0.01	0.28	28704
Montenegro	-2.10	-0.12	0.01	0.18	2.24	0.02	0.39	4627
Morocco	-1.78	-0.11	-0.00	0.12	1.99	0.01	0.23	15218
Namibia	-1.78	-0.04	0.04	0.14	1.99	0.10	0.38	831
Netherlands	-2.10	-0.14	-0.01	0.11	2.24	-0.02	0.28	45225
New Zealand	-1.61	-0.13	-0.00	0.13	1.88	0.00	0.29	26695
Nigeria	-1.78	-0.16	-0.00	0.17	1.99	0.02	0.36	26924
Norway	-2.10	-0.16	-0.00	0.17	2.24	0.01	0.37	60088
Oman	-1.78	-0.11	-0.00	0.13	1.99	0.00	0.27	17076
Pakistan	-1.78	-0.18	-0.01	0.22	1.99	0.05	0.40	71226
Peru	-1.78	-0.15	0.00	0.16	1.99	0.02	0.33	17758
Philippines	-1.78	-0.17	-0.02	0.15	1.99	0.00	0.35	56656
Poland	-2.10	-0.17	0.00	0.21	2.24	0.02	0.39	113126
Portugal	-2.10	-0.16	-0.02	0.12	2.24	-0.02	0.28	19403
Romania	-2.10	-0.13	0.03	0.24	2.24	0.06	0.40	23406
Russian Federation	-2.10	-0.19	-0.01	0.17	2.24	-0.01	0.40	36561
Rwanda	-0.36	-0.08	0.02	0.10	0.54	0.03	0.16	161
Saudi Arabia	-1.78	-0.11	0.02	0.16	1.99	0.02	0.25	25591
Serbia	-2.10	-0.11	0.01	0.16	2.24	0.03	0.33	20784
Singapore	-1.61	-0.15	-0.00	0.14	1.88	0.01	0.31	162646
Slovakia	-2.10	-0.17	0.02	0.26	2.24	0.04	0.45	4359
Slovenia	-2.10	-0.10	0.04	0.18	2.24	0.01	0.33	12271
South Africa	-1.78	-0.18	-0.01	0.16	1.99	-0.01	0.36	104232
South Korea	-1.61	-0.18	-0.03	0.15	1.88	-0.01	0.36	458344
Spain	-2.10	-0.12	0.01	0.15	2.24	0.02	0.29	50860
Sri Lanka	-1.78	-0.12	0.01	0.18	1.99	0.04	0.28	34397
Sweden	-2.10	-0.12	0.03	0.20	2.24	0.05	0.36	122391
Switzerland	-2.10	-0.11	-0.00	0.11	2.24	-0.00	0.25	71146
Taiwan	-1.61	-0.13	-0.00	0.13	1.88	0.01	0.25	200740
Tanzania	-1.04	-0.05	0.06	0.22	1.25	0.09	0.23	1085
Thailand	-1.78	-0.16	-0.01	0.14	1.99	-0.00	0.31	142345
Tunisia	-1.78	-0.09	-0.00	0.10	1.82	0.01	0.20	11535
Turkey	-2.10	-0.19	-0.01	0.18	2.24	0.00	0.35	87525
Uganda	-1.08	-0.15	-0.04	0.12	1.46	-0.01	0.33	783
UK	-2.10	-0.16	0.01	0.18	2.24	0.01	0.37	509010
Ukraine	-2.10	-0.26	0.00	0.27	2.24	-0.00	0.53	8836
United Arab Emirates	-1.78	-0.10	0.01	0.13	1.99	0.01	0.25	11614
US	-1.93	-0.16	-0.00	0.14	1.88	-0.02	0.33	1867899
Venezuela	-1.78	-0.22	0.00	0.25	1.99	0.03	0.53	6013
Vietnam	-1.78	-0.16	-0.02	0.14	1.99	-0.01	0.28	70128

M/B

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
Argentina	0.18	0.83	1.00	1.26	15.09	1.40	1.87	17569
Australia	0.15	0.68	1.00	1.74	13.99	1.75	2.28	380757
Austria	0.12	0.88	1.00	1.26	18.58	1.22	0.99	26108
Bahrain	0.33	0.88	1.00	1.14	5.52	1.08	0.39	4322
Bangladesh	0.18	0.81	1.00	1.44	15.09	1.45	1.55	23523
Belgium	0.12	0.85	1.00	1.31	18.58	1.32	1.35	39130
Bosnia and Herzegovina	0.13	0.69	1.00	1.44	18.58	1.17	1.07	7644
Botswana	0.29	0.83	1.00	1.32	15.09	1.38	1.45	3485
Brazil	0.18	0.79	1.00	1.37	15.09	1.66	2.50	69027
Bulgaria	0.12	0.72	1.00	1.36	18.58	1.26	1.38	14844
Canada	0.16	0.75	1.00	1.57	59.29	1.91	4.62	272760
Chile	0.18	0.77	1.00	1.39	15.09	1.29	1.44	37380
China	0.24	0.74	1.00	1.44	23.95	1.29	1.31	385120
Colombia	0.18	0.83	1.00	1.23	6.00	1.10	0.57	8200
Croatia	0.15	0.78	1.00	1.22	18.58	1.12	0.91	18238
Cyprus	0.12	0.77	1.00	1.30	18.58	1.23	1.38	18623
Czech Republic	0.20	0.78	1.00	1.27	18.58	1.13	0.71	7201
Denmark	0.12	0.89	1.00	1.36	18.58	1.52	1.92	53909
Egypt	0.20	0.81	1.00	1.38	15.09	1.26	1.03	25759
Estonia	0.22	0.86	1.00	1.32	18.58	1.37	1.63	3265
Finland	0.14	0.81	1.00	1.35	18.58	1.31	1.31	36765
France	0.12	0.83	1.00	1.36	18.58	1.37	1.55	197480
Germany	0.12	0.81	1.00	1.40	18.58	1.43	1.67	224682
Ghana	0.39	0.87	1.00	1.37	15.09	1.43	1.39	1830
Greece	0.12	0.81	1.00	1.29	18.58	1.20	0.94	66088
Hong Kong	0.15	0.73	1.00	1.55	13.99	1.53	1.85	291642
Hungary	0.12	0.78	1.00	1.32	18.58	1.24	1.23	9485
Iceland	0.12	0.87	1.00	1.20	18.58	1.10	0.57	5343
India	0.19	0.77	1.00	1.46	14.03	1.51	1.86	612133
Indonesia	0.18	0.81	1.00	1.40	15.09	1.37	1.40	89499
Ireland	0.16	0.80	1.00	1.37	18.58	1.31	1.32	10675
Israel	0.12	0.87	1.00	1.31	18.58	1.55	2.22	93861
Italy	0.18	0.87	1.00	1.25	18.58	1.21	0.93	77133
Jamaica	0.18	0.81	1.00	1.35	15.09	1.30	1.13	7606
Japan	0.15	0.85	1.00	1.22	13.99	1.23	1.06	996621
Jordan	0.18	0.79	1.00	1.25	15.09	1.15	0.77	36154
Kazakhstan	0.24	0.89	1.00	1.11	15.09	1.31	1.47	1699
Kenya	0.19	0.79	1.00	1.25	15.09	1.25	1.07	10141
Kuwait	0.18	0.82	1.00	1.25	15.09	1.13	0.61	31233
Latvia	0.15	0.74	1.00	1.24	12.91	1.10	0.76	4472
Lithuania	0.28	0.82	1.00	1.23	6.11	1.11	0.53	5862
Luxembourg	0.32	0.78	1.00	1.30	18.58	1.82	3.51	3789
Macedonia	0.12	0.75	1.00	1.19	18.58	1.22	1.84	3796
Malawi	0.36	0.85	1.00	1.25	15.09	1.20	0.81	943
Malaysia	0.18	0.80	1.00	1.31	15.09	1.26	1.11	236937
Malta	0.33	0.88	1.00	1.42	14.41	1.34	1.02	2472
Mauritius	0.18	0.78	1.00	1.25	15.09	1.18	0.94	7174
Mexico	0.18	0.80	1.00	1.33	14.27	1.15	0.58	26851
Montenegro	0.12	0.65	1.00	1.62	18.58	1.42	1.73	2938
Morocco	0.23	0.86	1.00	1.46	11.73	1.27	0.70	14165
Namibia	0.61	0.89	1.00	1.09	4.02	1.18	0.62	732
Netherlands	0.12	0.82	1.00	1.37	18.58	1.39	1.71	42047
New Zealand	0.15	0.77	1.00	1.53	13.99	1.57	1.97	24624
Nigeria	0.18	0.81	1.00	1.40	15.09	1.40	1.39	23466
Norway	0.12	0.84	1.00	1.43	18.58	1.49	1.74	55624
Oman	0.18	0.87	1.00	1.28	5.53	1.14	0.48	15713
Pakistan	0.18	0.81	1.00	1.29	15.09	1.28	1.16	40129
Peru	0.18	0.74	1.00	1.39	15.09	1.27	1.00	15894
Philippines	0.18	0.73	1.00	1.60	15.09	1.86	2.79	53180
Poland	0.12	0.78	1.00	1.39	18.58	1.41	1.71	85232
Portugal	0.12	0.87	1.00	1.21	18.58	1.11	0.60	17475
Romania	0.12	0.75	1.00	1.31	18.58	1.25	1.59	15029
Russian Federation	0.12	0.73	1.00	1.33	18.58	1.32	1.68	33064
Rwanda	0.35	0.66	1.00	1.58	1.99	1.07	0.47	131
Saudi Arabia	0.18	0.74	1.00	1.50	15.09	1.31	1.02	23619
Serbia	0.12	0.75	1.00	1.25	18.58	1.08	0.77	14043
Singapore	0.15	0.80	1.00	1.35	13.99	1.31	1.26	153270
Slovakia	0.16	0.80	1.00	1.14	4.80	1.00	0.38	2625
Slovenia	0.12	0.79	1.00	1.21	18.58	1.11	1.05	8642
South Africa	0.18	0.76	1.00	1.46	15.09	1.39	1.58	94763
South Korea	0.15	0.82	1.00	1.35	13.99	1.35	1.32	395686
Spain	0.12	0.85	1.00	1.27	18.58	1.22	0.96	47030
Sri Lanka	0.27	0.82	1.00	1.27	15.09	1.28	1.25	31205
Sweden	0.12	0.75	1.00	1.60	18.58	1.56	1.80	112122
Switzerland	0.14	0.84	1.00	1.40	18.58	1.35	1.22	67302
Taiwan	0.26	0.83	1.00	1.34	13.99	1.23	0.79	185249
Tanzania	0.44	0.72	1.00	1.65	15.09	1.79	2.37	948
Thailand	0.18	0.80	1.00	1.33	15.09	1.23	0.89	131721
Tunisia	0.20	0.90	1.00	1.29	6.40	1.22	0.63	10417
Turkey	0.12	0.80	1.00	1.39	18.58	1.67	2.86	81773
Uganda	0.55	0.81	1.00	1.14	15.09	1.13	1.10	699
UK	0.12	0.73	1.00	1.57	18.58	1.59	2.15	462851
Ukraine	0.12	0.76	1.00	1.39	18.58	1.41	1.87	7351
United Arab Emirates	0.33	0.85	1.00	1.16	9.95	1.07	0.45	11232
US	0.16	0.78	1.00	1.57	59.29	1.58	2.51	1786575
Venezuela	0.18	0.69	1.00	1.28	15.09	2.25	4.05	4556
Vietnam	0.18	0.87	1.00	1.18	15.09	1.11	0.58	65884

SIGMA

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
Argentina	0.02	0.09	0.11	0.15	0.69	0.13	0.06	15676
Australia	0.03	0.12	0.23	0.34	1.02	0.25	0.16	339603
Austria	0.02	0.06	0.09	0.13	1.33	0.12	0.10	25024
Bahrain	0.03	0.07	0.10	0.14	0.39	0.11	0.05	2262
Bangladesh	0.03	0.10	0.12	0.16	0.70	0.13	0.05	26789
Belgium	0.02	0.06	0.08	0.12	1.41	0.10	0.08	38297
Bosnia and Herzegovina	0.02	0.11	0.15	0.21	0.77	0.17	0.10	4281
Botswana	0.02	0.03	0.05	0.07	0.42	0.06	0.05	1719
Brazil	0.02	0.09	0.13	0.21	1.09	0.17	0.13	56336
Bulgaria	0.02	0.11	0.17	0.26	1.11	0.20	0.13	11109
Canada	0.03	0.10	0.17	0.27	1.04	0.21	0.16	279154
Chile	0.02	0.06	0.08	0.11	0.83	0.10	0.07	26578
China	0.03	0.08	0.11	0.14	0.43	0.12	0.05	430818
Colombia	0.02	0.06	0.08	0.11	0.56	0.10	0.06	5938
Croatia	0.02	0.09	0.13	0.19	1.03	0.16	0.10	13424
Cyprus	0.02	0.15	0.20	0.28	1.41	0.25	0.18	15809
Czech Republic	0.03	0.08	0.12	0.16	0.66	0.12	0.05	6541
Denmark	0.02	0.07	0.10	0.15	1.23	0.13	0.10	45553
Egypt	0.03	0.10	0.13	0.18	0.68	0.15	0.08	26570
Estonia	0.02	0.07	0.11	0.18	0.68	0.14	0.09	3254
Finland	0.02	0.08	0.10	0.15	1.41	0.13	0.09	34102
France	0.02	0.07	0.11	0.16	1.41	0.13	0.09	198807
Germany	0.02	0.09	0.14	0.26	1.41	0.24	0.25	253822
Ghana	0.03	0.08	0.09	0.12	1.09	0.12	0.11	1034
Greece	0.02	0.10	0.14	0.19	0.90	0.16	0.09	66694
Hong Kong	0.03	0.10	0.15	0.22	1.02	0.17	0.10	320033
Hungary	0.02	0.08	0.12	0.20	0.75	0.15	0.10	8593
Iceland	0.03	0.06	0.09	0.13	0.61	0.11	0.07	3831
India	0.04	0.14	0.18	0.22	1.04	0.21	0.12	643213
Indonesia	0.02	0.11	0.16	0.25	1.09	0.20	0.13	77242
Ireland	0.03	0.08	0.11	0.19	1.41	0.16	0.14	9087
Israel	0.03	0.10	0.14	0.22	1.04	0.17	0.10	101382
Italy	0.02	0.07	0.09	0.12	0.69	0.11	0.05	80476
Jamaica	0.03	0.13	0.16	0.22	0.84	0.19	0.09	5921
Japan	0.03	0.08	0.11	0.15	1.02	0.12	0.07	994897
Jordan	0.02	0.09	0.12	0.15	0.88	0.13	0.06	30939
Kazakhstan	0.02	0.09	0.12	0.20	0.95	0.17	0.13	995
Kenya	0.04	0.09	0.12	0.16	0.52	0.13	0.05	9633
Kuwait	0.03	0.11	0.14	0.18	0.58	0.15	0.06	27466
Latvia	0.03	0.09	0.13	0.21	0.94	0.17	0.11	2533
Lithuania	0.02	0.08	0.11	0.17	1.02	0.13	0.09	5963
Luxembourg	0.02	0.07	0.10	0.13	0.52	0.11	0.05	2902
Macedonia	0.02	0.08	0.11	0.17	0.66	0.13	0.08	2390
Malawi	0.02	0.07	0.13	0.27	0.58	0.17	0.10	95
Malaysia	0.02	0.09	0.14	0.20	1.09	0.16	0.10	241591
Malta	0.02	0.05	0.07	0.09	0.59	0.09	0.07	1203
Mauritius	0.02	0.04	0.06	0.09	0.43	0.08	0.05	5517
Mexico	0.02	0.07	0.09	0.13	1.03	0.11	0.07	20994
Montenegro	0.05	0.14	0.21	0.41	1.41	0.32	0.30	1754
Morocco	0.02	0.07	0.10	0.12	0.47	0.10	0.04	12342
Namibia	0.02	0.04	0.05	0.06	0.11	0.05	0.02	228
Netherlands	0.02	0.06	0.09	0.13	1.41	0.11	0.10	42027
New Zealand	0.03	0.06	0.08	0.14	1.02	0.12	0.11	21754
Nigeria	0.02	0.10	0.13	0.16	0.60	0.13	0.06	20563
Norway	0.03	0.09	0.14	0.21	1.26	0.17	0.11	48875
Oman	0.02	0.07	0.10	0.13	1.08	0.11	0.07	11614
Pakistan	0.03	0.10	0.14	0.23	1.09	0.20	0.17	59621
Peru	0.02	0.08	0.12	0.17	0.55	0.13	0.07	9726
Philippines	0.02	0.10	0.15	0.24	0.97	0.19	0.12	45586
Poland	0.02	0.11	0.16	0.26	1.41	0.21	0.15	105944
Portugal	0.02	0.07	0.10	0.16	1.21	0.13	0.10	14607
Romania	0.03	0.12	0.17	0.25	1.41	0.20	0.13	14840
Russian Federation	0.02	0.09	0.13	0.22	1.25	0.17	0.12	25017
Rwanda	0.02	0.03	0.07	0.09	0.13	0.06	0.03	124
Saudi Arabia	0.03	0.08	0.11	0.15	0.79	0.12	0.07	24674
Serbia	0.02	0.12	0.20	0.27	0.81	0.21	0.10	7331
Singapore	0.03	0.09	0.14	0.23	1.02	0.19	0.15	144497
Slovakia	0.02	0.08	0.11	0.18	0.55	0.13	0.09	1302
Slovenia	0.02	0.07	0.10	0.16	1.27	0.14	0.13	7681
South Africa	0.02	0.09	0.13	0.23	1.09	0.19	0.17	90358
South Korea	0.03	0.11	0.15	0.21	1.02	0.17	0.08	448314
Spain	0.02	0.06	0.09	0.13	0.95	0.10	0.06	42280
Sri Lanka	0.02	0.10	0.14	0.19	1.09	0.15	0.09	32038
Sweden	0.02	0.09	0.14	0.25	1.41	0.19	0.16	113177
Switzerland	0.02	0.06	0.09	0.13	1.41	0.11	0.08	62321
Taiwan	0.03	0.07	0.10	0.12	0.62	0.10	0.04	197338
Tanzania	0.02	0.04	0.07	0.10	0.31	0.08	0.05	786
Thailand	0.02	0.09	0.12	0.17	1.09	0.14	0.09	131214
Tunisia	0.02	0.06	0.07	0.09	0.46	0.08	0.04	9933
Turkey	0.03	0.10	0.13	0.18	1.09	0.15	0.07	86276
Uganda	0.02	0.08	0.12	0.20	0.47	0.15	0.11	340
UK	0.02	0.08	0.12	0.19	1.41	0.15	0.10	443438
Ukraine	0.02	0.11	0.17	0.26	1.17	0.22	0.16	3820
United Arab Emirates	0.02	0.09	0.12	0.17	0.43	0.14	0.06	8387
US	0.03	0.09	0.14	0.22	1.04	0.17	0.12	1792309
Venezuela	0.02	0.13	0.19	0.26	1.09	0.21	0.13	3717
Vietnam	0.02	0.11	0.14	0.18	0.62	0.15	0.06	64814

Table A.9: Exits classified as ”Defaults”.

Default	
Action Type	**Subcategory**
Bankruptcy filing	Administration, Arrangement, Canadian Companies' Creditors Arrangement Act (CCAA), Chapter 7,11,15 (United States bankruptcy code), Conservatorship, Insolvency, Japanese Corporate Reogranization Law (CRL), Judicial management, Liquidation, Pre-negotiation Chapter 11, Protection, Receivership, Rehabilitation, Rehabilitation (Thailand 1997), Reorganization, Restructuring, Section 304, Supreme Court declaration, Winding up, Work out, Sued by creditor, Petition withdrawn
Delisting	Due to bankruptcy
Default corporate action	Bankruptcy, Coupon & principal payment, Coupon payment only, Debt restructuring, Interest payment, Loan payment, Principal payment, Alternative Dispute Resolution (ADR, Japan only), Declared sick (India only), Regulatory action (Taiwan only), Financial difficulty and shutdown (Taiwan only), Buyback option

Table A.10: Exits classified as ”Other Exits”.

Other Exits	
Action Type	**Subcategory**
Delisting	Acquired/merged, Assimilated with underlying shares, Bid price below minimum, Cancellation of listing, Failure to meet listing requirements, Failure to pay listing fees, Inactive security, Insufficient assets, Insufficient capital and surplus, Insufficient number of market makers, Issue postponed, Lack of market maker interest, Lack of public interest, Liquidated, Not current in required filings, NP/FP finished, Privatized, Reorganization, Security called for redemptions, the company's request, Scheme of arrangement, Selective capital reduction of the company, From exchange to Over-the-Counter (OTC), Privatised

Table A.11: Number of defaults and other exits of 87 economics from 1990 to 2017.

Economy: Argentina

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	1	0	0.00	0	0.00
1993	1	0	0.00	0	0.00
1994	25	0	0.00	1	4.00
1995	97	0	0.00	4	4.12
1996	100	0	0.00	5	5.00
1997	97	0	0.00	12	12.37
1998	89	1	1.12	8	8.99
1999	85	1	1.18	12	14.12
2000	79	1	1.27	5	6.33
2001	75	2	2.67	12	16.00
2002	79	7	8.86	3	3.80
2003	77	3	3.90	3	3.90
2004	74	2	2.70	1	1.35
2005	73	0	0.00	1	1.37
2006	75	0	0.00	0	0.00
2007	80	0	0.00	1	1.25
2008	80	0	0.00	5	6.25
2009	75	1	1.33	6	8.00
2010	73	1	1.37	0	0.00
2011	73	0	0.00	0	0.00
2012	74	0	0.00	1	1.35
2013	73	0	0.00	4	5.48
2014	70	0	0.00	4	5.71
2015	68	0	0.00	1	1.47
2016	72	1	1.39	0	0.00
2017	81	0	0.00	1	1.23

Economy: Australia

		Defaults		Others	
Year	Active	#	%	#	%
1990	760	0	0.00	39	5.13
1991	741	4	0.54	26	3.51
1992	765	0	0.00	20	2.61
1993	848	0	0.00	11	1.30
1994	951	0	0.00	12	1.26
1995	986	1	0.10	24	2.43
1996	1035	1	0.10	29	2.80
1997	1086	2	0.18	56	5.16
1998	1082	3	0.28	66	6.10
1999	1133	3	0.26	50	4.41
2000	1260	10	0.79	58	4.60
2001	1260	27	2.14	63	5.00
2002	1254	8	0.64	59	4.70
2003	1287	8	0.62	53	4.12
2004	1394	4	0.29	46	3.30
2005	1523	5	0.33	55	3.61
2006	1659	3	0.18	76	4.58
2007	1840	4	0.22	78	4.24
2008	1835	25	1.36	73	3.98
2009	1785	26	1.46	64	3.59
2010	1816	5	0.28	76	4.19
2011	1854	1	0.05	98	5.29
2012	1815	3	0.17	92	5.07
2013	1786	4	0.22	69	3.86
2014	1801	7	0.39	93	5.16
2015	1817	3	0.17	96	5.28
2016	1859	1	0.05	112	6.02
2017	1881	11	0.58	44	2.34

Economy: Austria					
		Defaults		Others	
Year	Active	#	%	#	%
1990	1	0	0.00	1	100.00
1991	78	0	0.00	0	0.00
1992	89	0	0.00	0	0.00
1993	100	0	0.00	0	0.00
1994	111	0	0.00	0	0.00
1995	118	0	0.00	1	0.85
1996	120	0	0.00	3	2.50
1997	123	0	0.00	4	3.25
1998	121	0	0.00	8	6.61
1999	119	0	0.00	10	8.40
2000	125	0	0.00	8	6.40
2001	127	2	1.57	6	4.72
2002	123	0	0.00	9	7.32
2003	122	0	0.00	13	10.66
2004	113	0	0.00	10	8.85
2005	111	0	0.00	8	7.21
2006	111	0	0.00	4	3.60
2007	115	0	0.00	5	4.35
2008	114	2	1.75	3	2.63
2009	111	1	0.90	3	2.70
2010	110	1	0.91	9	8.18
2011	103	0	0.00	9	8.74
2012	96	1	1.04	6	6.25
2013	92	0	0.00	4	4.35
2014	90	0	0.00	0	0.00
2015	92	0	0.00	11	11.96
2016	84	0	0.00	8	9.52
2017	82	0	0.00	8	9.76

Economy: Bahrain					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	0	0	NaN	0	NaN
2003	0	0	NaN	0	NaN
2004	32	0	0.00	0	0.00
2005	36	0	0.00	0	0.00
2006	39	0	0.00	0	0.00
2007	40	0	0.00	1	2.50
2008	41	1	2.44	2	4.88
2009	38	0	0.00	1	2.63
2010	39	0	0.00	1	2.56
2011	38	1	2.63	2	5.26
2012	35	0	0.00	3	8.57
2013	32	0	0.00	0	0.00
2014	35	0	0.00	0	0.00
2015	35	0	0.00	2	5.71
2016	37	0	0.00	4	10.81
2017	38	0	0.00	1	2.63

Economy: Bangladesh					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	161	0	0.00	0	0.00
2000	171	0	0.00	37	21.64
2001	144	0	0.00	30	20.83
2002	126	0	0.00	12	9.52
2003	125	0	0.00	22	17.60
2004	111	0	0.00	4	3.60
2005	208	0	0.00	1	0.48
2006	216	0	0.00	2	0.93
2007	226	0	0.00	2	0.88
2008	235	0	0.00	6	2.55
2009	237	0	0.00	42	17.72
2010	233	0	0.00	9	3.86
2011	232	1	0.43	3	1.29
2012	241	0	0.00	0	0.00
2013	256	0	0.00	1	0.39
2014	274	1	0.36	0	0.00
2015	285	0	0.00	0	0.00
2016	294	0	0.00	1	0.34
2017	301	0	0.00	0	0.00

Economy: Belgium					
		Defaults		Others	
Year	Active	#	%	#	%
1990	114	0	0.00	1	0.88
1991	138	0	0.00	2	1.45
1992	139	0	0.00	0	0.00
1993	144	0	0.00	0	0.00
1994	150	0	0.00	1	0.67
1995	159	0	0.00	0	0.00
1996	172	0	0.00	5	2.91
1997	182	0	0.00	15	8.24
1998	193	0	0.00	16	8.29
1999	200	2	1.00	5	2.50
2000	202	0	0.00	6	2.97
2001	200	2	1.00	9	4.50
2002	191	3	1.57	11	5.76
2003	187	1	0.53	9	4.81
2004	182	1	0.55	10	5.49
2005	183	1	0.55	10	5.46
2006	193	2	1.04	6	3.11
2007	224	1	0.45	10	4.46
2008	226	0	0.00	10	4.42
2009	221	1	0.45	6	2.71
2010	219	0	0.00	11	5.02
2011	209	0	0.00	10	4.78
2012	204	1	0.49	3	1.47
2013	204	2	0.98	11	5.39
2014	193	1	0.52	16	8.29
2015	185	0	0.00	8	4.32
2016	184	1	0.54	10	5.43
2017	188	0	0.00	5	2.66

Economy: Bosnia and Herzegovina

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	0	0	NaN	0	NaN
2003	0	0	NaN	0	NaN
2004	0	0	NaN	0	NaN
2005	0	0	NaN	0	NaN
2006	286	0	0.00	0	0.00
2007	325	0	0.00	1	0.31
2008	338	0	0.00	27	7.99
2009	316	0	0.00	114	36.08
2010	211	0	0.00	39	18.48
2011	185	0	0.00	50	27.03
2012	148	0	0.00	20	13.51
2013	141	0	0.00	18	12.77
2014	134	0	0.00	16	11.94
2015	153	0	0.00	11	7.19
2016	167	0	0.00	15	8.98
2017	241	0	0.00	3	1.24

Economy: Botswana

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	8	0	0.00	0	0.00
1997	11	0	0.00	0	0.00
1998	12	0	0.00	0	0.00
1999	15	0	0.00	0	0.00
2000	16	0	0.00	0	0.00
2001	16	0	0.00	0	0.00
2002	18	0	0.00	0	0.00
2003	19	0	0.00	0	0.00
2004	19	0	0.00	2	10.53
2005	17	0	0.00	0	0.00
2006	17	0	0.00	0	0.00
2007	18	0	0.00	0	0.00
2008	21	0	0.00	1	4.76
2009	20	0	0.00	0	0.00
2010	22	0	0.00	1	4.55
2011	22	0	0.00	0	0.00
2012	23	0	0.00	0	0.00
2013	24	0	0.00	1	4.17
2014	23	0	0.00	1	4.35
2015	23	0	0.00	2	8.70
2016	23	0	0.00	0	0.00
2017	25	0	0.00	1	4.00

Economy: Brazil					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	266	0	0.00	0	0.00
1995	298	0	0.00	5	1.68
1996	309	0	0.00	6	1.94
1997	324	1	0.31	22	6.79
1998	357	1	0.28	32	8.96
1999	349	1	0.29	26	7.45
2000	335	2	0.60	29	8.66
2001	314	0	0.00	34	10.83
2002	296	1	0.34	23	7.77
2003	287	2	0.70	14	4.88
2004	284	0	0.00	14	4.93
2005	286	1	0.35	17	5.94
2006	301	0	0.00	14	4.65
2007	356	0	0.00	14	3.93
2008	355	1	0.28	21	5.92
2009	343	0	0.00	14	4.08
2010	344	0	0.00	19	5.52
2011	338	0	0.00	14	4.14
2012	334	6	1.80	22	6.59
2013	323	7	2.17	8	2.48
2014	315	6	1.90	10	3.17
2015	318	4	1.26	14	4.40
2016	321	8	2.49	18	5.61
2017	320	5	1.56	12	3.75

Economy: Bulgaria					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	14	0	0.00	0	0.00
2001	25	0	0.00	0	0.00
2002	32	0	0.00	0	0.00
2003	36	0	0.00	1	2.78
2004	39	0	0.00	0	0.00
2005	141	1	0.71	1	0.71
2006	218	0	0.00	0	0.00
2007	242	0	0.00	8	3.31
2008	256	0	0.00	16	6.25
2009	243	0	0.00	21	8.64
2010	228	1	0.44	25	10.96
2011	208	0	0.00	20	9.62
2012	197	0	0.00	18	9.14
2013	186	0	0.00	13	6.99
2014	179	2	1.12	15	8.38
2015	170	0	0.00	10	5.88
2016	175	0	0.00	10	5.71
2017	180	0	0.00	10	5.56

Economy: Canada

		Defaults		Others	
Year	Active	#	%	#	%
1990	925	0	0.00	63	6.81
1991	927	0	0.00	52	5.61
1992	984	1	0.10	22	2.24
1993	1167	0	0.00	6	0.51
1994	1335	0	0.00	8	0.60
1995	1469	0	0.00	15	1.02
1996	1658	0	0.00	35	2.11
1997	1893	6	0.32	101	5.34
1998	1992	7	0.35	202	10.14
1999	1921	13	0.68	707	36.80
2000	1340	8	0.60	182	13.58
2001	1233	20	1.62	227	18.41
2002	1052	6	0.57	95	9.03
2003	1048	13	1.24	85	8.11
2004	1078	6	0.56	77	7.14
2005	1120	2	0.18	82	7.32
2006	1178	3	0.25	92	7.81
2007	1237	3	0.24	109	8.81
2008	1216	12	0.99	97	7.98
2009	1165	13	1.12	113	9.70
2010	1158	3	0.26	81	6.99
2011	1178	5	0.42	86	7.30
2012	1162	6	0.52	90	7.75
2013	1144	3	0.26	83	7.26
2014	1154	7	0.61	89	7.71
2015	1169	7	0.60	94	8.04
2016	1149	11	0.96	89	7.75
2017	1151	5	0.43	76	6.60

Economy: Chile

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	145	0	0.00	0	0.00
1995	167	0	0.00	1	0.60
1996	177	0	0.00	0	0.00
1997	190	0	0.00	0	0.00
1998	193	0	0.00	4	2.07
1999	192	0	0.00	9	4.69
2000	184	0	0.00	6	3.26
2001	181	1	0.55	6	3.31
2002	179	1	0.56	5	2.79
2003	176	0	0.00	7	3.98
2004	181	1	0.55	2	1.10
2005	185	0	0.00	5	2.70
2006	186	0	0.00	7	3.76
2007	181	0	0.00	3	1.66
2008	181	0	0.00	5	2.76
2009	181	0	0.00	5	2.76
2010	181	0	0.00	8	4.42
2011	178	0	0.00	6	3.37
2012	182	0	0.00	7	3.85
2013	183	0	0.00	5	2.73
2014	182	1	0.55	2	1.10
2015	186	0	0.00	9	4.84
2016	186	0	0.00	12	6.45
2017	182	0	0.00	4	2.20

Economy: China

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	8	0	0.00	0	0.00
1991	10	0	0.00	0	0.00
1992	45	0	0.00	0	0.00
1993	159	0	0.00	0	0.00
1994	271	1	0.37	0	0.00
1995	308	6	1.95	0	0.00
1996	518	10	1.93	0	0.00
1997	730	15	2.05	1	0.14
1998	870	34	3.91	1	0.11
1999	948	23	2.43	3	0.32
2000	1093	27	2.47	5	0.46
2001	1190	49	4.12	13	1.09
2002	1252	51	4.07	12	0.96
2003	1305	43	3.30	12	0.92
2004	1457	106	7.28	14	0.96
2005	1445	93	6.44	16	1.11
2006	1462	62	4.24	32	2.19
2007	1538	51	3.32	32	2.08
2008	1583	39	2.46	13	0.82
2009	1687	38	2.25	18	1.07
2010	2013	39	1.94	16	0.79
2011	2263	14	0.62	11	0.49
2012	2417	16	0.66	9	0.37
2013	2431	14	0.58	7	0.29
2014	2543	5	0.20	11	0.43
2015	2760	3	0.11	10	0.36
2016	2982	7	0.23	12	0.40
2017	3420	19	0.56	4	0.12

Economy: Colombia

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	1	0	0.00	0	0.00
1995	48	0	0.00	0	0.00
1996	51	0	0.00	4	7.84
1997	52	0	0.00	6	11.54
1998	62	0	0.00	12	19.35
1999	53	0	0.00	4	7.55
2000	51	0	0.00	5	9.80
2001	54	0	0.00	6	11.11
2002	50	0	0.00	1	2.00
2003	53	0	0.00	2	3.77
2004	53	0	0.00	2	3.77
2005	60	0	0.00	7	11.67
2006	53	0	0.00	8	15.09
2007	52	0	0.00	4	7.69
2008	48	0	0.00	4	8.33
2009	49	0	0.00	3	6.12
2010	49	0	0.00	1	2.04
2011	48	0	0.00	1	2.08
2012	50	1	2.00	2	4.00
2013	48	0	0.00	1	2.08
2014	49	0	0.00	3	6.12
2015	46	0	0.00	1	2.17
2016	48	0	0.00	3	6.25
2017	49	0	0.00	2	4.08

Economy: Croatia					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	30	0	0.00	0	0.00
2003	47	0	0.00	2	4.26
2004	56	0	0.00	2	3.57
2005	61	0	0.00	2	3.28
2006	202	0	0.00	3	1.49
2007	224	0	0.00	4	1.79
2008	221	0	0.00	30	13.57
2009	192	0	0.00	23	11.98
2010	172	1	0.58	13	7.56
2011	163	0	0.00	10	6.13
2012	157	1	0.64	14	8.92
2013	145	0	0.00	14	9.66
2014	146	1	0.68	14	9.59
2015	136	0	0.00	10	7.35
2016	136	0	0.00	14	10.29
2017	131	0	0.00	6	4.58

Economy: Cyprus					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	37	0	0.00	1	2.70
1997	43	0	0.00	0	0.00
1998	50	0	0.00	2	4.00
1999	59	0	0.00	1	1.69
2000	120	0	0.00	3	2.50
2001	144	0	0.00	5	3.47
2002	149	0	0.00	0	0.00
2003	150	0	0.00	3	2.00
2004	149	0	0.00	5	3.36
2005	146	0	0.00	6	4.11
2006	142	0	0.00	3	2.11
2007	144	0	0.00	7	4.86
2008	140	0	0.00	11	7.86
2009	129	0	0.00	9	6.98
2010	124	0	0.00	10	8.06
2011	114	0	0.00	11	9.65
2012	105	0	0.00	22	20.95
2013	86	2	2.33	21	24.42
2014	67	0	0.00	9	13.43
2015	67	0	0.00	4	5.97
2016	72	0	0.00	4	5.56
2017	79	0	0.00	3	3.80

Economy: Czech Republic

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	1	0	0.00	0	0.00
1995	51	0	0.00	1	1.96
1996	148	0	0.00	0	0.00
1997	586	0	0.00	319	54.44
1998	268	1	0.37	30	11.19
1999	238	3	1.26	85	35.71
2000	152	7	4.61	24	15.79
2001	122	2	1.64	39	31.97
2002	82	1	1.22	21	25.61
2003	60	0	0.00	15	25.00
2004	48	0	0.00	11	22.92
2005	37	0	0.00	15	40.54
2006	24	0	0.00	8	33.33
2007	17	0	0.00	2	11.76
2008	16	0	0.00	0	0.00
2009	17	0	0.00	4	23.53
2010	16	0	0.00	0	0.00
2011	19	1	5.26	1	5.26
2012	17	0	0.00	1	5.88
2013	17	0	0.00	3	17.65
2014	15	0	0.00	1	6.67
2015	15	0	0.00	0	0.00
2016	18	0	0.00	2	11.11
2017	16	0	0.00	0	0.00

Economy: Denmark

		Defaults		Others	
Year	Active	#	%	#	%
1990	105	0	0.00	1	0.95
1991	145	0	0.00	1	0.69
1992	167	0	0.00	0	0.00
1993	173	0	0.00	0	0.00
1994	182	0	0.00	0	0.00
1995	208	0	0.00	0	0.00
1996	221	0	0.00	0	0.00
1997	226	0	0.00	5	2.21
1998	233	0	0.00	11	4.72
1999	228	0	0.00	12	5.26
2000	226	0	0.00	10	4.42
2001	220	5	2.27	15	6.82
2002	200	2	1.00	10	5.00
2003	192	1	0.52	9	4.69
2004	185	2	1.08	10	5.41
2005	181	0	0.00	9	4.97
2006	199	0	0.00	6	3.02
2007	224	1	0.45	3	1.34
2008	229	1	0.44	9	3.93
2009	220	4	1.82	6	2.73
2010	214	0	0.00	13	6.07
2011	203	2	0.99	10	4.93
2012	192	2	1.04	11	5.73
2013	182	4	2.20	10	5.49
2014	171	2	1.17	13	7.60
2015	160	1	0.63	6	3.75
2016	157	0	0.00	15	9.55
2017	148	0	0.00	5	3.38

Economy: Egypt					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	0	0	NaN	0	NaN
2003	0	0	NaN	0	NaN
2004	0	0	NaN	0	NaN
2005	0	0	NaN	0	NaN
2006	172	0	0.00	4	2.33
2007	194	0	0.00	4	2.06
2008	205	0	0.00	2	0.98
2009	208	0	0.00	8	3.85
2010	218	0	0.00	20	9.17
2011	214	0	0.00	3	1.40
2012	217	0	0.00	5	2.30
2013	223	0	0.00	1	0.45
2014	231	0	0.00	4	1.73
2015	234	1	0.43	3	1.28
2016	238	0	0.00	2	0.84
2017	243	0	0.00	2	0.82

Economy: Estonia					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	17	0	0.00	0	0.00
1998	19	0	0.00	0	0.00
1999	20	0	0.00	0	0.00
2000	21	0	0.00	3	14.29
2001	18	0	0.00	3	16.67
2002	15	0	0.00	3	20.00
2003	12	0	0.00	0	0.00
2004	12	0	0.00	0	0.00
2005	15	0	0.00	1	6.67
2006	16	0	0.00	2	12.50
2007	17	0	0.00	0	0.00
2008	18	0	0.00	0	0.00
2009	18	0	0.00	2	11.11
2010	17	0	0.00	1	5.88
2011	16	0	0.00	0	0.00
2012	17	0	0.00	0	0.00
2013	17	0	0.00	0	0.00
2014	17	0	0.00	1	5.88
2015	17	0	0.00	0	0.00
2016	18	0	0.00	0	0.00
2017	19	0	0.00	0	0.00

Economy: Finland					
		Defaults		Others	
Year	Active	#	%	#	%
1990	17	0	0.00	1	5.88
1991	27	0	0.00	0	0.00
1992	92	0	0.00	0	0.00
1993	95	0	0.00	0	0.00
1994	99	0	0.00	1	1.01
1995	106	0	0.00	0	0.00
1996	111	0	0.00	0	0.00
1997	124	0	0.00	0	0.00
1998	134	1	0.75	5	3.73
1999	156	0	0.00	9	5.77
2000	165	0	0.00	11	6.67
2001	162	1	0.62	9	5.56
2002	153	1	0.65	5	3.27
2003	148	1	0.68	5	3.38
2004	144	0	0.00	9	6.25
2005	140	0	0.00	5	3.57
2006	141	0	0.00	7	4.96
2007	138	0	0.00	5	3.62
2008	134	1	0.75	3	2.24
2009	131	1	0.76	2	1.53
2010	129	0	0.00	3	2.33
2011	126	1	0.79	1	0.79
2012	126	0	0.00	5	3.97
2013	127	2	1.57	1	0.79
2014	131	0	0.00	4	3.05
2015	141	3	2.13	3	2.13
2016	142	0	0.00	4	2.82
2017	148	1	0.68	5	3.38

Economy: France					
		Defaults		Others	
Year	Active	#	%	#	%
1990	260	0	0.00	4	1.54
1991	414	0	0.00	15	3.62
1992	651	0	0.00	6	0.92
1993	674	0	0.00	9	1.34
1994	733	0	0.00	9	1.23
1995	764	0	0.00	6	0.79
1996	822	0	0.00	15	1.82
1997	888	1	0.11	61	6.87
1998	950	0	0.00	112	11.79
1999	927	0	0.00	55	5.93
2000	997	2	0.20	54	5.42
2001	1013	9	0.89	52	5.13
2002	986	6	0.61	58	5.88
2003	942	5	0.53	37	3.93
2004	932	2	0.21	55	5.90
2005	934	4	0.43	45	4.82
2006	982	3	0.31	37	3.77
2007	1037	4	0.39	44	4.24
2008	1028	9	0.88	59	5.74
2009	995	6	0.60	51	5.13
2010	978	4	0.41	76	7.77
2011	931	1	0.11	60	6.44
2012	896	1	0.11	66	7.37
2013	864	3	0.35	58	6.71
2014	849	2	0.24	46	5.42
2015	867	2	0.23	36	4.15
2016	882	3	0.34	42	4.76
2017	877	5	0.57	33	3.76

Economy: Germany					
		Defaults		Others	
Year	Active	#	%	#	%
1990	195	0	0.00	2	1.03
1991	385	0	0.00	0	0.00
1992	413	0	0.00	3	0.73
1993	439	0	0.00	5	1.14
1994	610	0	0.00	2	0.33
1995	631	0	0.00	1	0.16
1996	661	4	0.61	9	1.36
1997	696	3	0.43	19	2.73
1998	770	2	0.26	15	1.95
1999	954	2	0.21	18	1.89
2000	1101	2	0.18	24	2.18
2001	1144	27	2.36	26	2.27
2002	1152	39	3.39	75	6.51
2003	1063	18	1.69	52	4.89
2004	1029	8	0.78	30	2.92
2005	1064	4	0.38	39	3.67
2006	1218	7	0.57	34	2.79
2007	1377	5	0.36	45	3.27
2008	1488	17	1.14	59	3.97
2009	1479	11	0.74	76	5.14
2010	1528	1	0.07	80	5.24
2011	1696	4	0.24	243	14.33
2012	1490	10	0.67	411	27.58
2013	1101	16	1.45	66	5.99
2014	1050	7	0.67	74	7.05
2015	1012	7	0.69	81	8.00
2016	956	3	0.31	65	6.80
2017	927	6	0.65	36	3.88

Economy: Ghana					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	0	0	NaN	0	NaN
2003	0	0	NaN	0	NaN
2004	0	0	NaN	0	NaN
2005	0	0	NaN	0	NaN
2006	0	0	NaN	0	NaN
2007	0	0	NaN	0	NaN
2008	0	0	NaN	0	NaN
2009	0	0	NaN	0	NaN
2010	12	0	0.00	0	0.00
2011	24	0	0.00	0	0.00
2012	25	0	0.00	0	0.00
2013	26	0	0.00	0	0.00
2014	26	0	0.00	0	0.00
2015	28	0	0.00	0	0.00
2016	31	0	0.00	0	0.00
2017	32	0	0.00	0	0.00

Economy: Greece

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	90	0	0.00	0	0.00
1993	97	0	0.00	0	0.00
1994	162	0	0.00	0	0.00
1995	183	0	0.00	1	0.55
1996	202	0	0.00	6	2.97
1997	211	0	0.00	3	1.42
1998	233	0	0.00	4	1.72
1999	269	0	0.00	6	2.23
2000	316	0	0.00	7	2.22
2001	327	0	0.00	13	3.98
2002	333	0	0.00	18	5.41
2003	328	0	0.00	9	2.74
2004	329	0	0.00	10	3.04
2005	325	0	0.00	20	6.15
2006	307	0	0.00	15	4.89
2007	298	0	0.00	13	4.36
2008	295	0	0.00	15	5.08
2009	284	0	0.00	12	4.23
2010	273	0	0.00	12	4.40
2011	261	0	0.00	14	5.36
2012	247	0	0.00	23	9.31
2013	224	0	0.00	16	7.14
2014	209	0	0.00	12	5.74
2015	198	1	0.51	11	5.56
2016	191	0	0.00	8	4.19
2017	191	0	0.00	9	4.71

Economy: Hong Kong

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	238	0	0.00	4	1.68
1991	318	0	0.00	4	1.26
1992	364	0	0.00	2	0.55
1993	432	0	0.00	2	0.46
1994	482	0	0.00	7	1.45
1995	509	0	0.00	5	0.98
1996	553	0	0.00	10	1.81
1997	632	0	0.00	8	1.27
1998	659	2	0.30	9	1.37
1999	697	7	1.00	6	0.86
2000	785	5	0.64	9	1.15
2001	872	10	1.15	16	1.83
2002	970	4	0.41	18	1.86
2003	1024	5	0.49	28	2.73
2004	1060	0	0.00	30	2.83
2005	1102	3	0.27	30	2.72
2006	1143	2	0.17	22	1.92
2007	1223	2	0.16	13	1.06
2008	1253	6	0.48	15	1.20
2009	1304	3	0.23	12	0.92
2010	1382	1	0.07	19	1.37
2011	1446	1	0.07	19	1.31
2012	1496	1	0.07	22	1.47
2013	1593	4	0.25	18	1.13
2014	1691	1	0.06	19	1.12
2015	1810	8	0.44	20	1.10
2016	1909	8	0.42	20	1.05
2017	2053	9	0.44	21	1.02

Economy: Hungary

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	32	0	0.00	0	0.00
1996	37	0	0.00	1	2.70
1997	43	0	0.00	4	9.30
1998	46	0	0.00	1	2.17
1999	55	0	0.00	0	0.00
2000	57	1	1.75	4	7.02
2001	53	0	0.00	4	7.55
2002	49	0	0.00	8	16.33
2003	43	0	0.00	2	4.65
2004	43	0	0.00	3	6.98
2005	41	0	0.00	3	7.32
2006	41	0	0.00	5	12.20
2007	37	0	0.00	3	8.11
2008	36	0	0.00	0	0.00
2009	39	0	0.00	0	0.00
2010	44	0	0.00	0	0.00
2011	48	0	0.00	3	6.25
2012	51	1	1.96	3	5.88
2013	48	0	0.00	2	4.17
2014	48	0	0.00	2	4.17
2015	47	0	0.00	5	10.64
2016	43	1	2.33	5	11.63
2017	40	0	0.00	2	5.00

Economy: Iceland

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	24	0	0.00	0	0.00
1997	34	0	0.00	0	0.00
1998	51	0	0.00	0	0.00
1999	58	0	0.00	1	1.72
2000	69	0	0.00	5	7.25
2001	68	0	0.00	7	10.29
2002	65	0	0.00	11	16.92
2003	56	0	0.00	16	28.57
2004	40	0	0.00	10	25.00
2005	31	0	0.00	7	22.58
2006	28	0	0.00	3	10.71
2007	28	0	0.00	3	10.71
2008	25	2	8.00	9	36.00
2009	15	1	6.67	2	13.33
2010	12	0	0.00	3	25.00
2011	10	0	0.00	0	0.00
2012	13	0	0.00	0	0.00
2013	16	0	0.00	0	0.00
2014	17	0	0.00	1	5.88
2015	19	0	0.00	0	0.00
2016	21	0	0.00	0	0.00
2017	22	0	0.00	0	0.00

Economy: India					
		Defaults		Others	
Year	Active	#	%	#	%
1990	250	0	0.00	1	0.40
1991	1284	0	0.00	0	0.00
1992	1527	1	0.07	6	0.39
1993	1961	0	0.00	38	1.94
1994	2949	0	0.00	33	1.12
1995	4219	2	0.05	45	1.07
1996	4680	5	0.11	244	5.21
1997	4501	11	0.24	772	17.15
1998	3809	9	0.24	523	13.73
1999	3573	11	0.31	479	13.41
2000	3354	0	0.00	197	5.87
2001	3312	2	0.06	139	4.20
2002	3345	4	0.12	822	24.57
2003	2644	6	0.23	168	6.35
2004	2668	5	0.19	134	5.02
2005	2759	3	0.11	243	8.81
2006	2755	6	0.22	54	1.96
2007	2995	4	0.13	30	1.00
2008	3166	6	0.19	57	1.80
2009	3254	19	0.58	41	1.26
2010	3443	19	0.55	67	1.95
2011	3576	19	0.53	46	1.29
2012	3774	47	1.25	83	2.20
2013	3830	60	1.57	101	2.64
2014	3895	45	1.16	35	0.90
2015	4085	46	1.13	235	5.75
2016	4036	15	0.37	129	3.20
2017	4245	56	1.32	69	1.63

Economy: Indonesia					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	110	0	0.00	0	0.00
1992	140	0	0.00	0	0.00
1993	163	0	0.00	2	1.23
1994	208	0	0.00	5	2.40
1995	231	0	0.00	1	0.43
1996	250	1	0.40	0	0.00
1997	283	2	0.71	4	1.41
1998	301	19	6.31	2	0.66
1999	297	24	8.08	5	1.68
2000	298	12	4.03	12	4.03
2001	316	14	4.43	8	2.53
2002	326	7	2.15	14	4.29
2003	319	3	0.94	7	2.19
2004	324	4	1.23	13	4.01
2005	322	1	0.31	13	4.04
2006	327	0	0.00	6	1.83
2007	351	2	0.57	7	1.99
2008	365	0	0.00	16	4.38
2009	377	4	1.06	14	3.71
2010	391	2	0.51	10	2.56
2011	414	0	0.00	10	2.42
2012	441	1	0.23	5	1.13
2013	474	1	0.21	12	2.53
2014	491	3	0.61	4	0.81
2015	508	1	0.20	10	1.97
2016	518	2	0.39	3	0.58
2017	556	1	0.18	3	0.54

Economy: Ireland

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	30	0	0.00	0	0.00
1991	31	0	0.00	0	0.00
1992	31	0	0.00	0	0.00
1993	34	0	0.00	0	0.00
1994	37	0	0.00	3	8.11
1995	35	0	0.00	0	0.00
1996	39	0	0.00	0	0.00
1997	49	0	0.00	2	4.08
1998	50	0	0.00	2	4.00
1999	52	0	0.00	3	5.77
2000	54	0	0.00	1	1.85
2001	54	0	0.00	6	11.11
2002	48	0	0.00	6	12.50
2003	42	0	0.00	5	11.90
2004	39	0	0.00	3	7.69
2005	38	0	0.00	2	5.26
2006	43	0	0.00	2	4.65
2007	48	0	0.00	1	2.08
2008	48	0	0.00	3	6.25
2009	46	1	2.17	5	10.87
2010	40	0	0.00	4	10.00
2011	36	0	0.00	2	5.56
2012	35	0	0.00	3	8.57
2013	36	1	2.78	1	2.78
2014	37	0	0.00	1	2.70
2015	38	0	0.00	3	7.89
2016	35	0	0.00	3	8.57
2017	37	0	0.00	3	8.11

Economy: Israel

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	9	0	0.00	0	0.00
1995	83	0	0.00	0	0.00
1996	629	0	0.00	6	0.95
1997	648	0	0.00	19	2.93
1998	648	0	0.00	22	3.40
1999	641	0	0.00	17	2.65
2000	666	0	0.00	38	5.71
2001	638	0	0.00	59	9.25
2002	590	1	0.17	70	11.86
2003	537	0	0.00	39	7.26
2004	536	0	0.00	16	2.99
2005	551	0	0.00	23	4.17
2006	569	0	0.00	17	2.99
2007	615	0	0.00	17	2.76
2008	601	0	0.00	25	4.16
2009	580	0	0.00	18	3.10
2010	583	2	0.34	23	3.95
2011	572	1	0.17	36	6.29
2012	540	0	0.00	50	9.26
2013	498	2	0.40	31	6.22
2014	471	1	0.21	32	6.79
2015	446	2	0.45	21	4.71
2016	433	1	0.23	18	4.16
2017	432	0	0.00	13	3.01

Economy: Italy					
		Defaults		Others	
Year	Active	#	%	#	%
1990	170	0	0.00	2	1.18
1991	183	0	0.00	2	1.09
1992	187	0	0.00	2	1.07
1993	186	0	0.00	2	1.08
1994	198	0	0.00	2	1.01
1995	216	0	0.00	6	2.78
1996	222	0	0.00	6	2.70
1997	228	0	0.00	13	5.70
1998	239	0	0.00	11	4.60
1999	259	0	0.00	7	2.70
2000	297	0	0.00	16	5.39
2001	299	0	0.00	18	6.02
2002	296	1	0.34	12	4.05
2003	293	6	2.05	24	8.19
2004	271	2	0.74	10	3.69
2005	278	0	0.00	11	3.96
2006	292	0	0.00	15	5.14
2007	309	0	0.00	13	4.21
2008	304	1	0.33	15	4.93
2009	300	3	1.00	16	5.33
2010	290	0	0.00	11	3.79
2011	295	0	0.00	11	3.73
2012	295	3	1.02	15	5.08
2013	299	2	0.67	16	5.35
2014	309	1	0.32	13	4.21
2015	328	1	0.30	18	5.49
2016	331	1	0.30	17	5.14
2017	361	2	0.55	15	4.16

Economy: Jamaica					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	32	0	0.00	0	0.00
1994	35	0	0.00	0	0.00
1995	36	0	0.00	0	0.00
1996	36	0	0.00	1	2.78
1997	35	0	0.00	5	14.29
1998	30	0	0.00	0	0.00
1999	31	0	0.00	0	0.00
2000	33	0	0.00	0	0.00
2001	33	0	0.00	1	3.03
2002	32	0	0.00	0	0.00
2003	33	0	0.00	0	0.00
2004	33	0	0.00	0	0.00
2005	34	0	0.00	0	0.00
2006	36	0	0.00	1	2.78
2007	36	0	0.00	2	5.56
2008	38	0	0.00	2	5.26
2009	37	0	0.00	0	0.00
2010	45	0	0.00	0	0.00
2011	49	0	0.00	4	8.16
2012	46	0	0.00	4	8.70
2013	49	0	0.00	2	4.08
2014	50	0	0.00	1	2.00
2015	54	0	0.00	1	1.85
2016	62	0	0.00	2	3.23
2017	68	0	0.00	2	2.94

Economy: Japan					
		Defaults		Others	
Year	Active	#	%	#	%
1990	2405	0	0.00	5	0.21
1991	2529	0	0.00	2	0.08
1992	2557	3	0.12	3	0.12
1993	2646	4	0.15	6	0.23
1994	2786	0	0.00	5	0.18
1995	2971	2	0.07	5	0.17
1996	3133	5	0.16	7	0.22
1997	3267	7	0.21	16	0.49
1998	3338	16	0.48	21	0.63
1999	3411	8	0.23	40	1.17
2000	3581	12	0.34	54	1.51
2001	3709	16	0.43	59	1.59
2002	3808	30	0.79	96	2.52
2003	3846	19	0.49	96	2.50
2004	3939	13	0.33	87	2.21
2005	4029	9	0.22	88	2.18
2006	4149	2	0.05	83	2.00
2007	4208	6	0.14	99	2.35
2008	4201	36	0.86	108	2.57
2009	4118	28	0.68	135	3.28
2010	4017	9	0.22	129	3.21
2011	3932	4	0.10	100	2.54
2012	3896	6	0.15	98	2.52
2013	3868	3	0.08	74	1.91
2014	3882	0	0.00	44	1.13
2015	3951	4	0.10	68	1.72
2016	3980	0	0.00	70	1.76
2017	4018	1	0.02	38	0.95

Economy: Jordan					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	71	0	0.00	1	1.41
1997	105	0	0.00	0	0.00
1998	119	0	0.00	1	0.84
1999	122	0	0.00	0	0.00
2000	128	0	0.00	2	1.56
2001	133	0	0.00	7	5.26
2002	130	0	0.00	4	3.08
2003	139	0	0.00	3	2.16
2004	148	0	0.00	2	1.35
2005	164	0	0.00	2	1.22
2006	195	0	0.00	4	2.05
2007	210	0	0.00	3	1.43
2008	228	0	0.00	3	1.32
2009	233	0	0.00	8	3.43
2010	231	0	0.00	6	2.60
2011	230	0	0.00	4	1.74
2012	228	0	0.00	7	3.07
2013	222	0	0.00	2	0.90
2014	224	0	0.00	11	4.91
2015	215	0	0.00	6	2.79
2016	210	0	0.00	2	0.95
2017	208	0	0.00	4	1.92

Economy: Kazakhstan

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	1	0	0.00	0	0.00
2002	7	0	0.00	0	0.00
2003	7	0	0.00	0	0.00
2004	8	0	0.00	2	25.00
2005	6	0	0.00	0	0.00
2006	6	0	0.00	4	66.67
2007	24	0	0.00	0	0.00
2008	26	0	0.00	0	0.00
2009	28	4	14.29	5	17.86
2010	22	1	4.55	4	18.18
2011	18	0	0.00	1	5.56
2012	22	2	9.09	0	0.00
2013	20	0	0.00	3	15.00
2014	18	0	0.00	5	27.78
2015	16	0	0.00	1	6.25
2016	20	0	0.00	0	0.00
2017	32	0	0.00	0	0.00

Economy: Kenya

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	44	0	0.00	0	0.00
1998	44	0	0.00	0	0.00
1999	44	0	0.00	0	0.00
2000	44	0	0.00	2	4.55
2001	46	0	0.00	1	2.17
2002	45	0	0.00	0	0.00
2003	47	0	0.00	1	2.13
2004	46	0	0.00	1	2.17
2005	46	0	0.00	2	4.35
2006	48	0	0.00	0	0.00
2007	51	0	0.00	0	0.00
2008	53	0	0.00	0	0.00
2009	54	0	0.00	3	5.56
2010	51	0	0.00	0	0.00
2011	55	0	0.00	1	1.82
2012	56	0	0.00	0	0.00
2013	58	0	0.00	3	5.17
2014	60	1	1.67	0	0.00
2015	60	0	0.00	0	0.00
2016	64	2	3.13	0	0.00
2017	64	2	3.13	1	1.56

Economy: Kuwait

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	51	0	0.00	0	0.00
1997	65	0	0.00	0	0.00
1998	67	0	0.00	0	0.00
1999	75	0	0.00	4	5.33
2000	72	0	0.00	2	2.78
2001	72	0	0.00	0	0.00
2002	80	0	0.00	2	2.50
2003	92	0	0.00	0	0.00
2004	103	0	0.00	0	0.00
2005	140	0	0.00	1	0.71
2006	158	0	0.00	0	0.00
2007	178	0	0.00	2	1.12
2008	187	0	0.00	5	2.67
2009	196	1	0.51	6	3.06
2010	200	0	0.00	8	4.00
2011	196	0	0.00	8	4.08
2012	199	0	0.00	6	3.02
2013	194	0	0.00	5	2.58
2014	195	0	0.00	6	3.08
2015	193	0	0.00	7	3.63
2016	194	0	0.00	17	8.76
2017	179	0	0.00	12	6.70

Economy: Latvia

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	18	0	0.00	0	0.00
2001	34	0	0.00	3	8.82
2002	33	0	0.00	1	3.03
2003	32	0	0.00	7	21.88
2004	30	0	0.00	0	0.00
2005	33	0	0.00	0	0.00
2006	34	0	0.00	2	5.88
2007	36	0	0.00	0	0.00
2008	36	0	0.00	1	2.78
2009	35	0	0.00	2	5.71
2010	33	0	0.00	0	0.00
2011	33	0	0.00	1	3.03
2012	33	0	0.00	1	3.03
2013	33	1	3.03	1	3.03
2014	31	0	0.00	1	3.23
2015	32	1	3.13	3	9.38
2016	29	0	0.00	1	3.45
2017	29	0	0.00	2	6.90

Economy: Lithuania

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	35	0	0.00	1	2.86
2001	36	0	0.00	0	0.00
2002	42	0	0.00	1	2.38
2003	44	0	0.00	4	9.09
2004	42	0	0.00	0	0.00
2005	42	0	0.00	0	0.00
2006	43	0	0.00	2	4.65
2007	42	0	0.00	3	7.14
2008	40	0	0.00	0	0.00
2009	40	0	0.00	2	5.00
2010	41	0	0.00	2	4.88
2011	40	1	2.50	5	12.50
2012	34	0	0.00	0	0.00
2013	35	1	2.86	1	2.86
2014	37	1	2.70	2	5.41
2015	36	0	0.00	5	13.89
2016	32	0	0.00	2	6.25
2017	31	0	0.00	0	0.00

Economy: Luxembourg

		Defaults		Others	
Year	Active	#	%	#	%
1990	1	0	0.00	0	0.00
1991	1	0	0.00	0	0.00
1992	1	0	0.00	0	0.00
1993	1	0	0.00	0	0.00
1994	1	0	0.00	0	0.00
1995	23	0	0.00	0	0.00
1996	24	0	0.00	0	0.00
1997	29	0	0.00	2	6.90
1998	29	0	0.00	1	3.45
1999	31	0	0.00	4	12.90
2000	31	0	0.00	3	9.68
2001	28	0	0.00	1	3.57
2002	27	0	0.00	2	7.41
2003	26	0	0.00	0	0.00
2004	26	0	0.00	0	0.00
2005	27	0	0.00	1	3.70
2006	27	0	0.00	3	11.11
2007	25	0	0.00	3	12.00
2008	23	0	0.00	2	8.70
2009	21	0	0.00	3	14.29
2010	19	0	0.00	1	5.26
2011	19	0	0.00	2	10.53
2012	18	0	0.00	2	11.11
2013	16	0	0.00	1	6.25
2014	18	0	0.00	2	11.11
2015	18	0	0.00	2	11.11
2016	18	0	0.00	1	5.56
2017	20	0	0.00	1	5.00

Economy: Macedonia

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	0	0	NaN	0	NaN
2003	0	0	NaN	0	NaN
2004	11	0	0.00	0	0.00
2005	68	0	0.00	0	0.00
2006	88	0	0.00	0	0.00
2007	101	0	0.00	7	6.93
2008	98	0	0.00	7	7.14
2009	91	1	1.10	6	6.59
2010	85	0	0.00	14	16.47
2011	71	0	0.00	4	5.63
2012	71	0	0.00	10	14.08
2013	64	0	0.00	6	9.38
2014	65	0	0.00	4	6.15
2015	71	0	0.00	3	4.23
2016	79	2	2.53	3	3.80
2017	113	0	0.00	0	0.00

Economy: Malawi

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	2	0	0.00	0	0.00
1999	2	0	0.00	0	0.00
2000	3	0	0.00	0	0.00
2001	4	0	0.00	0	0.00
2002	4	0	0.00	0	0.00
2003	5	0	0.00	0	0.00
2004	5	0	0.00	0	0.00
2005	5	0	0.00	0	0.00
2006	5	0	0.00	5	100.00
2007	0	0	NaN	0	NaN
2008	0	0	NaN	0	NaN
2009	11	0	0.00	0	0.00
2010	11	0	0.00	0	0.00
2011	11	0	0.00	0	0.00
2012	13	0	0.00	0	0.00
2013	13	0	0.00	0	0.00
2014	13	0	0.00	0	0.00
2015	13	0	0.00	0	0.00
2016	13	0	0.00	1	7.69
2017	12	0	0.00	1	8.33

Economy: Malaysia					
		Defaults		Others	
Year	Active	#	%	#	%
1990	271	0	0.00	0	0.00
1991	314	0	0.00	0	0.00
1992	361	0	0.00	1	0.28
1993	405	0	0.00	0	0.00
1994	472	0	0.00	0	0.00
1995	524	0	0.00	0	0.00
1996	615	0	0.00	0	0.00
1997	703	0	0.00	1	0.14
1998	738	14	1.90	19	2.57
1999	739	8	1.08	11	1.49
2000	775	13	1.68	8	1.03
2001	791	15	1.90	15	1.90
2002	828	13	1.57	24	2.90
2003	881	7	0.79	15	1.70
2004	951	6	0.63	8	0.84
2005	1027	5	0.49	26	2.53
2006	1053	14	1.33	26	2.47
2007	1055	13	1.23	60	5.69
2008	1027	23	2.24	40	3.89
2009	996	19	1.91	30	3.01
2010	999	22	2.20	28	2.80
2011	990	11	1.11	33	3.33
2012	976	9	0.92	35	3.59
2013	953	5	0.52	27	2.83
2014	939	2	0.21	16	1.70
2015	935	1	0.11	14	1.50
2016	937	1	0.11	23	2.45
2017	937	1	0.11	14	1.49

Economy: Malta					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	5	0	0.00	0	0.00
1997	6	0	0.00	0	0.00
1998	7	0	0.00	0	0.00
1999	7	0	0.00	0	0.00
2000	9	0	0.00	0	0.00
2001	11	0	0.00	0	0.00
2002	12	0	0.00	1	8.33
2003	11	0	0.00	0	0.00
2004	11	0	0.00	0	0.00
2005	11	0	0.00	0	0.00
2006	12	0	0.00	0	0.00
2007	13	0	0.00	0	0.00
2008	16	0	0.00	2	12.50
2009	14	0	0.00	2	14.29
2010	12	0	0.00	0	0.00
2011	15	0	0.00	0	0.00
2012	20	0	0.00	0	0.00
2013	21	0	0.00	0	0.00
2014	21	0	0.00	0	0.00
2015	22	0	0.00	2	9.09
2016	22	0	0.00	1	4.55
2017	22	0	0.00	0	0.00

Economy: Mauritius					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	26	0	0.00	0	0.00
1996	29	0	0.00	0	0.00
1997	29	0	0.00	0	0.00
1998	29	0	0.00	0	0.00
1999	29	0	0.00	0	0.00
2000	29	0	0.00	0	0.00
2001	29	0	0.00	0	0.00
2002	30	0	0.00	0	0.00
2003	30	0	0.00	0	0.00
2004	30	0	0.00	0	0.00
2005	31	0	0.00	0	0.00
2006	32	0	0.00	0	0.00
2007	32	0	0.00	0	0.00
2008	33	0	0.00	0	0.00
2009	33	0	0.00	0	0.00
2010	33	0	0.00	0	0.00
2011	34	0	0.00	0	0.00
2012	38	0	0.00	0	0.00
2013	39	0	0.00	0	0.00
2014	42	0	0.00	0	0.00
2015	42	0	0.00	1	2.38
2016	44	0	0.00	0	0.00
2017	48	0	0.00	2	4.17

Economy: Mexico					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	96	0	0.00	3	3.13
1995	100	0	0.00	1	1.00
1996	115	0	0.00	3	2.61
1997	132	1	0.76	8	6.06
1998	126	0	0.00	15	11.90
1999	119	1	0.84	11	9.24
2000	113	1	0.88	6	5.31
2001	110	1	0.91	4	3.64
2002	110	1	0.91	8	7.27
2003	108	2	1.85	4	3.70
2004	109	0	0.00	4	3.67
2005	114	0	0.00	6	5.26
2006	113	0	0.00	2	1.77
2007	118	1	0.85	9	7.63
2008	116	2	1.72	8	6.90
2009	111	5	4.50	2	1.80
2010	116	3	2.59	2	1.72
2011	116	0	0.00	8	6.90
2012	116	2	1.72	3	2.59
2013	126	5	3.97	2	1.59
2014	124	3	2.42	2	1.61
2015	131	1	0.76	3	2.29
2016	138	0	0.00	5	3.62
2017	142	2	1.41	1	0.70

Economy: Montenegro

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	0	0	NaN	0	NaN
2003	40	0	0.00	1	2.50
2004	69	0	0.00	3	4.35
2005	101	0	0.00	2	1.98
2006	132	0	0.00	3	2.27
2007	150	0	0.00	5	3.33
2008	147	0	0.00	29	19.73
2009	126	0	0.00	27	21.43
2010	101	0	0.00	3	2.97
2011	99	0	0.00	26	26.26
2012	74	0	0.00	18	24.32
2013	60	0	0.00	13	21.67
2014	49	0	0.00	7	14.29
2015	49	0	0.00	0	0.00
2016	66	0	0.00	6	9.09
2017	96	0	0.00	1	1.04

Economy: Morocco

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	16	0	0.00	0	0.00
1997	43	0	0.00	0	0.00
1998	49	0	0.00	0	0.00
1999	52	0	0.00	1	1.92
2000	53	0	0.00	0	0.00
2001	55	0	0.00	1	1.82
2002	54	0	0.00	0	0.00
2003	54	0	0.00	2	3.70
2004	54	0	0.00	1	1.85
2005	55	0	0.00	2	3.64
2006	63	0	0.00	1	1.59
2007	72	0	0.00	0	0.00
2008	78	0	0.00	1	1.28
2009	77	0	0.00	1	1.30
2010	78	0	0.00	4	5.13
2011	77	0	0.00	1	1.30
2012	77	0	0.00	0	0.00
2013	78	0	0.00	3	3.85
2014	76	0	0.00	2	2.63
2015	77	1	1.30	3	3.90
2016	74	0	0.00	2	2.70
2017	72	0	0.00	0	0.00

Economy: Namibia

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	0	0	NaN	0	NaN
2003	5	0	0.00	0	0.00
2004	5	0	0.00	0	0.00
2005	5	0	0.00	0	0.00
2006	6	0	0.00	1	16.67
2007	5	0	0.00	0	0.00
2008	5	0	0.00	1	20.00
2009	4	0	0.00	0	0.00
2010	5	0	0.00	0	0.00
2011	6	0	0.00	1	16.67
2012	5	0	0.00	0	0.00
2013	8	0	0.00	0	0.00
2014	8	0	0.00	0	0.00
2015	8	0	0.00	0	0.00
2016	8	0	0.00	0	0.00
2017	11	0	0.00	0	0.00

Economy: Netherlands

		Defaults		Others	
Year	Active	#	%	#	%
1990	137	0	0.00	3	2.19
1991	154	0	0.00	1	0.65
1992	157	0	0.00	0	0.00
1993	164	0	0.00	0	0.00
1994	167	0	0.00	1	0.60
1995	177	0	0.00	0	0.00
1996	186	1	0.54	0	0.00
1997	200	0	0.00	11	5.50
1998	209	1	0.48	8	3.83
1999	220	0	0.00	16	7.27
2000	212	0	0.00	18	8.49
2001	202	8	3.96	19	9.41
2002	185	8	4.32	9	4.86
2003	170	5	2.94	12	7.06
2004	155	0	0.00	6	3.87
2005	155	0	0.00	8	5.16
2006	152	1	0.66	7	4.61
2007	149	0	0.00	9	6.04
2008	142	1	0.70	8	5.63
2009	139	4	2.88	2	1.44
2010	134	0	0.00	5	3.73
2011	131	0	0.00	7	5.34
2012	126	0	0.00	5	3.97
2013	123	1	0.81	8	6.50
2014	121	2	1.65	6	4.96
2015	126	2	1.59	7	5.56
2016	124	1	0.81	5	4.03
2017	120	1	0.83	2	1.67

Economy: New Zealand

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	30	0	0.00	0	0.00
1993	33	0	0.00	0	0.00
1994	41	0	0.00	0	0.00
1995	43	0	0.00	1	2.33
1996	47	0	0.00	1	2.13
1997	49	0	0.00	0	0.00
1998	51	0	0.00	0	0.00
1999	56	0	0.00	0	0.00
2000	64	0	0.00	0	0.00
2001	72	0	0.00	0	0.00
2002	77	0	0.00	0	0.00
2003	89	0	0.00	0	0.00
2004	104	0	0.00	0	0.00
2005	108	0	0.00	0	0.00
2006	114	0	0.00	0	0.00
2007	121	0	0.00	0	0.00
2008	122	0	0.00	1	0.82
2009	122	0	0.00	0	0.00
2010	127	0	0.00	3	2.36
2011	129	0	0.00	2	1.55
2012	130	0	0.00	5	3.85
2013	134	2	1.49	7	5.22
2014	142	0	0.00	6	4.23
2015	140	0	0.00	5	3.57
2016	146	2	1.37	7	4.79
2017	140	0	0.00	5	3.57

Economy: Nigeria

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	102	0	0.00	0	0.00
2003	107	0	0.00	5	4.67
2004	130	0	0.00	4	3.08
2005	140	0	0.00	2	1.43
2006	157	0	0.00	3	1.91
2007	170	0	0.00	1	0.59
2008	197	0	0.00	12	6.09
2009	198	0	0.00	9	4.55
2010	193	0	0.00	7	3.63
2011	189	0	0.00	12	6.35
2012	180	0	0.00	2	1.11
2013	186	0	0.00	6	3.23
2014	183	0	0.00	4	2.19
2015	180	0	0.00	1	0.56
2016	183	1	0.55	13	7.10
2017	172	1	0.58	6	3.49

Economy: Norway

		Defaults		Others	
Year	Active	#	%	#	%
1990	38	0	0.00	3	7.89
1991	61	0	0.00	0	0.00
1992	82	0	0.00	0	0.00
1993	98	0	0.00	0	0.00
1994	112	0	0.00	0	0.00
1995	134	0	0.00	0	0.00
1996	157	0	0.00	0	0.00
1997	209	0	0.00	8	3.83
1998	228	0	0.00	11	4.82
1999	226	0	0.00	22	9.73
2000	228	1	0.44	29	12.72
2001	238	3	1.26	18	7.56
2002	224	4	1.79	9	4.02
2003	218	4	1.83	26	11.93
2004	211	0	0.00	13	6.16
2005	253	0	0.00	17	6.72
2006	288	0	0.00	30	10.42
2007	297	0	0.00	33	11.11
2008	277	2	0.72	27	9.75
2009	251	5	1.99	21	8.37
2010	242	1	0.41	18	7.44
2011	238	2	0.84	11	4.62
2012	230	1	0.43	13	5.65
2013	227	3	1.32	22	9.69
2014	220	0	0.00	14	6.36
2015	221	4	1.81	14	6.33
2016	223	6	2.69	5	2.24
2017	238	7	2.94	12	5.04

Economy: Oman

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	52	0	0.00	0	0.00
1997	71	0	0.00	0	0.00
1998	84	0	0.00	5	5.95
1999	80	0	0.00	6	7.50
2000	77	0	0.00	2	2.60
2001	76	0	0.00	13	17.11
2002	86	0	0.00	0	0.00
2003	95	0	0.00	2	2.11
2004	99	0	0.00	2	2.02
2005	103	0	0.00	5	4.85
2006	105	0	0.00	2	1.90
2007	105	0	0.00	4	3.81
2008	103	0	0.00	11	10.68
2009	93	0	0.00	1	1.08
2010	94	0	0.00	6	6.38
2011	89	0	0.00	4	4.49
2012	89	0	0.00	3	3.37
2013	92	0	0.00	0	0.00
2014	96	0	0.00	5	5.21
2015	93	0	0.00	6	6.45
2016	92	0	0.00	1	1.09
2017	101	0	0.00	2	1.98

Economy: Pakistan

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	347	0	0.00	0	0.00
1999	420	0	0.00	2	0.48
2000	446	0	0.00	0	0.00
2001	462	1	0.22	7	1.52
2002	492	1	0.20	3	0.61
2003	508	0	0.00	0	0.00
2004	523	0	0.00	2	0.38
2005	538	0	0.00	7	1.30
2006	543	0	0.00	10	1.84
2007	557	0	0.00	6	1.08
2008	563	0	0.00	9	1.60
2009	573	1	0.17	30	5.24
2010	553	2	0.36	26	4.70
2011	532	1	0.19	48	9.02
2012	493	2	0.41	26	5.27
2013	474	0	0.00	10	2.11
2014	477	3	0.63	10	2.10
2015	475	3	0.63	12	2.53
2016	469	0	0.00	16	3.41
2017	462	1	0.22	4	0.87

Economy: Peru

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	0	0	NaN	0	NaN
1991	1	0	0.00	0	0.00
1992	1	0	0.00	0	0.00
1993	1	0	0.00	0	0.00
1994	59	0	0.00	0	0.00
1995	90	0	0.00	0	0.00
1996	102	0	0.00	2	1.96
1997	126	0	0.00	8	6.35
1998	127	0	0.00	17	13.39
1999	117	0	0.00	19	16.24
2000	106	2	1.89	18	16.98
2001	92	0	0.00	10	10.87
2002	91	2	2.20	8	8.79
2003	88	2	2.27	9	10.23
2004	88	1	1.14	5	5.68
2005	89	0	0.00	3	3.37
2006	94	0	0.00	4	4.26
2007	99	1	1.01	1	1.01
2008	98	0	0.00	4	4.08
2009	97	0	0.00	3	3.09
2010	96	0	0.00	4	4.17
2011	93	0	0.00	5	5.38
2012	91	0	0.00	7	7.69
2013	87	1	1.15	6	6.90
2014	82	0	0.00	3	3.66
2015	83	0	0.00	5	6.02
2016	87	0	0.00	3	3.45
2017	109	1	0.92	3	2.75

Economy: Philippines					
		Defaults		Others	
Year	Active	#	%	#	%
1990	66	0	0.00	0	0.00
1991	71	0	0.00	0	0.00
1992	94	0	0.00	1	1.06
1993	115	1	0.87	0	0.00
1994	139	0	0.00	4	2.88
1995	161	0	0.00	1	0.62
1996	183	0	0.00	0	0.00
1997	194	0	0.00	2	1.03
1998	197	1	0.51	5	2.54
1999	200	4	2.00	3	1.50
2000	200	2	1.00	6	3.00
2001	199	3	1.51	5	2.51
2002	204	6	2.94	9	4.41
2003	202	5	2.48	2	0.99
2004	206	6	2.91	5	2.43
2005	204	3	1.47	3	1.47
2006	208	2	0.96	4	1.92
2007	221	1	0.45	8	3.62
2008	219	3	1.37	0	0.00
2009	225	3	1.33	1	0.44
2010	229	0	0.00	1	0.44
2011	240	0	0.00	1	0.42
2012	247	1	0.40	9	3.64
2013	247	0	0.00	3	1.21
2014	253	0	0.00	2	0.79
2015	256	0	0.00	13	5.08
2016	247	0	0.00	2	0.81
2017	251	1	0.40	1	0.40

Economy: Poland					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	31	0	0.00	0	0.00
1995	58	0	0.00	0	0.00
1996	76	0	0.00	0	0.00
1997	138	0	0.00	1	0.72
1998	193	0	0.00	3	1.55
1999	214	0	0.00	3	1.40
2000	224	1	0.45	6	2.68
2001	226	1	0.44	5	2.21
2002	226	1	0.44	20	8.85
2003	210	3	1.43	14	6.67
2004	222	0	0.00	8	3.60
2005	244	1	0.41	9	3.69
2006	263	0	0.00	9	3.42
2007	339	0	0.00	9	2.65
2008	433	0	0.00	2	0.46
2009	467	1	0.21	9	1.93
2010	559	0	0.00	9	1.61
2011	748	0	0.00	13	1.74
2012	855	9	1.05	18	2.11
2013	883	6	0.68	32	3.62
2014	887	6	0.68	28	3.16
2015	902	12	1.33	38	4.21
2016	885	7	0.79	43	4.86
2017	871	6	0.69	19	2.18

Economy: Portugal

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	1	0	0.00	0	0.00
1992	1	0	0.00	0	0.00
1993	78	0	0.00	1	1.28
1994	89	0	0.00	3	3.37
1995	97	0	0.00	1	1.03
1996	98	0	0.00	1	1.02
1997	105	0	0.00	7	6.67
1998	104	0	0.00	11	10.58
1999	105	0	0.00	14	13.33
2000	98	0	0.00	13	13.27
2001	86	0	0.00	11	12.79
2002	75	0	0.00	7	9.33
2003	70	0	0.00	3	4.29
2004	72	0	0.00	2	2.78
2005	72	0	0.00	3	4.17
2006	71	0	0.00	4	5.63
2007	70	0	0.00	6	8.57
2008	67	0	0.00	2	2.99
2009	65	0	0.00	3	4.62
2010	63	0	0.00	2	3.17
2011	61	0	0.00	3	4.92
2012	60	0	0.00	3	5.00
2013	60	1	1.67	1	1.67
2014	59	1	1.69	1	1.69
2015	59	2	3.39	1	1.69
2016	58	0	0.00	0	0.00
2017	60	0	0.00	3	5.00

Economy: Romania

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	50	0	0.00	0	0.00
1998	75	0	0.00	0	0.00
1999	140	0	0.00	1	0.71
2000	153	0	0.00	15	9.80
2001	148	0	0.00	26	17.57
2002	124	0	0.00	4	3.23
2003	121	0	0.00	12	9.92
2004	120	0	0.00	7	5.83
2005	150	1	0.67	12	8.00
2006	164	0	0.00	21	12.80
2007	158	0	0.00	9	5.70
2008	156	0	0.00	17	10.90
2009	140	0	0.00	21	15.00
2010	121	0	0.00	5	4.13
2011	122	0	0.00	7	5.74
2012	123	0	0.00	6	4.88
2013	121	2	1.65	7	5.79
2014	117	1	0.85	4	3.42
2015	273	2	0.73	27	9.89
2016	271	0	0.00	3	1.11
2017	308	1	0.32	6	1.95

Economy: Russian Federation					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	58	0	0.00	0	0.00
1998	62	2	3.23	4	6.45
1999	64	0	0.00	10	15.63
2000	68	0	0.00	5	7.35
2001	76	0	0.00	4	5.26
2002	92	0	0.00	26	28.26
2003	94	0	0.00	2	2.13
2004	131	2	1.53	3	2.29
2005	175	0	0.00	6	3.43
2006	249	2	0.80	20	8.03
2007	287	0	0.00	14	4.88
2008	327	1	0.31	26	7.95
2009	327	7	2.14	15	4.59
2010	329	1	0.30	13	3.95
2011	331	0	0.00	41	12.39
2012	298	2	0.67	60	20.13
2013	254	0	0.00	52	20.47
2014	205	2	0.98	33	16.10
2015	237	2	0.84	21	8.86
2016	223	2	0.90	13	5.83
2017	223	5	2.24	10	4.48

Economy: Rwanda					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	0	0	NaN	0	NaN
2003	0	0	NaN	0	NaN
2004	0	0	NaN	0	NaN
2005	0	0	NaN	0	NaN
2006	0	0	NaN	0	NaN
2007	0	0	NaN	0	NaN
2008	0	0	NaN	0	NaN
2009	0	0	NaN	0	NaN
2010	0	0	NaN	0	NaN
2011	0	0	NaN	0	NaN
2012	0	0	NaN	0	NaN
2013	2	0	0.00	0	0.00
2014	2	0	0.00	0	0.00
2015	3	0	0.00	0	0.00
2016	3	0	0.00	0	0.00
2017	3	0	0.00	0	0.00

Economy: Saudi Arabia

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	62	0	0.00	0	0.00
2001	65	0	0.00	0	0.00
2002	68	0	0.00	1	1.47
2003	69	0	0.00	0	0.00
2004	72	0	0.00	0	0.00
2005	76	0	0.00	0	0.00
2006	86	0	0.00	0	0.00
2007	111	0	0.00	2	1.80
2008	126	0	0.00	0	0.00
2009	135	0	0.00	1	0.74
2010	145	0	0.00	0	0.00
2011	149	0	0.00	0	0.00
2012	157	0	0.00	1	0.64
2013	162	1	0.62	0	0.00
2014	167	0	0.00	4	2.40
2015	167	1	0.60	0	0.00
2016	172	1	0.58	0	0.00
2017	189	1	0.53	0	0.00

Economy: Serbia

Year	Active	Defaults #	Defaults %	Others #	Others %
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	0	0	NaN	0	NaN
2003	0	0	NaN	0	NaN
2004	1	0	0.00	0	0.00
2005	183	0	0.00	0	0.00
2006	317	0	0.00	11	3.47
2007	449	0	0.00	29	6.46
2008	467	0	0.00	104	22.27
2009	386	0	0.00	101	26.17
2010	305	0	0.00	62	20.33
2011	273	0	0.00	68	24.91
2012	226	0	0.00	46	20.35
2013	201	0	0.00	36	17.91
2014	176	1	0.57	35	19.89
2015	153	0	0.00	29	18.95
2016	147	0	0.00	29	19.73
2017	164	0	0.00	5	3.05

Economy: Singapore

		Defaults		Others	
Year	Active	#	%	#	%
1990	162	0	0.00	8	4.94
1991	168	0	0.00	3	1.79
1992	181	0	0.00	4	2.21
1993	201	0	0.00	0	0.00
1994	231	0	0.00	0	0.00
1995	252	1	0.40	0	0.00
1996	276	2	0.72	1	0.36
1997	309	1	0.32	6	1.94
1998	329	3	0.91	3	0.91
1999	376	4	1.06	11	2.93
2000	444	0	0.00	10	2.25
2001	471	2	0.42	22	4.67
2002	481	2	0.42	21	4.37
2003	519	1	0.19	11	2.12
2004	589	2	0.34	7	1.19
2005	643	4	0.62	8	1.24
2006	693	1	0.14	19	2.74
2007	729	0	0.00	15	2.06
2008	746	4	0.54	23	3.08
2009	753	13	1.73	16	2.12
2010	760	2	0.26	31	4.08
2011	749	1	0.13	34	4.54
2012	737	0	0.00	28	3.80
2013	736	1	0.14	25	3.40
2014	738	0	0.00	27	3.66
2015	732	6	0.82	26	3.55
2016	722	8	1.11	36	4.99
2017	706	9	1.27	19	2.69

Economy: Slovakia

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	10	0	0.00	0	0.00
1999	12	0	0.00	0	0.00
2000	13	0	0.00	0	0.00
2001	18	0	0.00	1	5.56
2002	27	0	0.00	0	0.00
2003	41	0	0.00	0	0.00
2004	42	0	0.00	0	0.00
2005	44	0	0.00	6	13.64
2006	39	0	0.00	2	5.13
2007	39	0	0.00	6	15.38
2008	38	0	0.00	2	5.26
2009	49	0	0.00	7	14.29
2010	47	0	0.00	1	2.13
2011	51	0	0.00	2	3.92
2012	50	0	0.00	5	10.00
2013	46	0	0.00	3	6.52
2014	43	0	0.00	6	13.95
2015	37	0	0.00	9	24.32
2016	30	0	0.00	4	13.33
2017	33	0	0.00	1	3.03

Economy: Slovenia					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	74	0	0.00	1	1.35
1999	98	0	0.00	3	3.06
2000	118	0	0.00	4	3.39
2001	131	0	0.00	17	12.98
2002	124	0	0.00	19	15.32
2003	116	0	0.00	8	6.90
2004	126	0	0.00	12	9.52
2005	119	0	0.00	26	21.85
2006	95	0	0.00	16	16.84
2007	82	0	0.00	9	10.98
2008	80	0	0.00	2	2.50
2009	79	3	3.80	8	10.13
2010	69	0	0.00	4	5.80
2011	65	1	1.54	6	9.23
2012	59	1	1.69	3	5.08
2013	57	2	3.51	7	12.28
2014	52	2	3.85	4	7.69
2015	46	0	0.00	5	10.87
2016	41	0	0.00	7	17.07
2017	63	0	0.00	2	3.17

Economy: South Africa					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	388	0	0.00	0	0.00
1993	400	0	0.00	0	0.00
1994	429	0	0.00	2	0.47
1995	474	0	0.00	3	0.63
1996	501	0	0.00	7	1.40
1997	548	0	0.00	12	2.19
1998	631	2	0.32	58	9.19
1999	637	3	0.47	53	8.32
2000	591	6	1.02	85	14.38
2001	509	9	1.77	79	15.52
2002	428	7	1.64	65	15.19
2003	363	1	0.28	41	11.29
2004	329	3	0.91	36	10.94
2005	309	2	0.65	21	6.80
2006	319	0	0.00	17	5.33
2007	360	0	0.00	15	4.17
2008	356	0	0.00	18	5.06
2009	344	1	0.29	16	4.65
2010	339	2	0.59	18	5.31
2011	326	1	0.31	17	5.21
2012	318	5	1.57	17	5.35
2013	324	3	0.93	21	6.48
2014	323	0	0.00	19	5.88
2015	324	2	0.62	24	7.41
2016	309	0	0.00	15	4.85
2017	314	0	0.00	16	5.10

Economy: South Korea

		Defaults		Others	
Year	Active	#	%	#	%
1990	617	0	0.00	0	0.00
1991	634	0	0.00	0	0.00
1992	638	1	0.16	0	0.00
1993	645	0	0.00	0	0.00
1994	675	0	0.00	0	0.00
1995	704	1	0.14	0	0.00
1996	760	6	0.79	1	0.13
1997	1112	52	4.68	2	0.18
1998	1125	81	7.20	12	1.07
1999	1161	32	2.76	39	3.36
2000	1294	17	1.31	44	3.40
2001	1430	17	1.19	27	1.89
2002	1574	14	0.89	37	2.35
2003	1612	11	0.68	30	1.86
2004	1646	8	0.49	53	3.22
2005	1694	8	0.47	53	3.13
2006	1720	2	0.12	14	0.81
2007	1793	1	0.06	15	0.84
2008	1846	10	0.54	27	1.46
2009	1895	7	0.37	81	4.27
2010	1924	10	0.52	91	4.73
2011	1912	4	0.21	69	3.61
2012	1881	5	0.27	74	3.93
2013	1903	11	0.58	46	2.42
2014	1959	5	0.26	38	1.94
2015	2084	2	0.10	42	2.02
2016	2175	4	0.18	37	1.70
2017	2266	3	0.13	45	1.99

Economy: Spain

		Defaults		Others	
Year	Active	#	%	#	%
1990	104	0	0.00	0	0.00
1991	156	0	0.00	0	0.00
1992	164	0	0.00	1	0.61
1993	191	0	0.00	5	2.62
1994	257	0	0.00	1	0.39
1995	273	0	0.00	4	1.47
1996	283	0	0.00	5	1.77
1997	290	0	0.00	7	2.41
1998	299	0	0.00	47	15.72
1999	265	0	0.00	33	12.45
2000	245	0	0.00	14	5.71
2001	246	0	0.00	20	8.13
2002	240	2	0.83	18	7.50
2003	226	0	0.00	40	17.70
2004	194	0	0.00	15	7.73
2005	186	0	0.00	8	4.30
2006	194	0	0.00	26	13.40
2007	186	1	0.54	13	6.99
2008	178	2	1.12	8	4.49
2009	173	0	0.00	12	6.94
2010	174	1	0.57	11	6.32
2011	170	0	0.00	12	7.06
2012	165	2	1.21	5	3.03
2013	171	6	3.51	7	4.09
2014	174	0	0.00	9	5.17
2015	195	1	0.51	9	4.62
2016	215	1	0.47	2	0.93
2017	240	2	0.83	6	2.50

Economy: Sri Lanka

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	1	0	0.00	0	0.00
1994	1	0	0.00	0	0.00
1995	132	0	0.00	0	0.00
1996	145	0	0.00	0	0.00
1997	152	0	0.00	0	0.00
1998	164	0	0.00	1	0.61
1999	167	0	0.00	1	0.60
2000	174	0	0.00	1	0.57
2001	178	0	0.00	1	0.56
2002	186	0	0.00	1	0.54
2003	193	0	0.00	3	1.55
2004	197	0	0.00	0	0.00
2005	211	0	0.00	0	0.00
2006	219	0	0.00	0	0.00
2007	220	0	0.00	1	0.45
2008	222	0	0.00	3	1.35
2009	223	0	0.00	0	0.00
2010	234	0	0.00	0	0.00
2011	261	0	0.00	2	0.77
2012	277	0	0.00	1	0.36
2013	277	0	0.00	1	0.36
2014	282	0	0.00	5	1.77
2015	280	1	0.36	3	1.07
2016	282	1	0.35	6	2.13
2017	281	1	0.36	1	0.36

Economy: Sweden

		Defaults		Others	
Year	Active	#	%	#	%
1990	41	0	0.00	0	0.00
1991	62	0	0.00	0	0.00
1992	121	0	0.00	0	0.00
1993	145	0	0.00	1	0.69
1994	173	0	0.00	2	1.16
1995	184	0	0.00	0	0.00
1996	238	0	0.00	0	0.00
1997	307	0	0.00	36	11.73
1998	320	1	0.31	20	6.25
1999	365	1	0.27	26	7.12
2000	402	1	0.25	34	8.46
2001	392	4	1.02	26	6.63
2002	382	6	1.57	21	5.50
2003	365	2	0.55	21	5.75
2004	379	1	0.26	21	5.54
2005	406	2	0.49	13	3.20
2006	457	0	0.00	21	4.60
2007	520	1	0.19	13	2.50
2008	543	2	0.37	29	5.34
2009	530	4	0.75	24	4.53
2010	535	2	0.37	28	5.23
2011	536	3	0.56	32	5.97
2012	524	0	0.00	41	7.82
2013	515	3	0.58	21	4.08
2014	572	3	0.52	26	4.55
2015	639	2	0.31	21	3.29
2016	706	1	0.14	23	3.26
2017	811	3	0.37	18	2.22

Economy: Switzerland

		Defaults		Others	
Year	Active	#	%	#	%
1990	140	0	0.00	0	0.00
1991	158	0	0.00	6	3.80
1992	157	0	0.00	1	0.64
1993	174	0	0.00	0	0.00
1994	184	0	0.00	1	0.54
1995	194	0	0.00	2	1.03
1996	209	0	0.00	1	0.48
1997	221	2	0.90	3	1.36
1998	231	0	0.00	5	2.16
1999	247	0	0.00	8	3.24
2000	262	0	0.00	6	2.29
2001	268	2	0.75	9	3.36
2002	260	1	0.38	9	3.46
2003	253	2	0.79	10	3.95
2004	245	1	0.41	7	2.86
2005	250	1	0.40	6	2.40
2006	260	0	0.00	13	5.00
2007	259	0	0.00	6	2.32
2008	260	0	0.00	8	3.08
2009	260	0	0.00	6	2.31
2010	260	0	0.00	8	3.08
2011	258	2	0.78	10	3.88
2012	251	1	0.40	8	3.19
2013	247	0	0.00	5	2.02
2014	249	1	0.40	7	2.81
2015	245	1	0.41	13	5.31
2016	239	0	0.00	8	3.35
2017	236	0	0.00	10	4.24

Economy: Taiwan

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	193	0	0.00	0	0.00
1992	234	0	0.00	2	0.85
1993	255	0	0.00	0	0.00
1994	287	0	0.00	0	0.00
1995	332	0	0.00	0	0.00
1996	367	0	0.00	0	0.00
1997	395	0	0.00	1	0.25
1998	428	3	0.70	3	0.70
1999	465	7	1.51	6	1.29
2000	540	7	1.30	9	1.67
2001	603	8	1.33	12	1.99
2002	675	7	1.04	28	4.15
2003	687	1	0.15	10	1.46
2004	755	5	0.66	8	1.06
2005	766	3	0.39	21	2.74
2006	763	2	0.26	14	1.83
2007	787	2	0.25	18	2.29
2008	798	3	0.38	10	1.25
2009	810	1	0.12	4	0.49
2010	837	1	0.12	9	1.08
2011	853	0	0.00	6	0.70
2012	871	0	0.00	4	0.46
2013	883	0	0.00	4	0.45
2014	899	2	0.22	6	0.67
2015	909	0	0.00	3	0.33
2016	927	1	0.11	7	0.76
2017	923	0	0.00	5	0.54

Economy: Tanzania					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	0	0	NaN	0	NaN
2003	0	0	NaN	0	NaN
2004	0	0	NaN	0	NaN
2005	0	0	NaN	0	NaN
2006	0	0	NaN	0	NaN
2007	0	0	NaN	0	NaN
2008	0	0	NaN	0	NaN
2009	9	0	0.00	0	0.00
2010	9	0	0.00	0	0.00
2011	9	0	0.00	0	0.00
2012	10	0	0.00	0	0.00
2013	10	0	0.00	0	0.00
2014	12	0	0.00	0	0.00
2015	12	0	0.00	0	0.00
2016	15	0	0.00	1	6.67
2017	18	0	0.00	0	0.00

Economy: Thailand					
		Defaults		Others	
Year	Active	#	%	#	%
1990	147	0	0.00	0	0.00
1991	190	0	0.00	1	0.53
1992	279	0	0.00	0	0.00
1993	330	0	0.00	0	0.00
1994	377	0	0.00	0	0.00
1995	408	1	0.25	4	0.98
1996	445	6	1.35	1	0.22
1997	449	21	4.68	29	6.46
1998	407	12	2.95	31	7.62
1999	379	15	3.96	19	5.01
2000	371	20	5.39	9	2.43
2001	362	8	2.21	8	2.21
2002	379	4	1.06	9	2.37
2003	404	4	0.99	6	1.49
2004	446	0	0.00	10	2.24
2005	494	3	0.61	16	3.24
2006	500	0	0.00	5	1.00
2007	510	2	0.39	11	2.16
2008	513	2	0.39	11	2.14
2009	527	10	1.90	8	1.52
2010	525	4	0.76	10	1.90
2011	528	2	0.38	11	2.08
2012	535	1	0.19	6	1.12
2013	560	1	0.18	4	0.71
2014	594	0	0.00	5	0.84
2015	633	1	0.16	10	1.58
2016	652	2	0.31	8	1.23
2017	738	4	0.54	10	1.36

Economy: Tunisia					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	33	0	0.00	0	0.00
2000	37	0	0.00	0	0.00
2001	41	0	0.00	0	0.00
2002	43	0	0.00	0	0.00
2003	43	0	0.00	0	0.00
2004	43	0	0.00	1	2.33
2005	45	0	0.00	0	0.00
2006	48	0	0.00	0	0.00
2007	51	0	0.00	0	0.00
2008	53	0	0.00	4	7.55
2009	51	0	0.00	0	0.00
2010	55	0	0.00	1	1.82
2011	55	0	0.00	0	0.00
2012	56	0	0.00	0	0.00
2013	65	0	0.00	0	0.00
2014	75	0	0.00	1	1.33
2015	77	0	0.00	0	0.00
2016	78	0	0.00	0	0.00
2017	80	0	0.00	0	0.00

Economy: Turkey					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	9	0	0.00	0	0.00
1993	15	0	0.00	0	0.00
1994	34	0	0.00	0	0.00
1995	201	0	0.00	0	0.00
1996	223	1	0.45	2	0.90
1997	257	0	0.00	1	0.39
1998	277	0	0.00	2	0.72
1999	284	0	0.00	9	3.17
2000	313	0	0.00	17	5.43
2001	298	0	0.00	13	4.36
2002	293	0	0.00	7	2.39
2003	290	0	0.00	6	2.07
2004	296	0	0.00	0	0.00
2005	305	0	0.00	2	0.66
2006	320	0	0.00	6	1.88
2007	323	0	0.00	5	1.55
2008	320	0	0.00	4	1.25
2009	319	0	0.00	4	1.25
2010	337	0	0.00	0	0.00
2011	364	0	0.00	2	0.55
2012	401	0	0.00	5	1.25
2013	422	0	0.00	6	1.42
2014	431	0	0.00	13	3.02
2015	426	0	0.00	13	3.05
2016	418	0	0.00	14	3.35
2017	408	0	0.00	9	2.21

Economy: Uganda

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	0	0	NaN	0	NaN
2003	0	0	NaN	0	NaN
2004	0	0	NaN	0	NaN
2005	0	0	NaN	0	NaN
2006	0	0	NaN	0	NaN
2007	0	0	NaN	0	NaN
2008	0	0	NaN	0	NaN
2009	6	0	0.00	0	0.00
2010	7	0	0.00	0	0.00
2011	7	0	0.00	0	0.00
2012	8	0	0.00	0	0.00
2013	8	0	0.00	0	0.00
2014	9	1	11.11	0	0.00
2015	8	0	0.00	0	0.00
2016	8	0	0.00	0	0.00
2017	8	0	0.00	0	0.00

Economy: Ukraine

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	30	0	0.00	1	3.33
1999	38	0	0.00	0	0.00
2000	39	0	0.00	5	12.82
2001	34	0	0.00	12	35.29
2002	27	0	0.00	5	18.52
2003	29	0	0.00	7	24.14
2004	44	0	0.00	0	0.00
2005	75	0	0.00	1	1.33
2006	118	0	0.00	2	1.69
2007	133	0	0.00	2	1.50
2008	138	0	0.00	9	6.52
2009	135	1	0.74	39	28.89
2010	98	0	0.00	44	44.90
2011	67	0	0.00	13	19.40
2012	65	0	0.00	8	12.31
2013	77	0	0.00	11	14.29
2014	69	0	0.00	14	20.29
2015	57	0	0.00	27	47.37
2016	31	0	0.00	18	58.06
2017	19	0	0.00	2	10.53

Economy: United Arab Emirates					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	0	0	NaN	0	NaN
2001	0	0	NaN	0	NaN
2002	0	0	NaN	0	NaN
2003	0	0	NaN	0	NaN
2004	0	0	NaN	0	NaN
2005	0	0	NaN	0	NaN
2006	76	0	0.00	0	0.00
2007	87	0	0.00	2	2.30
2008	92	0	0.00	5	5.43
2009	89	0	0.00	1	1.12
2010	92	0	0.00	2	2.17
2011	94	0	0.00	2	2.13
2012	95	1	1.05	2	2.11
2013	95	0	0.00	2	2.11
2014	104	0	0.00	1	0.96
2015	106	0	0.00	5	4.72
2016	106	0	0.00	1	0.94
2017	118	2	1.69	3	2.54

Economy: UK					
		Defaults		Others	
Year	Active	#	%	#	%
1990	260	0	0.00	2	0.77
1991	1056	1	0.09	5	0.47
1992	1112	0	0.00	6	0.54
1993	1201	0	0.00	5	0.42
1994	1308	0	0.00	2	0.15
1995	1460	0	0.00	2	0.14
1996	1656	0	0.00	10	0.60
1997	1799	0	0.00	36	2.00
1998	1859	0	0.00	147	7.91
1999	1809	3	0.17	200	11.06
2000	1882	2	0.11	171	9.09
2001	1839	12	0.65	114	6.20
2002	1800	14	0.78	109	6.06
2003	1762	5	0.28	126	7.15
2004	1915	2	0.10	96	5.01
2005	2185	2	0.09	120	5.49
2006	2362	0	0.00	175	7.41
2007	2428	3	0.12	169	6.96
2008	2332	24	1.03	231	9.91
2009	2106	32	1.52	216	10.26
2010	1942	4	0.21	172	8.86
2011	1833	9	0.49	131	7.15
2012	1755	18	1.03	128	7.29
2013	1699	10	0.59	107	6.30
2014	1714	7	0.41	97	5.66
2015	1741	6	0.34	128	7.35
2016	1699	3	0.18	133	7.83
2017	1688	3	0.18	72	4.27

Economy: US					
		Defaults		Others	
Year	Active	#	%	#	%
1990	3829	5	0.13	83	2.17
1991	4130	18	0.44	102	2.47
1992	5394	18	0.33	88	1.63
1993	6158	25	0.41	143	2.32
1994	6903	17	0.25	222	3.22
1995	7386	17	0.23	361	4.89
1996	7935	16	0.20	401	5.05
1997	8306	51	0.61	558	6.72
1998	8282	80	0.97	879	10.61
1999	7992	77	0.96	918	11.49
2000	7628	117	1.53	778	10.20
2001	6966	167	2.40	756	10.85
2002	6256	114	1.82	532	8.50
2003	5836	82	1.41	472	8.09
2004	5668	31	0.55	370	6.53
2005	5653	38	0.67	384	6.79
2006	5589	16	0.29	380	6.80
2007	5612	28	0.50	462	8.23
2008	5285	65	1.23	382	7.23
2009	5000	93	1.86	320	6.40
2010	4860	29	0.60	313	6.44
2011	4713	35	0.74	303	6.43
2012	4601	38	0.83	263	5.72
2013	4627	25	0.54	238	5.14
2014	4779	27	0.56	212	4.44
2015	4868	42	0.86	274	5.63
2016	4808	63	1.31	359	7.47
2017	4707	41	0.87	300	6.37

Economy: Venezuela					
		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	7	0	0.00	0	0.00
1994	12	0	0.00	0	0.00
1995	16	0	0.00	1	6.25
1996	15	0	0.00	0	0.00
1997	49	0	0.00	2	4.08
1998	47	0	0.00	4	8.51
1999	46	0	0.00	9	19.57
2000	38	0	0.00	4	10.53
2001	37	1	2.70	4	10.81
2002	34	0	0.00	5	14.71
2003	32	0	0.00	3	9.38
2004	32	0	0.00	2	6.25
2005	31	0	0.00	0	0.00
2006	32	0	0.00	3	9.38
2007	29	0	0.00	0	0.00
2008	32	0	0.00	1	3.13
2009	31	0	0.00	1	3.23
2010	30	0	0.00	2	6.67
2011	28	0	0.00	7	25.00
2012	22	0	0.00	4	18.18
2013	18	0	0.00	1	5.56
2014	20	0	0.00	0	0.00
2015	22	0	0.00	0	0.00
2016	22	0	0.00	0	0.00
2017	25	0	0.00	0	0.00

Economy: Vietnam

		Defaults		Others	
Year	Active	#	%	#	%
1990	0	0	NaN	0	NaN
1991	0	0	NaN	0	NaN
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	0	0	NaN	0	NaN
1996	0	0	NaN	0	NaN
1997	0	0	NaN	0	NaN
1998	0	0	NaN	0	NaN
1999	0	0	NaN	0	NaN
2000	5	0	0.00	0	0.00
2001	10	0	0.00	0	0.00
2002	18	0	0.00	0	0.00
2003	20	0	0.00	0	0.00
2004	23	0	0.00	0	0.00
2005	29	0	0.00	0	0.00
2006	84	0	0.00	0	0.00
2007	201	0	0.00	2	1.00
2008	264	0	0.00	2	0.76
2009	387	0	0.00	24	6.20
2010	579	0	0.00	9	1.55
2011	627	1	0.16	12	1.91
2012	637	0	0.00	10	1.57
2013	641	0	0.00	23	3.59
2014	643	0	0.00	16	2.49
2015	676	0	0.00	13	1.92
2016	695	1	0.14	5	0.72
2017	736	0	0.00	4	0.54

B APPENDIX: PERFORMANCE ANALYSIS

Table B.1: Accuracy ratios (AR) and Area Under Receiver Operating Characteristic (AUROC) for four calibration groups and different economies.

	AR				AUROC			
Economy	1mth	1yr	2yr	5yr	1mth	1yr	2yr	5yr
Argentina	0.84696	0.76995	0.65224	0.365	0.92351	0.88573	0.82854	0.69485
Australia	0.83333	0.66748	0.54499	0.38556	0.91668	0.83415	0.77361	0.69653
Brazil	0.85687	0.78524	0.68803	0.46931	0.92846	0.89312	0.84534	0.73938
Canada	0.9491	0.83437	0.72199	0.54686	0.97456	0.91744	0.86183	0.77643
China	0.70288	0.68568	0.6678	0.57243	0.85156	0.84423	0.83668	0.79467
Denmark	0.87906	0.84443	0.69339	0.55444	0.93954	0.92244	0.84764	0.78061
France	0.84188	0.74656	0.66518	0.59327	0.92095	0.87346	0.83306	0.79798
Germany	0.87511	0.71228	0.60833	0.50079	0.93758	0.85689	0.80611	0.75563
Hong Kong	0.71127	0.54436	0.45749	0.26305	0.85565	0.77249	0.72949	0.63404
India	0.78501	0.72269	0.67363	0.59422	0.89254	0.86186	0.838	0.80051
Indonesia	0.74924	0.68292	0.60495	0.40142	0.87467	0.84232	0.8049	0.7103
Italy	0.8845	0.86056	0.73251	0.57177	0.94226	0.9304	0.86669	0.78762
Japan	0.90596	0.85297	0.7952	0.66356	0.95298	0.92659	0.89789	0.83305
Malaysia	0.83346	0.76671	0.69103	0.51048	0.91676	0.8839	0.84695	0.76114
Mexico	0.74153	0.67781	0.6003	0.44343	0.87083	0.84	0.80271	0.73108
Netherlands	0.87514	0.82135	0.68623	0.48705	0.93759	0.91102	0.84435	0.74775
Norway	0.96174	0.84862	0.70906	0.46373	0.98088	0.92463	0.85567	0.73594
Philippines	0.66543	0.64268	0.62961	0.5676	0.83277	0.82203	0.81635	0.78927
Poland	0.84147	0.73616	0.61785	0.36347	0.92076	0.86852	0.81023	0.68655
Russian Federation	0.68628	0.48225	0.23181	0.12206	0.84319	0.74218	0.61858	0.56631
Singapore	0.83103	0.73496	0.56299	0.2881	0.91553	0.86782	0.7826	0.64785
South Africa	0.91687	0.83693	0.71918	0.45105	0.95844	0.9187	0.86044	0.72931
South Korea	0.87968	0.74835	0.66605	0.54099	0.93985	0.87448	0.83387	0.77341
Sweden	0.91066	0.82903	0.74677	0.51955	0.95534	0.91469	0.87389	0.7618
Taiwan	0.91008	0.78532	0.69065	0.56423	0.95505	0.89277	0.84567	0.78342
Thailand	0.82037	0.78391	0.71456	0.56438	0.91022	0.89254	0.85894	0.78863
UK	0.87808	0.76461	0.63148	0.42298	0.93905	0.88254	0.8165	0.7142
US	0.94535	0.85922	0.76285	0.59851	0.97269	0.92992	0.88247	0.80307
Developed Asia-Pacific	0.86429	0.75498	0.66768	0.52261	0.93215	0.8777	0.83443	0.76345
Emerging MKT	0.80795	0.74761	0.67527	0.50864	0.904	0.87423	0.83877	0.7589
Europe	0.87479	0.75854	0.64416	0.47661	0.93741	0.87955	0.82289	0.74095
North America	0.9457	0.85654	0.7585	0.59281	0.97286	0.92858	0.88027	0.80012

Note: *This table only shows the economies with more than 20 defaults in the testing period.

Figure B.1: Plots of US default parameters across all horizons for the Stock index one-year return, Short-term interest rate, Aggregate DTDs (financial and non–financial), CA/CL Level and Trend (non–financial firms), and CASH/TA Level and Trend (financial firms). Solid lines are the parameter estimates and dashed lines are the 90% confidence level. Horizontal axis is the horizon in months.

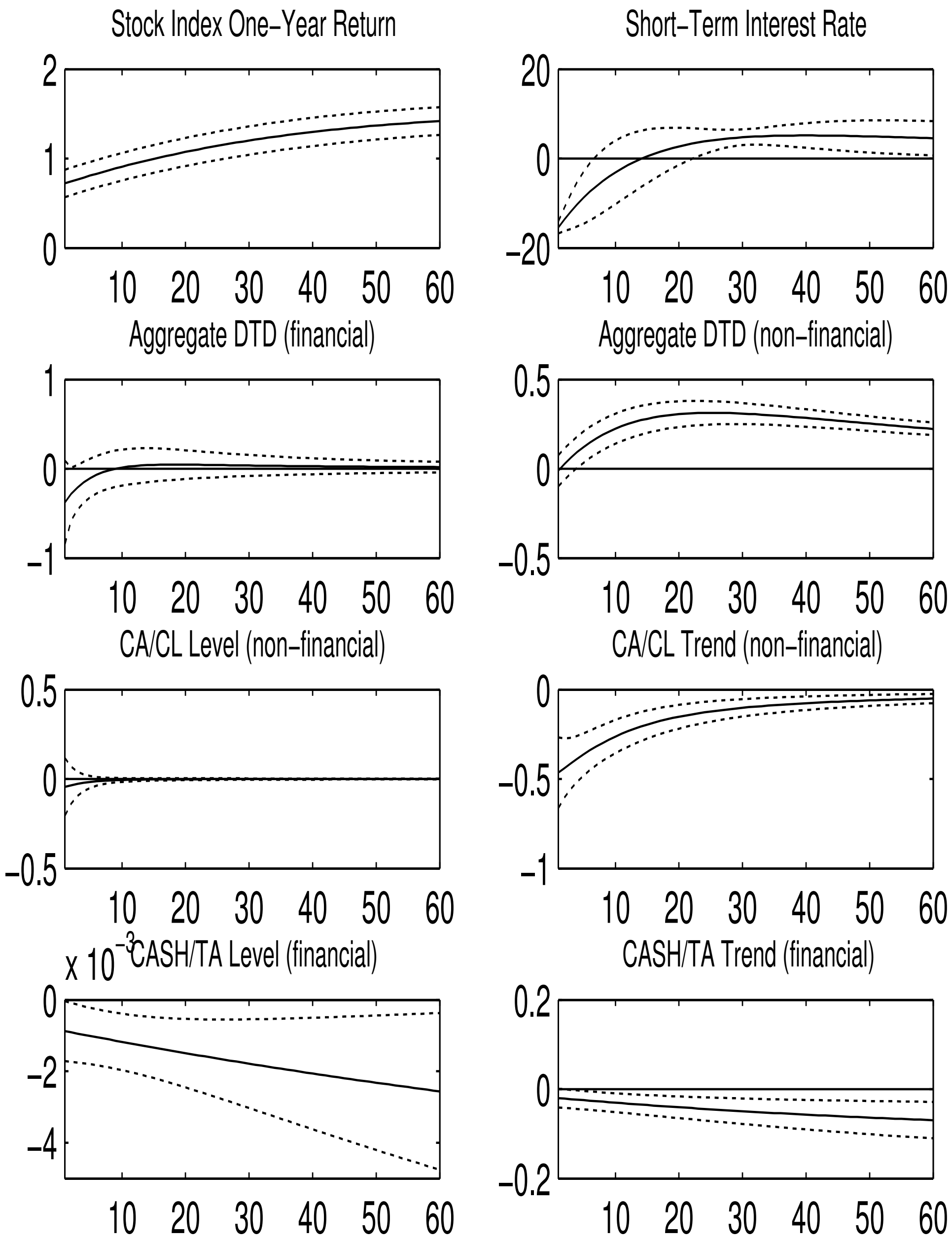


Figure B.2: Plots of US default parameters across all horizons for DTD Level, DTD Trend, the NI/TA Level, NI/TA Trend, SIZE Level, SIZE Trend, M/B, and SIGMA. Solid lines are the parameter estimates and dashed lines are the 90% confidence level. Horizontal axis is the horizon in months.

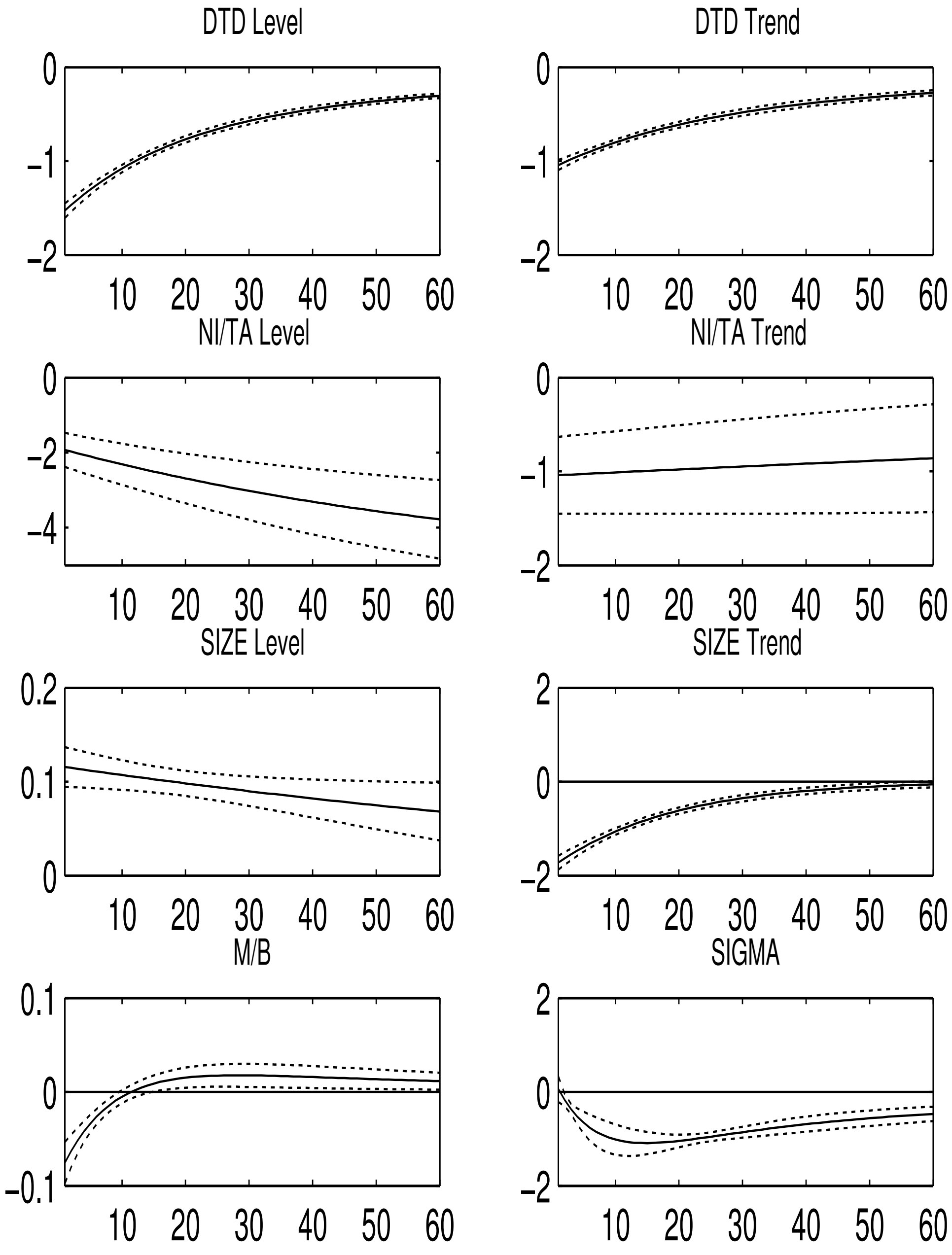
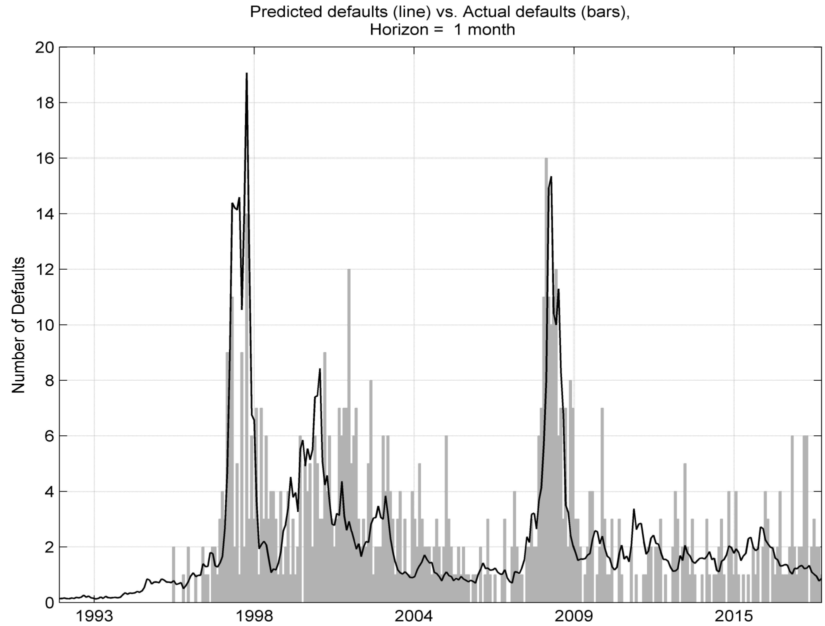
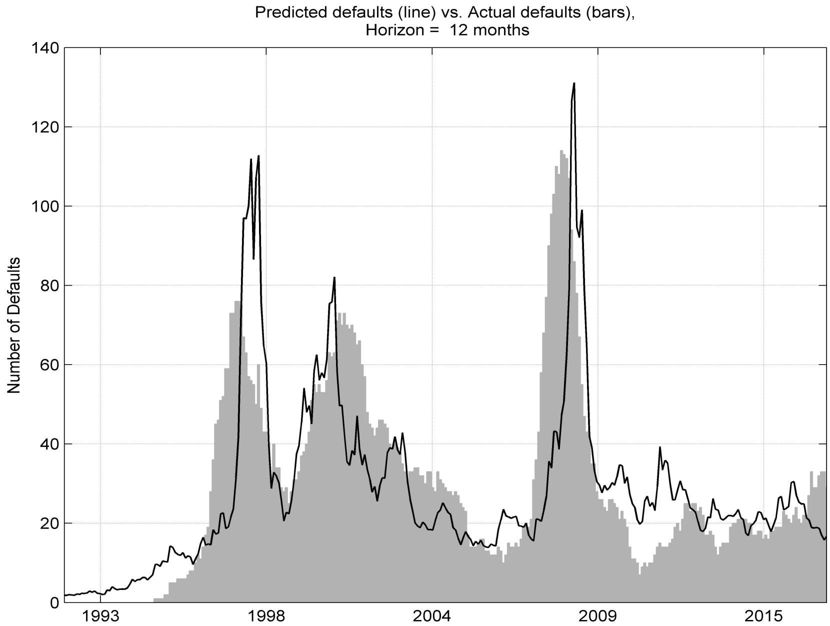
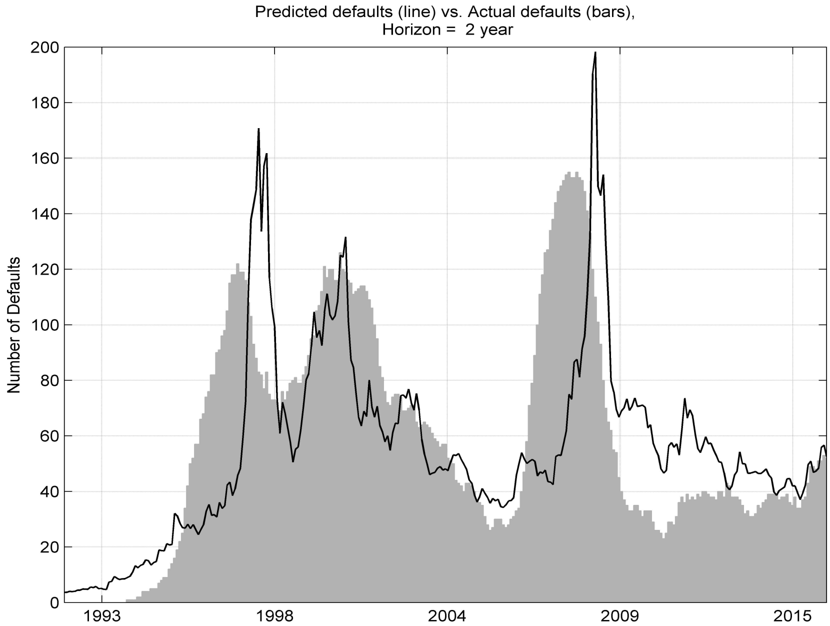


Figure B.3: Performance test for Asia Pacific (Developed), in sample.






Predicted defaults (line) vs. Actual defaults (bars),
Horizon = 2 year
Number of Defaults
0
20
40
60
80
100
120
140
160
180
200
1993
1998
2004
2009
2015

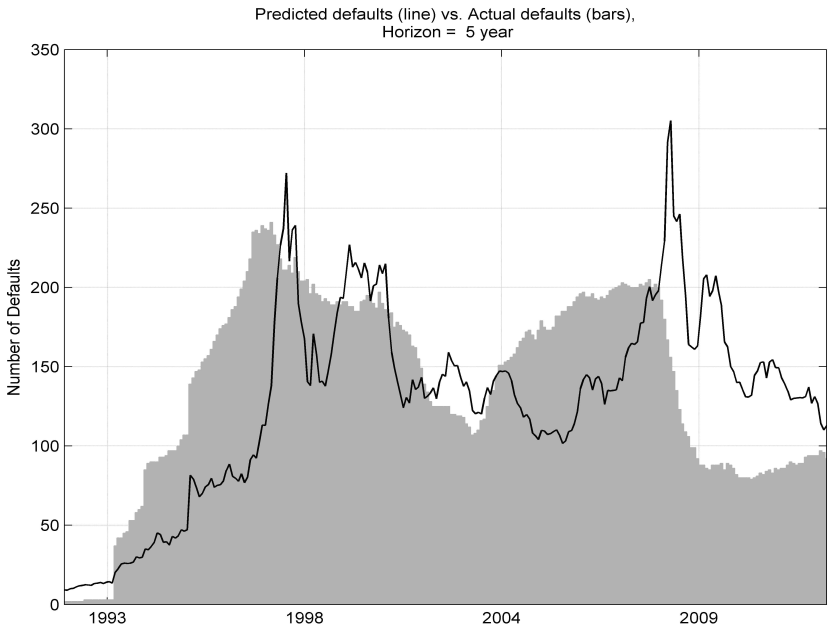
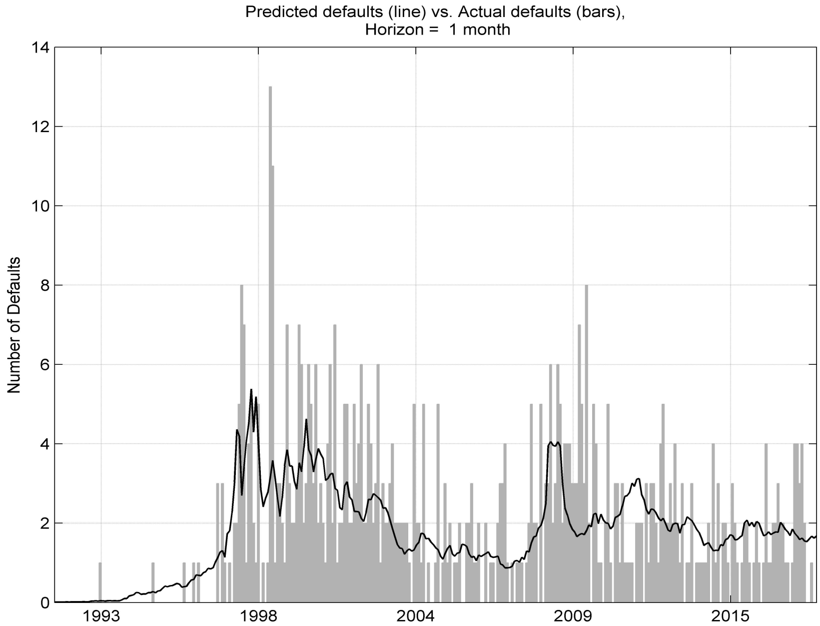
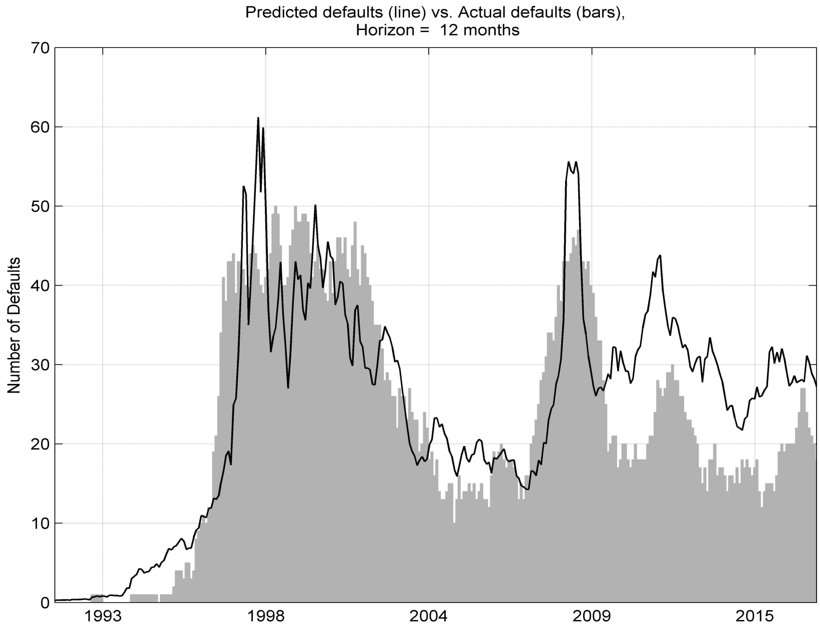
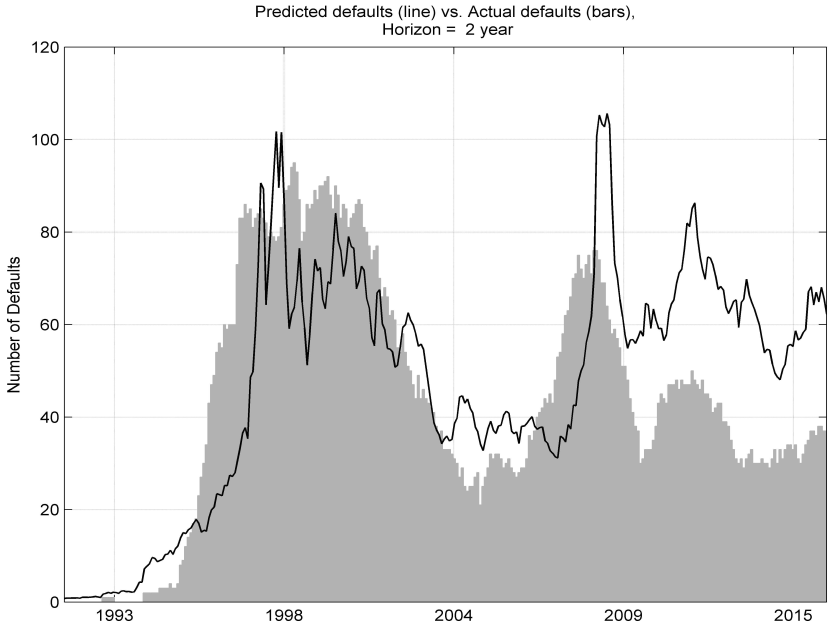

Predicted defaults (line) vs. Actual defaults (bars),
Horizon = 5 year
Number of Defaults
0
50
100
150
200
250
300
350
1993
1998
2004
2009

Figure B.4: Performance test for the Emerging Market, in sample.






Predicted defaults (line) vs. Actual defaults (bars),
Horizon = 2 year
Number of Defaults
0
20
40
60
80
100
120
1993
1998
2004
2009
2015

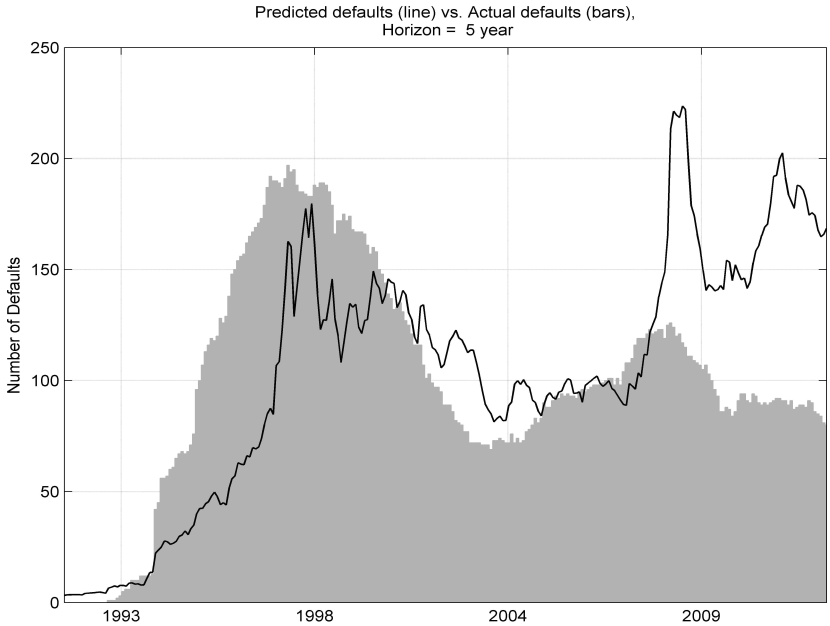
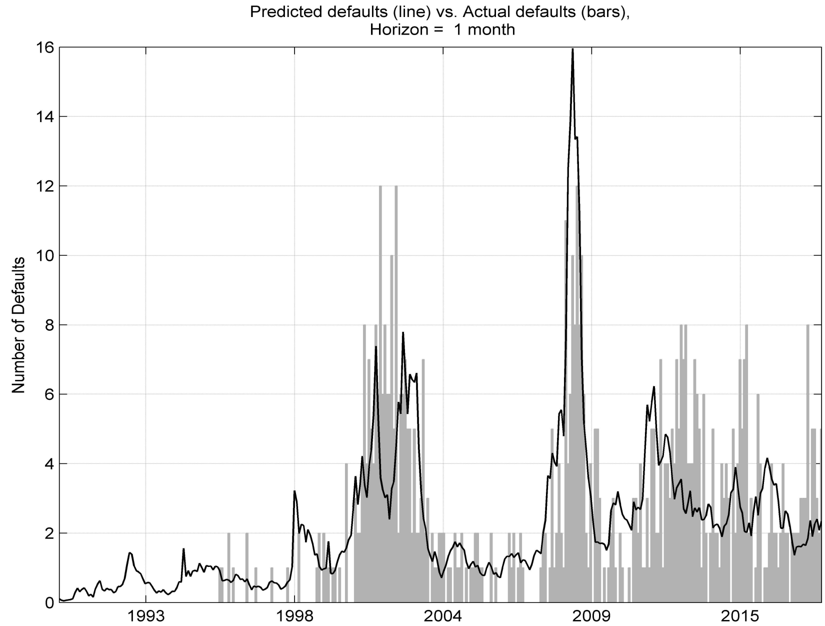
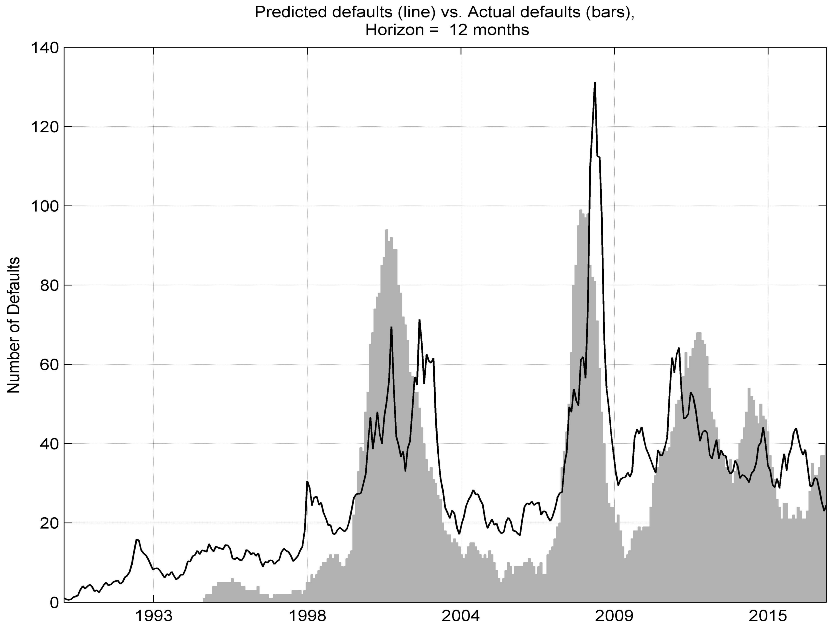
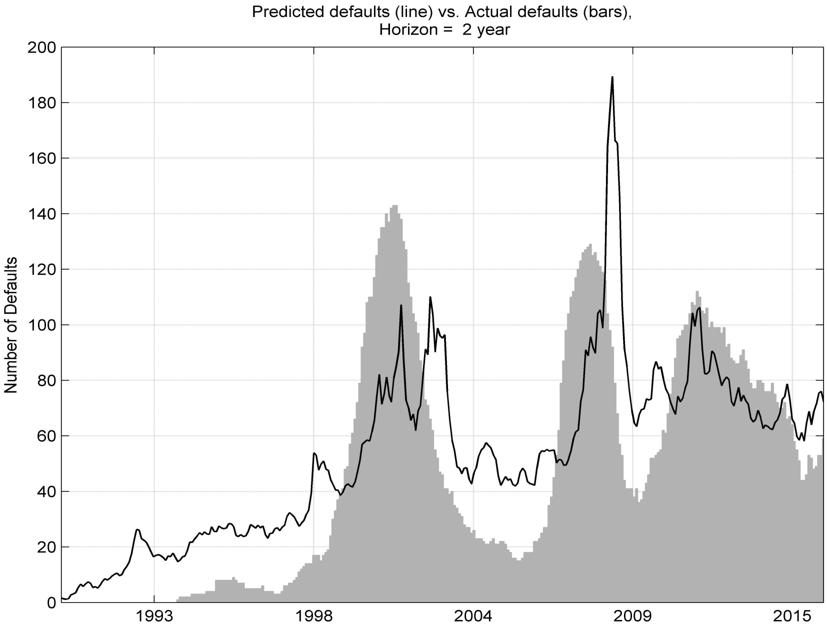

Predicted defaults (line) vs. Actual defaults (bars),
Horizon = 5 year
Number of Defaults
0
50
100
150
200
250
1993
1998
2004
2009

Figure B.5: Performance test for the Europe group, in sample.






Predicted defaults (line) vs. Actual defaults (bars),
Horizon = 2 year
Number of Defaults
0
20
40
60
80
100
120
140
160
180
200
1993
1998
2004
2009
2015

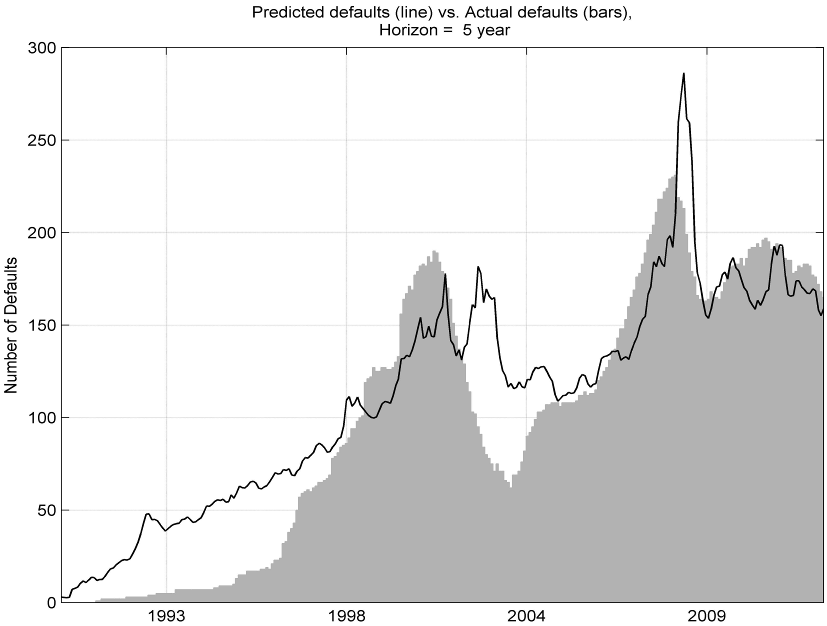
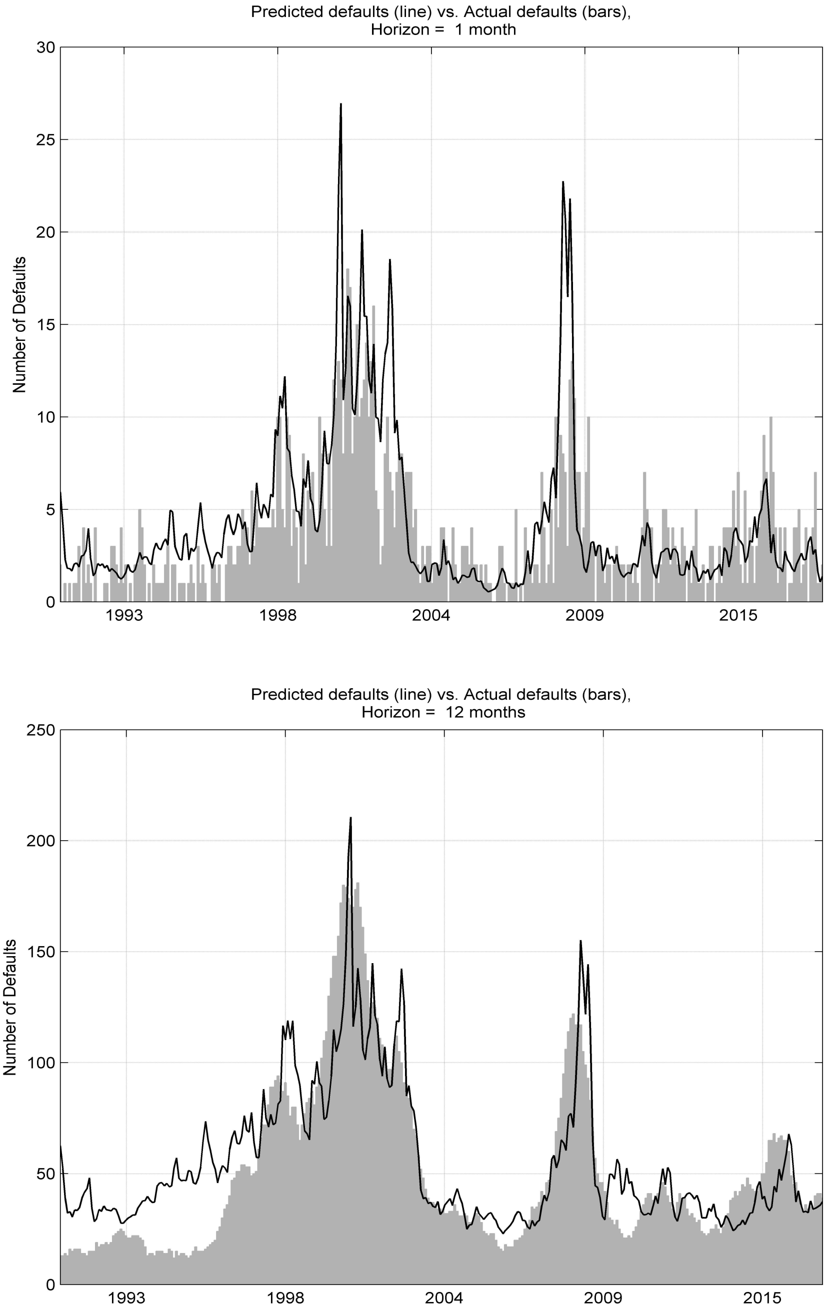
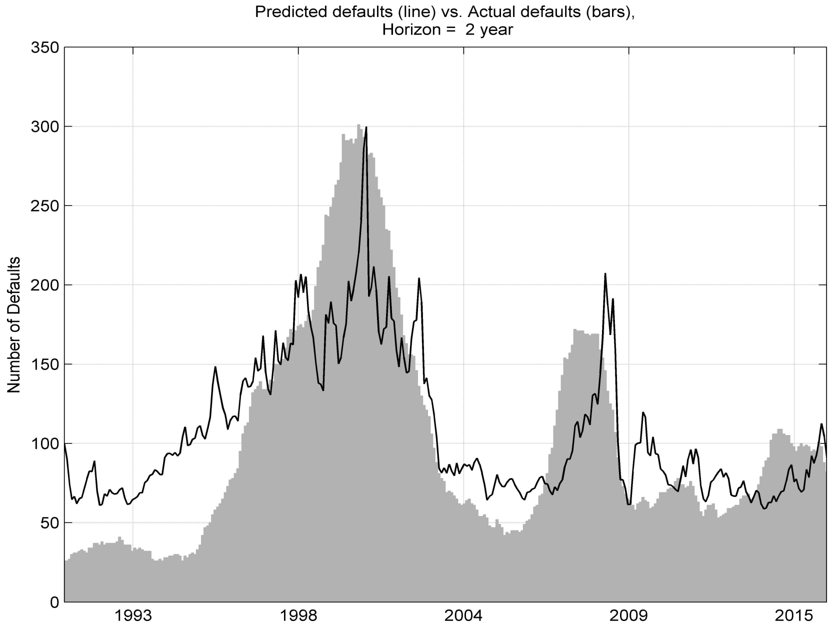

Predicted defaults (line) vs. Actual defaults (bars),
Horizon = 5 year
Number of Defaults
0
50
100
150
200
250
300
1993
1998
2004
2009

Figure B.6: Performance test for North America group, in sample.




Predicted defaults (line) vs. Actual defaults (bars),
Horizon = 2 year
Number of Defaults
350
300
250
200
150
100
50
0
1993
1998
2004
2009
2015

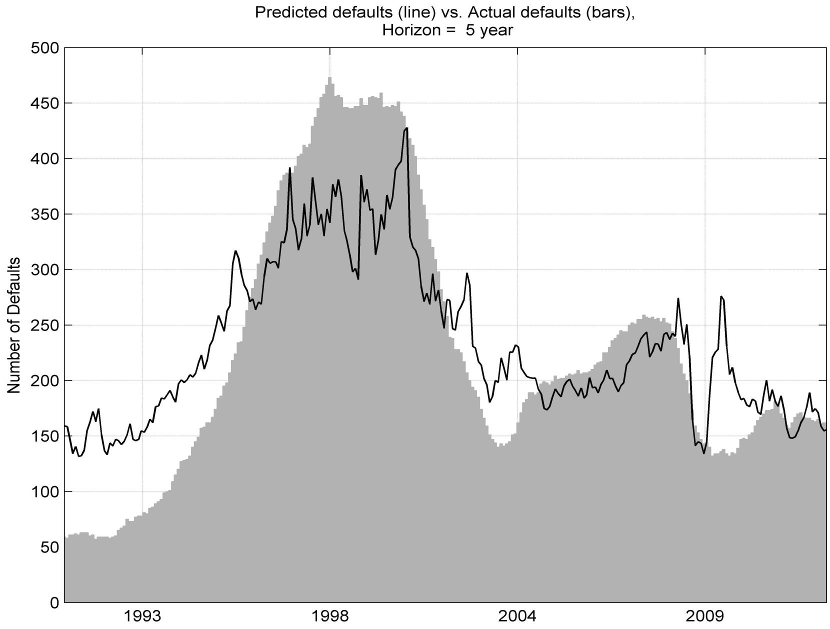
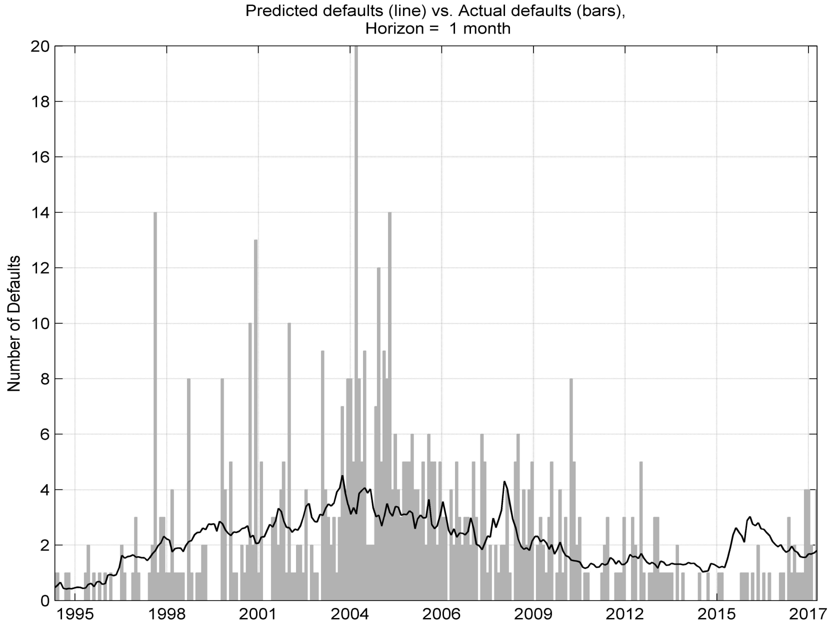
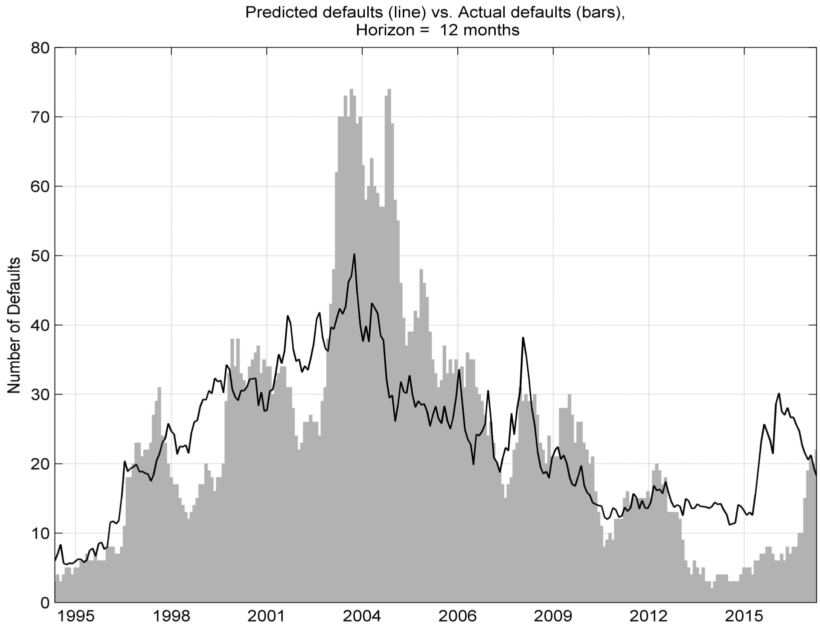
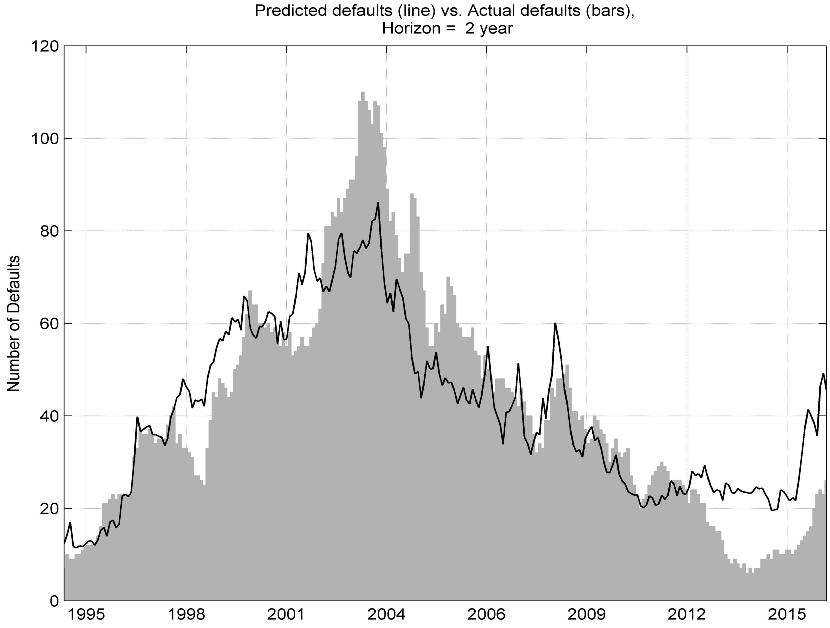

Predicted defaults (line) vs. Actual defaults (bars),
Horizon = 5 year
Number of Defaults
500
450
400
350
300
250
200
150
100
50
0
1993
1998
2004
2009

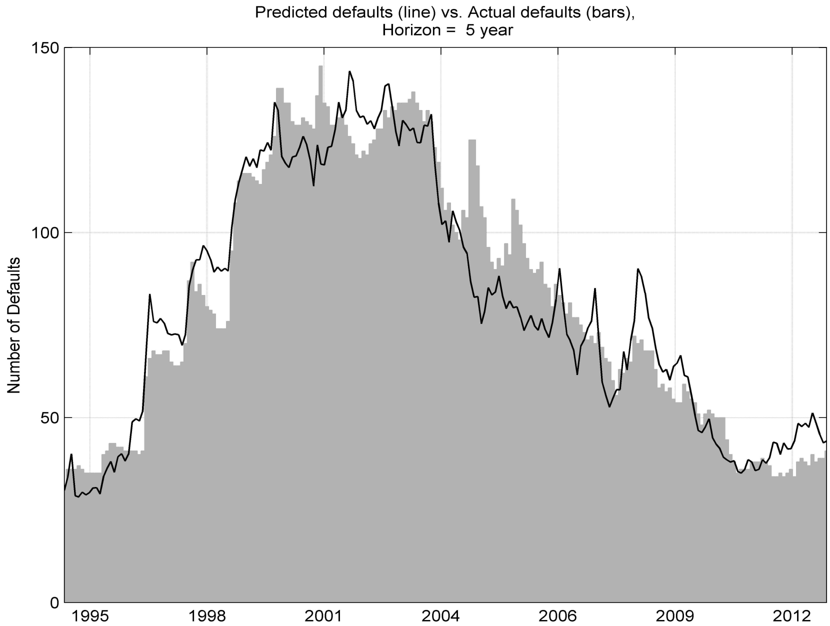
Figure B.7: Performance test for China, in sample.





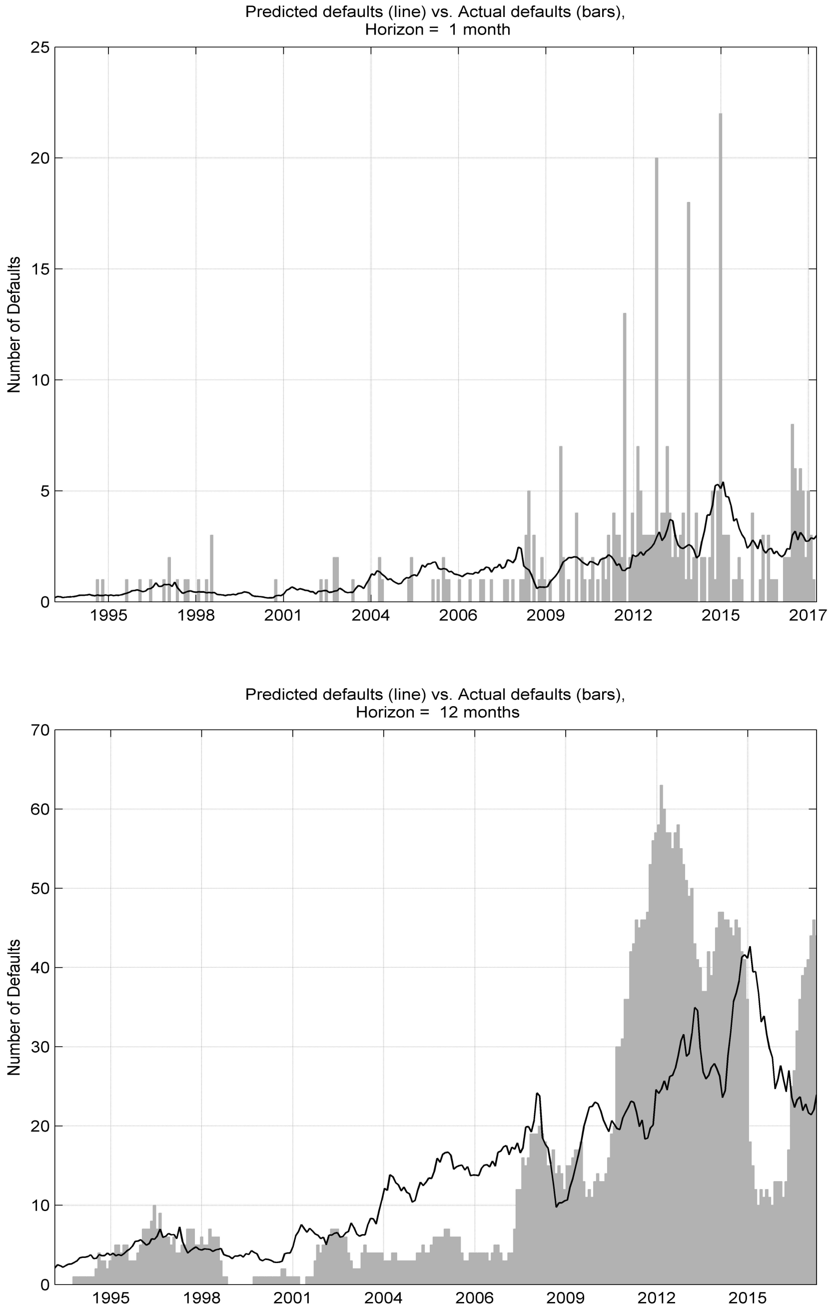


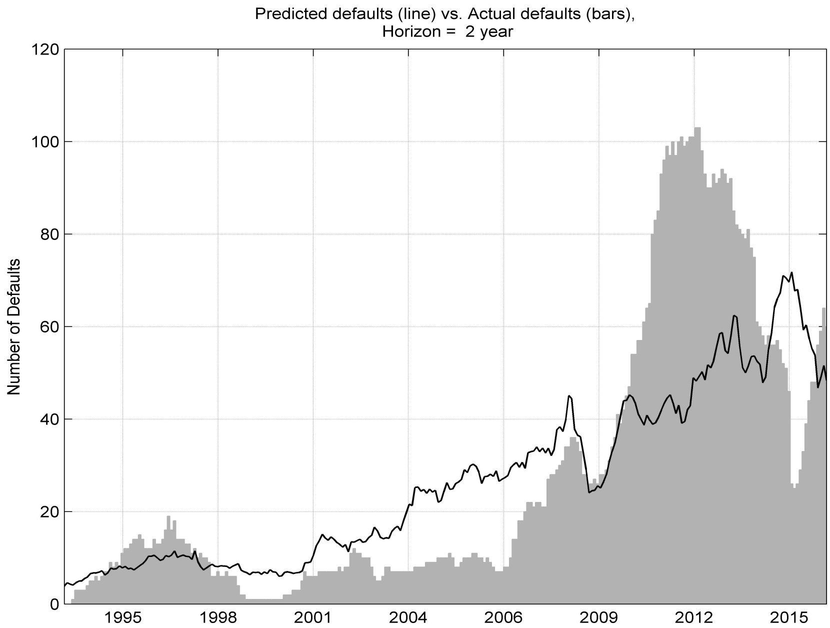
Predicted defaults (line) vs. Actual defaults (bars),
Horizon = 2 year
Number of Defaults
0
20
40
60
80
100
120
1995
1998
2001
2004
2006
2009
2012
2015

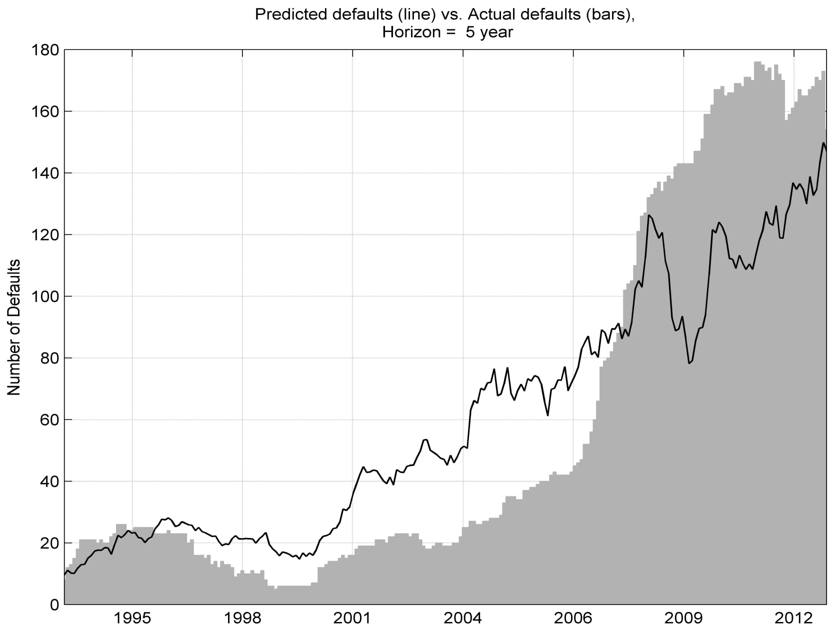


Predicted defaults (line) vs. Actual defaults (bars),
Horizon = 5 year
Number of Defaults
0
50
100
150
1995
1998
2001
2004
2006
2009
2012

Figure B.8: Performance test for India, in sample.







References

L. Anderson, J. Sidenius, and S. Basu. All your Hedges in one Basket. *Risk*, pages 67–72, 2003.

J. A. Chan-Lau, C. Chuang, J.-C. Duan, and W Sun. Banking Network and Systemic Risk via Forward-Looking Partial Default Correlations. working paper, International Monetary Fund and National University of Singapore. 2016.

N. Chopin. A Sequential Particle Filter Method for Static Models. *Biometrika*, 89:539–551, 2002.

CRI. NUS-RMI Credit Research Initiative Technical Report. *Global Credit Review*, 2:109–167, 2012.

P. Crosbie and J. Bohn. Modeling Default Risk. Moody's KMV technical document. 2003.

P. Del Moral, A. Doucet, and A. Jasra. Sequential Monte Carlo Samplers. *Journal of Royal Statistical Society B*, 68:411436, 2006.

J.-C. Duan. Maximum Likelihood Estimation Using Price Data of the Derivative Contract. *Mathematical Finance*, 4:155–167, 1994.

J.-C. Duan. Correction: Maximum Likelihood Estimation Using Price Data of the Derivative Contract. *Mathematical Finance*, 10:461–462, 2000.

J.-C. Duan. Clustered Defaults. National University of Singapore Working Paper. 2010.

J.-C. Duan. Actuarial Par Spread and Empirical Pricing of CDS by Decomposition. *Global Credit Review*, 04:51–65, 2014.

J.-C. Duan and W. Miao. Default Correlations and Large-Portfolio Credit Analysis. *Journal of Business & Economic Statistics*, 34:536–546, 2016.

J.-C. Duan and K. Shrestha. Statistical Credit Rating Methods. *Global Credit Review*, pages 43–64, 2011.

J.-C. Duan and E. Van Laere. A public good approach to credit ratings From concept to reality. *Journal of Banking & Finance*, 36:3239–3247, 2012.

J.-C. Duan and T. Wang. Measuring Distance-to-Default for Financial and Non-Financial Firms. *Global Credit Review*, 02:95–108, 2012.

J.-C. Duan, J. Sun, and T. Wang. Multiperiod Corporate Default Prediction – A Forward Intensity Approach. *Journal of Econometrics*, 170:191–209, 2012.

J.C. Duan and A. Fulop. Multiperiod Corporate Default Predeiction with the Partially Conditioned Forward Intensity. *National University of Singapore working paper*, 2013.

D. Duffie, L. Saita, and K. Wang. Multi-Period Corporate Default Prediction with Stochastic Covariates. *Journal of Financial Economics*, 83:635–665, 2007.

D. Duffie, A. Eckner, G. Horel, and L. Saita. Frailty Correlated Default. *Journal of Finance*, pages 2089–2123, 2009.

K. Khare, S. Y. Oh, and B. Rajaratnam. A convex pseudolikelihood framework for high dimensional partial correlation estimation with convergence guarantees. *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, 77:803–825, 2015.

N.M. Kiefer, T.J. Vogelsang, and H. Bunzel. Simple Robust Testing of Regression Hypotheses. *Econometrica*, 68:695–714, 2000.

R. C. Merton. On the pricing of corporate debt: The Risk Structure of Interest Rates. *Journal of Finance*, 29:449–470, 1974.

C.R. Nelson and A.F. Siegel. Parsimonious modeling of yield curves. *Journal of Business*, 60: 473–489, 1987.

S.Y. Oh, O. Dalal, K. Khare, and B. Rajaratnam. Optimization Methods for Sparse Pseudolikelihood Graphical Model Selection conference proceedings for 'Neural Information Processing System 2014'. 2014.

X. Shao. A Self-Normalized Approach to Confidence Interval Construction in Time Series. *Journal of the Royal Statistical Society: Series B*, 72:343–366, 2010.

T. Shumway. Forecasting Bankruptcy More Accurately: A Simple Hazard Model. *Journal of Business*, 74:101–124, 2001.

H. Zou. The Adaptive Lasso and Its Oracle Properties. *Journal of the American statistical association*, 101:1418–1429, 2006.