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NUS-RMI Credit Research Initiative Technical Report

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RMI staff article

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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 (PDs). As of this version of the Technical Report, RMI covers around 60,400 listed firms (including delisted ones) in 106 economies around the world (see Table A.1). Of the around 40,000 active firms under the CRI coverage, around 34,000 firms have sufficient data to release daily updated PDs. The PD for all firms is 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 3,000 firms. The individual company PD data, along with aggregate PDs 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 changes to the 2013 technical report and operational implementation of our model are: (1) the changes in financial statement (FS) priority rules for Australia, South-Korea and Taiwan; (2) the changes to the winsorization for market-to-book ratio; (3) some changes to the monthly calibration for the Emerging Markets Group;

(4) a reclassification of default events in Thailand; (5) a replacement for the stock index in Jordan; (6) replacements for the 3-month interest rates in Russia and Singapore; (7) a replacement for the risk-free rate in Sweden; and (8) revision to balance sheet items used in distance-to-default (DTD). 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 2014. More specifically, in addition to Technical Report version: 2013 update 2, the current version of the technical report specifies some revisions to the monthly parameter updates that went into effect as of the April 2014 calibration. The latest version of the Technical Report and addenda to the latest version are available via the web portal and will include any changes to the system that have been implemented since the publication of this version.

The remainder of this Technical Report is organized as follows. The next section describes the quantitative model that is currently used to compute PDs from the CRI. The model was first described in Duan *et al.* (2012). The description includes calibration procedures, which are performed on a monthly basis, and individual firm PD computations, which are performed on a daily basis.

Section II describes the input variables of the model as well as the data used to produce the variables for input into the model. 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 when calibrating a probability of default estimation system is the default data, and this is also described in this section.

While Section I provides a broader description of the model, Section III 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 PDs and aggregation of the individual firm PDs. 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 IV 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. This is because, at the CRI's current stage of development, the economies all use the variables used in the academic study of US firms in Duan *et al.* (2012). Future development within the CRI will deal with variable selection specific to different economies, and the performance is then expected to improve. Other planned developments are discussed in Sec. V.

I. 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 I.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 I.2 explains how the model can be calibrated. Subsection I.3 details the way parameters are estimated based on the SMC technique.

I.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 ith firm at the end of the nth 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. For example, in mergers and acquisitions involving two public companies, there will be one company that delists from its stock exchange. This is important in predicting defaults because a default cannot happen if a firm has been previously delisted. An exception is if the exit is a distressed exit and is followed soon after by a credit event. See Subsec. II.4 for details on how this case is handled in the CRI system.

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 $m < n$.

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:

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

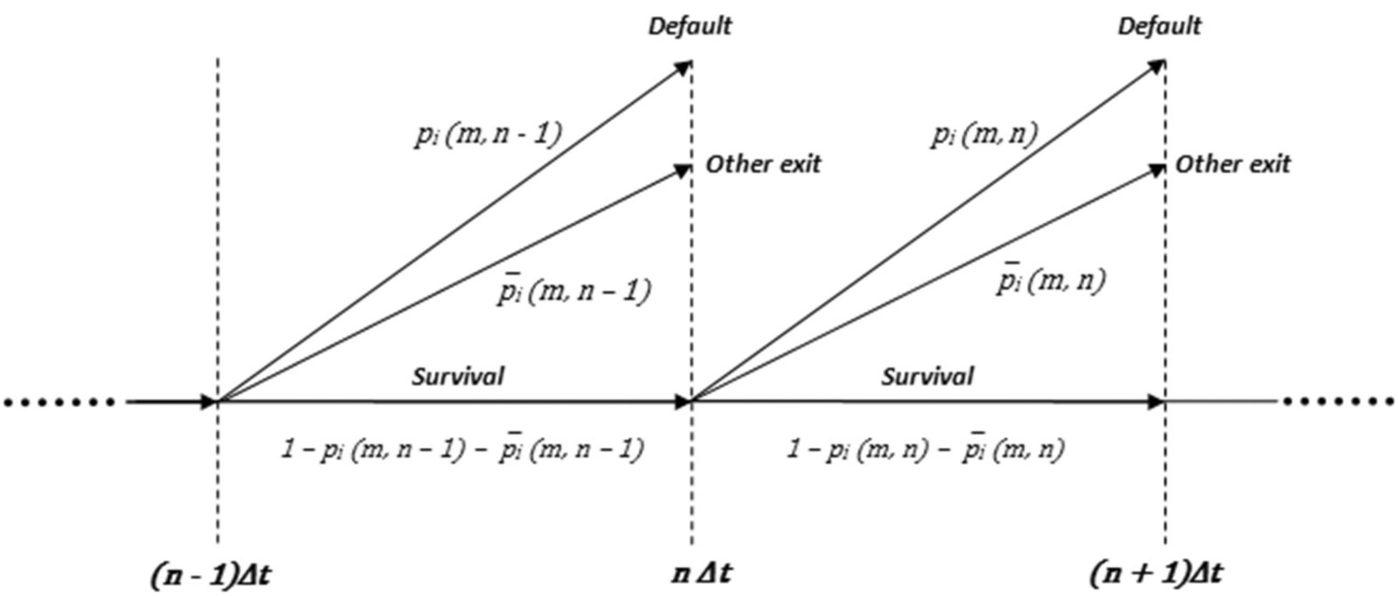


Figure 1. Default-other exit-survival tree for firm i, viewed from time $t = m\Delta t$.

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 $m \le n$. 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:

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

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 12 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 Subsecs. I.2 and I.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:

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

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:

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

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.

I.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 ith firm in the nth 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 ith 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 from 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:

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

Here, $P_{\min(N-m,\ell)}(\beta, \bar{\beta}; \tau_i, \bar{\tau}_i, X_i(m))$ is a probability for the ith 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:

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

In words, if the ith 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:

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

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 I.3 will further explain how the optimum parameters can be estimated.

I.3. Parameter Estimation

Previously, the CRI system produced default predictions to a horizon of two years (RMI, 2012). An extension of the forecast horizon has been implemented as of the PD released on April 1, 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, $\bar{\beta}$ 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 in a working paper by Duan and Fulop (2013). The remainder of this section details the new parameter estimation. Subsection I.3.1 describes the parameterization of the parameters by NS functions, Subsec. I.3.2 gives an overview of the SMC method that is used to estimate the NS functions, Subsec. I.3.3 details the calculation of the confidence intervals for the parameter estimation, and Subsec. I.3.4 describes how the parameters can be re-estimated given new data or updates of old data.

I.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 RMI 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 12 covariates for forward default intensities up to 60 months would require a joint estimation of $13 \times 60 = 780$ parameters. Here, 13 comes from adding an intercept to the intensity function with 12 covariates. If the coefficients corresponding to each covariate are represented by the NS function of 4 parameters, there will be at most $13 \times 4 = 52$ 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 13 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:

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

where t is the forecast horizon (measured in years). In the RMI 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, $\bar{\beta}$ 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 12 covariates, there will be a total of $12 \times 3 + 1 \times 4 = 40$ parameters.

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

I.3.2. *Parameter estimation by SMC*

Reliably estimating a system involving 40 parameters presents a numerical challenge. Moreover, the number of parameters can be greater than 40 if there are more than 12 covariates. The RMI 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 RMI 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 RMI 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 the 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 coefficient vectors from Eq. (6) generated from the NS functions with parameter θ. 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 Sec. I.1, consider the following pseudo-posterior distribution at time n after one makes the ℓ-period prediction:

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

One can apply the sequential batch-resampling routine of Chopin (2012) 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 RMI implementation, $K = 1{,}000$.

***Initialization*:** Draw an initial random sample from the prior: $(\theta^{(k,0)} \sim \pi(\theta), w^{(k,0)} = 1/K)$. Here, the only role of the prior $\pi(\theta)$, is to provide the initial particle cloud from which the algorithm can start. Of course, the support of $\pi(\theta)$ must contain the true parameter value θ_0. In the RMI implementation, normal/truncated normal priors are used. Truncation applies in order to impose the restriction $d > 0$. To obtain the means of the priors for the SMC method, a least square fit of the MLE parameter estimates to the NS function is conducted. The standard deviations of the priors are set to 5.

***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:

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

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 decribed 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*: 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:

$$\overline{\theta}^{(k,n+1,p)} = \overline{\theta}^{(k,n+1,p-1)}, \tag{19}$$

$$\begin{aligned}\overline{w}^{(k,n+1,p)} &= \overline{w}^{(k,n+1,p-1)} \\ &\quad \times \frac{\overline{\gamma}_{n+1,p}(\overline{\theta}^{(k,n+1,p)})}{\overline{\gamma}_{n+1,p-1}(\overline{\theta}^{(k,n+1,p)})} \\ &= \overline{w}^{(k,n+1,p-1)} \\ &\quad \times \mathcal{L}^{\xi_p-\xi_{p-1}}_{n+1,\min(N\Delta t-(n+1)\Delta t,\ell)}(\overline{\theta}^{(k,n+1,p)}).\end{aligned} \tag{20}$$

To avoid particle impoverishment in sequential importance sampling where most of the weight is concentrated in a small number of particles, a resample-move step is run, which is triggered whenever a measure of particle diversity — the efficient sample size (ESS) defined as

$$\text{ESS} = \frac{\left(\sum_{k=1}^{N} \overline{w}^{(k,n+1,p)}\right)^2}{\sum_{k=1}^{N}(\overline{w}^{(k,n+1,p)})^2}, \tag{21}$$

falls below some preset value B. Here, resampling directs the particle cloud towards more likely areas of the sampling space, while the move step enriches particle diversity.

In the RMI implementation, B is set to 50%. Thus, if ESS $<$ 50%, the following resampling and move steps are performed.

- *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

$$\overline{\theta}^{(k,n+1,p)} = \overline{\theta}^{(I^{(k,n+1,p)},n+1,p)}, \tag{22}$$

$$\overline{w}^{(k,n+1,p)} = \frac{1}{K}. \tag{23}$$

- *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 $\theta^{*(k)} \sim \mathcal{Q}_{n+1,p}\left(\,\cdot \mid \overline{\theta}^{(k,n+1,p)}\right)$.

(2) Compute the acceptance weight α, where:

$$\alpha = \min\left(1, \frac{\overline{\gamma}_{n+1,p}\left(\theta^{*(k)}\right) Q_{n+1,p}\left(\overline{\theta}^{(k,n+1,p)} \,\middle|\, \theta^{*(k)}\right)}{\overline{\gamma}_{n+1,p}\left(\overline{\theta}^{(k,n+1,p)}\right) Q_{n+1,p}\left(\theta^{*(k)} \,\middle|\, \overline{\theta}^{(k,n+1,p)}\right)}\right). \tag{24}$$

(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 RMI implementation, block independent normal distribution proposals using the means and the standard deviations implied by the particle set are fitted to the particle cloud before the move. Three (or four) NS parameters corresponding to each covariate form one block. To ensure that the NS parameter d remains positive, any block with a non-positive value for d is discarded. To ensure the smoothness of the term structure of the forward intensity parameters, any block that does not produce an increasing or decreasing structure of the NS function for the first five months is also discarded. Once some block is discarded, the particle is regenerated until it meets the requirements. Note that the likelihood ratio in the Metropolis–Hastings algorithm is not affected by this because the truncated normal creates a common adjustment term in both numerator and denominator.

As mentioned previously, the coefficients for some covariates are also required to be non-positive over all forward starting times. This is achieved by checking whether the NS curve at a particular set of three (or four) parameters meets the condition. If not, the parameter set will be discarded.

To improve the support of the particle cloud, one can execute multiple such Metropolis–Hastings steps each time. In the RMI implementation, such Metropolis–Hastings steps are consecutively performed in each resampling-move step until the number of unique particles exceeds $K/2$.

When $p = P_{n+1}$ is reached, a representation of $\gamma_{n+1}(\theta)$ is:

$$(\theta^{(k,n+1)}, w^{(k,n+1)}) = (\overline{\theta}^{(k,n+1,P_{n+1})}, \overline{w}^{(k,n+1,P_{n+1})}). \tag{25}$$

Following Duan and Fulop (2013), the tempering sequence ξ_p is automatically set to ensure that the ESS stays close to 50%. This is done by a grid search, where the ESS is evaluated at a grid of candidate ξ_p and the one that produces the closest ESS to 50% is chosen.

After the recursion procedure (i.e., ξ_p reaches 1), additional moves using the means implied by the particle set but all standard deviations increased by a factor of 30% are further performed to enrich the support and adjust the location of the particle set. The number of such moves is set to 20 for the first time point and exponentially declines to 3 mid-way to the sample period and stays at 3 for the remainder. After that, if the number of unique particles is still below $K/2$, more moves using the means and the standard deviations implied by the particle set (without expansions) are consecutively performed until the particle set meets the requirement. (This case could only happen when $\text{ESS} \geq B$ for $\xi_p = 1$.)

I.3.3. *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 $n = 2, \ldots, N$,

$$\hat{\theta}_n = \frac{1}{\sum_{k=1}^{K} w^{(k,n)}} \sum_{k=1}^{K} w^{(k,n)} \theta^{(k,n)}. \tag{26}$$

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. 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:

$$t^* = \frac{\sqrt{N-1}\left(\hat{\theta}_N^{(k)} - a\right)}{\sqrt{\hat{\delta}_{k,N}}} \xrightarrow{d} \frac{W(1)}{\left[\int_0^1 (W(r) - rW(1))^2 dr\right]^{1/2}}, \quad (27)$$

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

$$\hat{C}_N = \frac{1}{(N-1)^2} \sum_{n=2}^{N} n^2 (\hat{\theta}_n - \hat{\theta}_N)(\hat{\theta}_n - \hat{\theta}_N)'. \quad (28)$$

The right-hand-side random variable for t^* 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.

I.3.4. *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 $N + 1$. A particular strength of Duan and Fulop (2013)'s methodology is that the estimation routine does not need to be re-initialized from the prior as the pseudo-posterior using data up to $N\Delta t$ will provide a much better proposal distribution.

Let the pseudo-posterior at time N (based on the old data set available at time N) be denoted by

$$\gamma_N^{(N)}(\theta) \propto \prod_{m=1}^{N-1} \mathcal{L}_{m,\min(N-m,\ell)}^{(N)}(\theta)\pi(\theta), \quad (29)$$

and the pseudo-posterior at time $N + 1$ (based on the new data set available at time $N + 1$) by

$$\gamma_{N+1}^{(N+1)}(\theta) \propto \prod_{m=1}^{N} \mathcal{L}_{m,\min((N+1)-m,\ell)}^{(N+1)}(\theta)\pi(\theta). \quad (30)$$

The superscript is introduced to differentiate the data set available at time N and $N + 1$, respectively. It is important to note that $\mathcal{L}_{m,k}^{(N+1)}(\theta) \neq \mathcal{L}_{m,k}^{(N)}(\theta)$ can be caused by revisions to the old data set. More importantly, there is a generic difference between the pseudo-posterior distribution up to time N under the new data set and the corresponding quantity under the old data set specifically due to multiperiod prediction; that is, $\gamma_{N+1}^{(N)}(\theta) \neq \gamma_N^{(N)}(\theta)$ even without any data revisions to the period covered by the old data set. To put it concretely, using the new data set and at, say, one period before the last (i.e., time $N - 1$), one can make default predictions up to two periods, whereas at the same time point, it was only possible to make one-period predictions under the old data set because there were no data beyond time N. Adjustments to the weights are thus necessary to reflect the change in data set before making any sequential updates.

There are several possible ways of advancing the system. The RMI implementation decomposes the move into two steps. First, we take care of data revision up to time N and then act as if we were making predictions with data only up to time N. Doing it this way is meant to maintain the same default prediction setting; that is, for example, only makes one-period default prediction at time $N - 1$ even though the new data set permits predictions up to two periods. Thus, we introduce

$$\gamma_N^{(N+1,N)}(\theta) \propto \prod_{m=1}^{N-1} \mathcal{L}_{m,\min(N-m,\ell)}^{(N+1)}(\theta)\pi(\theta) \quad (31)$$

to denote this pseudo-posterior when the superscript $(N + 1, N)$ stands for the updated data set available at time $N+1$ but making default predictions as if the data were only available up to time N.

From the previous run up to time N, one already has a weighted set of particles $(\theta^{(k,N)}, w^{(k,N)})$ representing the pseudo-posterior distribution $\gamma_N^{(N)}(\theta)$. Next, preform a reweighting by

$$\theta^{*(k,N)} = \theta^{(k,N)}, \quad (32)$$

$$w^{*(k,N)} = w^{(k,N)} \times \frac{\gamma_N^{(N+1,N)}\left(\theta^{(k,N)}\right)}{\gamma_N^{(N)}\left(\theta^{(k,N)}\right)}. \quad (33)$$

Since the denominator is available from the previous run, one only needs to compute the numerator using the new data set up to time N. Then, the weighted set $(\theta^{*(k,N)}, w^{*(k,N)})$ represents the revised pseudo-posterior distribution at time N, i.e., $\gamma_N^{(N+1,N)}(\theta)$, specifically to account for data revisions. From this point onward, one can apply the same recursive procedure described in Subsec. I.3.2, starting from Eq. (18), to complete the updating task.

Reweighting may substantially alter the ESS of the particle set due to a large volume of data changes. If the reweighting leads to a satisfactory ESS, i.e., ESS $\geq B$, advancing to $N+1$ continues as usual. Otherwise, the weighted sample will be discarded to prevent the support from degeneration. One can return to the particle set before reweighting and perform resampling to create an equally-weighted particle set. Then, make the Metropolis–Hastings moves by targeting $\gamma_N^{(N+1,N)}(\theta)$ using the Gaussian-type sampler described earlier and starting with the mean and variance implied by the resampled particle set. One should make these Metropolis–Hastings moves until the particle set reaches a desirable level of distinctiveness, and perhaps with a preset minimum number of moves to ensure that the resulting particle set is close enough to the target distribution. In the RMI implementation, the number of moves is set to be 20.

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.

The initial parameter estimation is carried out for all calibration groups using the data up to the end of January 2013. Relevant quantities (parameter estimates, the 1,000 parameter particles and corresponding weights and sample likelihoods) are saved for periodic updating for all future months. Additional implementation details on the calibration are given in Sec. III.

II. INPUT VARIABLES AND DATA

Subsection II.1 describes the input variables used in the quantitative model. Currently, the same set of input variables is common to all of the economies under the CRI's coverage. Future enhancements to the CRI system will allow different input variables for different economies. The effect of each of the variables on the PD output will be discussed in the empirical analysis of Sec. IV.

Subsection II.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 II.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 II.4 discusses the definition and sources of defaults and of other exits used in the CRI.

II.1. Input Variables

Following the notation that was introduced in Sec. I, 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, as described below, were selected as having the greatest predictive power for corporate defaults in the United States. In the current stage of development, this same set of 12 input variables is used for all economies. Future development will include variable selection for firms in different economies.

- Common variables

  The vector $W(n)$ contains two 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.

- Firm-specific variables

  The 10 firm-specific input variables are transformations of measures of 6 different firm characteristics. The six firm characteristics are:

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

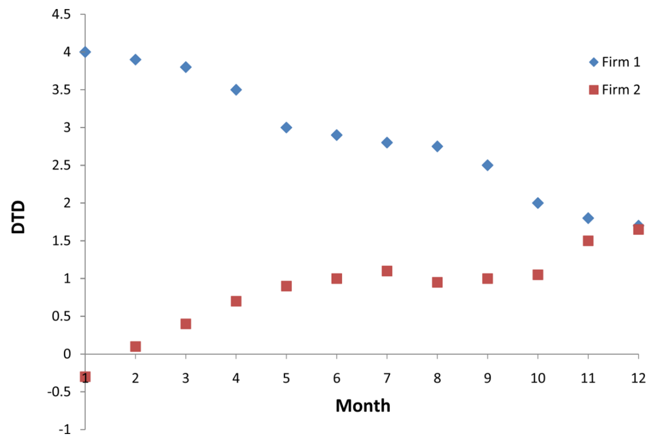


Figure 2. Two firms with all current values equal to each other, but DTD trending in the opposite direction.

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 Sec. III.

Liquidity is measured as a ratio of cash and short-term investments to total assets. 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 has 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.

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.

One of the remaining two firm characteristics is the market mis-valuation/future growth opportunities characteristic, which is taken as the market-to-book asset ratio and measured as a ratio of market capitalization and total liabilities to total assets. 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 Sec. IV.

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 10 elements, consisting of:

(1) Level of DTD.
(2) Trend of DTD.
(3) Level of (Cash + Short term investments)/Total assets, abbreviated as CASH/TA.
(4) Trend of CASH/TA.
(5) Level of Net income/Total assets, abbreviated as NI/TA.
(6) Trend of NI/TA.
(7) Level of log (Firm market capitalization/Economy's median market capitalization), abbreviated as SIZE.
(8) Trend of SIZE.
(9) Current value of (Market capitalization + Total liabilities)/Total asset, abbreviated as M/B.
(10) Current value of SIGMA.

The data fields that are needed to compute DTD and short-term investments are described in Subsec. II.3. The remaining data fields required are straightforward and standard. The computation for DTD is explained in Sec. III.

II.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 comes 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 FSs as companies release them. Firms will often have multiple versions of FSs 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 FSs to decide which data should be used. The priority rules are described in Sec. III.

The firm coverage of the Back Office Product is of sufficient quality that nearly 34,000 firms can be updated on a daily basis in the 106 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; and data from Prowess for Indian firms.

With all of the databases merged together and for the 106 economies under CRI's coverage, over 60,000 exchange listed firms are in the CRI database. This includes over 30,000 firms that have been delisted at some point in time. 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 106 economies, 71 economies have their own stock exchange (see Table A.2). For the other 35 economies under the RMI 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.

II.3. Constructing Input Variables

The chosen stock indices and short-term interest rates for the 71 economies with their own stock exchange 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' FSs 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 Sec. III. 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 71 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 for 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 non-financial firms, the numerator of the ratio (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).

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 FSs. 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, NI/TA, SIZE, M/B, and SIGMA, and the statistics grouped by economy are listed in Table A.8.

II.4. Data for Defaults

The CRI database contains credit events of over 4,000 firms from 1990 to the present. The default events come from numerous sources, including Bloomberg, Compustat, CRSP, Moodys reports, TEJ, exchange websites and news sources.

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. However, firms that are delisted from an exchange and then experience a default event within 365 calendar days of the delisting will have an exit event reclassified as credit default. 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 made.

Complete statistics of the total number of firms, number of defaults and number of other exits in each of the 71 economies from 1992 to 2012 are listed in Table A.11.

III. IMPLEMENTATION DETAILS

Section I 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 III.1 describes implementation details related to data, mainly dealing with data cleaning and missing data. Subsection III.2 describes the specific computation of DTD used by the CRI system that leads to meaningful DTD for financial firms. Subsection III.3 explains how the calibration previously described in Subsec. I.2 can be implemented. Subsection III.4 gives the implementation details relevant to the daily output. This includes an explanation of the various modifications needed to compute daily PD so that the daily PD is consistent with the usual month end PD, and a description of the computation of the aggregate PDs provided by the CRI.

III.1. Data Treatment

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 FSs 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 RMI 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 RMI 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 FSs: As described in Subsec. II.2, data provided in Bloomberg's Back Office Product can include numerous versions of FSs within the same period. If there are multiple FSs 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 status is relevant only to firms in India, Japan, South Korea and Taiwan, so this rule is only relevant in those economies. Most firms in these economies issue unconsolidated FSs more frequently than consolidated ones, so these are given higher priority. This simple prioritization can, however, lead to cases where the FSs used switch from consolidated statements to unconsolidated statements and back again. More specifically, in South Korea and Taiwan, where corporate structures are biased toward large holding companies, the effect of this switching means that the DTD calculation is not meaningful 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 FSs, 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 FSs 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. Here, FSs that are reported using Generally Accepted Accounting Principles (GAAP) are given higher priority than FSs that are reported using International Financial Reporting Standards (IFRS). If an accounting standard is not indicated at all, the FS is not used.

Financial statement entries with all other descriptors the same but with different filing statuses will be grouped together. For each variable separately, the variable value is taken from the highest priority FS within the group where the value is non-null.

For example, we may consider two FS entries having the same period end, and they both are from annual, consolidated statements, and both use the same accounting standard, but the first entry is classified as the "Most Recent" entry and the second is "Original" entry. Suppose the total assets and total liabilities are reported in the "Original" entry, and in the "Most Recent" entry only the total liabilities have been updated but the total assets have been replaced with a null value, then the total liabilities will be taken from the "Most Recent" entry while the total assets will be taken from the "Original" entry.

The rule mentioned above allows us to group the "Most Recent" and the "Original" entries together, as Bloomberg occasionally only updates values that change without updating other values. If the entries are not grouped, most of the variables would have null values.

One variable that requires special attention is the net income. Net income is a flow variable and needs to be adjusted based on the 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. Due to the different coverage periods, several types of net income can still be used. 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 higher priority than any 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, there are gaps in the market capitalization data provided by Bloomberg. Previously, the first recourse was to use the share price multiplied by the shares outstanding listed in the balance sheet and multiplied by an adjustment factor that Bloomberg provides to account for splits, dividends, etc. However, this data is frequently in error and using the shares outstanding as the previous available market capitalization divided by the price on that day was found to be more reliable.

If the gap in market capitalization data is more than a year, then the previous computation using the shares outstanding from the balance sheet is again used. If there are still remaining gaps in the data, then shares outstanding from Compustat data is 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 that reported at the relevant market close. For firms traded in Asia and Asia-Pacific, the Tokyo closing rate is used; for firms traded in Western Europe, the London closing rate is used; and for firms traded in North 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.

Provisions 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 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. This 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 PD, the PD can be reported again once there are enough valid variables.

With regard to the level variables, the current month and the last 11 months are averaged to compute the level. A minimum of six observations are required to calculate the level variables. However, this condition is not enforced during the first six months of a firm. In the absence of six valid observations after the initial six months of a company, the level variable will be considered as missing.

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 the 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 eight 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 and 0.1 percentile 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. In addition to the special winsorization levels indicated in this table, as of October 2013 calibration; we also apply a winsorization of 0.1 and 99.5 percentile for market-to-book ratio in the Emerging Markets and Europe calibration group.

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 six 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. The median is for the financial or non-financial firms (as indicated by their Bloomberg industry sector code) within the economy during that month. Replacement by the sector median should have a neutral effect on the PD of the firm; the firm is assessed by the other variables that it does have values for. This sector median is always performed in calibration. However, when reporting historical PD, the sector replacement is not done if it results in a relative change in PD of 10% or more where the initial PD was at or above 100 bps, or an absolute change in PD of 10 bps or more where the initial PD was below 100 bps.

However, this treatment of missing values is not always meaningful and occasionally results in counter intuitive patterns in a company's historical PD. Accordingly, the RMI CRI team is reconsidering the treatment of missing values in two stages of development, with the first stage focusing on the replacement of missing values in the initial phase of a company, and the second stage of development focusing on later periods in the company's time series. The first stage has been implemented and is explained below.

In the initial phase of a company — up until 6 months after IPO — it can be expected that the company's data availability and quality is relatively low due to, for example, a delay in the issuance of FSs or illiquid trading. So, many companies require missing value replacements during that period. However, as observed in our data, replacing the missing values during these first six months with a sector median affects a company's PD in an unmeaningful way, sometimes resulting in extreme spikes and falls in the company's PD. Since this occurs at the beginning of a company's history, there are no previous PD values to compare to as can be done at later periods in a company's history.

Hence, in order to avoid this, as of the 2013 February calibration, we set a criterion to start the missing value treatment only six months after the beginning of a company's data. Doing so ensures that PDs in the beginning of a company's history are more reflective of the true creditworthiness of that individual company.

The RMI CRI team is currently developing a method to deal with missing values later in the history of a company in a more meaningful way. This second stage of development for treating missing values will be completed in the coming months.

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 dually listed, in which two corporations listed in different exchanges operate as a single entity but retain separate legal status. In the CRI system, a combined company will be assigned to the single economy it is most associated with. An example is the Rio Tinto Group. This consists of Rio Tinto plc, listed in the UK; and Rio Tinto Limited, listed in Australia. Most of Rio Tinto's operations are in Australia rather than the UK, so Rio Tinto is assigned to Australia.

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 examples include Taiwan's GreTai Securities Market and Singapore's Catalist. The challenge for markets outside of the US or Canada is that the data on whether firms are listed on the smaller markets rather than the main board is difficult to obtain. For all economies besides the US and Canada, there is continuing work being done in the CRI system to exclude firms that are not listed on major exchanges within a country.

Firms that record an exit (other than due to no trading for 90 calendar days) will not enter back into the calibration even if the firm continues to trade and issues FSs, as that can happen after the firms declare bankruptcy. There are two exceptions to this exclusion. The first, determined on a case by case basis, is if the firm should be deemed to have re-emerged from bankruptcy. The second exception is for all firms in China, where two situations are prevalent. The first situation is that the firm experiences few repercussions from the default and continues operating normally. The other situation is for one firm to take over a defaulted firm's listing. This happens due to the limited supply of exchange listings. Both of these situations can be considered as emerging from default, so the CRI system enters all of these companies back into the calibration as new companies.

III.2. DTD 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:

$$\mathrm{d}V_t = \mu V_t \mathrm{d}t + \sigma V_t \mathrm{d}B_t. \tag{34}$$

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. 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: $E_t = \max(V_t - L, 0)$. 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,

$$E_t = V_t N(d_+) - e^{-r(T-t)} L N(d_-), \tag{35}$$

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

$$d_\pm = \frac{\log\left(\frac{V_t}{L}\right) + \left(r \pm \frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}}. \tag{36}$$

Following the Merton (1974) model, the probability of the company's default at time T evaluated at time t is $N(-\mathrm{DTD}_t)$, where DTD at time t is defined as:

$$\mathrm{DTD}_t = \frac{\log\left(\frac{V_t}{L}\right) + \left(\mu - \frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}}. \tag{37}$$

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 firms current liabilities plus one half of its long-term debt. Here, the current liabilities and long-term debt are taken from the firm's FSs. If the firm is missing the current liabilities field, then various substitutes for this field can be used, as described in Subsec. II.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 maximum likelihood estimation method developed in Duan (1994; 2000) 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 is:

$$\begin{aligned}\mathcal{L}(\mu,\sigma,\delta) = &-\frac{n-1}{2}\log(2\pi) - \frac{1}{2}\sum_{t=2}^{n}\log(\sigma^2 h_t)\\ &-\sum_{t=2}^{n}\log\left(\frac{\hat{V}_t(\sigma,\delta)}{A_t}\right)\\ &-\sum_{t=2}^{n}\log[N(\hat{d}_+(\hat{V}_t(\sigma,\delta),\sigma,\delta))]\\ &-\frac{1}{2\sigma^2}\sum_{t=2}^{n}\frac{1}{h_t}\left[\log\left(\frac{\hat{V}_t(\sigma,\delta)}{A_t}\right.\right.\\ &\left.\left.\times\frac{A_{t-1}}{\hat{V}_{t-1}(\sigma,\delta)}\right) - \left(\mu-\frac{\sigma^2}{2}\right)h_t\right]^2,\end{aligned} \tag{38}$$

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. (35), $\hat{d}_+$ is computed with Eq. (36) 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. (35). If there are fewer than 50 days of valid observations for the market capitalization, then the DTD value is set to 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 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 (38) over $\sigma \geq 0$ and $0 \leq \delta \leq 1$, and then to calculate the DTD from Eq. (37). 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

$$\hat{\mu} = \frac{\hat{\sigma}^2}{2} + \frac{1}{\sum_{t=2}^{n} h_t}\log\left(\frac{\hat{V}_n(\hat{\sigma},\hat{\delta})}{A_n}\times\frac{A_1}{\hat{V}_1(\hat{\sigma},\hat{\delta})}\right). \tag{39}$$

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

$$\begin{aligned}\tilde{\mathcal{L}}(\sigma,\delta) = &-\frac{n-1}{2}\log(2\pi) - \frac{1}{2}\sum_{t=2}^{n}\log(\sigma^2 h_t)\\ &-\sum_{t=2}^{n}\log\left(\frac{\hat{V}_t(\sigma,\delta)}{A_t}\right) - \frac{1}{2\sigma^2}\left\{\sum_{t=2}^{n}\frac{1}{h_t}\right.\\ &\times\left[\log\left(\frac{\hat{V}_t(\sigma,\delta)}{A_t}\times\frac{A_{t-1}}{\hat{V}_{t-1}(\sigma,\delta)}\right)\right]^2\\ &-\frac{1}{\sum_{t=2}^{n} h_t}\\ &\left.\times\left[\log\left(\frac{\hat{V}_n(\hat{\sigma},\hat{\delta})}{A_n}\times\frac{A_1}{\hat{V}_1(\hat{\sigma},\hat{\delta})}\right)\right]^2\right\}.\end{aligned} \tag{40}$$

However, with quarterly FSs 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. All financial sector firms in the same economy are assumed to share the same estimate of δ, chosen to be the average of all its individual estimates. The same is done for non-financial firms. Accordingly, with δ being fixed to be the sector average, the original maximization of $\tilde{\mathcal{L}}(\sigma, \delta)$ is reduced to a one-dimensional maximization in σ. Thus, this maximization is used to perform the estimates of 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 is used instead of one year, and a minimum of 250 days of valid observations of the market capitalization 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. (37) is eliminated.

In summary, the DTD for each firm is computed using the economy and sector (financial or non-financial) average 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 a computational grid administered by the NUS Computer Center, the DTD computational time for all firms over the full history of twenty years takes only about 3.5 hours.

III.3. Calibration

Implementation: As shown in Sec. I, 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, 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, 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 71 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.

Starting from the August 2012 calibration, Canada and the US remain in the same 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, which now includes Israel, Russia and Turkey. The other emerging economies of Asia Pacific (Kazakhastan, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam) are grouped together with the Latin American economies (Argentina, Brazil, Colombia, Chile, Mexico, Peru, and Venezuela), Middle-East economies (Bahrain, Jordan, Kuwait, Saudi Arabia and United Arab Emirates) and African economies (Egypt, Morocco, Nigeria and South Africa), to form the "emerging markets" calibration group.

All economies in these new calibration groups share the same coefficients for all variables except for the benchmark risk-free interest rate variable. The benchmark interest rates coefficient will be allowed to vary, because different economies based in different currencies naturally have different dependencies on their interest rates and the interest rate levels can differ significantly across economies. After adopting the euro, all eurozone countries use Germany's three-month Bubill rate as this is more reflective of monetary rather than sovereign credit conditions in each economy, which is the intent of this variable. For the period before joining the eurozone, their own interest rates are used.

In addition, the benchmark interest rate is entered as the current value minus the historical month-end mean. This allows the variable to reflect its value relative to the historical average. When an economy does not have enough default events to identify a separate interest rate coefficient, the interest rate variable will be disabled for that economy by inputting a zero value for the whole time series. In fact, that is also why we de-mean all interest rate series so that setting the interest rate series of a particular economy to zero, when necessary, does not induce a bias by the base economy in the same group.

Since all eurozone countries except Germany do not have enough default events prior to joining the eurozone, their benchmark interest rate is entered as zero for that period. Among the non-eurozone members of the European group, Denmark, Norway, Sweden and the UK each have separate coefficients for the benchmark interest rate. Switzerland and Iceland do not use this variable for their whole history.

In the Developed Asia-Pacific group, all economies have their own coefficient for the benchmark interest rate, except for Japan and New Zealand who share the same coefficient. For the North American group, both Canada and the US have their own coefficient for the benchmark interest rate.

In the Emerging Markets group, there are insufficient defaults in the Latin American economies to calibrate individual economy benchmark interest rate coefficients in a statistically significant way, so all Latin American economies share the same benchmark interest rate coefficient. Among the Asian economies in the Emerging Markets group, Indonesia, Malaysia, and the Philippines have their own coefficient for the benchmark interest rate, while Vietnam does not use this variable. All the other economies in the Emerging Markets group share the same benchmark interest rate coefficient. Indonesia also has its own intercept and uses its own coefficients for the stock index return, CASH/TA level and Relative Size level. These coefficients are required because these characteristics for defaulting firms in Indonesia are substantially different than in other economies. Separate coefficients are required to improve the accuracy of the PD forecasts. In October 2013, an additional 50 default events were collected for Indonesia. With these additional events, a re-assessment of the special treatment of Indonesia was called for. Based on our analysis, as of now Indonesia only uses its own coefficients for interest rate and relative size, indicating that the two variables are still significantly different compared to other economies in the Emerging Markets group. The common Emerging Markets coefficient for the CASH/TA level is now used for Indonesian companies.

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 firm's 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.

To avoid this problem, we use a combination of the economy's stock index and the economy's median market cap as the divisor in the Relative Size variable:

(1) We choose a recent month where there is a more complete set of firms in the economy that have trading activity, and calculate the ratio of the economy's median market cap to stock index value at the end of the month.
(2) For each month, the divisor for the Relative Size variable of firms in the economy is taken as the month end stock index multiplied by that ratio.

III.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.

Exclusion rule for Mergers & Acquisitions: Mergers & Acquisitions (M&A) events are common occurrences. When an important M&A deal is closed, the Market Capitalization (MC) of the acquirer changes immediately as the MC of the acquirer will now reflect the joint value of the acquirer and the target. However, the FS will not immediately reflect the new situation. In this case, the DTD and market-to-book ratio, which are important inputs for the PD computation, will be distorted due to a mismatch in the MC and the FS variables. In order to ensure the accuracy and reliability of our PD estimates, we apply a rule to disable PD calculations for companies that are involved in important M&A deals.

An important M&A deal is defined as an M&A event on which all the following three criteria apply:

(1) Upon the deal's completion, the acquiring company 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 MC is material, with the largest absolute daily MC return, within 20 days of the M&A completion day, larger than or equal to 5%.

In the event of an important M&A, the PDs of the acquirer will be not be computed until we are able to include FS variables reflecting the new situation (typically between 3 and 6 months after deal completion). The RMI CRI team is currently developing a method to deal with M&A cases more systematically, and will avoid having to disable PDs for companies involved in an important M&A deal.

Aggregating PD: 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. With the individual firms' PD, the expected number of defaults is trivial to compute. The algorithm used to compute the probability distribution of the number of defaults was originally reported in Anderson *et al.* (2003). It assumes conditional independence and uses a fast recursive scheme to compute the necessary probability distribution.

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.

Inclusion of firms in aggregation: As explained in Subsec. III.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.

In order to implement the treatment, default events are classified into hard defaults and soft defaults (see Table 1).

Hard defaults are default events that are typically permanent. In other words, companies typically cannot emerge from hard defaults. An example of a hard default is a forced liquidation of a company. PDs will not be computed after the default event unless there is an exceptional circumstance that warrants a manual intervention. General Motors (GM) is an example of such an event. Although GM filed for Chapter 11 reorganization in June 2009, the company resumed operations in March 2011. As of March 2011, after the company resumed operations, we decided to treat GM as a new company.

Table 1. Classification of default events.

Default-Action Type	Subcategory
Hard Defaults (Default events that are typically permanent)	Administration, Arrangement, Canadian CCAA, Chapter 7, Chapter 11, Chapter 15, Conservatorship, Insolvency, Japanese CRL, Judicial Management, Liquidation, Pre-Negotiated Chapter 11, Protection, Receivership, Rehabilitation, Reorganization, Restructuring, Section 304, Supreme court declaration, Winding Up, Work Out, Other, Unknown.
Soft Defaults (Default events that companies can emerge from)	Coupon & Principal Payment, Coupon Payment Only, Debt Restructuring, Interest Payment, Loan Payment, Principal Payment, ADR (Japan only), Declared Sick (India only), Rehabilitation (Thailand 1997), Unknown.

Soft defaults are default events that companies can typically emerge from. An example of a soft default is a debt restructuring. More specifically, after a soft default, if there is sufficient data for the company, then the company is assumed to have been able to continue its operations and PDs are computed. The PDs are generated once sufficient history of both the market capitalization data and the new FS data (released after the event) becomes available. Take the Australian company Marion Energy Ltd as an example, which had a debt restructuring in April 2010. We stopped calculating PD after 31 March 2010. As debt restructuring is considered as a soft default, we started calculating PD again from 30 September 2010 onwards, when data requirements were met.

This treatment does not apply to Chinese companies, based on two reasons: (1) a firm typically experiences few repercussions from the default and continues operating normally; and (2) it is common for another firm to take over a defaulted firm's listing, due to the limited supply of exchange listings. Both of these situations can be considered as emerging from default, so the CRI system enters all of these companies back into the calibration as new companies.

IV. EMPIRICAL ANALYSIS

This section presents an empirical analysis of the CRI outputs for the 71 economies with their own exchange that are currently being covered. In Subsec. IV.1, an overview is given of the default parameter estimates. Subsection IV.2 explains and provides the accuracy ratios for the different countries under the CRI coverage.

IV.1. Parameter Estimates

With 60 months of forecast horizons, 13 variables 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 2014 using data up until the end of March 2014. As an example, plots of the default parameters for the US are given in figures included 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 conditional 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 a different relationship 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, almost all of the calibrations for the different groups lead to negative default parameters for the DTD level.

The ratio of the sum of cash and short-term investments to total assets (CASH/TA) measures liquidity of a firm. This indicates the availability of a firm's funds and its ability to make interest and principal payments. As expected, for almost all economies (Indonesia being the only exception) the default parameters for CASH/TA level in shorter horizons are significantly negative. The magnitude of the default parameters typically decreases for longer horizons, indicating that CASH/TA level is a better indicator of a firm's ability to make payments in the short term than the long term.

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 most economies and most horizons.

The logarithm of the market capitalization of a firm over the median market capitalization of firms 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 all horizons, suggesting that the complexity of larger firms outweighs the potential benefits, such as diversified business lines and funding sources, are a benefit in the shorter term but not in the longer term. On the other hand, in Japan the default parameters for SIZE level are negative across all horizons. These differences may reflect differences in the business environments in the respective economies.

The default parameters associated with DTD Trend, CASH/TA 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 sum of market capitalization and total liabilities to total assets (M/B) can either indicate the market mis-valuation effect or the future growth effect. This default parameter is negative in most economies, indicating that higher M/B implies lower PD, and the future growth effect dominates. 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 misvaluation 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. Currently, for the different economies, this variable is no longer significant.

IV.2. Prediction Accuracy

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

A single calibration is conducted for the in-sample tests, using data to the end of the data sample. As an example, one-year PD forecasts are made for December 31, 2000 by using the data at or before December 31, 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 tests 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: $\mathrm{AR} = 2 \times \mathrm{AUROC} - 1$.

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 PD are taken to be non-overlapping. For example, the one-year AR is based on PDs computed on 31/12/2000, 31/12/2001, . . . , 31/12/2009 and firms defaulting within one year of those dates, while the two-year AR is based on PDs computed on 31/12/2000, 31/12/2002, . . . , 31/12/2008 and firms defaulting within two years of those dates.

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. Australia, the UK and Singapore have sharp drops in AR at the two-year horizon. Hong Kong has comparatively worse AR over all horizons as compared to other developed economies.

The AR in emerging market economies such as Brazil, China, India, Indonesia, Malaysia, Philippines, Russia, and Vietnam 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 were selected based on the predictive power in a developed economy, 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 Fig. B.3 to B.8. For China and India in particular, these figures show that there is room for improvement in the predictive power of the model.

V. ONGOING DEVELOPMENTS

The CRI can be developed along 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.

As an example, the CRI will soon start a parallel implementation using the partially-conditioned forward intensity approach proposed in Duan and Fulop (2013) to study its practicality and performance. In fact, the parameter constraints on the forward-intensity function essential to the implementation of that approach has already been incorporated into the current CRI system in making longer-term default predictions.

Within the current modeling framework, future developments involve, for example, variable selection where more experiments are needed to identify common risk factors and company-specific attributes that are more indicative of defaults in emerging markets.

Finally, a series of new applications and tools using the RMI PD as an input are currently being developed. More specifically, RMI 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. Some interesting areas include research in counterparty risk management and stress testing of financial systems by policy makers. RMI also remains committed to making its vast resources available for academic research.

ACKNOWLEDGMENT

The RMI CRI 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@globalcreditreview.com.

APPENDIX A: DATA

Table A.1. All countries under the RMI coverage.

Region	Economy
Asia-Pacific (21)	Australia, China, Hong Kong, Indonesia, India, Japan, Kazakhstan, Malaysia, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, Vietnam, New Zealand, Cambodia, Macau, Mongolia and Papua New Guinea.
North America (2)	Canada, the United States.
Europe (43)	Austria, Belgium, Bermuda, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Macedonia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom, Ukraine, Faeroe Island, Gibraltar, Guernsey, Isle Of Man, Jersey, Liechtenstein and Monaco.
Latin America (17)	Argentina, Brazil, Columbia, Chile, Mexico, Peru, Venezuela, Bahamas, Belize, Cayman Islands, Curacao, Dominican Republic, Falkland Islands, Panama, Puerto Rico, Virgin Islands and Virgin Islands, British.
Middle-East (10)	Bahrain, Israel, Jordan, Kuwait, Saudi Arabia, United Arab Emirates, Azerbaijan, Iraq, Qatar and Sudan.
Africa (13)	Angola, Egypt, Morocco, Nigeria, South Africa, Gabon, Mauritius, Mozambique, Namibia, Sierra Leone, Tanzania, United Republic of, Togo and Zambia.

Table A.2. The 71 countries under the RMI coverage for which we cover companies listed on the exchange.

Region	Economy
Asia-Pacific (17)	Australia, China, Hong Kong, Indonesia, India, Japan, Kazakhstan, Malaysia, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, Vietnam and New Zealand.
North America (2)	Canada and the United States.
Europe (35)	Austria, Belgium, Bermuda, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Macedonia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom, Ukraine.
Latin America (7)	Argentina, Brazil, Columbia, Chile, Mexico, Peru and Venezuela.
Middle-East (6)	Bahrain, Israel, Jordan, Kuwait, Saudi Arabia and United Arab Emirates.
Africa (4)	Egypt, Morocco, Nigeria and South Africa.

Table A.3. The 35 countries under the RMI 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	Gibraltar	Panama
Azerbaijan	Guernsey	Papua New Guinea
Bahamas	Iraq	Puerto Rico
Belize	Isle Of Man	Qatar
Bermuda	Jersey	Sierra Leone
Cambodia	Liechtenstein	Sudan
Cayman Islands	Macau	Tanzania, United Republic of
Curacao	Mauritius	Togo
Dominican Republic	Monaco	Virgin Islands
Faeroe Island	Mongolia	Virgin Islands, British
Falkland Islands	Mozambique	Zambia
Gabon	Namibia	

Table A.4. ISO codes for economies currently covered by the CRI and the group that each economy is calibrated in.

ISO Code	Economy	Calibration Group
ARE	United Arab Emirates	Emerging
ARG	Argentina	Emerging
AUS	Australia	Developed Asia-Pacific
AUT	Austria	Europe
BEL	Belgium	Europe
BGR	Bulgaria	Europe
BHR	Bahrain	Emerging
BRA	Brazil	Emerging
CAN	Canada	North America
CHE	Switzerland	Europe
CHL	Chile	Emerging
CHN	China	China
COL	Colombia	Emerging
CYP	Cyprus	Europe
CZE	Czech Republic	Europe
DEU	Germany	Europe
DNK	Denmark	Europe
EGY	Egypt	Emerging
ESP	Spain	Europe
EST	Estonia	Europe
FIN	Finland	Europe
FRA	France	Europe
GBR	United Kingdom	Europe
GRC	Greece	Europe
HKG	Hong Kong	Developed Asia-Pacific
HRV	Croatia	Europe

(*Continued*)

Table A.4. (*Continued*)

ISO Code	Economy	Calibration Group
HUN	Hungary	Europe
IDN	Indonesia	Emerging
IND	India	India
IRL	Ireland	Europe
ISL	Iceland	Europe
ISR	Israel	Europe
ITA	Italy	Europe
JOR	Jordan	Emerging
JPN	Japan	Developed Asia-Pacific
KAZ	Kazakhstan	Emerging
KOR	South Korea	Developed Asia-Pacific
KWT	Kuwait	Emerging
LKA	Sri Lanka	Emerging
LTU	Lithuania	Europe
LUX	Luxembourg	Europe
LVA	Latvia	Europe
MAR	Morocco	Emerging
MEX	Mexico	Emerging
MKD	Macedonia	Europe
MLT	Malta	Europe
MYS	Malaysia	Emerging
NGA	Nigeria	Emerging
NLD	Netherlands	Europe
NOR	Norway	Europe
NZL	New Zealand	Developed Asia-pacific
PAK	Pakistan	Emerging
PER	Peru	Emerging
PHL	Philippines	Emerging
POL	Poland	Europe
PRT	Portugal	Europe
ROM	Romania	Europe
RUS	Russian Federation	Europe
SAU	Saudi Arabia	Emerging
SGP	Singapore	Developed Asia-Pacific
SVK	Slovakia	Europe
SVN	Slovenia	Europe
SWE	Sweden	Europe
THA	Thailand	Emerging
TUR	Turkey	Europe
TWN	Taiwan	Developed Asia-Pacific
UKR	Ukraine	Emerging
USA	United States	North America
VEN	Venezuela	Emerging
VNM	Vietnam	Emerging
ZAF	South Africa	Emerging

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

Country	Stock Exchange	Period Used*
ARE	FTSE NASDAQ DUB UAE 20	6/28/2006–Present
ARG	Buenos Aires Stock Exchange Merval Index	
AUS	All Ordinaries Index	
AUT	Austrian Traded ATX Index	
BEL	Belgian All Shares Return Index	
BGR	Bulgaria Stock Exchange Sofix Index	10/24/2000–Present
BHR	Bahrain Bourse All Share Index	7/8/2004–Present
BRA	Brazil Bovespa Stock Index	
CAN	S&P/TSX Composite Index	
CHE	SPI Swiss Performance Index	
CHL	Santiago Stock Exchange IPSA Index	
CHN	Shanghai Stock Exchange Composite Index	
COL	FTSE All World Series Colombia Local	
CYP	Cyprus Stock Exchange General Index	9/3/2004–Present
	Cyprus Stock Exchange General	4/2/1996–9/2/2004
CZE	Prague Stock Exch Index	4/5/1994–Present
DEU	CDAX Performance Index	
DNK	OMX Copenhagen 20 Index	
EGY	EGX 100 Index	5/1/2006–Present
ESP	IBEX 35 Index	
EST	OMX Tallinn OMXT	
FIN	OMX Helsinki Index	
FRA	CAC 40 Index	
GBR	FTSE 100 Index	
GRC	Athex Composite Share Price Index	
HKG	Hang Seng Index	
HRV	Croatia Zagreb CROBEX	6/14/2002–Present
HUN	Budapest Stock Exch Index	1/2/1991–Present
IDN	Jakarta Composite Index	
IND	BSE Sensex 30 Index	
IRL	Irish Overall Index	
ISL	OMX Iceland All-Share Price Index	
ISR	Tel Aviv 100 Index	12/31/1991–Present
ITA	Italy Stock Market BCI Comit Global	
JOR	MSCI Jordan	3/7/2011–Present
JPN	Nikkei 500	
KAZ	Kazakhstan Stock Exchange Index KASE	7/12/2000–Present
KOR	KOSPI Index	
KWT	Kuwait SE Weighted Index	1/2/2012–Present
	Kuwait Global General Index	1/2/1984–1/2/2012
LKA	Sri Lanka Colombo All-Share Index	1/2/1985–Present
LTU	OMX Vilnius OMXV	1/4/2000–Present
LUX	Luxembourg Stock Exchange LuxX Index	1/4/1999–Present
	Luxembourg Stock Exchange 13 'Dead'	1/2/1998–1/3/1999
LVA	OMX GIRA OMXR	1/2/2000–Present
MAR	CFG 25	12/31/1993–Present
MEX	Mexico Bolsa Index	
MKD	Macedonian Stock Exchange MBI 10	12/30/2004–Present
MLT	Malta Stock Exchange	
MYS	FTSE Bursa Malaysia KLCI	
NGA	NIGERIA STCK EXC ALL SHR	1/30/1998–Present
NLD	AEX Index	
NOR	OBX Price Index	

(*Continued*)

Table A.5. (*Continued*)

Country	Stock Exchange	Period Used*
NZL	NZX All Index	3/30/1992–Present
PAK	Karachi All Share Index	3/11/1998–Present
PER	Bolsa de Valores de Lima General Sector Index	
PHL	PSEI-Philippine Stock Exchange Index	
POL	WSE WIG Index	4/16/1991–Present
PRT	PSI General Index	
ROM	BSE COMPOSITE INDEX	4/17/1998–Present
RUS	MICEX INDEX	9/22/1997–Present
SAU	TADAWUL ALL SHARE INDEX	1/31/1994–Present
SGP	Straits Times Index	1/10/2008–Present
	Straits Times Old Index	8/31/1999–1/9/2008
SVK	Slovak Share Index	
SVN	HSBC Slovenia Dollar	
SWE	OMX Stockholm All-Share Index	
THA	Stock Exchange of Thailand Index	
TUR	Istanbul Stock Exchange National 100 Index	1/4/1988–Present
TWN	Taiwan Taiex Index	
UKR	Ukraine PFTS Index	1/12/1998–Present
USA	S&P 500 Index	
VEN	Caracas Stock Exchange Stock Market Index	
VNM	Ho Chi Minh Stock Index	7/28/2000–Present
ZAF	MSCI South Africa Index	12/31/1992–Present

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

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

Country	Short Term Interest Rate	Period Used
ARE	UAE Ibor 3 Months	5/15/2000–Present
ARG	Argentina Deposit 90 Days	
AUS	Australia Dealer Bill 90 Days	
AUT	Germany 3 Month Bubill	1/1/1999–Present
	—	–12/31/1998
BEL	Germany 3 Month Bubill	1/1/1999–Present
	—	–12/31/1998
BGR	Bulgaria Interbank 3 Months	2/17/2003–Present
BHR	Bahrain Ibor 3 Months	12/14/2006
BRA	Andima Brazil Govt Bond Fixed Rate 3 Months	4/3/2000–Present
	Brazil CDB (up to 30 Days)	10/10/1994–3/31/2000
CAN	Canada Treasury Bill 3 Months	
CHE	—	
CHL	Chile TAB UF Interbank Rate 90 Days	
CHN	China Time Deposit Rate 3 Months	
COL	Colombia CD Rate 90-Day	
CYP	Germany 3 Month Bubill	1/1/2008–Present
	—	–12/31/2007
CZE	Czech Republic Interbank 3 MTH	4/22/1992–Present
DEU	Germany 3 Month Bubill	5/25/1993–Present
	Germany Interbank 3 Months	1/2/1986–5/24/1993
DNK	Denmark Interbank 3 Months	
EGY	Egypt 91 Days T-Bill	7/6/2004–Present

(*Continued*)

Table A.6. (*Continued*)

Country	Short Term Interest Rate	Period Used
ESP	Germany 3 Month Bubill	1/1/1999–Present
	—	–12/31/1998
EST	Germany 3 Month Bubill	1/1/2011–Present
	—	–12/31/2010
FIN	Germany 3 Month Bubill	1/1/1999–Present
	—	–12/31/1998
FRA	Germany 3 Month Bubill	1/1/1999–Present
	—	–12/31/1998
GBR	UK Treasury Bill Tender 3 Months	
GRC	Germany 3 Month Bubill	1/1/2001–Present
	—	–12/31/2000
HKG	Hong Kong Exchange Fund Bill 3 Months	
HRV	Croatia Zibor Rate 3 Months	6/2/1997–Present
HUN	Hungary Interbank 3 Months	9/7/1995–Present
IDN	Indonesia SBI 90 Days	7/10/2003–Present
	Indonesia SBI/DISC 90 Days	1/1/1985–7/9/2003
IND	India T-Bill Secondary 91 Days	
IRL	Germany 3 Month Bubill	1/1/1999–Present
	—	–12/31/1998
ISL	—	
ISR	Israel T-Bill Secondary 3 Months	5/30/1995–Present
ITA	Germany 3 Month Bubill	1/1/1999–Present
	—	–12/31/1998
JOR	Amman Interbank 3 Months	3/9/2001–Present
JPN	Japan Treasury Discount Bills 3 Months	7/10/1992–Present
	Japanese Government Bond Interest Rate — 1 Year Maturity	9/24/1974–7/9/1992
KAZ	Kazakhstan KIBOR/KIBID 90 Days Interbank	9/29/2001–Present
KOR	Korea Commercial Paper 91 Days	
KWT	Kuwait Interbank 3 Months	8/17/1983–Present
LKA	Sri Lanka Treasury Bill 3 Months	1/6/1989–Present
LTU	VILNIUS Interbank Three Months	1/6/1999–Present
LUX	Germany 3 Month Bubill	1/1/1999–Present
	—	–12/31/1998
LVA	Treasury Bill Rate 3 Months	5/11/1994–Present
MAR	Morocco Deposit Rate 3 Months	6/6/2003–Present
MEX	Mexico Cetes 2ND MKT. 90 Days	6/26/1996–Present
	Mexico Cetes 91 Dat AVG.RET.AT AUC.	3/9/1989–6/25/1996
MKD	Macedonia Skibor 3 Months	7/2/2007–Present
MLT	Germany 3 Month Bubill	1/1/2008–Present
	—	–12/31/2007
MYS	Malaysia Deposit 3 Months	
NGA	Nigeria Interbank Offered Rate 3 Months	1/30/2004–Present
NLD	Germany 3 Month Bubill	1/1/1999–Present
	—	–12/31/1998
NOR	Norway Govt Treasury Bills 3 Months	6/27/1995–Present
	Norway Interbank 3 Months (effective)	1/2/1986–6/26/1995
NZL	New Zealand Dollar Deposit 3 Months	9/27/1988–Present
PAK	PKR 3 Months Repo	10/29/1999–Present
PER	Peru Savings Rate	
PHL	Philippine Treasury Bill 91 Days	
POL	Poland Interbank 3 Months (EOD)	6/4/1993–Present
PRT	Germany 3 Month Bubill	1/1/1999–Present
	—	–12/31/1998

(*Continued*)

Table A.6. (*Continued*)

Country	Short Term Interest Rate	Period Used
ROM	Romanian Interbank 3 Months	8/1/1995–Present
RUS	MosPime 3 Months Rate	4/18/2005–Present
	Russia Moscow Interbank Non Co	8/14/2000-4/17/2005
	Russian Federation Interbank 31–90 Days	9/1/1994-8/13/2000
SAU	Saudi Interbank 3 Months	1/1/1987–Present
SGP	Monetary Authority of Singapore Benchmark Govt Bill Yield 3 Months	9/20/2013–Present
	Singapore T-Bill 3 Months	1/8/1988–9/19/2013
SVK	Germany 3 Month Bubill	1/1/2009–Present
	—	–12/31/2008
SVN	Germany 3 Month Bubill	1/1/2007–Present
	—	–12/31/2006
SWE	Sweden T-Bill 3 Months	5/25/1993–Present
	Sweden Treasury Bill 90 Days	4/25/1989–5/24/1993
THA	Thailand Repo 3 Months (BOT)	
TUR	Turkish Interbank 3 Months	8/1/2002–Present
TWN	Taiwan Money Market 90 Days	
UKR	Ukraine Interbank 3 Months	3/1/2001–Present
USA	US Generic Govt 3-Month Yield	
VEN	Venezuela Overnight	
VNM	Vietnam Interbank 3 Months	12/11/1998–Present
ZAF	South Africa T-Bill 91 Days (Tender Rates)	12/31/1980–Present

*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.

Country	Interest Rate Name	Period Used*
ARE	UAE Ibor 1 Year	5/15/2000–Present
ARG	Aregentina Deposit 90 Days (PA.)	
AUS	Australia Govt. Bonds Generic Mid Yield 1 Year	
AUT	German Government Bonds 1 Year BKO	1/1/1999–Present
	Austria VIBOR 12 Months	6/10/1991–12/31/1998
BEL	German Government Bonds 1 Year BKO	1/1/1999–Present
	Belgium Treasury Bill 1 Year	4/2/1991–12/31/1998
BGR	Bulgaria Interbank 3 Months	2/17/2003–Present
BHR	Bahrain Ibor 1 Year	12/14/2006
BRA	Andima Brazil Govt Bond Fixed Rate 1 Year	4/3/2000–Present
	BRAZIL CDB (UP TO 30 DAYS)	10/10/1994–3/31/2000
CAN	Canada Treasury Bill 1 Year	
CHE	Swiss Interbank 1 Year (ZRC:SNB)	
CHL	Chile TAB UF Interbank Rates 360 Days	8/1/1996–Present
	Chile TAB UF Interbank Rate 90 Days	11/2/1992–7/30/1996
CHN	China Household Savings Deposits 1 Year Rate	
COL	Colombia Government Generic Bond 1 Year Yield	3/1/2001–Present
	Colombia CD Rate 360-Dat	7/12/1993–2/8/2001
CYP	Cyprus Treasury Bill Rate — 13 Weeks	
CZE	Czech Republic Interbank 3 MTH	4/22/1992–Present
DEU	German Government Bonds 1 Year BKO	1/10/1995–Present
	Germany Interbank 12 Months	11/2/1990–1/9/1995
DNK	Denmark Government Bonds 1 Year Note Generic Bid Yield	6/1/2008–Present
	Denmark Euro-Krone 1 Year (FT/ICAP/TR)	6/14/1985–5/31/2008

(*Continued*)

Table A.7. (*Continued*)

Country	Interest Rate Name	Period Used*
EGY	Egypt 364 Days T-Bill	7/6/2004–Present
ESP	German Government Bonds 1 Year BKO	1/1/1999–Present
	Spain 12 Months Treasury Bill Yield	11/30/1992–12/31/1998
	Spain Interbank 12 Months	12/19/1991–11/29/1992
EST	Estonia, Interest Rates, Prices, Production, & Labor, Interest Rates, Deposit Rate	
FIN	German Government Bonds 1 Year BKO	1/1/1999–Present
	Finland Interbank Close 12 Months	4/2/1992–12/31/1998
FRA	German Government Bonds 1 Year BKO	1/1/1999–Present
	France Treasury Bill 12 Months	1/3/1989–12/31/1998
GBR	UK Govt. Bonds 1 Year Note Generic	9/12/2001–Present
	UK Govt. Liability Nominal Spot Curve 12 Months	12/13/1985–9/11/2001
GRC	German Government Bonds 1 Year BKO	1/1/2001–Present
	Greece Treasury Bill 1 Year	1/2/1990–12/31/2000
HKG	HKMA Hong Kong Exchange Fund Bill 12 Months	
HRV	Croatia Zibor Rate 3 Months	6/2/1997–Present
HUN	Hungary Interbank 3 Months	9/7/1995–Present
IDN	Indonesia SBI 90 Days	7/10/2003–Present
	Indonesia SBI/DISC 90 Days	1/1/1985–7/9/2003
IND	India T-Bill Secondary 1 Year	
IRL	UK Govt. Liability Nominal Spot Curve 12 Months	
ISL	Iceland Interbank 12 Months	2/1/2000–Present
	Iceland Interbank 3 Months	8/4/1998–1/31/2000
	Iceland 90-day CB Notes	5/12/1987–8/3/1998
ISR	Israel T-Bill Secondary 1 Year	11/15/1994–Present
ITA	German Government Bonds 1 Year BKO	1/1/1999–Present
	Italy Bots Treasury Bill 12 Months Gross Yields	9/5/1994–12/31/1998
	Italy T-Bill Auction Gross 12 Months	3/31/1987–9/4/1994
JOR	Amman Interbank 1 Year	3/9/2001–Present
JPN	Japan Treasury Bills 12 Months	12/14/1999–Present
	Japanese Government Bond Interest Rate — 1 Year Maturity	9/24/1979–12/13/1999
KAZ	Kazakhstan KIBOR/KIBID 90 Days Interbank	9/29/2001–Present
KOR	Korea Monetary Stabilization Bonds 1 Year	
KWT	Kuwait Interbank 1 Year	8/17/1983–Present
LKA	Sri Lanka Fixed Deposit 1 Year	3/31/1988–Present
LTU	Vilnius Interbank 12 Months	3/29/2000–Present
LUX	Long Term Government Bond Yields — Maastricht Definition (Avg.)	
LVA	Treasury Bill Rate 1 Year	4/3/1998–Present
MAR	Morocco Deposit Rate 1 Year	6/6/2003–Present
MKD	Macedonia Skibor 3 Months	7/2/2007–Present
MEX	Mexico Cetes 2ND MKT. 360 Days	6/26/1996–Present
	Mexico Cete 91 DAY AVG.RET.AT AUC	3/9/1989–6/25/1996
MLT	Long Term Government Bond Yields — Maastricht Definition (Avg.)	
MYS	Bank Negara Malaysia 1 Year Govt. Securities Indicative YTM	6/21/2005–Present
	Malaysia Deposit 1 Year	1/1/1985–6/20/2005
NGA	Nigeria Interbank Offered Rate 3 Months	1/30/2004–Present
NLD	German Government Bonds 1 Year BKO	1/1/1999–Present
	Netherland Interbank 1 Year	1/2/1987–12/31/1998
NOR	Norway Govt Treasury Bills 12 Months	7/1/1997–Present
	Norway Interbank 1 Year	1/2/1986–6/30/1997
NZL	New Zealand Dollar Deposit 1 Year	9/27/1988–Present
PAK	PKR 12 Months Repo	10/29/2004–Present
PER	Peru Savings Rate	
PHL	Philippine Treasury Bill 364 Days	

(*Continued*)

Table A.7. (*Continued*)

Country	Interest Rate Name	Period Used*
POL	Poland Interbank 1 Year (EOD)	10/11/1995–Present
PRT	German Government Bonds 1 Year BKO	1/1/1999–Present
	Portugal 1-Year-LISBOR-Act/365 Days convention	8/16/1993–12/31/1998
ROM	Romanian Interbank 12 Months	8/1/1995–Present
RUS	MosPime 3 Months Rate	4/18/2005–Present
	Russia Moscow Interbank Non Co	8/14/2000–4/17/2005
	Russian Federation Interbank 31–90 Days	9/1/1994–8/13/2000
SAU	Saudi Interbank 1 Year	1/1/1987–Present
SGP	Monetary Authority of Singapore Benchmark Govt Bill Yield 3 Months	9/20/2013–Present
	Singapore T-Bill 3 Months	1/8/1988–9/19/2013
SVK	Slovak Rep.Interbank 1 Year	
SVN	Slovenia Treasury Bill 3 Months 'Dead'	
SWE	Sweden T Bill 3 Months	5/25/1993–Present
	Sweden Treasury Bill 90 Days	4/25/1989–5/24/1993
THA	Thailand Govt. Bond 1 Year Note	8/7/2000–Present
	Thailand Deposit 12 Months (KT)	1/2/1991–8/6/2000
TUR	Turkish Interbank 12 Months	8/1/2002–Present
TWN	Taiwan Deposit 12 Months	
UKR	UAE Ibor 1 Year	5/15/2000–Present
USA	US Treasury Constant Maturities 1 Year	
VEN	Venezuela Overnight	
VNM	Vietnam Interbank 3 Months	12/11/1998–Present
ZAF	South Africa T-Bill 91 Days (Tender Rates)	12/31/1980–Present

*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 1991 to March 2014).

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				DTD Level				
ARE	−0.80	1.85	2.82	3.86	13.33	3.12	1.90	5,591
ARG	−1.75	1.37	2.67	3.84	19.82	2.88	2.24	12,873
AUS	−1.40	1.85	2.97	4.20	18.66	3.29	2.19	289,095
AUT	−2.67	1.89	3.09	4.96	24.48	3.92	3.78	20,436
BEL	−2.67	2.55	4.41	6.75	24.48	5.06	3.76	29,567
BGR	−1.78	1.08	2.02	3.22	24.48	2.46	2.30	10,386
BHR	−0.27	1.73	2.43	4.56	18.23	3.53	2.92	1,460
BRA	−1.84	0.72	1.84	3.42	24.08	2.43	2.70	51,037
CAN	−1.13	1.91	3.27	4.96	24.84	3.71	2.61	218,173
CHE	−2.67	2.68	4.11	5.98	24.48	4.58	2.91	51,381
CHL	−1.84	3.58	5.24	6.79	25.62	5.63	3.45	28,944
CHN	0.04	3.11	4.21	5.77	16.57	4.68	2.29	277,785
COL	−1.35	2.33	3.94	5.78	20.21	4.38	3.09	5,836
CYP	−1.19	0.88	1.53	2.46	23.81	2.06	2.26	16,185
CZE	−2.67	1.30	2.42	3.73	20.20	2.73	2.22	5,985
DEU	−2.67	1.61	2.90	4.42	24.48	3.32	2.68	179,036
DNK	−1.92	1.88	3.18	4.71	24.48	3.66	2.95	42,075
EGY	−1.84	1.81	2.85	4.14	25.62	3.18	2.13	14,725
ESP	−2.67	2.00	3.43	4.96	24.48	3.82	3.03	35,143
EST	−0.30	1.99	3.50	5.94	13.59	3.97	2.70	769

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				DTD Level				
FIN	−2.67	2.26	3.44	4.97	18.16	3.79	2.40	28,399
FRA	−2.67	1.84	3.03	4.62	24.48	3.51	2.72	160,812
GBR	−2.67	2.23	3.60	5.32	24.48	4.05	2.73	382,413
GRC	−2.67	1.34	2.36	3.69	23.59	2.68	2.14	55,630
HKG	−1.40	1.54	2.57	4.01	18.66	3.07	2.31	213,945
HRV	−2.67	1.16	2.32	3.66	20.81	2.68	2.24	10,768
HUN	−0.73	1.64	2.72	4.29	24.48	3.11	2.27	7100
IDN	−1.84	0.70	1.72	2.88	25.55	2.05	2.10	60,191
IND	−1.79	0.82	1.70	2.86	19.49	2.12	2.16	463,078
IRL	−1.73	1.95	3.27	4.77	14.51	3.49	2.26	9,918
ISL	−1.48	1.76	3.01	4.34	20.01	3.35	2.37	4,368
ISR	−2.30	1.26	2.37	3.66	24.48	2.75	2.40	74,789
ITA	−2.67	1.55	2.81	4.37	24.48	3.19	2.52	59,551
JOR	−1.84	2.44	3.52	5.17	23.79	4.07	2.49	22,026
JPN	−1.40	2.09	3.16	4.52	18.66	3.56	2.21	816,444
KAZ	−1.60	0.54	1.30	3.15	25.62	2.60	4.23	850
KOR	−1.40	1.26	2.20	3.39	18.66	2.56	2.13	290,591
KWT	−0.44	2.30	3.26	4.49	25.62	3.72	2.28	22,256
LKA	−1.84	1.60	2.42	3.75	16.12	2.82	1.97	18,026
LTU	−1.30	1.45	3.17	5.36	20.95	3.74	3.27	4,361
LUX	−0.56	3.08	4.74	7.40	24.48	6.02	4.47	2,876
LVA	−1.45	1.31	2.31	3.84	24.48	2.88	2.48	3,090
MAR	−0.69	2.61	3.84	5.29	21.53	4.15	2.42	7,459
MEX	−1.84	2.05	3.70	5.61	25.62	4.17	3.12	18,962
MKD	−1.09	1.35	1.98	2.84	16.51	2.67	2.70	2,019
MLT	−0.65	2.33	3.57	5.14	14.99	4.14	2.95	951
MYS	−1.84	1.58	2.85	4.62	25.62	3.52	2.94	189,706
NGA	−1.78	1.17	2.28	3.23	25.62	2.83	3.54	14,292
NLD	−2.67	2.44	3.97	5.80	24.48	4.39	2.96	35,914
NOR	−2.63	1.24	2.37	3.81	20.49	2.66	2.06	43,504
NZL	−1.21	2.88	4.91	6.98	18.66	5.25	3.23	17,446
PAK	−1.84	0.45	1.66	3.29	14.67	2.08	2.28	24,135
PER	−1.84	1.96	3.19	4.52	22.71	3.58	2.56	11,146
PHL	−1.84	1.16	2.30	3.75	25.62	2.73	2.36	38,597
POL	−2.67	1.37	2.33	3.49	24.48	2.64	2.06	60,259
PRT	−2.67	1.09	2.30	3.83	20.10	2.73	2.36	13,696
ROM	−2.67	0.97	1.81	2.42	24.48	1.95	1.63	15,804
RUS	−2.51	1.21	2.50	3.98	24.48	2.72	2.09	21,191
SAU	−1.52	3.71	5.43	7.78	25.62	6.25	3.75	14,993
SGP	−1.19	1.55	2.67	4.30	18.66	3.20	2.39	118,629
SVK	−0.60	1.29	2.19	3.04	24.48	3.38	5.11	989
SVN	−2.47	2.14	3.37	5.34	16.84	3.87	2.89	6,793
SWE	−2.67	1.72	3.04	4.57	24.48	3.40	2.49	80,208
THA	−1.71	1.68	2.91	4.43	25.62	3.32	2.53	97,155
TUR	−2.67	1.64	2.93	4.65	24.48	3.58	3.01	40,300
TWN	−1.40	2.66	3.77	5.16	18.66	4.12	2.28	237,398
UKR	−1.69	0.87	1.69	2.73	21.76	1.88	1.73	5,067
USA	−1.13	1.80	3.07	4.75	24.84	3.56	2.64	1,482,028
VEN	−1.84	0.40	1.39	3.13	17.01	2.27	3.09	3,417
VNM	−1.84	0.97	1.73	2.82	25.62	2.07	1.74	37,816
ZAF	−1.84	1.34	2.78	4.54	25.62	3.37	3.13	78,514

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				DTD Trend				
ARE	−4.43	−0.36	0.00	0.37	6.00	−0.03	0.83	5,591
ARG	−7.70	−0.50	−0.01	0.40	7.28	−0.04	1.01	12,873
AUS	−5.75	−0.48	−0.03	0.37	5.42	−0.06	0.97	289,095
AUT	−7.97	−0.53	−0.03	0.42	7.60	−0.12	1.49	20,436
BEL	−7.97	−0.60	−0.00	0.60	7.60	−0.01	1.50	29,567
BGR	−7.97	−0.43	0.00	0.34	7.60	−0.06	1.00	10,386
BHR	−7.70	−0.27	0.01	0.30	4.36	−0.07	0.89	1,460
BRA	−7.70	−0.34	0.01	0.37	7.28	0.01	1.00	51,037
CAN	−6.39	−0.53	−0.02	0.46	5.53	−0.05	1.11	218,173
CHE	−7.97	−0.58	0.01	0.62	7.60	0.02	1.28	51,381
CHL	−7.70	−0.68	0.03	0.59	7.28	−0.03	1.49	28,944
CHN	−5.87	−0.56	−0.03	0.46	5.37	−0.07	1.02	277,785
COL	−7.70	−0.40	0.03	0.65	7.28	0.10	1.32	5,836
CYP	−7.97	−0.35	−0.07	0.17	7.60	−0.12	0.76	16,185
CZE	−7.78	−0.34	0.00	0.38	5.78	0.00	0.87	5,985
DEU	−7.97	−0.48	−0.02	0.43	7.60	−0.03	1.10	179,036
DNK	−7.97	−0.49	−0.00	0.44	7.60	−0.02	1.19	42,075
EGY	−7.70	−0.41	0.02	0.54	7.28	0.05	0.99	14,725
ESP	−7.97	−0.47	0.02	0.49	7.60	0.01	1.24	35,143
EST	−3.42	−0.07	0.19	0.73	3.80	0.35	0.83	769
FIN	−7.97	−0.44	0.04	0.55	7.60	0.04	1.05	28,399
FRA	−7.97	−0.46	0.00	0.46	7.60	−0.00	1.09	160,812
GBR	−7.97	−0.54	−0.01	0.42	7.60	−0.07	1.24	382,413
GRC	−7.97	−0.51	−0.08	0.32	7.60	−0.10	0.94	55,630
HKG	−5.75	−0.46	0.00	0.45	5.42	−0.01	0.97	213,945
HRV	−4.96	−0.53	−0.03	0.26	7.60	−0.10	0.93	10,768
HUN	−7.97	−0.41	0.00	0.41	7.60	−0.05	0.91	7,100
IDN	−7.70	−0.32	0.00	0.32	7.28	−0.02	0.77	60,191
IND	−7.02	−0.36	−0.03	0.33	5.51	−0.02	0.84	463,078
IRL	−7.97	−0.46	0.00	0.48	7.36	−0.03	1.01	9,918
ISL	−7.97	−0.68	−0.06	0.42	6.70	−0.17	1.33	4,368
ISR	−7.97	−0.42	0.00	0.42	7.60	−0.01	1.05	74,789
ITA	−7.97	−0.54	−0.01	0.49	7.60	−0.03	1.13	59,551
JOR	−7.70	−0.46	−0.02	0.38	7.28	−0.06	1.05	22,026
JPN	−5.75	−0.46	−0.02	0.42	5.42	−0.02	0.88	816,444
KAZ	−7.70	−0.50	0.00	0.41	7.28	−0.01	1.22	850
KOR	−5.75	−0.43	0.00	0.42	5.42	−0.01	0.91	290,591
KWT	−7.70	−0.43	0.00	0.40	7.28	−0.03	1.05	22,256
LKA	−7.70	−0.33	0.00	0.42	7.28	0.06	0.87	18,026
LTU	−6.23	−0.62	0.00	0.65	7.60	0.02	1.36	4,361
LUX	−7.97	−0.63	0.02	0.55	7.60	−0.09	1.38	2,876
LVA	−7.97	−0.34	0.05	0.34	7.60	−0.03	1.07	3,090
MAR	−7.70	−0.56	−0.06	0.39	7.28	−0.09	1.06	7,459
MEX	−7.70	−0.44	0.05	0.58	7.28	0.06	1.16	18,962
MKD	−6.14	−0.35	−0.04	0.32	6.55	0.04	0.87	2,019
MLT	−6.66	−0.57	−0.01	0.72	4.26	0.08	1.28	951
MYS	−7.70	−0.46	−0.00	0.42	7.28	−0.03	1.07	189,706
NGA	−7.70	−0.38	0.00	0.38	7.28	−0.00	1.43	14,292
NLD	−7.97	−0.62	−0.02	0.55	7.60	−0.05	1.21	35,914
NOR	−7.97	−0.40	0.00	0.39	7.60	−0.02	0.91	43,504

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				DTD Trend				
NZL	−5.75	−0.58	0.01	0.60	5.42	0.00	1.42	17,446
PAK	−6.29	−0.25	0.04	0.35	6.17	0.04	0.74	24,135
PER	−7.70	−0.41	0.00	0.51	7.28	0.04	1.22	11,146
PHL	−7.70	−0.35	0.00	0.34	7.28	−0.01	0.94	38,597
POL	−7.97	−0.47	−0.02	0.38	7.60	−0.06	0.91	60,259
PRT	−7.97	−0.42	−0.01	0.35	7.60	−0.03	0.94	13,696
ROM	−7.97	−0.26	0.00	0.25	7.60	0.00	0.74	15,804
RUS	−7.97	−0.45	0.00	0.41	7.60	−0.08	1.05	21,191
SAU	−7.70	−0.72	0.16	1.04	7.28	0.12	1.82	14,993
SGP	−5.75	−0.44	−0.00	0.41	5.42	−0.03	0.97	118,629
SVK	−7.97	−0.14	0.06	0.32	7.60	0.04	1.59	989
SVN	−5.13	−0.56	−0.08	0.21	7.60	−0.15	0.98	6,793
SWE	−7.97	−0.46	−0.01	0.45	7.60	−0.00	1.04	80,208
THA	−7.70	−0.52	−0.02	0.45	7.28	−0.05	1.05	97,155
TUR	−7.97	−0.59	0.04	0.62	7.60	0.03	1.36	40,300
TWN	−5.75	−0.53	0.01	0.57	5.42	0.02	1.03	237,398
UKR	−5.71	−0.51	−0.01	0.33	6.49	−0.14	0.89	5067
USA	−6.39	−0.47	0.00	0.47	5.53	−0.01	1.00	1,482,028
VEN	−6.72	−0.30	−0.00	0.29	7.28	0.01	0.96	3,417
VNM	−7.70	−0.37	−0.02	0.28	7.28	−0.04	0.67	37,816
ZAF	−7.70	−0.45	−0.01	0.37	7.28	−0.06	1.18	78,514
				CASH/TA Level				
ARE	0.00	0.07	0.14	0.23	0.94	0.17	0.14	6,700
ARG	0.00	0.02	0.05	0.11	0.69	0.08	0.08	13,407
AUS	0.00	0.04	0.13	0.35	0.97	0.23	0.25	300,910
AUT	0.00	0.03	0.07	0.15	0.99	0.11	0.13	22,520
BEL	0.00	0.03	0.07	0.18	0.99	0.14	0.18	32,089
BGR	0.00	0.01	0.03	0.08	0.58	0.06	0.08	10,687
BHR	0.00	0.09	0.18	0.26	0.91	0.20	0.15	2,956
BRA	0.00	0.02	0.08	0.17	0.94	0.12	0.13	54,565
CAN	0.00	0.01	0.06	0.21	0.99	0.16	0.21	224,124
CHE	0.00	0.05	0.10	0.20	0.99	0.15	0.16	56,712
CHL	0.00	0.01	0.03	0.08	0.94	0.06	0.09	30,854
CHN	0.00	0.08	0.15	0.25	0.89	0.19	0.16	283,560
COL	0.00	0.03	0.06	0.09	0.76	0.07	0.07	6,358
CYP	0.00	0.01	0.05	0.15	0.93	0.10	0.14	16,765
CZE	0.00	0.02	0.05	0.11	0.99	0.09	0.12	6,720
DEU	0.00	0.03	0.08	0.19	0.99	0.14	0.18	187,269
DNK	0.00	0.03	0.08	0.18	0.99	0.14	0.17	46,304
EGY	0.00	0.04	0.12	0.22	0.94	0.15	0.14	16,211
ESP	0.00	0.02	0.05	0.11	0.82	0.09	0.10	39,354
EST	0.00	0.03	0.05	0.12	0.53	0.09	0.09	2,579
FIN	0.00	0.03	0.08	0.16	0.99	0.12	0.14	30,053
FRA	0.00	0.03	0.08	0.17	0.99	0.13	0.14	168,024
GBR	0.00	0.03	0.09	0.22	0.99	0.17	0.21	388,884
GRC	0.00	0.02	0.05	0.13	0.83	0.10	0.11	57,391
HKG	0.00	0.06	0.14	0.26	0.97	0.19	0.17	220,051
HRV	0.00	0.01	0.02	0.05	0.52	0.05	0.08	12,668
HUN	0.00	0.02	0.06	0.13	0.74	0.09	0.10	7,739

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				CASH/TA Level				
IDN	0.00	0.03	0.08	0.17	0.90	0.12	0.12	64,011
IND	0.00	0.01	0.03	0.07	0.83	0.06	0.10	625,463
IRL	0.00	0.05	0.09	0.21	0.97	0.15	0.17	10,545
ISL	0.00	0.02	0.04	0.08	0.53	0.06	0.06	4,794
ISR	0.00	0.03	0.10	0.22	0.99	0.18	0.21	75,988
ITA	0.00	0.03	0.06	0.14	0.99	0.10	0.11	63,019
JOR	0.00	0.01	0.05	0.18	0.94	0.13	0.16	25,814
JPN	0.00	0.08	0.13	0.22	0.97	0.17	0.14	820,518
KAZ	0.00	0.07	0.13	0.17	0.36	0.13	0.08	1,035
KOR	0.00	0.04	0.09	0.18	0.97	0.13	0.13	294,250
KWT	0.00	0.03	0.07	0.20	0.94	0.15	0.18	23,325
LKA	0.00	0.02	0.05	0.10	0.94	0.09	0.13	18,344
LTU	0.00	0.01	0.03	0.07	0.51	0.06	0.09	4,528
LUX	0.00	0.05	0.11	0.18	0.97	0.14	0.14	3,267
LVA	0.00	0.01	0.04	0.12	0.44	0.08	0.09	3,325
MAR	0.00	0.01	0.05	0.12	0.78	0.09	0.11	10,983
MEX	0.00	0.03	0.06	0.11	0.77	0.08	0.08	20,690
MKD	0.00	0.02	0.05	0.17	0.59	0.11	0.13	2,517
MLT	0.00	0.03	0.08	0.20	0.50	0.14	0.14	1,418
MYS	0.00	0.02	0.07	0.16	0.94	0.12	0.13	192,519
NGA	0.00	0.03	0.07	0.20	0.73	0.13	0.15	15,623
NLD	0.00	0.02	0.05	0.12	0.99	0.10	0.13	38,264
NOR	0.00	0.04	0.09	0.19	0.99	0.15	0.18	45,681
NZL	0.00	0.01	0.03	0.10	0.97	0.10	0.17	18,399
PAK	0.00	0.01	0.05	0.14	0.90	0.10	0.12	30,696
PER	0.00	0.01	0.04	0.13	0.71	0.09	0.11	12,167
PHL	0.00	0.02	0.09	0.18	0.94	0.13	0.15	40,574
POL	0.00	0.03	0.06	0.14	0.99	0.11	0.12	61,773
PRT	0.00	0.01	0.03	0.07	0.54	0.06	0.08	14,762
ROM	0.00	0.01	0.03	0.08	0.73	0.07	0.10	16,508
RUS	0.00	0.02	0.06	0.15	0.99	0.11	0.12	23,448
SAU	0.00	0.04	0.09	0.18	0.94	0.16	0.19	15,690
SGP	0.00	0.06	0.13	0.24	0.97	0.17	0.15	120,532
SVK	0.00	0.02	0.05	0.10	0.59	0.08	0.09	1,498
SVN	0.00	0.01	0.03	0.08	0.41	0.06	0.07	7,371
SWE	0.00	0.04	0.09	0.20	0.99	0.16	0.19	83,062
THA	0.00	0.02	0.06	0.14	0.88	0.10	0.12	99,324
TUR	0.00	0.02	0.06	0.15	0.99	0.11	0.14	62,996
TWN	0.00	0.06	0.12	0.22	0.97	0.16	0.14	239,883
UKR	0.00	0.01	0.02	0.07	0.88	0.06	0.12	5,861
USA	0.00	0.03	0.07	0.24	0.99	0.18	0.22	1,536,923
VEN	0.00	0.04	0.07	0.18	0.94	0.12	0.11	3,980
VNM	0.00	0.03	0.08	0.17	0.93	0.13	0.15	39,343
ZAF	0.00	0.03	0.08	0.16	0.94	0.12	0.14	82,366

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				CASH/TA Trend				
ARE	−0.36	−0.02	−0.00	0.01	0.40	−0.01	0.06	6,700
ARG	−0.36	−0.01	0.00	0.01	0.40	0.00	0.04	13,407
AUS	−0.42	−0.03	−0.00	0.01	0.44	−0.01	0.09	300,910
AUT	−0.46	−0.01	0.00	0.00	0.46	−0.00	0.04	22,520
BEL	−0.46	−0.01	0.00	0.00	0.46	−0.00	0.05	32,089
BGR	−0.25	−0.00	0.00	0.00	0.46	−0.00	0.03	10,687
BHR	−0.36	−0.02	0.00	0.01	0.40	−0.00	0.06	2,956
BRA	−0.36	−0.01	0.00	0.01	0.40	−0.00	0.05	54,565
CAN	−0.44	−0.02	0.00	0.01	0.42	−0.00	0.07	224,124
CHE	−0.46	−0.01	0.00	0.01	0.46	−0.00	0.04	56,712
CHL	−0.36	−0.01	−0.00	0.00	0.40	−0.00	0.04	30,854
CHN	−0.30	−0.03	−0.00	0.01	0.30	−0.01	0.05	283,560
COL	−0.36	−0.01	0.00	0.01	0.40	0.00	0.04	6,358
CYP	−0.46	−0.01	0.00	0.00	0.46	−0.00	0.04	16,765
CZE	−0.33	−0.00	0.00	0.00	0.46	0.00	0.04	6,720
DEU	−0.46	−0.01	0.00	0.00	0.46	−0.00	0.06	187,269
DNK	−0.46	−0.01	−0.00	0.01	0.46	−0.00	0.05	46,304
EGY	−0.36	−0.02	−0.00	0.01	0.40	−0.00	0.05	16,211
ESP	−0.46	−0.01	0.00	0.01	0.46	−0.00	0.04	39,354
EST	−0.25	−0.01	0.00	0.01	0.17	−0.00	0.03	2,579
FIN	−0.46	−0.01	−0.00	0.01	0.46	−0.00	0.05	30,053
FRA	−0.46	−0.01	0.00	0.01	0.46	−0.00	0.04	168,024
GBR	−0.46	−0.02	0.00	0.01	0.46	−0.01	0.07	388,884
GRC	−0.46	−0.01	−0.00	0.01	0.46	−0.00	0.04	57,391
HKG	−0.42	−0.02	0.00	0.01	0.44	−0.00	0.07	220,051
HRV	−0.18	−0.00	−0.00	0.00	0.44	0.00	0.03	12,668
HUN	−0.46	−0.01	−0.00	0.01	0.46	−0.00	0.04	7,739
IDN	−0.36	−0.01	0.00	0.01	0.40	−0.00	0.04	64,011
IND	−0.35	−0.00	0.00	0.00	0.37	−0.00	0.04	625,463
IRL	−0.46	−0.01	0.00	0.01	0.46	−0.00	0.05	10,545
ISL	−0.36	−0.01	0.00	0.00	0.40	−0.00	0.03	4,794
ISR	−0.46	−0.02	−0.00	0.01	0.46	−0.00	0.08	75,988
ITA	−0.46	−0.01	−0.00	0.01	0.46	−0.00	0.04	63,019
JOR	−0.36	−0.01	0.00	0.00	0.40	−0.00	0.05	25,814
JPN	−0.42	−0.01	0.00	0.01	0.44	−0.00	0.04	820,518
KAZ	−0.17	−0.02	0.00	0.01	0.30	−0.00	0.04	1,035
KOR	−0.42	−0.02	−0.00	0.01	0.44	−0.00	0.06	294,250
KWT	−0.36	−0.01	−0.00	0.01	0.40	−0.00	0.06	23,325
LKA	−0.36	−0.01	−0.00	0.01	0.40	−0.00	0.05	18,344
LTU	−0.20	−0.01	−0.00	0.00	0.31	−0.00	0.03	4,528
LUX	−0.39	−0.01	0.00	0.00	0.26	0.00	0.04	3,267
LVA	−0.21	−0.01	0.00	0.01	0.32	−0.00	0.04	3,325
MAR	−0.36	−0.01	0.00	0.01	0.40	−0.00	0.04	10,983
MEX	−0.30	−0.01	−0.00	0.01	0.40	−0.00	0.03	20,690
MKD	−0.18	−0.00	0.00	0.00	0.31	0.00	0.04	2,517
MLT	−0.32	−0.01	0.00	0.00	0.18	−0.00	0.03	1,418
MYS	−0.36	−0.01	0.00	0.01	0.40	−0.00	0.04	192,519
NGA	−0.36	−0.01	0.00	0.00	0.40	−0.00	0.06	15,623
NLD	−0.46	−0.01	0.00	0.00	0.46	−0.00	0.04	38,264
NOR	−0.46	−0.02	−0.00	0.01	0.46	−0.00	0.06	45,681
NZL	−0.42	−0.01	0.00	0.00	0.44	−0.00	0.06	18,399

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				CASH/TA Trend				
PAK	−0.36	−0.01	0.00	0.00	0.40	−0.00	0.04	30,696
PER	−0.32	−0.01	0.00	0.01	0.39	0.00	0.04	12,167
PHL	−0.36	−0.01	0.00	0.01	0.40	−0.00	0.06	40,574
POL	−0.46	−0.01	0.00	0.00	0.46	−0.00	0.05	61,773
PRT	−0.40	−0.01	0.00	0.00	0.46	−0.00	0.03	14,762
ROM	−0.46	−0.00	0.00	0.00	0.46	−0.00	0.03	16,508
RUS	−0.46	−0.01	0.00	0.01	0.46	0.00	0.06	23,448
SAU	−0.36	−0.02	0.00	0.01	0.40	−0.00	0.06	15,690
SGP	−0.42	−0.02	0.00	0.01	0.44	−0.00	0.06	120,532
SVK	−0.13	−0.01	0.00	0.00	0.15	−0.00	0.02	1,498
SVN	−0.30	−0.00	0.00	0.00	0.28	−0.00	0.02	7,371
SWE	−0.46	−0.01	−0.00	0.01	0.46	−0.00	0.06	83,062
THA	−0.36	−0.01	−0.00	0.01	0.40	−0.00	0.04	99,324
TUR	−0.46	−0.01	−0.00	0.01	0.46	−0.00	0.06	62,996
TWN	−0.42	−0.02	0.00	0.02	0.44	0.00	0.05	239,883
UKR	−0.23	−0.00	0.00	0.00	0.32	0.00	0.03	5,861
USA	−0.44	−0.02	−0.00	0.01	0.42	−0.00	0.06	1,536,923
VEN	−0.18	−0.01	0.00	0.00	0.31	−0.00	0.03	3,980
VNM	−0.36	−0.02	−0.00	0.01	0.40	−0.00	0.05	39,343
ZAF	−0.36	−0.01	0.00	0.01	0.40	−0.00	0.05	82,366
				NI/TA Level				
ARE*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	6,740
ARG*	−0.04	−0.00	0.00	0.01	0.03	0.00	0.01	13,460
AUS*	−0.47	−0.02	−0.00	0.00	0.10	−0.02	0.05	301,452
AUT	−0.60	0.00	0.00	0.00	0.13	−0.00	0.02	22,647
BEL	−0.35	0.00	0.00	0.01	0.13	0.00	0.01	32,183
BGR	−0.19	−0.00	0.00	0.01	0.13	0.00	0.02	11,634
BHR*	−0.03	0.00	0.00	0.01	0.03	0.01	0.01	3,011
BRA*	−0.04	−0.00	0.00	0.01	0.03	0.00	0.01	54,622
CAN	−0.42	−0.01	0.00	0.00	0.20	−0.01	0.04	224,767
CHE	−0.60	0.00	0.00	0.00	0.13	0.00	0.02	56,930
CHL*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	30,950
CHN	−0.15	0.00	0.00	0.01	0.15	0.00	0.01	283,803
COL*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	6,403
CYP	−0.60	−0.00	0.00	0.00	0.13	−0.00	0.03	17,300
CZE	−0.29	0.00	0.00	0.00	0.04	0.00	0.01	6,778
DEU	−0.60	−0.00	0.00	0.00	0.13	−0.00	0.02	188,244
DNK	−0.60	0.00	0.00	0.00	0.13	−0.00	0.03	46,529
EGY*	−0.04	0.00	0.00	0.01	0.03	0.01	0.01	16,258
ESP	−0.60	0.00	0.00	0.00	0.13	0.00	0.03	39,413
EST	−0.09	−0.00	0.00	0.01	0.05	0.00	0.01	2,601
FIN	−0.22	0.00	0.00	0.01	0.13	0.00	0.01	30,106
FRA	−0.60	0.00	0.00	0.00	0.13	0.00	0.02	168,783
GBR*	−0.60	−0.01	0.00	0.01	0.13	−0.01	0.04	390,110
GRC	−0.60	−0.00	0.00	0.01	0.13	0.00	0.02	57,500
HKG	−0.47	−0.00	0.00	0.01	0.10	−0.00	0.03	220,088
HRV	−0.11	−0.00	0.00	0.00	0.13	0.00	0.01	12,933
HUN	−0.15	−0.00	0.00	0.01	0.03	0.00	0.01	7,763
IDN*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	64,103
IND*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	631,104

*Winsorization levels are at 1 and 99 percentiles instead of 0.1 and 99.9 percentiles.

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				NI/TA Level				
IRL	−0.60	−0.00	0.00	0.01	0.13	0.00	0.02	10,609
ISL	−0.13	0.00	0.00	0.01	0.02	0.00	0.01	4,827
ISR	−0.60	−0.00	0.00	0.00	0.13	−0.01	0.05	76,032
ITA	−0.49	−0.00	0.00	0.00	0.13	0.00	0.01	63,074
JOR*	−0.04	−0.00	0.00	0.00	0.03	0.00	0.01	26,045
JPN	−0.47	0.00	0.00	0.00	0.10	0.00	0.01	820,562
KAZ*	−0.04	0.00	0.00	0.00	0.03	0.00	0.01	1,048
KOR	−0.47	−0.00	0.00	0.01	0.10	−0.00	0.02	297,303
KWT*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	23,403
LKA*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	18,408
LTU	−0.05	−0.00	0.00	0.01	0.05	0.00	0.01	4,537
LUX	−0.20	0.00	0.00	0.01	0.09	0.00	0.02	3,417
LVA	−0.10	−0.00	0.00	0.01	0.13	0.00	0.01	3,444
MAR*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	11,058
MEX*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	20,826
MKD	−0.50	0.00	0.00	0.00	0.03	−0.00	0.03	2,620
MLT	−0.14	0.00	0.00	0.00	0.04	0.00	0.01	1,436
MYS*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	192,568
NGA*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	15,946
NLD	−0.60	0.00	0.00	0.01	0.13	0.00	0.03	38,290
NOR	−0.60	−0.00	0.00	0.00	0.13	−0.00	0.03	45,933
NZL	−0.47	−0.00	0.00	0.01	0.10	−0.01	0.05	18,434
PAK*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	30,785
PER*	−0.04	0.00	0.00	0.01	0.03	0.01	0.01	12,247
PHL*	−0.04	−0.00	0.00	0.01	0.03	0.00	0.01	40,643
POL	−0.54	−0.00	0.00	0.01	0.11	0.00	0.02	61,982
PRT	−0.22	−0.00	0.00	0.00	0.06	0.00	0.01	14,870
ROM	−0.60	−0.00	0.00	0.01	0.13	0.00	0.02	18,411
RUS	−0.60	0.00	0.00	0.01	0.13	0.00	0.02	23,853
SAU*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	15,741
SGP	−0.47	0.00	0.00	0.01	0.10	0.00	0.02	120,617
SVK	−0.02	0.00	0.00	0.00	0.03	0.00	0.01	1,609
SVN	−0.11	−0.00	0.00	0.00	0.03	0.00	0.01	7,437
SWE	−0.60	−0.01	0.00	0.01	0.13	−0.01	0.03	83,478
THA*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	99,368
TUR	−0.60	−0.00	0.00	0.01	0.13	0.00	0.03	63,007
TWN	−0.47	0.00	0.00	0.01	0.10	0.00	0.01	239,925
UKR	−0.10	−0.00	0.00	0.01	0.06	0.00	0.01	6,012
USA	−0.42	−0.00	0.00	0.01	0.20	−0.00	0.03	1,536,308
VEN*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	4,038
VNM*	−0.04	0.00	0.00	0.01	0.03	0.01	0.01	39,594
ZAF*	−0.04	0.00	0.00	0.01	0.03	0.00	0.01	82,657

*Winsorization levels are at 1 and 99 percentiles instead of 0.1 and 99.9 percentiles.

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				NI/TA Trend				
ARE*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	6,740
ARG*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	13,460
AUS*	−0.38	−0.00	0.00	0.00	0.29	−0.00	0.04	301,452
AUT	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.01	22,647
BEL	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.01	32,183
BGR	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.02	11,634
BHR*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.00	3,011
BRA*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	54,622
CAN	−0.32	−0.00	0.00	0.00	0.25	0.00	0.03	224,767
CHE	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.01	56,930
CHL*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	30,950
CHN	−0.18	−0.00	-0.00	0.00	0.15	−0.00	0.01	283,803
COL*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.00	6,403
CYP	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.02	17,300
CZE	−0.27	−0.00	0.00	0.00	0.26	−0.00	0.01	6,778
DEU	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.02	188,244
DNK	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.02	46,529
EGY*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	16,258
ESP	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.02	39,413
EST	−0.32	−0.00	0.00	0.00	0.11	−0.00	0.02	2,601
FIN	−0.20	−0.00	0.00	0.00	0.31	−0.00	0.01	30,106
FRA	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.01	168,783
GBR*	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.03	390,110
GRC	−0.35	−0.00	-0.00	0.00	0.31	−0.00	0.01	57,500
HKG	−0.38	−0.00	0.00	0.00	0.29	−0.00	0.03	220,088
HRV	−0.22	−0.00	0.00	0.00	0.10	−0.00	0.01	12,933
HUN	−0.10	−0.00	0.00	0.00	0.11	−0.00	0.01	7,763
IDN	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	64,103
IND*	−0.14	−0.00	0.00	0.00	0.12	−0.00	0.01	631,104
IRL	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.02	10,609
ISL	−0.12	−0.00	0.00	0.00	0.13	−0.00	0.01	4,827
ISR	−0.35	−0.00	-0.00	0.00	0.31	−0.00	0.04	76,032
ITA	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.01	63,074
JOR*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	26,045
JPN	−0.38	−0.00	0.00	0.00	0.29	−0.00	0.01	820,562
KAZ*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	1,048
KOR	−0.38	−0.00	0.00	0.00	0.29	−0.00	0.03	297,303
KWT*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	23,403
LKA*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	18,408
LTU	−0.12	−0.00	0.00	0.00	0.11	0.00	0.01	4,537
LUX	−0.09	−0.00	0.00	0.00	0.15	0.00	0.01	3,417
LVA	−0.19	−0.00	0.00	0.00	0.08	−0.00	0.01	3,444
MAR*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.00	11,058
MEX*	−0.03	−0.00	0.00	0.00	0.03	0.00	0.01	20,826
MKD	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.02	2,620
MLT	−0.04	−0.00	-0.00	0.00	0.03	−0.00	0.00	1,436
MYS*	−0.03	−0.00	-0.00	0.00	0.03	−0.00	0.01	192,568
NGA*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	15,946
NLD	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.02	38,290
NOR	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.02	45,933
NZL	−0.38	−0.00	0.00	0.00	0.29	−0.00	0.03	18,434

*Winsorization levels are at 1 and 99 percentiles instead of 0.1 and 99.9 percentiles.

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				NI/TA Trend				
PAK*	−0.03	−0.00	0.00	0.00	0.03	0.00	0.01	30,785
PER*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	12,247
PHL*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	40,643
POL	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.02	61,982
PRT	−0.35	−0.00	0.00	0.00	0.21	−0.00	0.01	14,870
ROM	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.02	18,411
RUS	−0.35	−0.00	0.00	0.00	0.31	0.00	0.02	23,853
SAU*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	15,741
SGP	−0.38	−0.00	-0.00	0.00	0.29	−0.00	0.02	120,617
SVK	−0.05	−0.00	0.00	0.00	0.06	−0.00	0.01	1,609
SVN	−0.17	−0.00	0.00	0.00	0.06	−0.00	0.01	7,437
SWE	−0.35	−0.00	0.00	0.00	0.31	−0.00	0.03	83,478
THA*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	99,368
TUR	−0.35	−0.00	-0.00	0.00	0.31	−0.00	0.03	63,007
TWN	−0.38	−0.00	-0.00	0.00	0.29	−0.00	0.01	239,925
UKR	−0.11	−0.00	0.00	0.00	0.13	−0.00	0.01	6,012
USA	−0.32	−0.00	0.00	0.00	0.25	−0.00	0.02	1,536,308
VEN*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.00	4,038
VNM*	−0.03	−0.00	-0.00	0.00	0.03	−0.00	0.01	39,594
ZAF*	−0.03	−0.00	0.00	0.00	0.03	−0.00	0.01	82,657
				SIZE Level				
ARE	−4.80	−0.88	0.08	1.15	4.25	0.14	1.51	7,608
ARG	−6.52	−1.41	0.25	1.57	7.06	0.14	2.06	14,787
AUS	−6.46	−1.24	-0.12	1.53	6.96	0.30	2.06	322,712
AUT	−6.75	−1.39	-0.15	1.32	4.50	−0.08	2.01	23,771
BEL	−6.75	−1.40	0.10	1.54	6.91	0.11	2.26	38,826
BGR	−6.75	−1.69	-0.32	0.91	7.97	−0.36	1.84	17,793
BHR	−3.60	−1.13	-0.27	1.05	3.23	−0.09	1.49	3,646
BRA	−6.52	−1.73	-0.07	1.31	7.37	−0.14	2.56	61,159
CAN	−6.08	−1.53	-0.23	1.25	6.00	−0.10	2.10	245,557
CHE	−6.75	−1.30	-0.06	1.26	6.31	0.06	1.97	55,797
CHL	−6.52	−1.11	0.07	1.27	4.30	−0.00	1.83	33,888
CHN	−2.46	−0.73	-0.24	0.32	3.84	−0.14	0.89	305,899
COL	−5.42	−1.44	-0.09	1.10	4.43	−0.25	1.69	7,487
CYP	−4.64	−1.02	0.03	1.07	6.87	0.05	1.65	20,814
CZE	−6.75	−1.51	-0.17	0.88	5.36	−0.25	1.90	8,969
DEU	−6.75	−0.40	1.10	2.75	7.97	1.16	2.51	215,855
DNK	−6.75	−0.27	0.91	2.23	7.41	1.03	1.90	46,715
EGY	−6.52	−1.05	0.02	1.50	5.40	0.21	1.76	19,275
ESP	−6.75	−1.69	-0.29	1.15	5.31	−0.32	2.12	41,717
EST	−3.62	−0.46	0.27	1.33	5.13	0.43	1.67	2,766
FIN	−6.36	−1.77	-0.47	1.11	6.40	−0.31	1.98	30,384
FRA	−6.75	−1.33	0.11	1.86	7.66	0.35	2.32	195,181
GBR	−6.75	−1.15	0.23	1.87	7.97	0.46	2.24	422,563
GRC	−6.75	−0.46	0.49	1.58	6.55	0.65	1.61	60,289
HKG	−8.79	−1.50	-0.49	0.87	6.96	−0.20	1.85	234,889
HRV	−6.75	−0.72	0.42	1.63	6.10	0.47	1.80	16,063
HUN	−6.75	−1.16	0.56	2.14	6.23	0.53	2.28	8,581
IDN	−6.52	−1.03	0.14	1.41	6.08	0.25	1.83	71,672

*Winsorization levels are at 1 and 99 percentiles instead of 0.1 and 99.9 percentiles.

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				SIZE Level				
IND	−5.27	−1.22	0.21	2.02	8.39	0.53	2.32	556,040
IRL	−6.75	−2.06	-0.84	0.65	4.79	−0.71	1.97	10,853
ISL	−6.75	−1.98	-1.05	-0.08	2.76	−1.05	1.53	5,981
ISR	−6.75	−0.77	0.29	1.59	7.97	0.50	1.85	98,621
ITA	−6.75	−0.91	0.22	1.66	6.36	0.40	1.93	63,750
JOR	−3.88	−0.88	-0.09	1.08	6.17	0.18	1.51	29,987
JPN	−9.57	−0.79	0.25	1.53	6.96	0.47	1.73	841,659
KAZ	−6.07	−2.15	-0.58	1.19	5.50	−0.52	1.92	1,548
KOR	−11.23	−0.49	0.29	1.34	6.96	0.48	1.80	345,407
KWT	−2.55	−0.33	0.58	1.41	5.14	0.65	1.34	25,848
LKA	−6.52	−0.82	0.12	1.29	5.26	0.26	1.54	20,509
LTU	−4.47	−0.89	0.19	1.16	4.08	0.15	1.55	5,876
LUX	−6.75	−2.35	-0.55	0.43	4.33	−0.84	2.07	4,590
LVA	−5.38	−1.43	-0.22	2.16	5.91	0.25	2.39	4,849
MAR	−6.52	−1.29	-0.13	1.65	4.76	0.10	1.81	11,560
MEX	−6.52	−1.19	0.17	1.53	5.16	0.10	1.97	22,526
MKD	−6.46	−1.26	0.20	1.37	5.37	0.11	1.86	4,456
MLT	−4.07	−0.98	-0.10	1.18	2.31	−0.00	1.36	2,007
MYS	−4.25	−0.21	0.68	1.78	6.47	0.84	1.58	204,304
NGA	−6.52	−1.40	-0.21	1.62	6.17	−0.00	2.15	19,030
NLD	−6.75	−1.89	-0.35	1.11	5.99	−0.26	2.18	38,602
NOR	−6.75	−0.93	0.15	1.39	6.65	0.26	1.74	48,794
NZL	−5.78	−1.54	-0.07	1.07	5.12	−0.21	1.89	20,373
PAK	−6.52	−1.12	0.77	2.77	7.37	0.78	2.53	49,297
PER	−6.52	−1.03	0.33	1.80	5.54	0.33	2.01	14,474
PHL	−6.52	−1.44	-0.32	1.07	5.31	−0.09	1.82	44,162
POL	−5.61	−1.15	0.11	1.53	7.97	0.26	2.06	73,226
PRT	−6.75	−1.95	-0.33	1.28	4.56	−0.43	2.47	16,646
ROM	−6.75	−1.00	0.26	1.58	7.97	0.26	2.11	48,073
RUS	−6.75	−1.74	-0.28	1.26	7.97	−0.19	2.23	30,678
SAU	−4.48	−0.75	0.14	1.46	5.34	0.42	1.57	17,144
SGP	−4.35	−0.63	0.35	1.59	6.96	0.58	1.71	129,749
SVK	−6.14	−0.40	1.02	3.01	7.97	1.47	2.61	4,265
SVN	−6.75	−0.52	0.82	2.34	7.97	1.12	2.44	11,200
SWE	−6.75	−0.72	0.98	2.57	7.97	1.05	2.38	88,335
THA	−5.99	−0.87	0.10	1.24	6.48	0.30	1.60	109,062
TUR	−5.21	−1.23	-0.03	1.25	6.88	0.09	1.86	67,078
TWN	−5.78	−0.72	0.24	1.27	6.90	0.36	1.51	262,305
UKR	−6.75	−0.97	0.10	1.06	7.97	−0.01	1.64	9,013
USA	−6.08	−1.99	-0.65	0.79	6.00	−0.53	2.01	1,598,295
VEN	−6.52	−1.68	-0.15	1.17	7.37	−0.42	2.60	5,450
VNM	−4.93	−1.21	-0.27	0.78	6.46	−0.11	1.63	45,171
ZAF	−6.52	−1.57	0.18	1.89	6.55	0.16	2.34	88,296

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				SIZE Trend				
ARE	−0.83	−0.13	−0.01	0.09	1.81	−0.00	0.23	7,608
ARG	−1.81	−0.16	−0.02	0.10	2.01	−0.02	0.32	14,787
AUS	−1.58	−0.18	−0.00	0.17	1.82	0.00	0.38	322,712
AUT	−2.03	−0.12	−0.02	0.08	2.11	−0.02	0.27	23,771
BEL	−2.03	−0.11	−0.02	0.07	2.11	−0.02	0.26	38,826
BGR	−2.03	−0.15	0.00	0.15	2.11	0.01	0.36	17,793
BHR	−0.80	−0.06	0.01	0.09	2.01	0.03	0.17	3,646
BRA	−1.81	−0.15	0.00	0.14	2.01	−0.01	0.35	61,159
CAN	−1.90	−0.16	0.00	0.16	1.84	−0.00	0.37	245,557
CHE	−2.03	−0.11	−0.01	0.08	2.11	−0.02	0.24	55,797
CHL	−1.81	−0.10	−0.00	0.09	2.01	−0.00	0.22	33,888
CHN	−0.96	−0.10	−0.00	0.11	1.13	0.01	0.19	305,899
COL	−1.34	−0.09	0.00	0.10	1.85	0.01	0.21	7,487
CYP	−2.03	−0.18	−0.00	0.17	2.11	0.00	0.35	20,814
CZE	−2.03	−0.13	0.00	0.12	2.11	−0.01	0.26	8,969
DEU	−2.03	−0.17	−0.03	0.09	2.11	−0.06	0.35	215,855
DNK	−2.03	−0.14	−0.02	0.09	2.11	−0.03	0.28	46,715
EGY	−1.81	−0.13	−0.01	0.11	2.01	0.02	0.27	19,275
ESP	−2.03	−0.11	−0.00	0.10	2.11	0.01	0.26	41,717
EST	−1.99	−0.13	−0.01	0.12	2.11	−0.00	0.27	2,766
FIN	−2.03	−0.13	0.00	0.14	2.11	0.00	0.27	30,384
FRA	−2.03	−0.12	0.00	0.12	2.11	0.00	0.28	195,181
GBR	−2.03	−0.15	0.00	0.13	2.11	−0.02	0.34	422,563
GRC	−2.03	−0.19	−0.03	0.13	2.11	−0.02	0.32	60,289
HKG	−1.58	−0.17	−0.02	0.14	1.82	0.00	0.35	234,889
HRV	−2.03	−0.14	−0.01	0.08	2.11	−0.02	0.24	16,063
HUN	−1.80	−0.19	−0.05	0.09	2.11	−0.05	0.30	8,581
IDN	−1.81	−0.18	−0.03	0.13	2.01	−0.01	0.34	71,672
IND	−1.71	−0.22	−0.04	0.13	2.08	−0.03	0.36	556,040
IRL	−2.03	−0.10	0.01	0.13	2.11	0.00	0.30	10,853
ISL	−2.03	−0.11	0.00	0.12	2.11	0.02	0.30	5,981
ISR	−2.03	−0.15	−0.02	0.10	2.11	−0.03	0.31	98,621
ITA	−2.03	−0.11	−0.01	0.09	2.11	−0.00	0.23	63,750
JOR	−1.81	−0.10	0.00	0.12	2.01	0.02	0.24	29,987
JPN	−1.58	−0.12	−0.01	0.09	1.82	−0.01	0.22	841,659
KAZ	−1.81	−0.11	0.00	0.13	2.01	0.03	0.41	1,548
KOR	−1.58	−0.18	−0.03	0.13	1.82	−0.02	0.34	345,407
KWT	−1.81	−0.12	−0.01	0.09	2.01	−0.01	0.24	25,848
LKA	−1.81	−0.13	−0.02	0.09	2.01	−0.00	0.23	20,509
LTU	−2.03	−0.14	−0.01	0.12	2.11	−0.01	0.32	5,876
LUX	−2.03	−0.08	0.00	0.10	2.11	0.01	0.21	4,590
LVA	−2.03	−0.12	0.01	0.17	2.11	0.04	0.32	4,849
MAR	−1.81	−0.09	−0.00	0.08	2.01	−0.00	0.20	11,560
MEX	−1.81	−0.13	−0.01	0.09	2.01	−0.02	0.25	22,526
MKD	−1.45	−0.10	0.00	0.07	1.26	−0.01	0.19	4,456
MLT	−1.23	−0.07	0.00	0.08	1.85	0.01	0.23	2,007
MYS	−1.81	−0.14	−0.03	0.09	2.01	−0.02	0.26	204,304
NGA	−1.81	−0.16	−0.02	0.13	2.01	0.01	0.34	19,030
NLD	−2.03	−0.11	0.00	0.11	2.11	−0.01	0.26	38,602
NOR	−2.03	−0.13	−0.00	0.13	2.11	0.00	0.33	48,794
NZL	−1.58	−0.09	0.01	0.11	1.82	0.02	0.25	20,373

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				SIZE Trend				
PAK	−1.81	−0.19	−0.04	0.10	2.01	−0.03	0.29	49,297
PER	−1.81	−0.13	0.00	0.12	2.01	0.00	0.27	14,474
PHL	−1.81	−0.15	−0.01	0.13	2.01	0.01	0.32	44,162
POL	−2.03	−0.21	−0.04	0.13	2.11	−0.04	0.36	73,226
PRT	−2.03	−0.14	−0.02	0.09	2.11	−0.02	0.25	16,646
ROM	−2.03	−0.13	0.00	0.20	2.11	0.05	0.39	48,073
RUS	−2.03	−0.14	0.00	0.11	2.11	−0.01	0.30	30,678
SAU	−1.81	−0.11	−0.01	0.10	2.01	0.01	0.22	17,144
SGP	−1.58	−0.14	−0.02	0.10	1.82	−0.01	0.26	129,749
SVK	−2.03	−0.06	0.01	0.12	2.11	0.04	0.30	4,265
SVN	−2.03	−0.16	−0.03	0.07	1.98	−0.06	0.31	11,200
SWE	−2.03	−0.15	−0.01	0.14	2.11	−0.00	0.34	88,335
THA	−1.81	−0.15	−0.02	0.12	2.01	−0.00	0.28	109,062
TUR	−2.03	−0.17	−0.03	0.12	2.11	−0.01	0.29	67,078
TWN	−1.58	−0.13	−0.02	0.11	1.82	−0.01	0.24	262,305
UKR	−2.03	−0.16	0.00	0.17	2.11	0.00	0.42	9,013
USA	−1.90	−0.15	−0.01	0.13	1.84	−0.02	0.33	1,598,295
VEN	−1.81	−0.17	−0.02	0.11	2.01	0.01	0.42	5,450
VNM	−1.81	−0.19	−0.04	0.09	2.01	−0.04	0.26	45,171
ZAF	−1.81	−0.16	−0.01	0.13	2.01	−0.03	0.36	88,296
				M/B				
ARE*	0.34	0.87	1.03	1.30	8.35	1.18	0.60	6,657
ARG*	0.18	0.83	1.01	1.27	32.77	1.54	2.90	13,152
AUS*	0.18	0.92	1.32	2.37	14.76	2.26	2.64	296,870
AUT*	0.20	0.94	1.06	1.37	19.59	1.31	1.11	21,066
BEL*	0.16	0.94	1.09	1.44	19.59	1.44	1.49	30,712
BGR*	0.16	0.66	0.92	1.28	19.59	1.21	1.39	10,689
BHR*	0.40	0.93	1.06	1.25	5.54	1.17	0.47	2,929
BRA*	0.18	0.84	1.07	1.60	32.77	2.71	6.29	53,136
CAN	0.22	0.98	1.31	2.08	64.92	2.26	4.35	220,867
CHE*	0.16	0.99	1.14	1.63	19.59	1.57	1.44	52,059
CHL*	0.18	0.86	1.14	1.68	32.77	1.63	2.82	30,256
CHN	0.67	1.46	2.07	3.11	44.08	2.69	2.49	282,397
COL*	0.23	0.79	1.03	1.28	32.77	1.21	1.10	6,218
CYP*	0.16	0.61	0.80	1.04	19.59	1.06	1.41	16,753
CZE*	0.16	0.65	0.92	1.16	9.28	1.02	0.60	6,516
DEU*	0.16	1.00	1.21	1.67	19.59	1.69	1.85	182,025
DNK*	0.16	0.96	1.06	1.42	19.59	1.53	1.72	43,387
EGY*	0.21	0.98	1.23	1.81	32.77	1.67	1.85	16,110
ESP*	0.16	0.95	1.10	1.46	19.59	1.41	1.24	37,683
EST*	0.17	0.95	1.17	1.75	19.59	1.67	1.85	2,569
FIN*	0.20	1.00	1.22	1.73	19.59	1.64	1.61	28,827
FRA*	0.16	0.94	1.13	1.56	19.59	1.55	1.66	162,873
GBR*	0.16	0.97	1.33	2.08	19.59	2.06	2.50	384,927
GRC*	0.16	0.86	1.09	1.60	19.59	1.65	1.98	56,715
HKG*	0.18	0.72	0.99	1.55	14.76	1.54	1.91	219,231
HRV*	0.16	0.71	0.93	1.18	19.59	1.09	1.07	12,551
HUN**	0.16	0.74	0.99	1.35	19.59	1.20	0.98	7,530
IDN*	0.18	0.87	1.07	1.50	32.77	1.44	1.48	63,044

*Winsorization levels are 0.1 and 99.5 percentiles instead of 0.1 and 99.9 percentiles.
**Winsorization levels are at 1 and 99 percentiles instead of 0.1 and 99.9 percentiles.

(*Continued*)

Table A.8. (*Continued*)

	Min	**25%**	**Median**	**75%**	**Max**	**Mean**	**StdDev**	**# Observations**
				M/B				
IND**	0.19	0.77	0.99	1.48	12.11	1.48	1.67	478,324
IRL*	0.16	0.99	1.21	1.70	19.59	1.68	1.74	10,121
ISL*	0.31	1.09	1.28	1.63	19.59	1.67	2.02	4,786
ISR*	0.16	0.91	1.04	1.37	19.59	1.57	2.17	75,612
ITA*	0.19	0.95	1.06	1.35	19.59	1.30	1.05	60,786
JOR*	0.18	0.84	1.05	1.40	32.77	1.28	1.21	25,439
JPN*	0.18	0.85	1.00	1.24	14.76	1.22	1.02	819,528
KAZ*	0.23	0.89	1.00	1.20	9.35	1.16	0.61	951
KOR*	0.18	0.80	0.99	1.32	14.76	1.32	1.35	294,834
KWT*	0.18	0.89	1.15	1.56	32.77	1.36	0.93	23,232
LKA*	0.24	0.94	1.13	1.57	32.77	1.56	1.74	18,128
LTU*	0.31	0.81	0.99	1.36	5.32	1.17	0.60	4,529
LUX*	0.33	0.74	0.97	1.19	9.28	1.09	0.66	3,166
LVA*	0.16	0.55	0.76	1.00	6.80	0.87	0.63	3,316
MAR*	0.18	1.07	1.28	1.84	15.95	1.64	0.99	10,855
MEX*	0.18	0.78	1.04	1.44	10.84	1.23	0.72	19,943
MKD*	0.16	0.67	0.92	1.17	19.59	1.53	3.23	2,510
MLT*	0.25	0.99	1.09	1.53	15.76	1.39	0.94	1,418
MYS*	0.18	0.77	0.99	1.41	32.77	1.37	1.64	192,047
NGA*	0.18	0.91	1.20	1.81	32.77	1.74	1.84	15,636
NLD*	0.16	1.00	1.21	1.67	19.59	1.64	1.63	36,682
NOR*	0.16	0.95	1.14	1.71	19.59	1.76	2.06	44,242
NZL*	0.18	0.97	1.27	1.96	14.76	1.92	2.17	18,208
PAK*	0.18	0.84	1.00	1.32	32.77	1.32	1.57	30,060
PER*	0.18	0.80	1.11	1.64	29.63	1.49	1.35	11,734
PHL*	0.18	0.77	1.06	1.71	32.77	2.31	4.96	39,566
POL*	0.16	0.86	1.11	1.65	19.59	1.61	1.89	61,443
PRT*	0.16	0.90	1.02	1.24	19.59	1.16	0.69	14,381
ROM*	0.16	0.66	0.91	1.23	19.59	1.21	1.79	16,500
RUS*	0.16	0.82	1.08	1.56	19.59	1.45	1.63	21,980
SAU*	0.19	1.19	1.73	2.86	32.77	2.46	2.28	15,677
SGP*	0.18	0.82	1.03	1.45	14.76	1.37	1.30	120,119
SVK*	0.21	0.71	0.87	1.03	3.18	0.89	0.29	1,466
SVN*	0.16	0.67	0.84	1.02	19.59	0.92	0.64	7,352
SWE*	0.16	1.03	1.38	2.17	19.59	2.11	2.36	80,849
THA*	0.18	0.86	1.06	1.46	32.77	1.32	1.00	98,910
TUR*	0.16	0.87	1.10	1.59	19.59	1.74	2.65	62,842
TWN*	0.29	0.93	1.17	1.65	14.76	1.49	1.08	239,779
UKR*	0.16	0.87	1.20	1.93	19.59	1.80	2.06	5,729
USA	0.22	1.03	1.31	2.09	64.92	2.12	3.32	1,533,990
VEN*	0.18	0.60	0.90	1.18	32.77	5.38	10.98	3,860
VNM*	0.18	0.81	0.94	1.17	18.99	1.13	0.76	39,271
ZAF*	0.18	0.89	1.19	1.84	32.77	1.84	2.93	81,822

*Winsorization levels are 0.1 and 99.5 percentiles instead of 0.1 and 99.9 percentiles.
**Winsorization levels are 1 and 99 percentiles instead of 0.1 and 99.9 percentiles.

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				SIGMA				
ARE	0.01	0.09	0.11	0.16	0.43	0.13	0.06	6,687
ARG	0.03	0.09	0.11	0.14	0.65	0.12	0.06	13,453
AUS	0.02	0.13	0.22	0.32	0.95	0.25	0.15	305,684
AUT	0.01	0.07	0.09	0.14	1.16	0.12	0.10	21,938
BEL	0.02	0.07	0.09	0.12	1.42	0.11	0.08	34,242
BGR	0.02	0.14	0.18	0.28	1.11	0.23	0.14	11,719
BHR	0.03	0.07	0.09	0.12	0.24	0.10	0.03	2,937
BRA	0.01	0.10	0.14	0.20	1.19	0.18	0.14	54,021
CAN	0.03	0.11	0.17	0.27	1.02	0.21	0.15	233,281
CHE	0.01	0.07	0.09	0.13	1.42	0.11	0.07	52,914
CHL	0.01	0.06	0.08	0.10	0.73	0.09	0.06	30,512
CHN	0.03	0.08	0.10	0.13	0.43	0.11	0.04	298,453
COL	0.01	0.06	0.09	0.12	0.48	0.10	0.06	6,327
CYP	0.02	0.16	0.21	0.28	1.42	0.25	0.17	17,755
CZE	0.03	0.09	0.13	0.18	0.42	0.14	0.05	7,163
DEU	0.01	0.10	0.15	0.24	1.42	0.22	0.22	199,451
DNK	0.01	0.07	0.10	0.15	1.29	0.13	0.11	43,966
EGY	0.01	0.09	0.12	0.18	1.19	0.15	0.09	17,118
ESP	0.01	0.06	0.09	0.12	0.95	0.10	0.06	38,560
EST	0.01	0.08	0.13	0.20	0.66	0.15	0.10	2,625
FIN	0.01	0.08	0.11	0.16	1.42	0.13	0.09	29,360
FRA	0.01	0.08	0.11	0.16	1.42	0.13	0.09	175,793
GBR	0.01	0.08	0.12	0.18	1.31	0.15	0.10	394,731
GRC	0.01	0.10	0.14	0.19	0.90	0.16	0.08	58,457
HKG	0.02	0.11	0.16	0.24	0.95	0.19	0.11	227,865
HRV	0.01	0.11	0.14	0.18	0.78	0.16	0.08	12,824
HUN	0.02	0.09	0.13	0.18	0.67	0.16	0.09	7,863
IDN	0.01	0.12	0.17	0.26	1.19	0.21	0.13	64,782
IND	0.05	0.15	0.19	0.24	1.00	0.22	0.13	503,137
IRL	0.03	0.08	0.11	0.17	1.42	0.16	0.14	10,209
ISL	0.03	0.08	0.11	0.14	0.61	0.12	0.07	5,064
ISR	0.01	0.10	0.13	0.20	1.15	0.16	0.09	83,567
ITA	0.01	0.07	0.10	0.13	0.76	0.11	0.05	62,136
JOR	0.01	0.09	0.12	0.15	0.74	0.13	0.05	26,803
JPN	0.02	0.08	0.11	0.16	0.95	0.13	0.07	827,007
KAZ	0.01	0.11	0.14	0.23	1.03	0.19	0.12	946
KOR	0.02	0.11	0.15	0.21	0.81	0.17	0.08	336,766
KWT	0.01	0.10	0.12	0.16	0.76	0.13	0.05	23,541
LKA	0.03	0.11	0.15	0.20	1.00	0.17	0.09	19,075
LTU	0.03	0.09	0.13	0.18	1.02	0.15	0.10	5,387
LUX	0.02	0.07	0.09	0.13	0.51	0.11	0.05	3,286
LVA	0.03	0.11	0.14	0.22	0.97	0.17	0.09	3,412
MAR	0.02	0.08	0.10	0.12	0.54	0.10	0.05	10,993
MEX	0.01	0.07	0.10	0.13	1.19	0.11	0.07	20,320
MKD	0.01	0.08	0.11	0.16	0.54	0.13	0.07	2,601
MLT	0.02	0.05	0.07	0.09	0.55	0.08	0.05	1,496
MYS	0.02	0.10	0.14	0.21	1.19	0.17	0.11	199,915
NGA	0.01	0.11	0.14	0.17	0.55	0.14	0.06	16,608
NLD	0.02	0.07	0.09	0.13	1.26	0.11	0.08	37,636
NOR	0.03	0.10	0.14	0.20	1.10	0.17	0.11	45,236
NZL	0.02	0.07	0.09	0.14	0.95	0.13	0.11	18,831

(*Continued*)

Table A.8. (*Continued*)

	Min	25%	Median	75%	Max	Mean	StdDev	# Observations
				SIGMA				
PAK	0.03	0.11	0.15	0.24	1.19	0.22	0.19	39,752
PER	0.02	0.09	0.12	0.16	0.62	0.13	0.07	11,811
PHL	0.01	0.12	0.17	0.25	0.94	0.20	0.12	40,571
POL	0.01	0.12	0.16	0.24	1.42	0.20	0.13	69,339
PRT	0.01	0.07	0.10	0.15	1.18	0.12	0.09	14,641
ROM	0.01	0.17	0.22	0.33	1.42	0.26	0.15	21,425
RUS	0.03	0.10	0.13	0.20	1.25	0.17	0.11	22,077
SAU	0.02	0.06	0.09	0.13	0.64	0.11	0.06	16,584
SGP	0.02	0.10	0.15	0.23	0.95	0.19	0.14	125,699
SVK	0.01	0.08	0.11	0.16	0.59	0.13	0.08	1,458
SVN	0.01	0.08	0.10	0.14	1.14	0.14	0.12	8,758
SWE	0.01	0.10	0.14	0.25	1.42	0.20	0.17	84,418
THA	0.01	0.09	0.13	0.18	1.19	0.15	0.10	105,776
TUR	0.01	0.10	0.14	0.19	1.25	0.15	0.07	65,671
TWN	0.02	0.08	0.11	0.14	0.88	0.12	0.05	255,014
UKR	0.01	0.15	0.19	0.29	1.05	0.24	0.16	5,690
USA	0.03	0.09	0.15	0.23	1.02	0.18	0.12	1,559,843
VEN	0.01	0.13	0.18	0.23	0.69	0.19	0.10	4,118
VNM	0.01	0.11	0.15	0.19	0.69	0.16	0.07	41,373
ZAF	0.01	0.09	0.13	0.22	1.19	0.19	0.18	83,354

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

Default	
Action Type	**Subcategory**
Bankruptcy filling	Administration, Arrangement, Canadian CCAA, Chapter 7, Chapter 11, Chapter 15, Conservatorship, Insolvency, Japanese 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, Other, Unknown.
Delisting	Bankruptcy
Default Corporate Action	Bankruptcy, Coupon & Principal Payment, Coupon Payment Only, Debt Restructuring, Interest Payment, Loan Payment, Principal Payment, ADR (Japan only), Declared Sick(India Only), Unknown.

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

Other Exits	
Action Type	**Subcategory**
Delisting	Unknown,Acquired/Merged, Assimilated with underlying shares,Bid price below minimum, Cancellation of listing, End of When- issued trading, Expired, 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, Matured, Not available, Not current in required filings, NP/FP finished, Privatized, Reorganization security called for redemptions, the company’s request, Scheme of arrangement, Insufficient spread of holders, Selective capital reduction of the company

Table A.11. Number of defaults and other exits of 71 economies from 1992 to 2013.

Economy: ARE					
		Defaults		Others	
Year	Active	#	%	#	%
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	73	0	0.00	7	8.75
2007	83	0	0.00	13	13.54
2008	80	0	0.00	17	17.53
2009	82	0	0.00	21	20.39
2010	85	0	0.00	23	21.30
2011	83	0	0.00	24	22.43
2012	80	1	0.96	23	22.12
2013	85	0	0.00	12	12.37

Economy:ARG					
		Defaults		Others	
Year	Active	#	%	#	%
1992	1	0	0.00	0	0.00
1993	1	0	0.00	0	0.00
1994	23	0	0.00	2	8.00
1995	87	0	0.00	14	13.86
1996	93	0	0.00	25	21.19
1997	84	0	0.00	26	23.64
1998	72	2	1.82	36	32.73
1999	72	1	0.98	29	28.43
2000	66	1	1.11	23	25.56
2001	50	2	2.35	33	38.82
2002	64	9	10.47	13	15.12
2003	68	2	2.38	14	16.67
2004	65	0	0.00	13	16.67
2005	68	0	0.00	5	6.85
2006	70	0	0.00	7	9.09
2007	75	0	0.00	9	10.71
2008	68	0	0.00	16	19.05
2009	67	1	1.30	9	11.69
2010	67	1	1.35	6	8.11
2011	64	0	0.00	9	12.33
2012	64	0	0.00	7	9.86
2013	66	0	0.00	4	5.71

Economy: AUS					
		Defaults		Others	
Year	Active	#	%	#	%
1992	706	1	0.12	109	13.36
1993	808	0	0.00	63	7.23
1994	904	0	0.00	89	8.96
1995	946	1	0.10	82	7.97
1996	991	1	0.09	66	6.24
1997	1,009	3	0.27	99	8.91
1998	1,005	1	0.09	109	9.78
1999	1,041	2	0.18	97	8.51
2000	1,171	7	0.54	108	8.40
2001	1,166	30	2.31	105	8.07
2002	1,182	9	0.70	101	7.82
2003	1,204	9	0.69	96	7.33
2004	1,321	2	0.14	78	5.57
2005	1,437	7	0.46	89	5.81
2006	1,544	5	0.30	115	6.91
2007	1,709	4	0.22	113	6.19
2008	1,691	28	1.50	148	7.93
2009	1,663	30	1.66	111	6.15
2010	1,676	4	0.22	134	7.39
2011	1,685	0	0.00	177	9.51
2012	1,664	3	0.16	170	9.25
2013	1,637	4	0.22	158	8.78

Economy: AUT					
		Defaults		Others	
Year	Active	#	%	#	%
1992	84	0	0.00	3	3.45
1993	101	0	0.00	8	7.34
1994	110	0	0.00	2	1.79
1995	118	0	0.00	2	1.67
1996	116	1	0.82	5	4.10
1997	118	0	0.00	5	4.07
1998	112	0	0.00	14	11.11
1999	108	0	0.00	17	13.60
2000	119	0	0.00	16	11.85
2001	119	1	0.69	24	16.67
2002	110	1	0.78	18	13.95
2003	107	0	0.00	20	15.75
2004	101	0	0.00	25	19.84
2005	101	0	0.00	16	13.68
2006	103	0	0.00	12	10.43
2007	107	0	0.00	11	9.32
2008	105	1	0.85	11	9.40
2009	100	2	1.75	12	10.53
2010	96	1	0.88	17	14.91
2011	86	0	0.00	18	17.31
2012	82	1	1.08	10	10.75
2013	83	0	0.00	15	15.31

(*Continued*)

Table A.11. (*Continued*)

Economy: BEL

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	136	0	0.00	6	4.23
1993	138	0	0.00	8	5.48
1994	145	0	0.00	11	7.05
1995	149	0	0.00	10	6.29
1996	159	0	0.00	11	6.47
1997	162	0	0.00	18	10.00
1998	174	0	0.00	15	7.94
1999	191	1	0.50	8	4.00
2000	193	1	0.49	10	4.90
2001	186	2	1.00	13	6.47
2002	176	2	1.05	13	6.81
2003	177	2	1.04	14	7.25
2004	170	1	0.54	14	7.57
2005	171	1	0.54	12	6.52
2006	185	3	1.54	7	3.59
2007	221	0	0.00	54	19.64
2008	199	2	0.70	85	29.72
2009	197	2	0.80	52	20.72
2010	195	0	0.00	54	21.69
2011	176	1	0.41	65	26.86
2012	186	1	0.45	37	16.52
2013	169	1	0.42	68	28.57

Economy: BGR

Year	Active	Defaults #	Defaults %	Others #	Others %
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	10	41.67
2001	21	0	0.00	8	27.59
2002	30	0	0.00	5	14.29
2003	30	0	0.00	11	26.83
2004	36	0	0.00	3	7.69
2005	130	1	0.67	19	12.67
2006	231	0	0.00	36	13.48
2007	241	2	0.64	71	22.61
2008	214	0	0.00	101	32.06
2009	206	0	0.00	82	28.47
2010	186	1	0.36	91	32.73
2011	171	0	0.00	81	32.14
2012	158	0	0.00	71	31.00
2013	163	0	0.00	72	30.64

Economy: BHR

Year	Active	Defaults #	Defaults %	Others #	Others %
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	29	0	0.00	1	3.33
2005	37	0	0.00	2	5.13
2006	32	0	0.00	8	20.00
2007	36	0	0.00	7	16.28
2008	33	0	0.00	8	19.51
2009	32	0	0.00	14	30.43
2010	29	0	0.00	15	34.09
2011	25	0	0.00	18	41.86
2012	29	0	0.00	19	39.58
2013	29	0	0.00	12	29.27

Economy: BRA

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	272	0	0.00	8	2.86
1995	278	0	0.00	100	26.46
1996	289	0	0.00	94	24.54
1997	266	0	0.00	135	33.67
1998	286	2	0.45	154	34.84
1999	323	2	0.46	107	24.77
2000	287	1	0.24	127	30.60
2001	275	1	0.24	138	33.33
2002	247	1	0.27	127	33.87
2003	278	3	0.81	89	24.05
2004	272	0	0.00	91	25.07
2005	267	1	0.30	70	20.71
2006	278	0	0.00	61	17.99
2007	351	0	0.00	38	9.77
2008	338	0	0.00	55	13.99
2009	336	0	0.00	39	10.40
2010	328	0	0.00	42	11.35
2011	323	1	0.28	37	10.25
2012	301	3	0.86	43	12.39
2013	290	8	2.40	35	10.51

(*Continued*)

Table A.11. (*Continued*)

Economy: CAN

		Defaults		Others	
Year	Active	#	%	#	%
1992	930	1	0.10	111	10.65
1993	1,126	0	0.00	77	6.40
1994	1,316	0	0.00	57	4.15
1995	1,442	0	0.00	76	5.01
1996	1,610	0	0.00	82	4.85
1997	1,773	4	0.21	129	6.77
1998	1,754	9	0.45	253	12.55
1999	1,192	9	0.47	726	37.68
2000	1,112	8	0.61	195	14.83
2001	947	20	1.67	231	19.28
2002	933	4	0.39	79	7.78
2003	929	14	1.36	83	8.09
2004	982	7	0.66	70	6.61
2005	1,041	3	0.27	80	7.12
2006	1,091	3	0.25	108	8.99
2007	1,119	3	0.24	119	9.59
2008	1,110	12	0.97	117	9.44
2009	1,034	12	1.01	141	11.88
2010	1,058	7	0.60	104	8.90
2011	1,079	4	0.33	119	9.90
2012	1,047	9	0.76	135	11.34
2013	1,021	8	0.70	106	9.34

Economy: CHE

		Defaults		Others	
Year	Active	#	%	#	%
1992	139	0	0.00	32	18.71
1993	172	0	0.00	9	4.97
1994	178	0	0.00	18	9.18
1995	190	0	0.00	15	7.32
1996	209	0	0.00	16	7.11
1997	218	1	0.43	14	6.01
1998	226	0	0.00	13	5.44
1999	248	0	0.00	10	3.88
2000	259	0	0.00	18	6.50
2001	260	1	0.36	14	5.09
2002	252	1	0.37	17	6.30
2003	246	2	0.77	13	4.98
2004	238	1	0.40	13	5.16
2005	246	0	0.00	7	2.77
2006	250	1	0.37	16	5.99
2007	257	0	0.00	9	3.38
2008	253	0	0.00	15	5.60
2009	258	0	0.00	17	6.18
2010	254	0	0.00	17	6.27
2011	247	1	0.37	19	7.12
2012	377	1	0.22	77	16.92
2013	385	0	0.00	155	28.70

Economy: CHL

		Defaults		Others	
Year	Active	#	%	#	%
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	141	0	0.00	5	3.42
1995	166	0	0.00	24	12.63
1996	173	0	0.00	44	20.28
1997	185	0	0.00	37	16.67
1998	173	0	0.00	56	24.45
1999	179	0	0.00	44	19.73
2000	169	0	0.00	41	19.52
2001	167	1	0.47	43	20.38
2002	160	1	0.47	50	23.70
2003	158	0	0.00	58	26.85
2004	164	0	0.00	37	18.41
2005	170	0	0.00	34	16.67
2006	169	0	0.00	44	20.66
2007	189	0	0.00	29	13.30
2008	149	0	0.00	51	25.50
2009	162	0	0.00	29	15.18
2010	164	0	0.00	36	18.00
2011	163	0	0.00	41	20.10
2012	167	0	0.00	49	22.69
2013	163	0	0.00	41	20.10

Economy: CHN

		Defaults		Others	
Year	Active	#	%	#	%
1992	41	0	0.00	2	4.65
1993	148	0	0.00	0	0.00
1994	281	1	0.35	1	0.35
1995	313	6	1.88	0	0.00
1996	496	7	1.39	1	0.20
1997	718	17	2.31	2	0.27
1998	834	29	3.35	2	0.23
1999	928	27	2.82	1	0.10
2000	1,050	28	2.59	1	0.09
2001	1,150	46	3.82	7	0.58
2002	1,201	49	3.86	21	1.65
2003	1,257	46	3.47	24	1.81
2004	1,343	111	7.51	25	1.69
2005	1,360	97	6.58	17	1.15
2006	1,365	77	5.12	62	4.12
2007	1,443	60	3.75	98	6.12
2008	1,574	49	2.91	62	3.68
2009	1,657	52	2.99	28	1.61
2010	1,959	39	1.91	45	2.20
2011	2,256	22	0.94	61	2.61
2012	2,424	17	0.68	55	2.20
2013	2,396	13	0.51	147	5.75

(*Continued*)

Table A.11. (*Continued*)

Economy: COL

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	1	0	0.00	0	0.00
1995	46	0	0.00	27	36.99
1996	54	0	0.00	36	40.00
1997	51	0	0.00	44	46.32
1998	60	0	0.00	62	50.82
1999	52	0	0.00	62	54.39
2000	45	0	0.00	39	46.43
2001	53	0	0.00	20	27.40
2002	52	0	0.00	25	32.47
2003	54	0	0.00	15	21.74
2004	53	0	0.00	14	20.90
2005	62	0	0.00	10	13.89
2006	47	0	0.00	25	34.72
2007	48	0	0.00	14	22.58
2008	37	0	0.00	24	39.34
2009	44	0	0.00	10	18.52
2010	42	0	0.00	15	26.32
2011	41	0	0.00	11	21.15
2012	38	1	2.04	10	20.41
2013	41	0	0.00	13	24.07

Economy: CYP

Year	Active	Defaults #	Defaults %	Others #	Others %
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	35	0	0.00	2	5.41
1997	40	0	0.00	1	2.44
1998	46	0	0.00	2	4.17
1999	52	0	0.00	2	3.70
2000	112	0	0.00	4	3.45
2001	137	0	0.00	6	4.20
2002	143	0	0.00	8	5.30
2003	137	0	0.00	19	12.18
2004	132	0	0.00	31	19.02
2005	138	0	0.00	23	14.29
2006	136	0	0.00	12	8.11
2007	137	0	0.00	8	5.52
2008	133	0	0.00	19	12.50
2009	113	0	0.00	34	23.13
2010	118	0	0.00	20	14.49
2011	86	0	0.00	54	38.57
2012	78	0	0.00	58	42.65
2013	55	2	1.69	61	51.69

Economy: CZE

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	1	0	0.00	0	0.00
1995	52	0	0.00	1	1.89
1996	53	0	0.00	8	13.11
1997	271	0	0.00	361	57.12
1998	240	1	0.35	41	14.54
1999	144	4	1.55	110	42.64
2000	110	6	3.43	59	33.71
2001	84	2	1.24	75	46.58
2002	44	1	0.93	62	57.94
2003	35	0	0.00	38	52.05
2004	43	0	0.00	26	37.68
2005	24	0	0.00	25	51.02
2006	17	0	0.00	19	52.78
2007	13	0	0.00	12	48.00
2008	16	0	0.00	7	30.43
2009	13	0	0.00	9	40.91
2010	17	0	0.00	2	10.53
2011	18	1	4.35	4	17.39
2012	16	0	0.00	5	23.81
2013	13	0	0.00	7	35.00

Economy: DEU

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	396	0	0.00	37	8.55
1993	416	0	0.00	32	7.14
1994	571	0	0.00	58	9.22
1995	595	0	0.00	64	9.71
1996	624	4	0.58	62	8.99
1997	625	1	0.14	78	11.08
1998	720	2	0.26	52	6.72
1999	903	2	0.21	50	5.24
2000	1,030	2	0.18	60	5.49
2001	1,035	21	1.89	53	4.78
2002	959	39	3.57	94	8.61
2003	896	19	1.91	79	7.95
2004	885	7	0.74	50	5.31
2005	905	5	0.53	40	4.21
2006	1,053	4	0.37	34	3.12
2007	1,201	4	0.32	62	4.89
2008	1,282	18	1.29	99	7.08
2009	1,251	10	0.70	177	12.31
2010	1,294	1	0.07	146	10.13
2011	1,324	3	0.18	331	19.96
2012	1,170	11	0.75	294	19.93
2013	915	12	0.97	304	24.70

(*Continued*)

Table A.11. (*Continued*)

Economy: DNK

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	155	0	0.00	19	10.92
1993	170	0	0.00	14	7.61
1994	173	0	0.00	23	11.73
1995	198	1	0.46	17	7.87
1996	216	0	0.00	11	4.85
1997	211	0	0.00	19	8.26
1998	209	0	0.00	28	11.81
1999	209	0	0.00	25	10.68
2000	208	1	0.44	20	8.73
2001	192	5	2.19	31	13.60
2002	175	3	1.44	31	14.83
2003	172	1	0.52	19	9.90
2004	170	1	0.54	15	8.06
2005	167	0	0.00	9	5.11
2006	183	0	0.00	6	3.17
2007	214	1	0.46	4	1.83
2008	216	0	0.00	11	4.85
2009	209	4	1.78	12	5.33
2010	200	0	0.00	15	6.98
2011	187	2	0.99	13	6.44
2012	176	2	1.05	12	6.32
2013	166	4	2.22	10	5.56

Economy: EGY

Year	Active	Defaults #	Defaults %	Others #	Others %
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	168	0	0.00	71	29.71
2007	200	0	0.00	123	38.08
2008	356	0	0.00	40	10.10
2009	219	0	0.00	182	45.39
2010	201	0	0.00	70	25.83
2011	236	0	0.00	15	5.98
2012	212	0	0.00	52	19.70
2013	240	0	0.00	6	2.44

Economy: ESP

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	144	0	0.00	38	20.88
1993	113	0	0.00	98	46.45
1994	244	0	0.00	8	3.17
1995	247	0	0.00	90	26.71
1996	268	0	0.00	73	21.41
1997	279	0	0.00	60	17.70
1998	240	0	0.00	99	29.20
1999	217	0	0.00	86	28.38
2000	216	0	0.00	51	19.10
2001	189	0	0.00	83	30.51
2002	209	2	0.74	61	22.43
2003	189	0	0.00	67	26.17
2004	158	0	0.00	57	26.51
2005	162	0	0.00	44	21.36
2006	160	0	0.00	43	21.18
2007	151	1	0.51	46	23.23
2008	153	2	1.14	20	11.43
2009	143	0	0.00	29	16.86
2010	141	1	0.62	19	11.80
2011	143	0	0.00	14	8.92
2012	134	2	1.28	20	12.82
2013	132	6	3.82	19	12.10

Economy: EST

Year	Active	Defaults #	Defaults %	Others #	Others %
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	1	5.00
1999	19	0	0.00	1	5.00
2000	16	0	0.00	3	15.79
2001	14	0	0.00	3	17.65
2002	11	0	0.00	3	21.43
2003	11	0	0.00	0	0.00
2004	11	0	0.00	0	0.00
2005	12	0	0.00	1	7.69
2006	14	0	0.00	1	6.67
2007	16	0	0.00	1	5.88
2008	17	0	0.00	0	0.00
2009	15	0	0.00	2	11.76
2010	15	0	0.00	1	6.25
2011	15	0	0.00	0	0.00
2012	16	0	0.00	0	0.00
2013	16	0	0.00	0	0.00

(*Continued*)

Table A.11. (*Continued*)

Economy: FIN

		Defaults		Others	
Year	Active	#	%	#	%
1992	91	0	0.00	0	0.00
1993	93	0	0.00	2	2.11
1994	96	0	0.00	6	5.88
1995	103	0	0.00	4	3.74
1996	110	0	0.00	4	3.51
1997	122	0	0.00	1	0.81
1998	126	1	0.76	5	3.79
1999	145	0	0.00	9	5.84
2000	152	0	0.00	11	6.75
2001	152	0	0.00	11	6.75
2002	144	2	1.28	10	6.41
2003	138	1	0.66	12	7.95
2004	132	0	0.00	10	7.04
2005	132	0	0.00	7	5.04
2006	132	0	0.00	8	5.71
2007	130	0	0.00	4	2.99
2008	127	1	0.76	4	3.03
2009	125	1	0.78	2	1.56
2010	123	0	0.00	4	3.15
2011	121	1	0.81	1	0.81
2012	121	0	0.00	3	2.42
2013	122	1	0.79	3	2.38

Economy: FRA

		Defaults		Others	
Year	Active	#	%	#	%
1992	620	0	0.00	61	8.96
1993	635	0	0.00	81	11.31
1994	688	0	0.00	96	12.24
1995	710	0	0.00	125	14.97
1996	758	0	0.00	113	12.97
1997	811	1	0.11	131	13.89
1998	844	0	0.00	164	16.27
1999	849	0	0.00	138	13.98
2000	912	2	0.20	92	9.15
2001	918	8	0.79	93	9.13
2002	875	5	0.50	111	11.20
2003	857	4	0.41	110	11.33
2004	839	3	0.32	103	10.90
2005	847	4	0.42	91	9.66
2006	904	7	0.71	79	7.98
2007	950	7	0.66	98	9.29
2008	904	11	1.04	144	13.60
2009	898	7	0.67	143	13.65
2010	847	2	0.20	174	17.01
2011	805	2	0.21	151	15.76
2012	770	0	0.00	158	17.03
2013	741	2	0.22	155	17.26

Economy: GBR

		Defaults		Others	
Year	Active	#	%	#	%
1992	1,075	1	0.09	87	7.48
1993	1,181	0	0.00	46	3.75
1994	1,277	0	0.00	45	3.40
1995	1,405	0	0.00	62	4.23
1996	1,604	0	0.00	66	3.95
1997	1,706	0	0.00	107	5.90
1998	1,690	0	0.00	195	10.34
1999	1,550	1	0.05	289	15.71
2000	1,665	3	0.16	216	11.46
2001	1,685	10	0.54	147	7.98
2002	1,640	15	0.82	169	9.27
2003	1,576	6	0.34	193	10.87
2004	1,747	2	0.11	149	7.85
2005	1,994	2	0.09	202	9.19
2006	2,169	0	0.00	235	9.78
2007	2,226	1	0.04	261	10.49
2008	2,051	27	1.11	353	14.52
2009	1,841	35	1.59	321	14.61
2010	1,767	3	0.15	260	12.81
2011	1,691	10	0.51	260	13.26
2012	1,578	20	1.09	241	13.10
2013	1,553	10	0.57	197	11.19

Economy: GRC

		Defaults		Others	
Year	Active	#	%	#	%
1992	89	0	0.00	0	0.00
1993	94	0	0.00	0	0.00
1994	152	0	0.00	2	1.30
1995	179	0	0.00	2	1.10
1996	193	0	0.00	5	2.53
1997	207	0	0.00	5	2.36
1998	226	0	0.00	4	1.74
1999	254	0	0.00	7	2.68
2000	307	0	0.00	8	2.54
2001	312	0	0.00	12	3.70
2002	313	0	0.00	17	5.15
2003	316	0	0.00	10	3.07
2004	317	0	0.00	9	2.76
2005	301	0	0.00	21	6.52
2006	288	0	0.00	17	5.57
2007	281	0	0.00	14	4.75
2008	277	0	0.00	16	5.46
2009	271	0	0.00	21	7.19
2010	274	0	0.00	20	6.80
2011	234	0	0.00	49	17.31
2012	220	0	0.00	42	16.03
2013	199	0	0.00	41	17.08

(*Continued*)

Table A.11. (*Continued*)

Economy: HKG

		Defaults		Others	
Year	Active	#	%	#	%
1992	352	0	0.00	11	3.03
1993	418	0	0.00	6	1.42
1994	459	0	0.00	13	2.75
1995	489	0	0.00	7	1.41
1996	518	0	0.00	18	3.36
1997	593	0	0.00	23	3.73
1998	621	2	0.31	27	4.15
1999	654	5	0.73	22	3.23
2000	734	5	0.66	20	2.64
2001	796	9	1.08	28	3.36
2002	905	4	0.42	36	3.81
2003	954	4	0.40	50	4.96
2004	990	0	0.00	56	5.35
2005	1,016	1	0.09	69	6.35
2006	1,061	4	0.36	40	3.62
2007	1,157	2	0.17	30	2.52
2008	1,174	6	0.49	33	2.72
2009	1,219	5	0.40	23	1.84
2010	1,300	1	0.08	26	1.96
2011	1,353	1	0.07	27	1.96
2012	1,403	2	0.14	44	3.04
2013	1,475	5	0.33	27	1.79

Economy: HRV

		Defaults		Others	
Year	Active	#	%	#	%
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	29	0	0.00	3	9.38
2003	37	0	0.00	6	13.95
2004	48	0	0.00	11	18.64
2005	53	0	0.00	9	14.52
2006	210	0	0.00	16	7.08
2007	243	0	0.00	54	18.18
2008	168	0	0.00	121	41.87
2009	158	0	0.00	80	33.61
2010	151	1	0.51	46	23.23
2011	134	0	0.00	67	33.33
2012	127	1	0.56	49	27.68
2013	117	0	0.00	54	31.58

Economy: HUN

		Defaults		Others	
Year	Active	#	%	#	%
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	0	0	NaN	0	NaN
1995	36	0	0.00	0	0.00
1996	37	0	0.00	9	19.57
1997	38	0	0.00	9	19.15
1998	43	0	0.00	5	10.42
1999	54	0	0.00	6	10.00
2000	50	1	1.72	7	12.07
2001	48	0	0.00	8	14.29
2002	39	0	0.00	12	23.53
2003	42	0	0.00	4	8.70
2004	38	0	0.00	8	17.39
2005	35	0	0.00	7	16.67
2006	38	0	0.00	4	9.52
2007	34	0	0.00	5	12.82
2008	37	0	0.00	1	2.63
2009	39	0	0.00	0	0.00
2010	43	0	0.00	1	2.27
2011	44	0	0.00	6	12.00
2012	46	0	0.00	4	8.00
2013	47	1	1.92	4	7.69

Economy: IDN

		Defaults		Others	
Year	Active	#	%	#	%
1992	124	0	0.00	27	17.88
1993	152	0	0.00	27	15.08
1994	174	0	0.00	46	20.91
1995	207	0	0.00	40	16.19
1996	230	1	0.38	30	11.49
1997	251	2	0.71	29	10.28
1998	240	19	6.23	46	15.08
1999	254	19	6.53	18	6.19
2000	256	14	4.62	33	10.89
2001	270	14	4.28	43	13.15
2002	265	6	1.80	62	18.62
2003	298	2	0.63	19	5.96
2004	290	5	1.40	62	17.37
2005	273	2	0.57	77	21.88
2006	302	0	0.00	56	15.64
2007	322	2	0.51	65	16.71
2008	291	0	0.00	92	24.02
2009	324	3	0.78	59	15.28
2010	361	2	0.49	46	11.25
2011	381	1	0.24	43	10.12
2012	411	1	0.22	40	8.85
2013	440	1	0.21	37	7.74

(*Continued*)

Table A.11. (*Continued*)

Economy: IND

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	1,484	1	0.06	145	8.90
1993	1,832	0	0.00	193	9.53
1994	2,728	0	0.00	262	8.76
1995	4,024	2	0.05	338	7.75
1996	4,077	3	0.06	1,038	20.28
1997	3,021	11	0.22	1,911	38.66
1998	2,619	9	0.22	1,519	36.63
1999	2,916	13	0.32	1,125	27.75
2000	2,558	11	0.29	1,289	33.41
2001	2,285	6	0.18	1,111	32.66
2002	2,644	6	0.18	752	22.10
2003	2,618	14	0.35	1,363	34.12
2004	2,553	7	0.20	874	25.45
2005	2,509	7	0.22	682	21.33
2006	2,854	10	0.32	307	9.68
2007	2,982	15	0.45	302	9.15
2008	3,048	25	0.69	537	14.88
2009	3,127	38	1.10	288	8.34
2010	3,604	9	0.20	936	20.58
2011	3,372	9	0.21	881	20.67
2012	3,550	26	0.65	425	10.62
2013	3,461	29	0.72	530	13.18

Economy: IRL

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	30	0	0.00	4	11.76
1993	37	0	0.00	4	9.76
1994	38	0	0.00	4	9.52
1995	36	0	0.00	2	5.26
1996	43	0	0.00	0	0.00
1997	49	0	0.00	3	5.77
1998	50	0	0.00	5	9.09
1999	51	0	0.00	5	8.93
2000	58	0	0.00	6	9.38
2001	55	0	0.00	5	8.33
2002	48	0	0.00	7	12.73
2003	43	0	0.00	5	10.42
2004	42	0	0.00	3	6.67
2005	42	0	0.00	2	4.55
2006	47	0	0.00	2	4.08
2007	51	0	0.00	2	3.77
2008	49	0	0.00	3	5.77
2009	44	1	2.04	4	8.16
2010	40	0	0.00	5	11.11
2011	38	0	0.00	2	5.00
2012	33	0	0.00	5	13.16
2013	33	1	2.78	2	5.56

Economy: ISL

Year	Active	Defaults #	Defaults %	Others #	Others %
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	26	0	0.00	0	0.00
1997	33	0	0.00	3	8.33
1998	44	0	0.00	2	4.35
1999	60	0	0.00	8	11.76
2000	59	0	0.00	18	23.38
2001	64	0	0.00	13	16.88
2002	54	0	0.00	15	21.74
2003	42	0	0.00	22	34.38
2004	32	0	0.00	13	28.89
2005	26	0	0.00	12	31.58
2006	24	0	0.00	6	20.00
2007	26	0	0.00	4	13.33
2008	13	4	13.33	13	43.33
2009	10	1	5.88	6	35.29
2010	8	0	0.00	3	27.27
2011	7	0	0.00	5	41.67
2012	11	0	0.00	1	8.33
2013	14	0	0.00	3	17.65

Economy: ISR

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	9	0	0.00	0	0.00
1995	82	0	0.00	2	2.38
1996	626	0	0.00	6	0.95
1997	632	0	0.00	20	3.07
1998	611	0	0.00	42	6.43
1999	610	0	0.00	54	8.13
2000	596	0	0.00	74	11.04
2001	548	0	0.00	175	24.20
2002	540	2	0.28	169	23.77
2003	530	0	0.00	165	23.74
2004	512	2	0.34	83	13.90
2005	517	0	0.00	53	9.30
2006	543	0	0.00	40	6.86
2007	594	0	0.00	25	4.04
2008	566	0	0.00	45	7.36
2009	566	0	0.00	26	4.39
2010	550	1	0.17	50	8.32
2011	544	1	0.17	43	7.31
2012	488	0	0.00	82	14.39
2013	475	2	0.39	36	7.02

(*Continued*)

Table A.11. (*Continued*)

Economy: ITA					
		Defaults		Others	
Year	Active	#	%	#	%
1992	185	0	0.00	4	2.12
1993	181	0	0.00	9	4.74
1994	196	0	0.00	12	5.77
1995	207	0	0.00	15	6.76
1996	213	1	0.44	15	6.55
1997	220	0	0.00	23	9.47
1998	226	0	0.00	17	7.00
1999	253	0	0.00	7	2.69
2000	274	0	0.00	24	8.05
2001	281	0	0.00	17	5.70
2002	276	1	0.34	14	4.81
2003	262	5	1.72	23	7.93
2004	257	3	1.11	10	3.70
2005	264	0	0.00	12	4.35
2006	274	0	0.00	16	5.52
2007	296	0	0.00	15	4.82
2008	287	1	0.32	21	6.80
2009	277	3	1.00	21	6.98
2010	278	1	0.34	16	5.42
2011	280	0	0.00	22	7.28
2012	276	2	0.65	29	9.45
2013	274	2	0.67	22	7.38

Economy: JOR					
		Defaults		Others	
Year	Active	#	%	#	%
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	65	0	0.00	13	16.67
1997	89	0	0.00	16	15.24
1998	109	0	0.00	30	21.58
1999	105	0	0.00	49	31.82
2000	110	0	0.00	50	31.25
2001	117	0	0.00	40	25.48
2002	114	0	0.00	33	22.45
2003	133	0	0.00	21	13.64
2004	137	0	0.00	16	10.46
2005	154	0	0.00	14	8.33
2006	191	0	0.00	12	5.91
2007	202	0	0.00	20	9.01
2008	220	0	0.00	14	5.98
2009	219	0	0.00	32	12.75
2010	218	0	0.00	23	9.54
2011	211	0	0.00	36	14.57
2012	209	0	0.00	31	12.92
2013	194	0	0.00	37	16.02

Economy: JPN					
		Defaults		Others	
Year	Active	#	%	#	%
1992	2,531	2	0.08	21	0.82
1993	2,609	3	0.11	25	0.95
1994	2,748	0	0.00	17	0.61
1995	2,928	1	0.03	18	0.61
1996	3,077	4	0.13	22	0.71
1997	3,207	5	0.15	28	0.86
1998	3,264	12	0.36	36	1.09
1999	3,318	6	0.18	47	1.39
2000	3,449	12	0.34	60	1.70
2001	3,557	14	0.39	62	1.71
2002	3,593	33	0.89	92	2.47
2003	3,613	18	0.48	103	2.76
2004	3,726	13	0.34	77	2.02
2005	3,798	9	0.23	93	2.38
2006	3,925	2	0.05	89	2.22
2007	3,978	6	0.15	100	2.45
2008	3,902	32	0.79	110	2.72
2009	3,784	31	0.79	131	3.32
2010	3,686	8	0.21	130	3.40
2011	3,626	6	0.16	99	2.65
2012	3,576	6	0.16	102	2.77
2013	3,565	3	0.08	85	2.33

Economy: KAZ					
		Defaults		Others	
Year	Active	#	%	#	%
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	7	0	0.00	5	41.67
2003	8	0	0.00	5	38.46
2004	14	0	0.00	11	44.00
2005	3	0	0.00	15	83.33
2006	3	0	0.00	3	50.00
2007	22	0	0.00	13	37.14
2008	23	0	0.00	11	32.35
2009	19	4	9.09	21	47.73
2010	10	0	0.00	21	67.74
2011	14	0	0.00	9	39.13
2012	15	0	0.00	10	40.00
2013	13	0	0.00	12	48.00

(*Continued*)

Table A.11. (*Continued*)

Economy: KOR

		Defaults		Others	
Year	**Active**	**#**	**%**	**#**	**%**
1992	634	0	0.00	1	0.16
1993	643	0	0.00	0	0.00
1994	670	0	0.00	0	0.00
1995	698	0	0.00	1	0.14
1996	740	6	0.80	3	0.40
1997	1,015	36	3.38	15	1.41
1998	902	92	8.36	106	9.64
1999	957	19	1.86	44	4.31
2000	1,150	12	1.00	40	3.33
2001	1,274	20	1.51	30	2.27
2002	1,441	15	1.01	32	2.15
2003	1,491	11	0.72	30	1.96
2004	1,503	9	0.58	52	3.32
2005	1,545	8	0.50	57	3.54
2006	1,625	2	0.12	12	0.73
2007	1,699	2	0.12	14	0.82
2008	1,735	5	0.28	35	1.97
2009	1,721	8	0.44	83	4.58
2010	1,736	10	0.54	98	5.31
2011	1,749	3	0.16	84	4.58
2012	1,728	8	0.44	77	4.25
2013	1,736	11	0.61	66	3.64

Economy: KWT

		Defaults		Others	
Year	**Active**	**#**	**%**	**#**	**%**
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	1	1.89
1997	66	0	0.00	2	2.94
1998	67	0	0.00	1	1.47
1999	70	0	0.00	6	7.89
2000	69	0	0.00	11	13.75
2001	73	0	0.00	0	0.00
2002	76	0	0.00	6	7.32
2003	94	0	0.00	0	0.00
2004	100	0	0.00	3	2.91
2005	137	0	0.00	4	2.84
2006	159	0	0.00	4	2.45
2007	172	0	0.00	16	8.51
2008	176	0	0.00	14	7.37
2009	181	2	0.93	31	14.49
2010	182	0	0.00	42	18.75
2011	160	1	0.44	65	28.76
2012	183	0	0.00	37	16.82
2013	186	0	0.00	25	11.85

Economy: LKA

		Defaults		Others	
Year	**Active**	**#**	**%**	**#**	**%**
1992	0	0	NaN	0	NaN
1993	1	0	0.00	0	0.00
1994	1	0	0.00	0	0.00
1995	122	0	0.00	1	0.81
1996	137	0	0.00	38	21.71
1997	137	0	0.00	34	19.88
1998	153	0	0.00	30	16.39
1999	151	0	0.00	35	18.82
2000	147	0	0.00	38	20.54
2001	166	0	0.00	22	11.70
2002	175	0	0.00	25	12.50
2003	177	0	0.00	28	13.66
2004	189	0	0.00	12	5.97
2005	205	0	0.00	10	4.65
2006	209	0	0.00	13	5.86
2007	218	0	0.00	8	3.54
2008	214	0	0.00	14	6.14
2009	221	0	0.00	9	3.91
2010	238	0	0.00	2	0.83
2011	259	0	0.00	9	3.36
2012	275	0	0.00	4	1.43
2013	276	0	0.00	2	0.72

Economy: LTU

		Defaults		Others	
Year	**Active**	**#**	**%**	**#**	**%**
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	33	0	0.00	5	13.16
2001	33	0	0.00	11	25.00
2002	41	0	0.00	3	6.82
2003	39	0	0.00	9	18.75
2004	40	0	0.00	1	2.44
2005	40	0	0.00	0	0.00
2006	39	0	0.00	2	4.88
2007	37	0	0.00	3	7.50
2008	38	0	0.00	0	0.00
2009	38	0	0.00	1	2.56
2010	38	0	0.00	2	5.00
2011	33	1	2.50	6	15.00
2012	32	0	0.00	1	3.03
2013	31	1	2.94	2	5.88

(*Continued*)

Table A.11. (*Continued*)

Economy: LUX					
		Defaults		Others	
Year	Active	#	%	#	%
1992	2	0	0.00	1	33.33
1993	2	0	0.00	1	33.33
1994	2	0	0.00	0	0.00
1995	32	0	0.00	9	21.95
1996	30	0	0.00	16	34.78
1997	38	0	0.00	10	20.83
1998	32	0	0.00	14	30.43
1999	34	0	0.00	12	26.09
2000	31	0	0.00	14	31.11
2001	28	0	0.00	14	33.33
2002	28	0	0.00	9	24.32
2003	27	0	0.00	11	28.95
2004	35	0	0.00	7	16.67
2005	38	0	0.00	6	13.64
2006	37	0	0.00	15	28.85
2007	35	0	0.00	10	22.22
2008	27	0	0.00	14	34.15
2009	23	0	0.00	9	28.13
2010	20	1	3.45	8	27.59
2011	14	0	0.00	10	41.67
2012	14	0	0.00	5	26.32
2013	19	0	0.00	2	9.52

Economy: LVA					
		Defaults		Others	
Year	Active	#	%	#	%
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	16	0	0.00	1	5.88
2001	34	0	0.00	9	20.93
2002	35	0	0.00	4	10.26
2003	33	0	0.00	4	10.81
2004	27	0	0.00	10	27.03
2005	32	0	0.00	3	8.57
2006	31	0	0.00	4	11.43
2007	32	0	0.00	6	15.79
2008	27	0	0.00	8	22.86
2009	28	0	0.00	9	24.32
2010	32	0	0.00	4	11.11
2011	27	1	2.78	8	22.22
2012	29	0	0.00	5	14.71
2013	29	0	0.00	8	21.62

Economy: MAR					
		Defaults		Others	
Year	Active	#	%	#	%
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	40	0	0.00	3	6.98
1998	48	0	0.00	1	2.04
1999	47	0	0.00	5	9.62
2000	51	0	0.00	2	3.77
2001	52	0	0.00	7	11.86
2002	51	0	0.00	7	12.07
2003	50	0	0.00	7	12.28
2004	48	0	0.00	7	12.73
2005	54	0	0.00	2	3.57
2006	56	0	0.00	6	9.68
2007	69	0	0.00	3	4.17
2008	77	0	0.00	1	1.28
2009	75	0	0.00	2	2.60
2010	73	0	0.00	4	5.19
2011	74	0	0.00	1	1.33
2012	76	0	0.00	1	1.30
2013	73	0	0.00	4	5.19

Economy: MEX					
		Defaults		Others	
Year	Active	#	%	#	%
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	99	0	0.00	25	20.16
1995	98	0	0.00	32	24.62
1996	105	0	0.00	20	16.00
1997	116	0	0.00	23	16.55
1998	113	0	0.00	19	14.39
1999	110	1	0.73	26	18.98
2000	106	1	0.81	17	13.71
2001	106	1	0.79	19	15.08
2002	97	0	0.00	28	22.40
2003	103	3	2.44	17	13.82
2004	109	0	0.00	10	8.40
2005	100	0	0.00	24	19.35
2006	105	0	0.00	10	8.70
2007	103	0	0.00	17	14.17
2008	93	2	1.68	24	20.17
2009	101	2	1.75	11	9.65
2010	106	2	1.65	13	10.74
2011	106	1	0.78	22	17.05
2012	105	0	0.00	12	10.26
2013	112	6	4.84	6	4.84

(*Continued*)

Table A.11. (*Continued*)

Economy: MKD					
		Defaults		Others	
Year	Active	#	%	#	%
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	61	0	0.00	61	50.00
2006	84	0	0.00	71	45.81
2007	94	0	0.00	73	43.71
2008	71	0	0.00	78	52.35
2009	68	0	0.00	68	50.00
2010	64	0	0.00	58	47.54
2011	59	0	0.00	69	53.91
2012	52	1	0.86	63	54.31
2013	42	0	0.00	76	64.41

Economy: MLT					
		Defaults		Others	
Year	Active	#	%	#	%
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	1	12.50
2000	9	0	0.00	0	0.00
2001	9	0	0.00	2	18.18
2002	9	0	0.00	2	18.18
2003	10	0	0.00	3	23.08
2004	11	0	0.00	2	15.38
2005	11	0	0.00	2	15.38
2006	13	0	0.00	0	0.00
2007	14	0	0.00	3	17.65
2008	14	0	0.00	6	30.00
2009	12	0	0.00	4	25.00
2010	12	0	0.00	2	14.29
2011	14	0	0.00	2	12.50
2012	19	0	0.00	1	5.00
2013	20	0	0.00	2	9.09

Economy: MYS					
		Defaults		Others	
Year	Active	#	%	#	%
1992	351	0	0.00	8	2.23
1993	399	0	0.00	2	0.50
1994	457	0	0.00	7	1.51
1995	517	0	0.00	2	0.39
1996	602	0	0.00	0	0.00
1997	692	0	0.00	2	0.29
1998	697	14	1.92	20	2.74
1999	703	8	1.11	12	1.66
2000	735	8	1.06	15	1.98
2001	737	9	1.18	18	2.36
2002	767	8	1.00	27	3.37
2003	821	3	0.36	21	2.49
2004	901	3	0.33	18	1.95
2005	981	1	0.10	27	2.68
2006	997	5	0.48	29	2.81
2007	967	6	0.58	70	6.71
2008	934	14	1.39	61	6.05
2009	920	14	1.43	48	4.89
2010	926	18	1.84	32	3.28
2011	927	5	0.52	33	3.42
2012	909	6	0.63	40	4.19
2013	898	5	0.54	30	3.22

Economy: NGA					
		Defaults		Others	
Year	Active	#	%	#	%
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	123	0	0.00	22	15.17
2003	75	0	0.00	66	46.81
2004	113	0	0.00	41	26.62
2005	131	0	0.00	24	15.48
2006	136	0	0.00	33	19.53
2007	166	0	0.00	26	13.54
2008	179	0	0.00	44	19.73
2009	188	0	0.00	25	11.74
2010	179	0	0.00	24	11.82
2011	159	0	0.00	35	18.04
2012	161	0	0.00	19	10.56
2013	177	0	0.00	20	10.15

(*Continued*)

Table A.11. (*Continued*)

Economy: NLD		Defaults		Others	
Year	Active	#	%	#	%
1992	158	0	0.00	6	3.66
1993	167	0	0.00	4	2.34
1994	174	0	0.00	6	3.33
1995	187	0	0.00	4	2.09
1996	193	1	0.50	5	2.51
1997	201	0	0.00	14	6.51
1998	211	0	0.00	10	4.52
1999	215	0	0.00	20	8.51
2000	204	1	0.44	20	8.89
2001	181	5	2.39	23	11.00
2002	161	11	5.82	17	8.99
2003	153	1	0.59	16	9.41
2004	145	0	0.00	10	6.45
2005	140	0	0.00	9	6.04
2006	137	1	0.69	7	4.83
2007	136	0	0.00	8	5.56
2008	128	1	0.71	11	7.86
2009	123	3	2.29	5	3.82
2010	120	0	0.00	6	4.76
2011	116	0	0.00	8	6.45
2012	111	0	0.00	10	8.26
2013	105	1	0.88	7	6.19

Economy: NOR		Defaults		Others	
Year	Active	#	%	#	%
1992	78	0	0.00	9	10.34
1993	95	0	0.00	2	2.06
1994	113	0	0.00	3	2.59
1995	134	0	0.00	2	1.47
1996	158	0	0.00	4	2.47
1997	195	0	0.00	10	4.88
1998	217	0	0.00	18	7.66
1999	201	0	0.00	30	12.99
2000	194	1	0.44	32	14.10
2001	216	2	0.80	31	12.45
2002	201	5	2.07	36	14.88
2003	186	3	1.31	40	17.47
2004	196	0	0.00	22	10.09
2005	235	0	0.00	14	5.62
2006	252	0	0.00	45	15.15
2007	270	0	0.00	42	13.46
2008	246	4	1.37	42	14.38
2009	229	6	2.19	39	14.23
2010	219	1	0.40	29	11.65
2011	220	1	0.43	12	5.15
2012	214	0	0.00	15	6.55
2013	200	2	0.90	21	9.42

Economy: NZL		Defaults		Others	
Year	Active	#	%	#	%
1992	29	0	0.00	1	3.33
1993	31	0	0.00	0	0.00
1994	40	0	0.00	0	0.00
1995	43	0	0.00	1	2.27
1996	45	0	0.00	3	6.25
1997	48	0	0.00	0	0.00
1998	50	0	0.00	1	1.96
1999	56	0	0.00	0	0.00
2000	61	0	0.00	1	1.61
2001	70	0	0.00	0	0.00
2002	75	0	0.00	0	0.00
2003	87	0	0.00	0	0.00
2004	102	0	0.00	1	0.97
2005	108	0	0.00	0	0.00
2006	113	0	0.00	0	0.00
2007	122	0	0.00	1	0.81
2008	115	0	0.00	13	10.16
2009	122	0	0.00	9	6.87
2010	123	0	0.00	14	10.22
2011	122	1	0.74	12	8.89
2012	120	0	0.00	19	13.67
2013	123	2	1.47	11	8.09

Economy: PAK		Defaults		Others	
Year	Active	#	%	#	%
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	243	0	0.00	119	32.87
1999	338	0	0.00	123	26.68
2000	368	0	0.00	155	29.64
2001	317	0	0.00	178	35.96
2002	429	0	0.00	96	18.29
2003	456	0	0.00	68	12.98
2004	500	0	0.00	41	7.58
2005	493	0	0.00	85	14.71
2006	469	0	0.00	99	17.43
2007	480	0	0.00	83	14.74
2008	240	0	0.00	300	55.56
2009	514	0	0.00	67	11.53
2010	492	0	0.00	52	9.56
2011	505	0	0.00	102	16.80
2012	457	0	0.00	88	16.15
2013	462	0	0.00	21	4.35

(*Continued*)

Table A.11. (*Continued*)

Economy: PER

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	1	0	0.00	0	0.00
1993	1	0	0.00	0	0.00
1994	25	0	0.00	0	0.00
1995	99	0	0.00	20	16.81
1996	95	0	0.00	46	32.62
1997	123	0	0.00	35	22.15
1998	109	0	0.00	62	36.26
1999	93	0	0.00	69	42.59
2000	86	0	0.00	65	43.05
2001	64	0	0.00	63	49.61
2002	75	0	0.00	49	39.52
2003	68	0	0.00	47	40.87
2004	77	0	0.00	41	34.75
2005	78	0	0.00	43	35.54
2006	76	0	0.00	39	33.91
2007	93	0	0.00	25	21.19
2008	81	0	0.00	50	38.17
2009	89	0	0.00	35	28.23
2010	90	0	0.00	32	26.23
2011	81	0	0.00	37	31.36
2012	80	0	0.00	38	32.20
2013	65	0	0.00	46	41.44

Economy: PHL

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	83	0	0.00	21	20.19
1993	110	1	0.78	18	13.95
1994	126	0	0.00	28	18.18
1995	156	0	0.00	16	9.30
1996	177	0	0.00	14	7.33
1997	186	0	0.00	20	9.71
1998	176	1	0.49	29	14.08
1999	186	3	1.49	12	5.97
2000	169	2	0.97	36	17.39
2001	163	3	1.46	40	19.42
2002	161	5	2.35	47	22.07
2003	174	5	2.33	36	16.74
2004	176	7	3.00	50	21.46
2005	181	3	1.36	36	16.36
2006	189	2	0.91	28	12.79
2007	191	2	0.90	30	13.45
2008	185	1	0.47	29	13.49
2009	203	2	0.88	23	10.09
2010	207	0	0.00	17	7.59
2011	218	0	0.00	14	6.03
2012	222	0	0.00	15	6.33
2013	224	0	0.00	15	6.28

Economy: POL

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	26	0	0.00	19	42.22
1995	58	0	0.00	0	0.00
1996	77	0	0.00	0	0.00
1997	129	0	0.00	2	1.53
1998	186	0	0.00	3	1.59
1999	211	0	0.00	2	0.94
2000	217	1	0.44	8	3.54
2001	221	1	0.44	4	1.77
2002	205	2	0.88	21	9.21
2003	190	3	1.44	15	7.21
2004	207	0	0.00	8	3.72
2005	235	1	0.41	7	2.88
2006	248	0	0.00	12	4.62
2007	316	0	0.00	10	3.07
2008	418	0	0.00	3	0.71
2009	452	0	0.00	11	2.38
2010	536	0	0.00	7	1.29
2011	711	0	0.00	17	2.34
2012	807	7	0.83	28	3.33
2013	837	5	0.56	43	4.86

Economy: PRT

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	1	0	0.00	0	0.00
1993	69	0	0.00	12	14.81
1994	81	0	0.00	11	11.96
1995	91	0	0.00	18	16.51
1996	92	0	0.00	23	20.00
1997	94	0	0.00	26	21.67
1998	87	0	0.00	33	27.50
1999	88	0	0.00	25	22.12
2000	86	0	0.00	17	16.50
2001	70	0	0.00	21	23.08
2002	62	0	0.00	20	24.39
2003	63	0	0.00	7	10.00
2004	68	0	0.00	6	8.11
2005	65	0	0.00	6	8.45
2006	62	0	0.00	13	17.33
2007	58	0	0.00	9	13.43
2008	57	0	0.00	8	12.31
2009	56	0	0.00	9	13.85
2010	57	0	0.00	5	8.06
2011	55	2	3.13	7	10.94
2012	55	0	0.00	4	6.78
2013	51	0	0.00	9	15.00

(*Continued*)

Table A.11. (*Continued*)

Economy: ROM

Year	Active	Defaults #	Defaults %	Others #	Others %
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	78	0	0.00	1	1.27
1999	341	0	0.00	28	7.59
2000	362	0	0.00	89	19.73
2001	338	0	0.00	175	34.11
2002	288	0	0.00	193	40.12
2003	280	0	0.00	172	38.05
2004	299	0	0.00	119	28.47
2005	324	1	0.20	179	35.52
2006	514	0	0.00	159	23.63
2007	717	0	0.00	704	49.54
2008	596	0	0.00	411	40.81
2009	466	0	0.00	456	49.46
2010	526	0	0.00	315	37.46
2011	451	1	0.11	479	51.45
2012	361	0	0.00	371	50.68
2013	360	2	0.28	344	48.73

Economy: RUS

Year	Active	Defaults #	Defaults %	Others #	Others %
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	77	0	0.00	22	22.22
1998	26	2	1.59	98	77.78
1999	34	0	0.00	45	56.96
2000	66	0	0.00	55	45.45
2001	71	0	0.00	77	52.03
2002	52	0	0.00	105	66.88
2003	77	0	0.00	65	45.77
2004	101	3	1.76	66	38.82
2005	171	1	0.41	74	30.08
2006	218	1	0.25	174	44.27
2007	308	0	0.00	180	36.89
2008	260	0	0.00	257	49.71
2009	301	9	2.19	101	24.57
2010	320	1	0.22	124	27.87
2011	281	2	0.42	196	40.92
2012	262	1	0.24	161	37.97
2013	188	1	0.18	365	65.88

Economy: SAU

Year	Active	Defaults #	Defaults %	Others #	Others %
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	60	0	0.00	4	6.25
2001	63	0	0.00	4	5.97
2002	65	0	0.00	3	4.41
2003	68	0	0.00	2	2.86
2004	71	0	0.00	0	0.00
2005	76	0	0.00	0	0.00
2006	84	0	0.00	0	0.00
2007	105	0	0.00	2	1.87
2008	126	0	0.00	1	0.79
2009	133	0	0.00	1	0.75
2010	145	0	0.00	0	0.00
2011	147	0	0.00	1	0.68
2012	155	0	0.00	1	0.64
2013	158	1	0.62	2	1.24

Economy: SGP

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	177	0	0.00	11	5.85
1993	198	0	0.00	4	1.98
1994	232	0	0.00	3	1.28
1995	249	1	0.39	6	2.34
1996	269	1	0.36	9	3.23
1997	295	1	0.32	18	5.73
1998	318	4	1.19	13	3.88
1999	354	4	1.07	15	4.02
2000	424	0	0.00	18	4.07
2001	435	2	0.43	31	6.62
2002	444	2	0.42	32	6.69
2003	498	1	0.19	15	2.92
2004	571	1	0.17	12	2.05
2005	622	4	0.62	15	2.34
2006	664	2	0.29	24	3.48
2007	708	0	0.00	20	2.75
2008	705	3	0.40	41	5.47
2009	714	15	1.97	31	4.08
2010	724	0	0.00	34	4.49
2011	704	1	0.13	54	7.11
2012	703	0	0.00	38	5.13
2013	707	0	0.00	31	4.20

(*Continued*)

Table A.11. (*Continued*)

Economy: SVK					
		Defaults		Others	
Year	Active	#	%	#	%
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	12	0	0.00	7	36.84
1999	12	0	0.00	26	68.42
2000	12	0	0.00	13	52.00
2001	13	0	0.00	15	53.57
2002	19	0	0.00	16	45.71
2003	42	0	0.00	22	34.38
2004	41	0	0.00	34	45.33
2005	43	0	0.00	25	36.76
2006	51	0	0.00	37	42.05
2007	23	0	0.00	52	69.33
2008	36	0	0.00	26	41.94
2009	31	0	0.00	31	50.00
2010	50	0	0.00	17	25.37
2011	49	0	0.00	47	48.96
2012	48	0	0.00	30	38.46
2013	45	0	0.00	20	30.77

Economy: SVN					
		Defaults		Others	
Year	Active	#	%	#	%
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	71	0	0.00	7	8.97
1999	95	0	0.00	7	6.86
2000	109	0	0.00	21	16.15
2001	118	0	0.00	36	23.38
2002	100	0	0.00	44	30.56
2003	103	0	0.00	19	15.57
2004	111	0	0.00	20	15.27
2005	87	0	0.00	36	29.27
2006	75	0	0.00	28	27.18
2007	62	0	0.00	23	27.06
2008	66	0	0.00	15	18.52
2009	56	1	1.22	25	30.49
2010	71	1	1.23	9	11.11
2011	60	0	0.00	17	22.08
2012	56	2	3.28	3	4.92
2013	49	2	3.45	7	12.07

Economy: SWE					
		Defaults		Others	
Year	Active	#	%	#	%
1992	116	0	0.00	3	2.52
1993	141	0	0.00	2	1.40
1994	170	0	0.00	2	1.16
1995	184	0	0.00	0	0.00
1996	220	0	0.00	15	6.38
1997	263	0	0.00	26	9.00
1998	296	0	0.00	21	6.62
1999	338	1	0.28	19	5.31
2000	372	2	0.49	38	9.22
2001	364	4	1.00	33	8.23
2002	348	7	1.82	30	7.79
2003	337	3	0.82	27	7.36
2004	349	1	0.27	23	6.17
2005	374	2	0.52	12	3.09
2006	422	0	0.00	19	4.31
2007	499	1	0.19	13	2.53
2008	509	2	0.37	30	5.55
2009	498	4	0.75	33	6.17
2010	502	2	0.38	29	5.44
2011	496	2	0.38	34	6.39
2012	478	1	0.19	46	8.76
2013	479	3	0.60	22	4.37

Economy: THA					
		Defaults		Others	
Year	Active	#	%	#	%
1992	277	0	0.00	1	0.36
1993	328	0	0.00	2	0.61
1994	371	0	0.00	1	0.27
1995	400	1	0.24	9	2.20
1996	420	7	1.57	20	4.47
1997	371	19	4.18	65	14.29
1998	343	18	4.35	53	12.80
1999	327	13	3.50	31	8.36
2000	309	19	5.31	30	8.38
2001	312	9	2.65	19	5.59
2002	335	3	0.85	14	3.98
2003	363	4	1.06	12	3.17
2004	403	2	0.47	22	5.15
2005	428	3	0.66	24	5.27
2006	464	0	0.00	12	2.52
2007	466	2	0.41	16	3.31
2008	464	1	0.20	26	5.30
2009	474	8	1.62	11	2.23
2010	478	5	1.02	7	1.43
2011	480	2	0.40	12	2.43
2012	494	1	0.20	7	1.39
2013	521	1	0.19	6	1.14

(*Continued*)

Table A.11. (*Continued*)

Economy: TUR					
		Defaults		Others	
Year	Active	#	%	#	%
1992	8	0	0.00	0	0.00
1993	15	0	0.00	0	0.00
1994	29	0	0.00	0	0.00
1995	197	0	0.00	4	1.99
1996	222	0	0.00	1	0.45
1997	247	0	0.00	10	3.89
1998	275	0	0.00	3	1.08
1999	271	0	0.00	10	3.56
2000	296	2	0.63	18	5.70
2001	284	0	0.00	17	5.65
2002	286	0	0.00	8	2.72
2003	284	0	0.00	6	2.07
2004	296	0	0.00	0	0.00
2005	302	0	0.00	3	0.98
2006	315	0	0.00	4	1.25
2007	318	0	0.00	7	2.15
2008	315	0	0.00	5	1.56
2009	315	0	0.00	3	0.94
2010	336	0	0.00	1	0.30
2011	360	0	0.00	3	0.83
2012	393	0	0.00	8	2.00
2013	411	0	0.00	7	1.67

Economy: TWN					
		Defaults		Others	
Year	Active	#	%	#	%
1992	232	0	0.00	2	0.85
1993	255	0	0.00	1	0.39
1994	289	0	0.00	1	0.34
1995	363	0	0.00	0	0.00
1996	428	0	0.00	1	0.23
1997	489	0	0.00	3	0.61
1998	551	4	0.71	11	1.94
1999	680	7	1.01	8	1.15
2000	785	8	0.99	17	2.10
2001	880	7	0.77	19	2.10
2002	981	9	0.88	36	3.51
2003	1,071	2	0.18	28	2.54
2004	1,333	5	0.37	25	1.83
2005	1,354	9	0.63	66	4.62
2006	1,384	3	0.21	38	2.67
2007	1,444	3	0.20	35	2.36
2008	1,448	6	0.40	48	3.20
2009	1,492	7	0.46	28	1.83
2010	1,589	1	0.06	24	1.49
2011	1,659	2	0.12	36	2.12
2012	1,701	2	0.11	46	2.63
2013	1,746	2	0.11	42	2.35

Economy: UKR					
		Defaults		Others	
Year	Active	#	%	#	%
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	26	0	0.00	22	45.83
1999	36	0	0.00	41	53.25
2000	62	0	0.00	29	31.87
2001	25	0	0.00	75	75.00
2002	11	0	0.00	39	78.00
2003	18	0	0.00	18	50.00
2004	30	0	0.00	25	45.45
2005	59	0	0.00	23	28.05
2006	102	0	0.00	50	32.89
2007	160	0	0.00	70	30.43
2008	114	0	0.00	117	50.65
2009	83	1	0.45	138	62.16
2010	57	0	0.00	80	58.39
2011	55	0	0.00	39	41.49
2012	61	0	0.00	38	38.38
2013	70	0	0.00	65	48.15

Economy: USA					
		Defaults		Others	
Year	Active	#	%	#	%
1992	5,270	14	0.26	107	1.98
1993	5,896	27	0.44	161	2.65
1994	6,645	21	0.30	256	3.70
1995	6,981	16	0.22	381	5.16
1996	7,537	21	0.26	418	5.24
1997	7,764	53	0.63	531	6.36
1998	7,442	80	0.95	859	10.25
1999	7,080	91	1.12	936	11.55
2000	6,846	123	1.59	778	10.04
2001	6,093	200	2.84	756	10.72
2002	5,643	148	2.35	507	8.05
2003	5,272	90	1.54	472	8.09
2004	5,241	37	0.65	374	6.62
2005	5,218	36	0.64	379	6.73
2006	5,184	26	0.47	372	6.66
2007	5,108	25	0.45	465	8.31
2008	4,856	71	1.34	366	6.91
2009	4,579	106	2.12	315	6.30
2010	4,491	33	0.68	307	6.35
2011	4,341	34	0.72	333	7.07
2012	4,268	37	0.81	264	5.78
2013	4,323	13	0.29	212	4.66

(*Continued*)

Table A.11. (*Continued*)

Economy: VEN

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	0	0	NaN	0	NaN
1993	0	0	NaN	0	NaN
1994	13	0	0.00	0	0.00
1995	15	0	0.00	4	21.05
1996	14	0	0.00	2	12.50
1997	48	0	0.00	16	25.00
1998	45	0	0.00	21	31.82
1999	39	0	0.00	22	36.07
2000	38	0	0.00	12	24.00
2001	29	1	2.38	12	28.57
2002	20	0	0.00	20	50.00
2003	25	0	0.00	10	28.57
2004	28	0	0.00	8	22.22
2005	28	0	0.00	8	22.22
2006	27	0	0.00	7	20.59
2007	23	0	0.00	7	23.33
2008	25	0	0.00	30	54.55
2009	26	0	0.00	24	48.00
2010	20	0	0.00	13	39.39
2011	29	0	0.00	17	36.96
2012	15	0	0.00	18	54.55
2013	15	0	0.00	10	40.00

Economy: VNM

Year	Active	Defaults #	Defaults %	Others #	Others %
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	4	0	0.00	0	0.00
2001	8	0	0.00	0	0.00
2002	19	0	0.00	0	0.00
2003	22	0	0.00	0	0.00
2004	24	0	0.00	0	0.00
2005	29	0	0.00	0	0.00
2006	49	0	0.00	0	0.00
2007	205	0	0.00	1	0.49
2008	290	0	0.00	4	1.36
2009	367	0	0.00	27	6.85
2010	661	0	0.00	22	3.22
2011	740	1	0.13	50	6.32
2012	735	0	0.00	87	10.58
2013	732	0	0.00	109	12.96

Economy: ZAF

Year	Active	Defaults #	Defaults %	Others #	Others %
1992	0	0	NaN	0	NaN
1993	389	0	0.00	39	9.11
1994	418	0	0.00	19	4.35
1995	463	0	0.00	28	5.70
1996	491	0	0.00	11	2.19
1997	533	0	0.00	21	3.79
1998	572	2	0.32	56	8.89
1999	594	3	0.46	52	8.01
2000	543	6	0.98	61	10.00
2001	466	9	1.56	101	17.53
2002	352	8	1.69	112	23.73
2003	329	1	0.26	54	14.06
2004	292	2	0.59	44	13.02
2005	296	2	0.60	37	11.04
2006	305	0	0.00	27	8.13
2007	332	0	0.00	39	10.51
2008	340	0	0.00	24	6.59
2009	320	1	0.28	34	9.58
2010	314	1	0.30	20	5.97
2011	314	2	0.60	19	5.67
2012	295	5	1.54	24	7.41
2013	292	2	0.62	30	9.26

APPENDIX B: PERFORMANCE ANALYSIS

Table B.1. Accuracy Ratios (AR) and Area Under Receiver Operating Characteristic (AUROC) for different economies.

	AR				AUROC			
Economy	**1 mth**	**1 yr**	**2 yr**	**5 yr**	**1 mth**	**1 yr**	**2 yr**	**5 yr**
AUS	0.812	0.644	0.521	0.367	0.906	0.822	0.762	0.688
CHN	0.593	0.524	0.449	0.317	0.797	0.765	0.731	0.677
HKG	0.696	0.431	0.322	0.204	0.848	0.716	0.662	0.605
IND	0.725	0.648	0.561	0.464	0.862	0.824	0.781	0.734
IDN	0.698	0.640	0.534	0.355	0.849	0.822	0.770	0.689
JPN	0.913	0.827	0.769	0.637	0.956	0.913	0.885	0.820
MYS	0.839	0.741	0.654	0.419	0.919	0.871	0.828	0.715
PHL	0.677	0.604	0.566	0.461	0.838	0.803	0.785	0.737
SGP	0.775	0.635	0.449	0.277	0.887	0.818	0.726	0.642
KOR	0.882	0.723	0.648	0.614	0.941	0.862	0.826	0.812
TWN	0.865	0.738	0.670	0.507	0.932	0.869	0.836	0.756
THA	0.837	0.754	0.702	0.571	0.918	0.878	0.853	0.793
USA	0.938	0.816	0.705	0.517	0.969	0.909	0.854	0.764
CAN	0.928	0.794	0.660	0.484	0.964	0.897	0.831	0.746
DNK	0.889	0.806	0.647	0.481	0.944	0.903	0.825	0.744
FRA	0.869	0.684	0.620	0.529	0.934	0.842	0.810	0.766
DEU	0.884	0.724	0.609	0.501	0.942	0.863	0.806	0.756
NLD	0.809	0.754	0.650	0.548	0.904	0.878	0.827	0.778
NOR	0.961	0.807	0.617	0.337	0.981	0.904	0.810	0.672
GBR	0.900	0.726	0.577	0.394	0.950	0.864	0.790	0.700
AsiaDev	0.860	0.724	0.644	0.535	0.930	0.862	0.823	0.771
EMR	0.822	0.737	0.664	0.508	0.911	0.869	0.833	0.758
EU	0.878	0.724	0.597	0.429	0.939	0.862	0.799	0.717

Note: The calibration groups, Developed Asia, Emerging Markets and Europe, are indicated by AsiaDev, EMR and EU. Only economies with more than 20 defaults are listed.

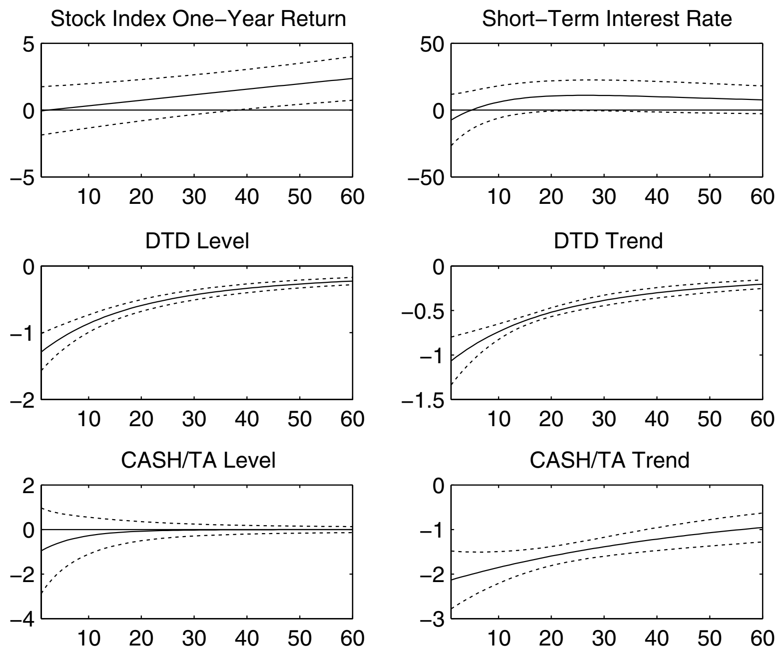


Figure B.1. Plots of US default parameters across all horizons for the Stock index one-year return, Short-term interest rate, DTD Level, DTD Trend, CASH/TA Level and CASH/TA Trend. Solid lines are the parameter estimates and dashed lines are the 90% confidence level. Horizontal axis is the horizon in months.

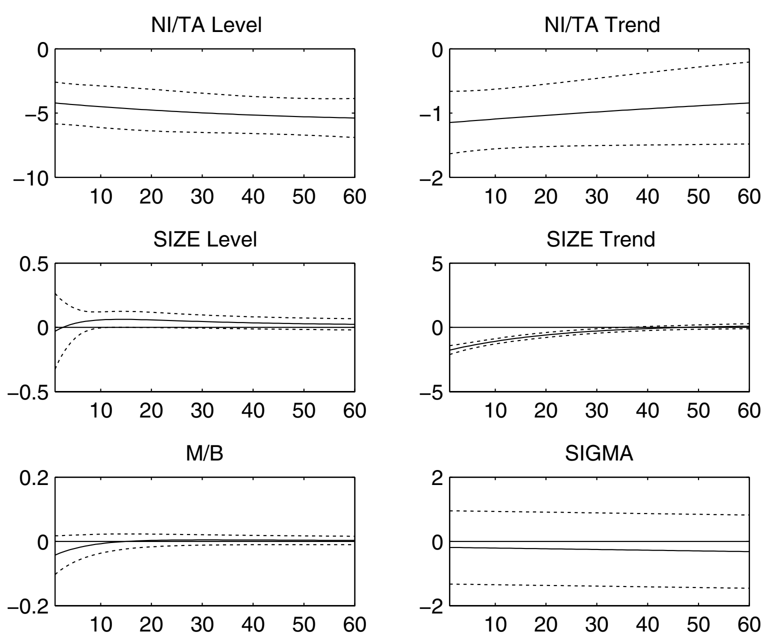


Figure B.2. Plots of US default parameters across all horizons for the NI/TA Level, NI/TA Trend, SIZE Level, SIZE Trend, M/B and SIGMA. Solid lines are the parameter estimates and dashed lines are the 90% confidence level. Horizontal axis is the horizon in months.

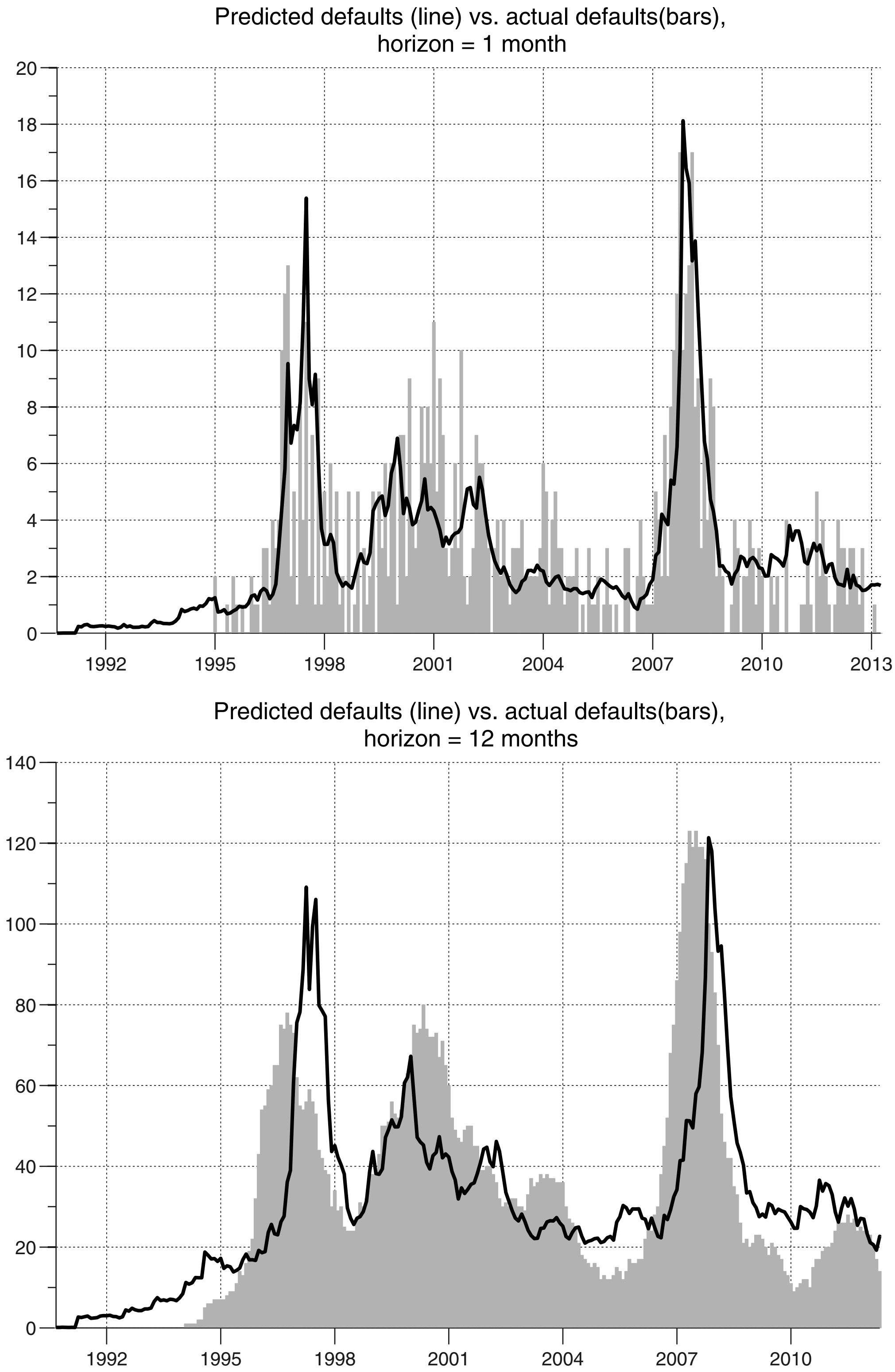


Figure B.3. Performance test for the Developed Asia, in sample.

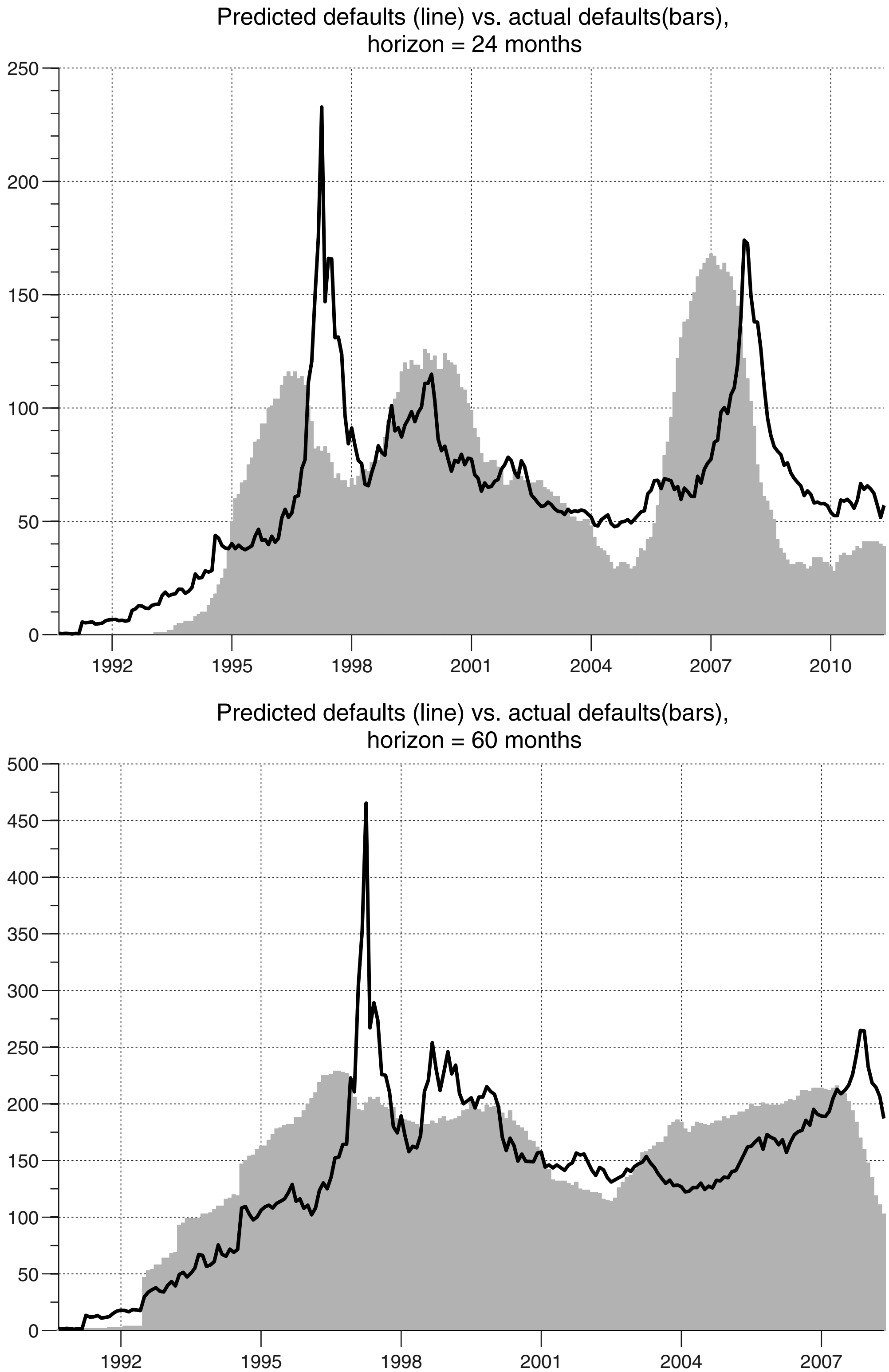


Figure B.3. (*Continued*)

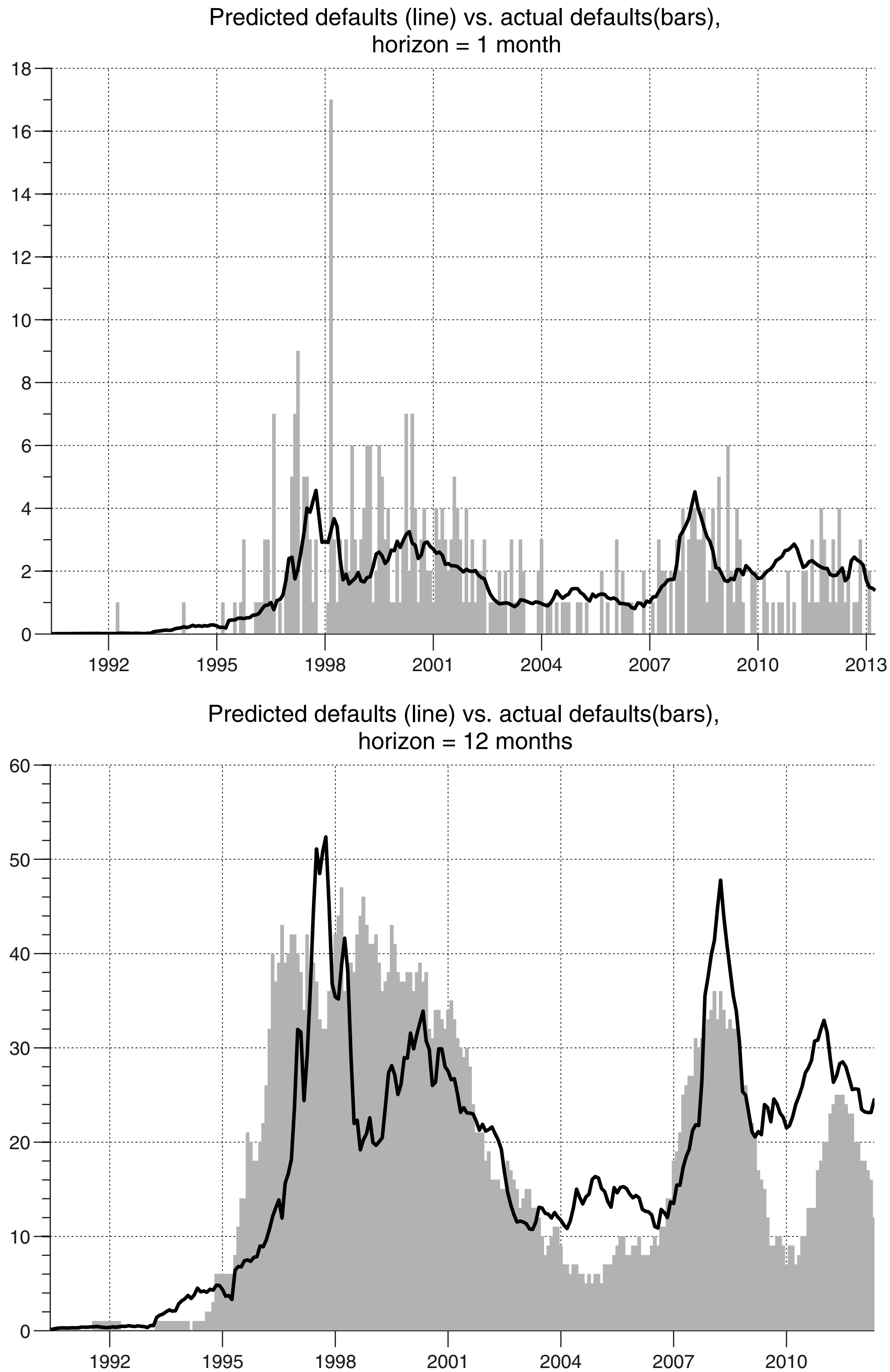
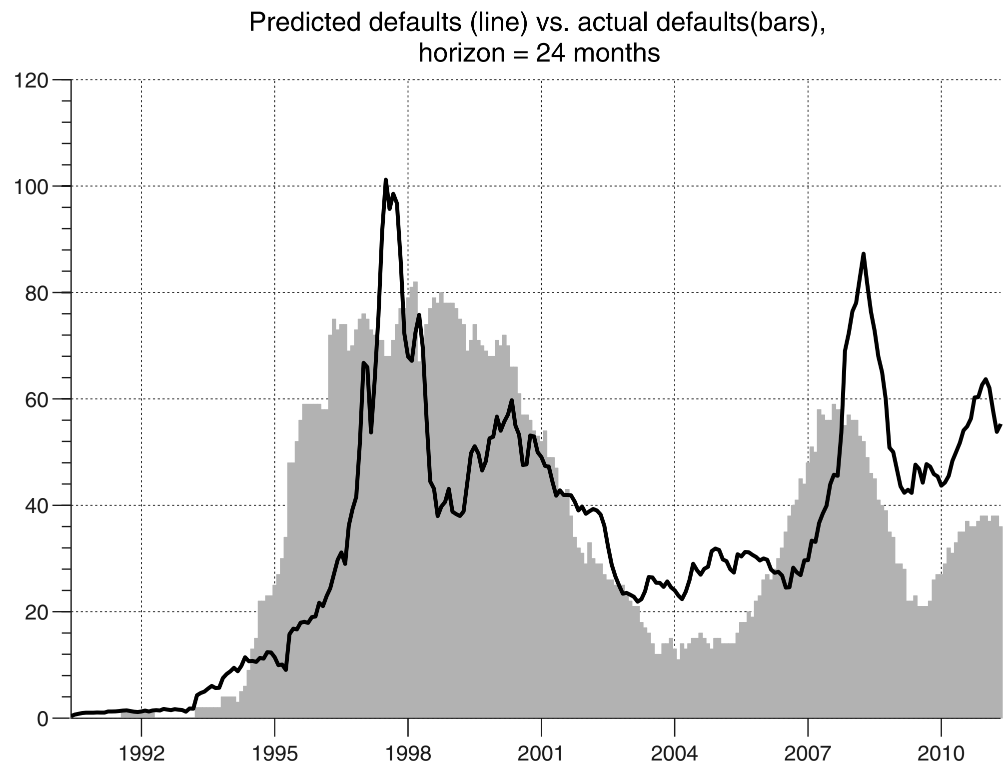


Figure B.4. Performance test for the Emerging Market, in sample.



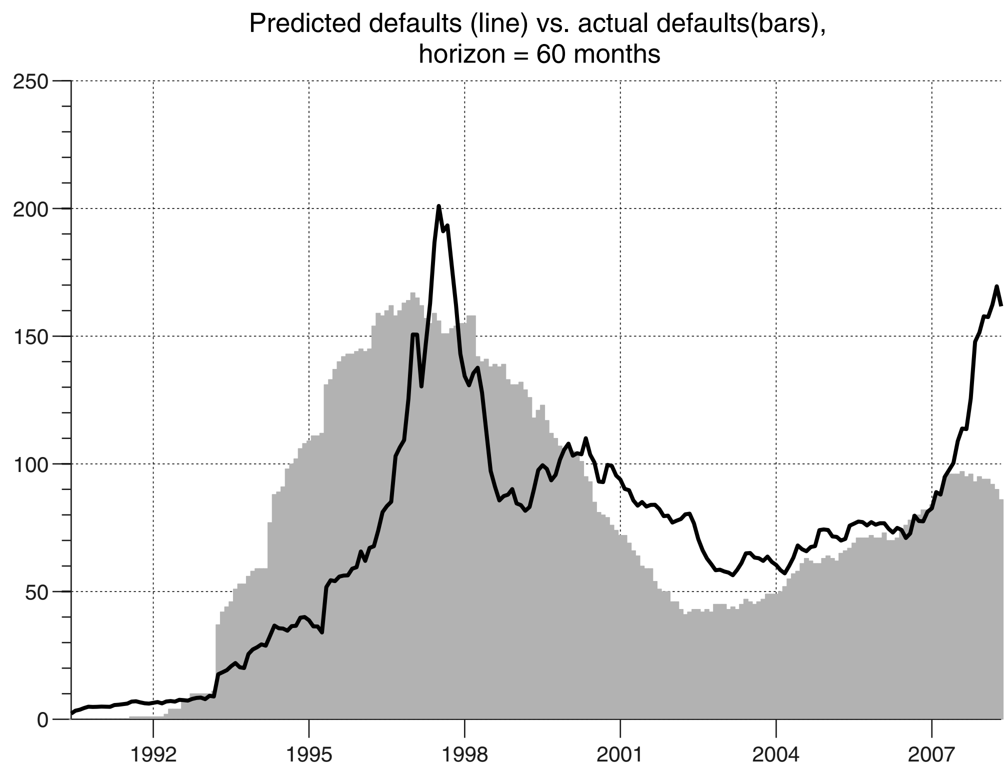


Figure B.4. (*Continued*)

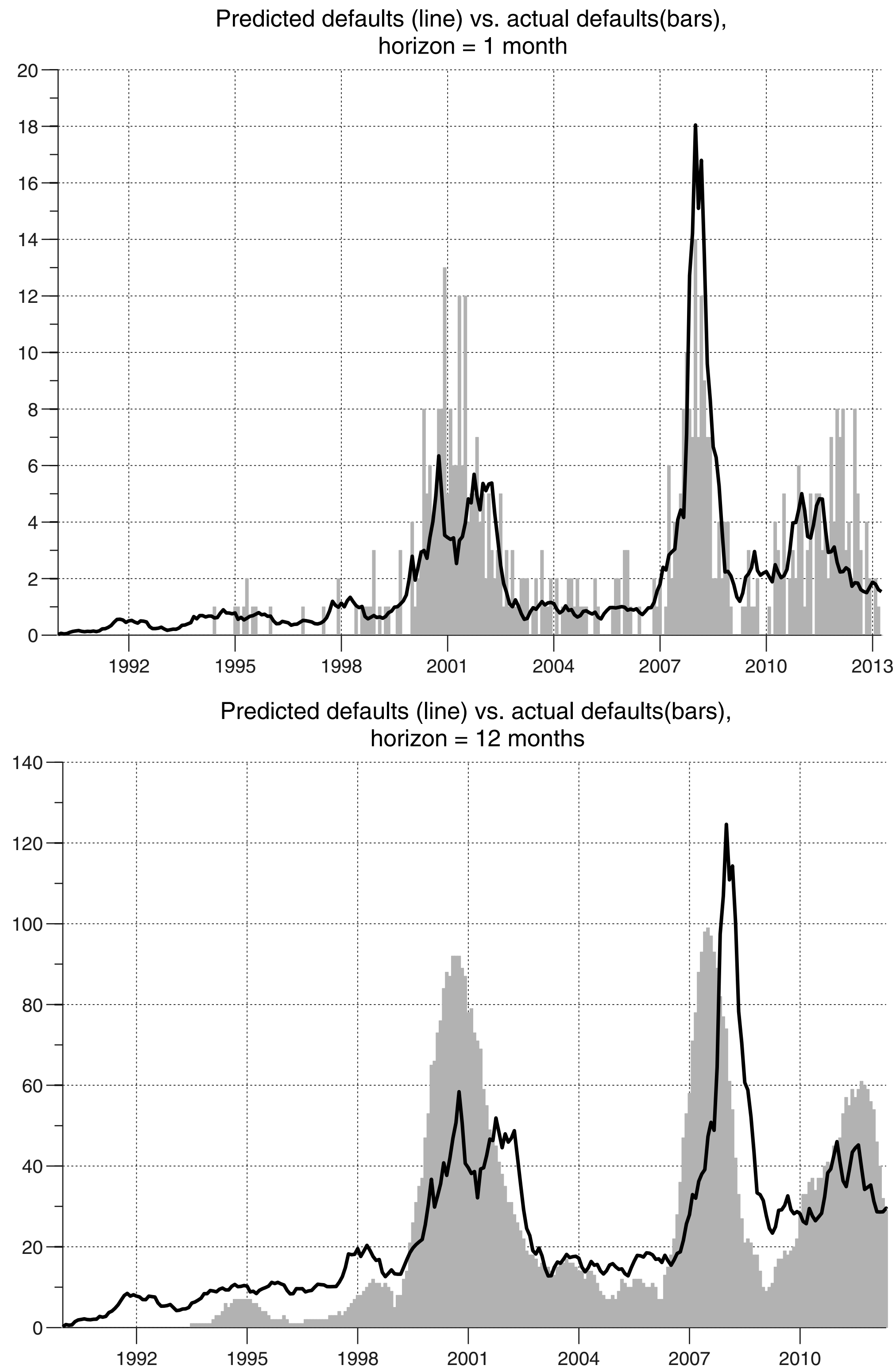
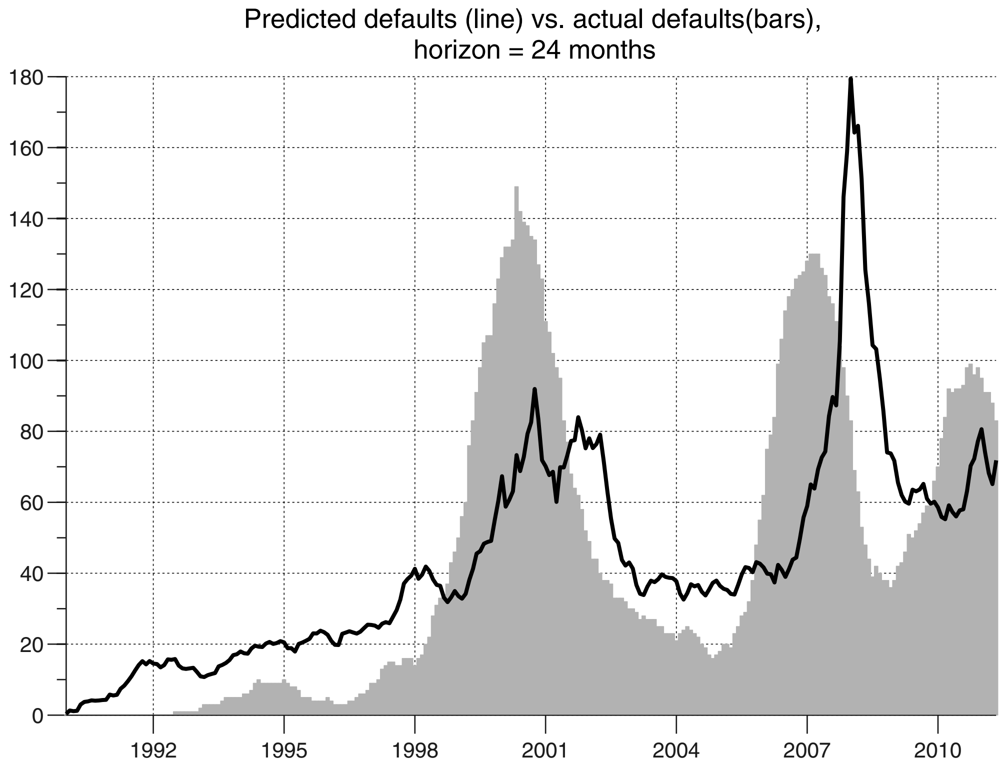


Figure B.5. Performance test for the Europe group, in sample.



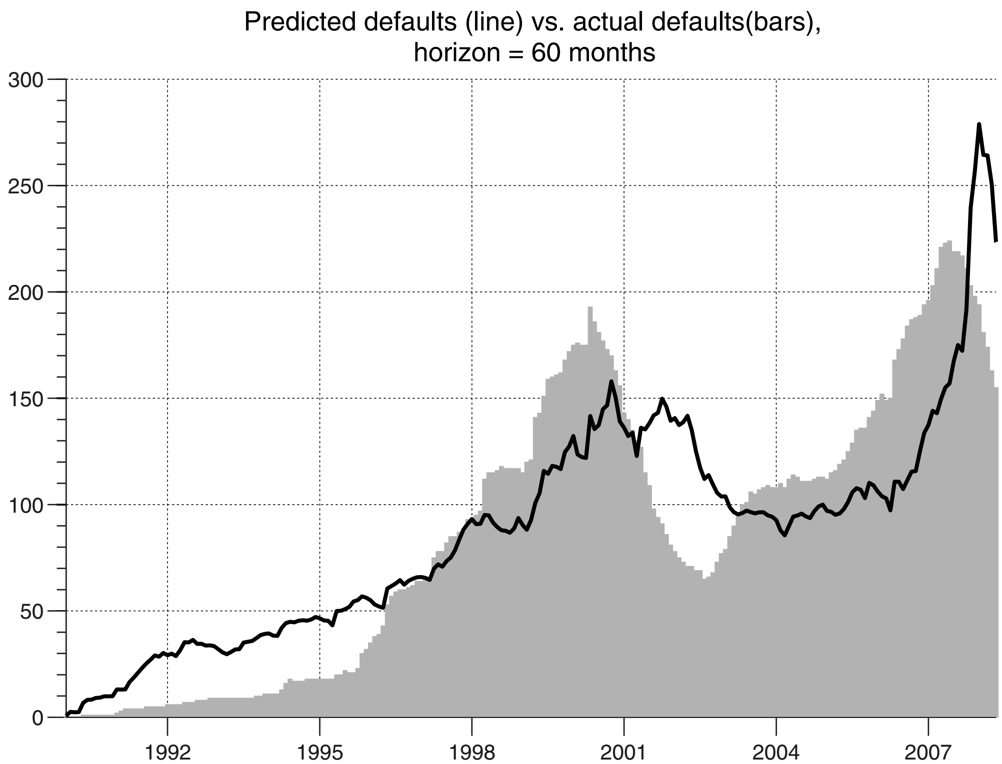


Figure B.5. (*Continued*)

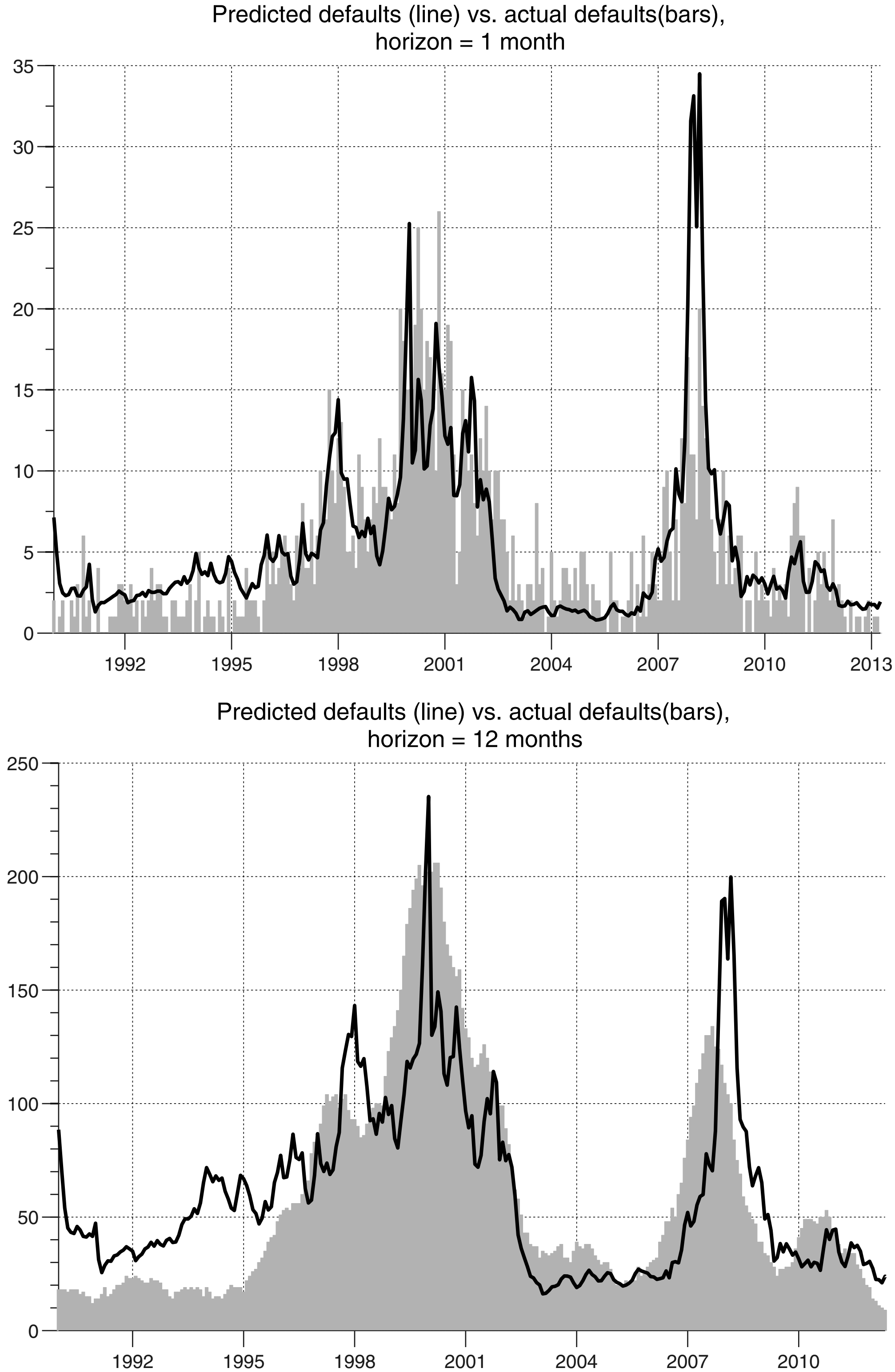
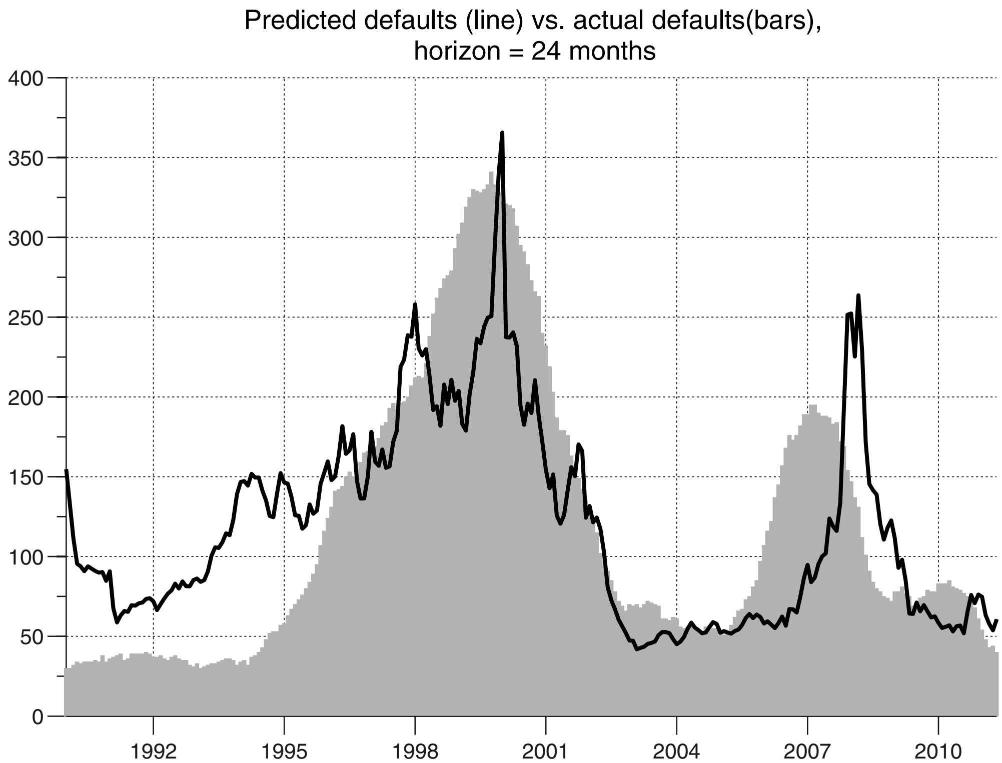


Figure B.6. Performance test for North America group, in sample.



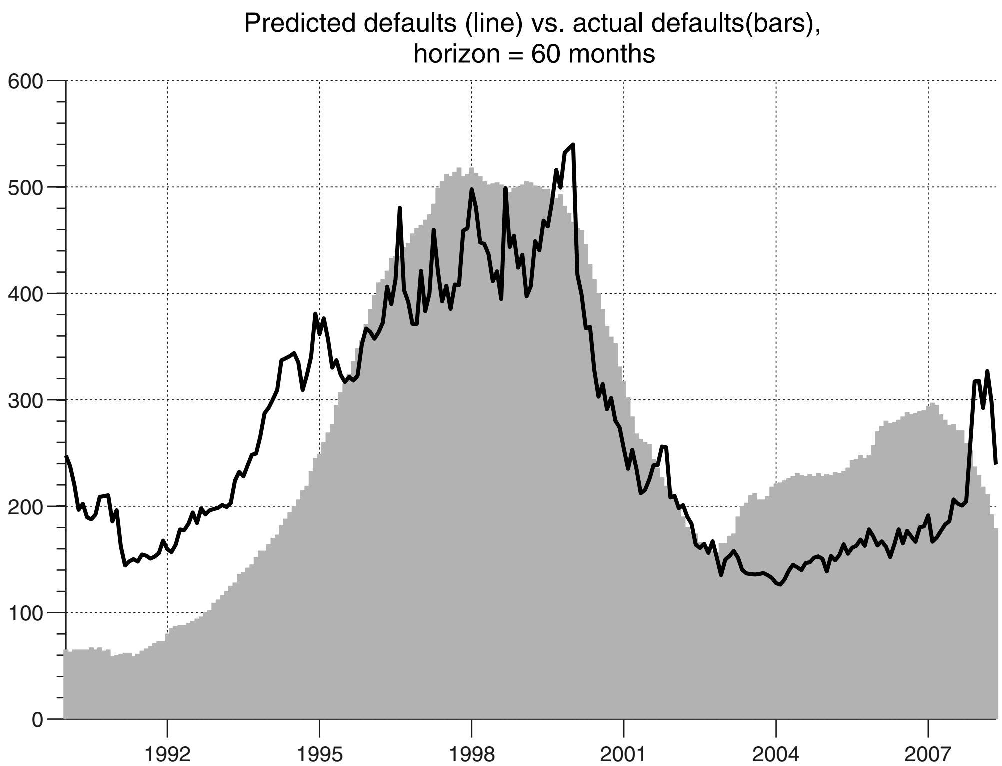


Figure B.6. (*Continued*)

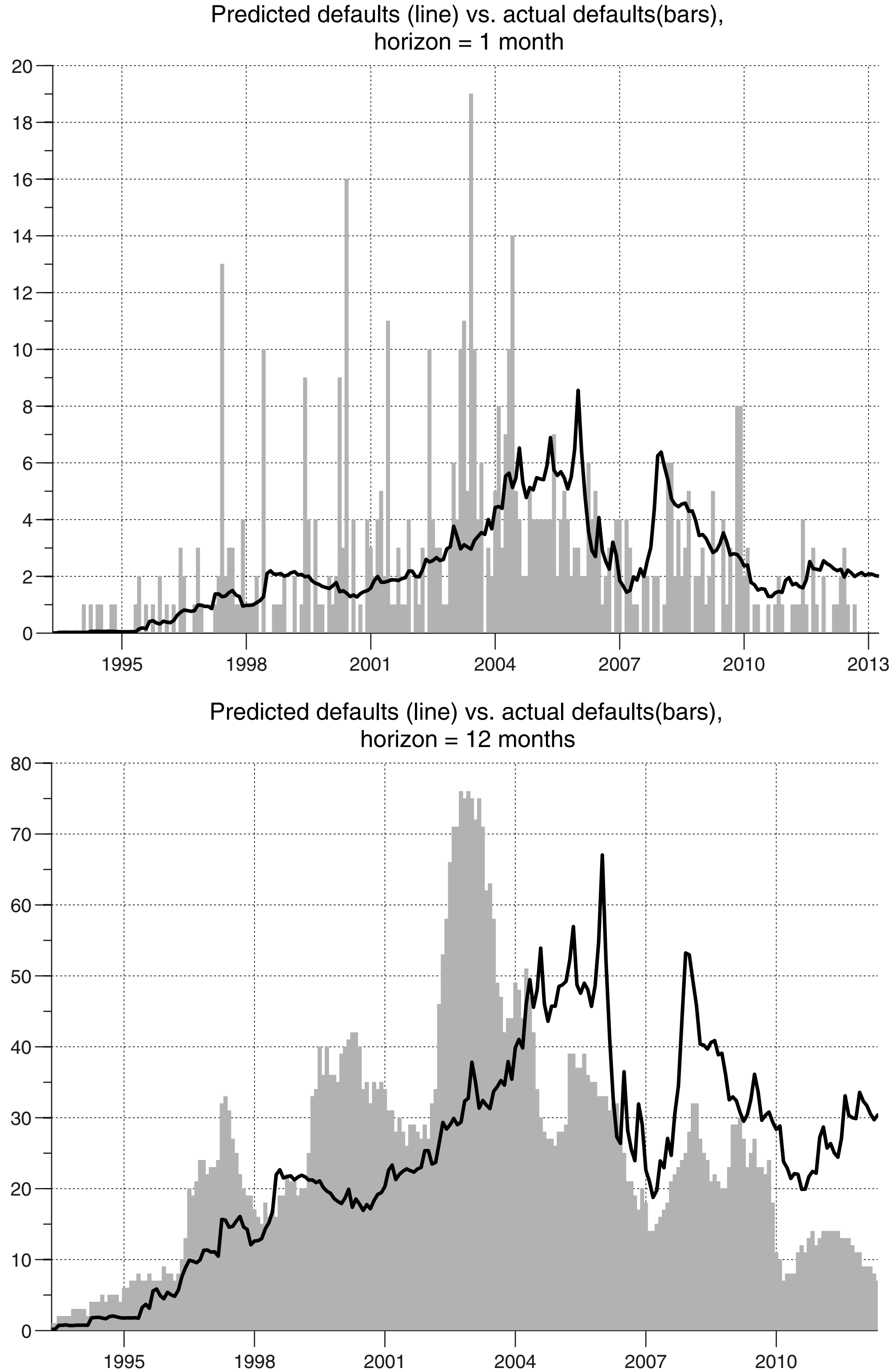
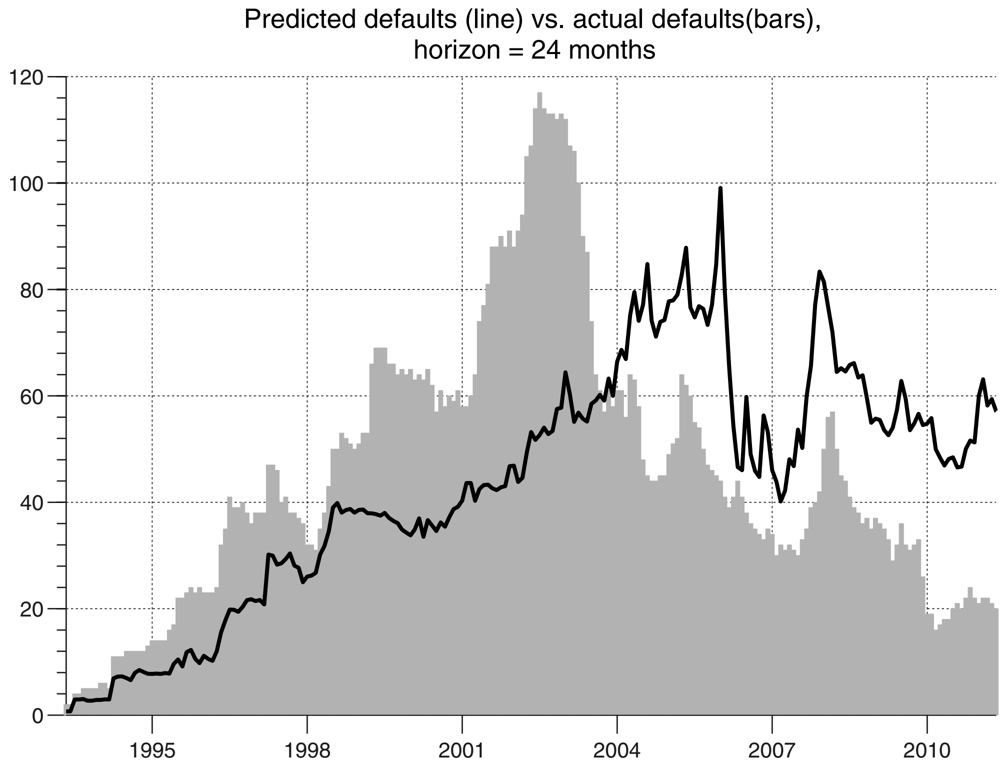


Figure B.7. Performance test for China, in sample.



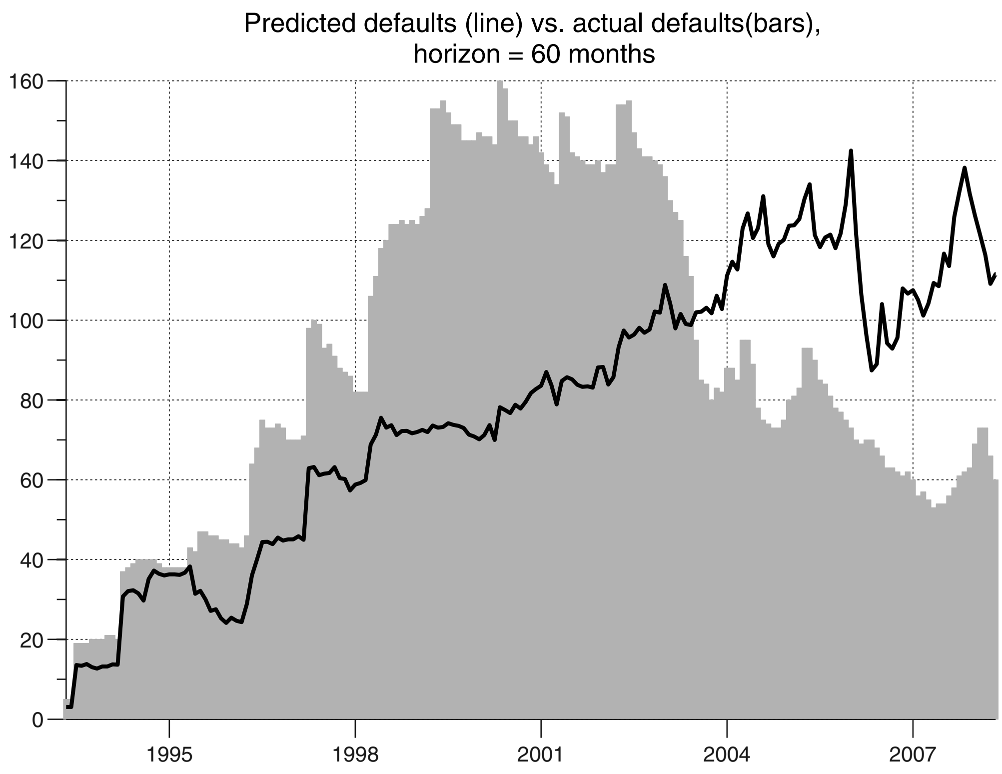
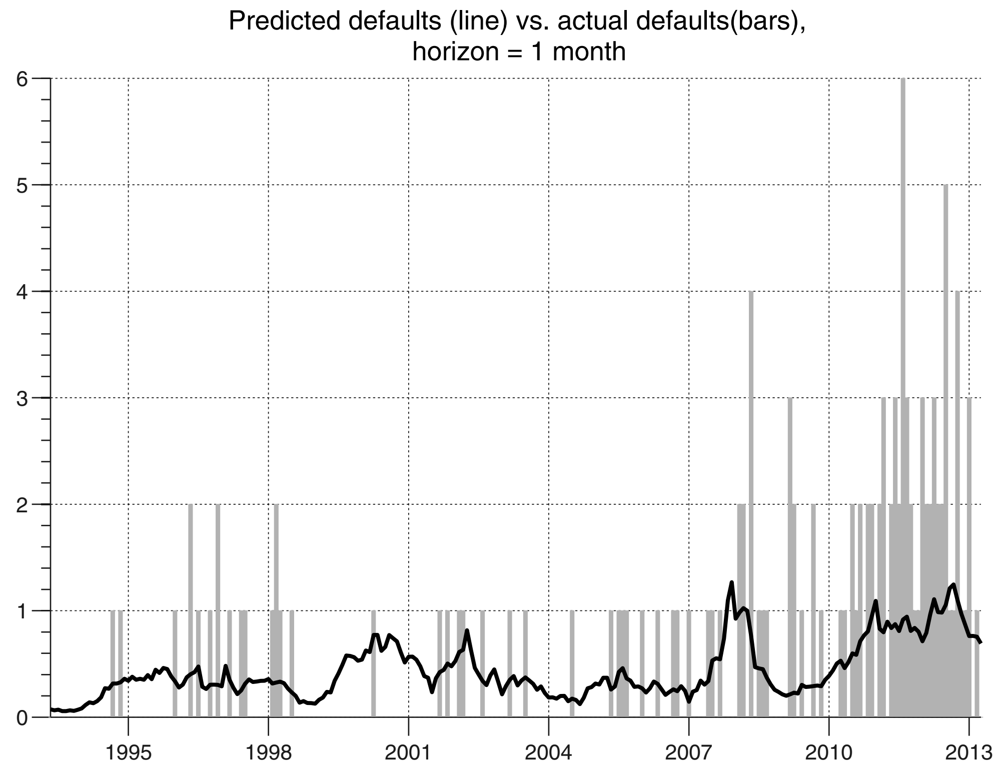


Figure B.7. (*Continued*)



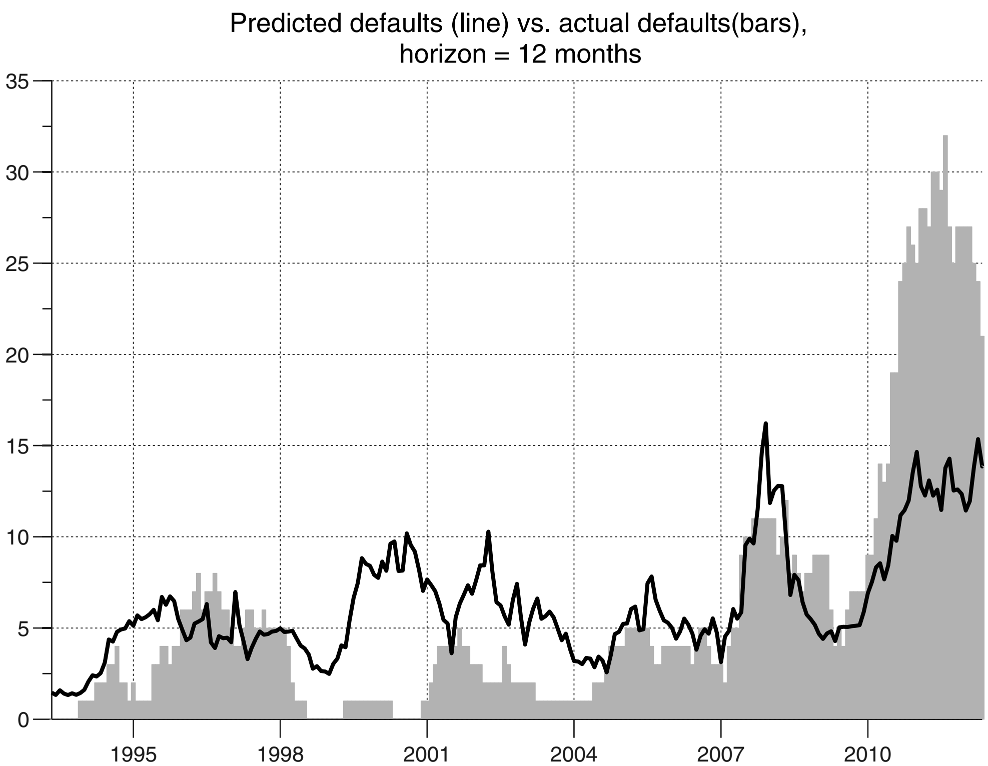
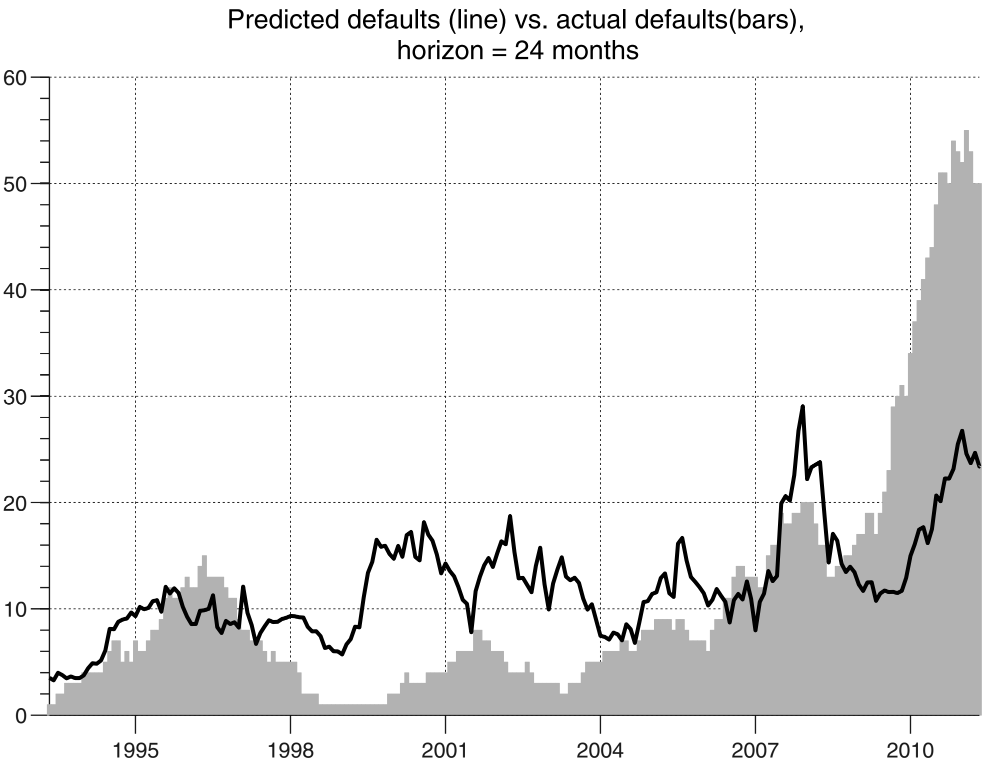


Figure B.8. Performance test for India, in sample.



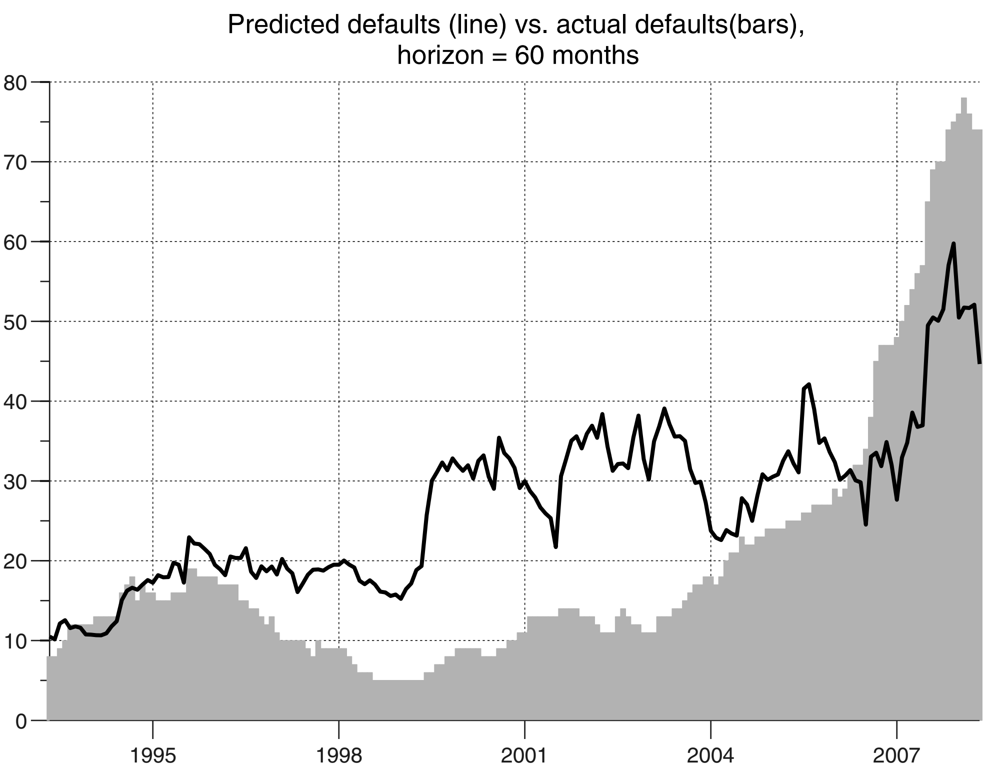


Figure B.8. (*Continued*)

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