BANK FOX
A 21ST CENTURY TOOL FOR TREASURY RISK MANAGEMENT.
GET PAID FOR THE COUNTERPARTY RISK.
PART OF THE CHECKRISK NETWORK RISK SYSTEM.
ABOUT US

CheckRisk is a trusted provider of risk services to over $70bn of risk assets globally. CheckRisk’s team of investment professionals has decades of combined experience within asset management, trading and qualitative/quantitative modelling disciplines. Our consulting services, risk models and commentaries provide a high level of value to any firm that is interested in having an independent view to aid decision making, formulating risk strategies, to put in place risk management systems or manage assets. Our work with the University of Bath, School of Management, and University of Bristol Systems Engineering Department means that investors wishing to understand risk have the backing of top level academic institutions and the pragmatic investment risk skills of CheckRisk’s team.

OUR APPROACH

Our approach to risk is innovative, forward-looking and multi-dimensional. We think of risk in the widest possible sense: from the macro global economy, down to the micro securities level, using both quantitative and qualitative analysis.

Legacy systems such as Value at Risk (VaR) are known to have failings and have not served the industry well. We aim to fill that gap.

Most investors spend their time chasing the thing they can’t control: returns. They spend little time thinking about the things they can control that make a difference: risk, cost and time.

The question CheckRisk is really trying to answer is: are you being paid to take risk?

Computers and new theories have transformed the way in which we can try and answer that question. We bring together the latest forward-looking methods and translate them into output that is easy to understand.

We recognise that there is no single ‘perfect’ approach and that there will always be a certain amount of irreducible uncertainty: this is why you need to use simulations and different techniques to build resilience. This offers us the best chance of achieving our objectives.

However, we should not leave it to computers alone. We believe that the future lies in combining their power with practitioner experience. Working closely with our clients, we have been successful in customizing our risk knowledge to provide specific client solutions.

The cross-fertilisation of the sciences and big data offers us new and exciting insights into how the world works. CheckRisk is at the leading edge of this new frontier.
We advise professional investors, boards and trustees on one of the most important and least understood risks: investment risk and its proper governance.

We do this by assisting our clients in reviewing their existing investment processes and looking for improvement in areas such as asset allocation, stress-testing and model validation.

We help decision makers get a clearer picture on the global economy and financial markets with our risk products.

We have off-the-shelf products and fully customisable systems to suit individual needs.

Our cutting edge products are primarily focused on forecasting financial conditions and reflect the interconnected world we live in.

We provide bespoke, cost-efficient risk solutions to assist institutions in managing financial and operational risk.

We partner with our clients to help them deliver specific projects for internal, commercial or marketing purposes.

Our experience and modelling skills are useful in different parts of an organisation and across industries.

CheckRisk creates bespoke structured products for institutional clients. These provide a diversified alternative to traditional asset classes, especially in an environment of low interest rates.

We adopt a multi-strategy approach and seek to create the best possible product. We also provide full ongoing after sales support.
CheckRisk Bank Fox helps risk managers and treasurers to maximise their cash returns against their counterparty risks.

Using an innovative network based approach, we can show you how your counterparty risks are evolving in real-time. Get faster information about your counterparties than the credit rating agencies can provide you with.

Many treasurers still rely on averages of credit rating agency rankings and CDS spreads to make their decisions. Anecdotally, many know that this is not sufficient, but are not yet aware of a better way. CheckRisk Bank Fox is the solution.

Solvency II regulations encourage many financial institutions to have their own cash management model and to move away from traditional methods. CheckRisk Bank Fox offers a way forwards.

The model has solid academic foundations, but the output can be understood by anyone to enhance treasury returns.

**WHO IS IT FOR?**

- Banks
- Insurers
- Corporate Treasurers
- Asset Managers
- Hedge funds
- Pension funds

**KEY FEATURES**

- Use the output to increase the rates of cash return against the level of counterparty risk.
- Communicate risks in a visual language that is easily understood by quants and senior managers alike.
- Track the counterparty risk of your cash portfolio against the wider financial system, and investigate areas that matter to you.
- Get more timely information with predictive value compared to the credit rating agencies. Spot discrepancies between the two.
- See the sensitivity of your portfolio to tail events in both benign and stressed conditions caused by institutional failure, or a systemic risk event.
- Meet and surpass Solvency II requirements for improved treasury management models.
BACKGROUND

Traditionally, corporate treasurers have managed the counterparty risks of their cash portfolios using ranking information from various credit rating agencies, or based on CDS (credit default swap) prices/spreads.

However, the great financial crisis of 2008 was a timely reminder of the limited usefulness of these approaches. Credit rating agencies can be slow to react for a number of reasons, such as the involved nature of physically assessing institutions; because of conflicts of interest arising out of how they are remunerated; and their politicisation due to the influence that they wield.

Similarly, CDS pricing may include unrealistic expectations as to the recovery rates (of the debt). This may lead to treasury teams having a false sense of security and miss the impact of institutional interdependencies via network risk.

As an example of these issues, the credit rating of AIG and Lehman Brothers prior to their collapse was AAA and AA. The CDS implied probability of default (PoD) of Lehman Brothers was below 10% and had barely moved to reflect deteriorating conditions.

CheckRisk offers a more accurate and timely way of assessing your counterparties that gives you a greater understanding of the risks, and enables better risk-adjusted returns. We do this using a form of network based contingent claims analysis (Network-CCA).

Our approach builds on the success of the ‘KMV Model’ that became more widely used during the 2000’s as a more timely way of assessing credit risk. We have augmented this by combining it with state of the art network analysis. This enables us to capture the effect of institutional and systemic interdependencies that are usually missed.

In other words, we can show risks managers how sensitive their portfolio is to systemic and institutional risk events.

As an example of these issues, the credit rating of AIG and Lehman Brothers prior to their collapse was AAA and AA. The CDS implied probability of default (PoD) of Lehman Brothers was below 10% and had barely moved to reflect deteriorating conditions.

Source: IMF (Singh, Spackman, 2009)

A BETTER WAY...

For example, our reports can show you how close a given institution is to distress, as well as the wider financial system, or region. We can tell you how many ‘bad’ days a bank can endure before getting into difficulty. You can plan accordingly.

“We can tell you how many ‘bad’ days a bank can endure before getting into distress. We can tell you how sensitive your portfolio is to liquidity risk...”
The foundation for this method is the risk-adjusted balance sheet. This shows the sensitivity of an organisation’s assets and liabilities to shocks. It is a versatile approach that can also be scaled up to the national level, whereby the sectors of an economy are viewed as an interconnected portfolio of assets, liabilities, and guarantees (some explicit and some implicit). As such, it can also model the sovereign banking interaction and the effect on the wider economy.

Traditional approaches have a problem in addressing how risks build-up in a system and then suddenly explode in a crisis. The contingent claims analysis (CCA) approach is well suited to capturing these kinds of non-linearities and quantifying the effect of asset-liability matches within and across institutions.

CCA, therefore, can enable us to perform simulations and stress-testing to evaluate the impact of the system and individual entities under different sets of market conditions. It can be done for a portfolio too. For this reason, many central banks find network CCA attractive.
HOW IT WORKS

WHAT IS A CONTINGENT CLAIM?

A contingent claim is any financial asset whose future payoff depends on the value of another asset. In the case of a bank, therefore, the return of your capital is dependent on the performance of other assets held by the bank, and the amount of liabilities the bank has. The prototypical contingent claim is an option – the right to buy or sell the underlying asset at a specified exercise price by a certain expiration date. A call is an option to buy; a put is an option to sell. Contingent claims analysis is a generalisation of the option pricing theory developed by Black-Scholes (1973) and Merton (1973).

CCA BASICS

The contingent claims approach is based on three principles:

1. The values of liabilities are derived from assets
2. Liabilities have a different priority (i.e. senior and junior)
3. Assets follow a stochastic process

The liabilities consist of senior claims (such as senior debt), subordinated claims (such as subordinated debt) and junior claims (equity or the most junior claim). As total assets decline, the value of risky debt declines and credit spreads on risky debt rise.

To estimate the individual risk exposures of institutions in a portfolio, CCA is applied to construct risk-adjusted balance sheets of financial institutions and we estimate their distance-to-distress. This measure is expressed in terms of standard deviations away from the assets being distressed e.g. how far an institution is away from needing recapitalisation.

In essence, CCA quantifies default risk by modelling the assets of a firm as a variable that may go up or down. Should the value of the assets fall to a level that is less than the payments they have promised (liabilities) then the institution may be considered distressed, as there will not be enough money to cover them.

The equity of the institution is modelled as if a shareholder has a call option on the institution’s assets after liabilities are paid off. Bonds are modelled as if the bondholder writes a European put option to equity owners.

Source: CheckRisk LLP
SYSTEMIC RISK MONITORING

To assess the strength of the financial system, we measure the overall distance-to-distress of the banking system. We do this by creating an index of the largest financial institutions. The result is an ability to identify when the market is paying you to take risk and when a defensive position is required.

![European Financial Market Distance-to-Distress](chart.png)

Source: CheckRisk LLP

NETWORK ANALYSIS

In order to capture the distance to distress and the interconnectedness between banks we use network analysis. This is different to traditional modelling in that it is non-linear and agent-based.

Understanding the interdependencies between banks and the financial system is one of the most important functions of CheckRisk Bank Fox. This is because, as stress builds in the financial system, these linkages become important. Banks have claims with other banks. Traditional models begin to lose their usefulness at exactly the wrong time as a result because they do not take into account these relationships.

The benefit of using network analysis is that it can uncover relationships that may be hidden by traditional methods, giving you greater clarity as to the true nature of the risks you are taking.

COMPONENTS OF A NETWORK

A network is comprised of nodes and edges. In CheckRisk Bank Fox, the nodes are the banks. The lines are the key correlations between them.

The larger the size of the node, the more important the bank is to the network. The colour denotes its current distance to distress. The thickness and colour of the lines connecting the nodes shows the strength of the correlation. The arrows denote the direction of the relationship.

A network can be considered to be fragile if there are a number of fragile banks at the core of the network. If one of these fails, the weakness is passed along the chain of connections (contagion). As a corporate treasurer, this is what you want to avoid at all costs.
EXAMPLE OUTPUTS

We provide assessments of the portfolio's sensitivity to institutional and systemic tail events. The benefit is that it augments the portfolio managers' understanding of current distress levels with what-if analysis of the occurrence of a tail event such as an institutional failure during a benign market like a Banca Monte Dei Paschi type event; or a systemic tail event such as the sub-prime mortgage crisis of 2007-2008. We also provide information on the criticality of institutions. This highlights institutions that would have a large impact on your portfolio should they become distressed. The benefit of this is to focus portfolio managers' attention on barometer institutions so that they get the best early warning of emerging threats.

THE EUROPEAN FINANCIAL SYSTEM AS A NETWORK...

Rather than looking at the distance to default of the whole financial system as a time series, as is shown on the previous page. We can visualise it as a network and get a much more nuanced picture.

You can see which banks are close to distress and those who are at the core and the periphery of the network.

If one were to see large weak banks at the core of the network, this would be an ominous sign of a fragile banking system.

Close to Distress

Far from Distress

Insensitive

Sensitive

Weaker

Stronger

Source: CheckRisk LLP Jan 2017

- Red nodes are those close to distress.
- Large nodes reflect sensitivity to changes in the overall systemic/market level of distance-to-distress.
- Clusters identify closely related banks.
- The numbers between the nodes, together with the thickness and darkness of the connecting arrow, show the strength of correlation of the distance to default between banks. This is the domino effect.
Assessment of the Sensitivity and Criticality of Portfolio Holdings Given Distressed Conditions...

As well as being able to show you global and regional financial systems, we can also visualise your portfolio and its sensitivity to system distress.

You can clearly see which institutions are sensitive to system distress, and those which are critical to its functioning. You can pick out the important neighbours to your key holdings. These can act as barometers for your portfolio. If a neighbour gets into distress, it is much more likely your holding will too, causing liquidity issues.

Banking crises can often originate from single failures e.g. a Monte dei Paschi type of event. The effects from this may be different to those from broader systemic stresses.

In the random portfolio example shown, it indicates that Sumitomo, Mitsubishi, RBS and Lloyds would become distressed should markets experience 15 consecutive days of <=5% tail risk event falls in distance-to-distress.

Out of the top 45 European institutions, they are ranked 8th, 11th, 13th and 14th for sensitivity to institutional distress.

One of the other main ways of looking at counterparty risk is to understand how your portfolio would perform given a systemic period of distress, like the sub-prime bubble bursting in 2007-2008.

When we look at it this way, we can see that Sumitomo, the most sensitive, could only withstand an average of 8 days of <=5% tail events during distressed conditions prior to becoming distressed itself. Similarly, ING Group could survive 33 days.

These kind of metrics are intuitively easy to understand. They can allow risk managers to perform more detailed analysis, such as in understanding whether these organisations are looking to raise more capital to improve their position.

"See your portfolio's sensitivity to systemic and institutional tail risk"
Data can be provided in a tabular format providing more granularity on the data. One can spot the differences between ratings by the well known agencies and our estimate of distance to distress. This enables you to take action on your portfolio, either by moving cash to another counterparty with a lower distance to distress and network exposure, or alternatively provides evidence to support the current portfolio positioning. Quantifying risk is the essential step to enhancing treasury returns.

<table>
<thead>
<tr>
<th>Sensitivity Rank</th>
<th>Bank Name</th>
<th>Distance to Distress</th>
<th>Credit Rating</th>
<th>Expected Shortfall</th>
<th>Insensitivity (Higher better)</th>
<th>Criticality</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Mitsubishi UFJ</td>
<td>2.29</td>
<td>N/A*</td>
<td>-0.21</td>
<td>11</td>
<td>4.13</td>
</tr>
<tr>
<td>12</td>
<td>Lloyds Banking Group</td>
<td>1.65</td>
<td>A-2</td>
<td>-0.17</td>
<td>14</td>
<td>4.68</td>
</tr>
<tr>
<td>13</td>
<td>Royal Bank of Scotland</td>
<td>1.95</td>
<td>A-3</td>
<td>-0.13</td>
<td>15</td>
<td>4.67</td>
</tr>
<tr>
<td>16</td>
<td>Bank of Ireland</td>
<td>1.63</td>
<td>A-2</td>
<td>-0.09</td>
<td>19</td>
<td>4.83</td>
</tr>
<tr>
<td>17</td>
<td>Barclays</td>
<td>1.46</td>
<td>A-2</td>
<td>-0.11</td>
<td>21</td>
<td>4.73</td>
</tr>
<tr>
<td>21</td>
<td>Standard Chartered</td>
<td>2.63</td>
<td>A-2</td>
<td>-0.10</td>
<td>26</td>
<td>4.87</td>
</tr>
<tr>
<td>23</td>
<td>Banco Santander</td>
<td>2.51</td>
<td>A-2</td>
<td>-0.08</td>
<td>32</td>
<td>5.42</td>
</tr>
<tr>
<td>31</td>
<td>ING Groep</td>
<td>3.05</td>
<td>A-2</td>
<td>-0.07</td>
<td>41</td>
<td>5.44</td>
</tr>
<tr>
<td>33</td>
<td>HSBC</td>
<td>4.76</td>
<td>A-1</td>
<td>-0.11</td>
<td>45</td>
<td>5.37</td>
</tr>
</tbody>
</table>

Table Note: Sensitivity rank 1-45. Criticality sum of all the change in distance to distress is passes on to the rest of the network. Expected shortfall - average of the 95% or worse tail risk to the network expressed as daily change to distance to distress. Insensitivity – distance to distress divided by expected shortfall. How many days on average the bank will survive for prior to distress, assuming recurring tail events. *LT rating A

In the example table above, you can see a snapshot of possible portfolio counterparties. From this we see that there are a range of values for distance to distress within the same credit rating. For example, Bank of Ireland stands out as weaker than the other credits scored short-term A-2 by Standard & Poors. Essentially rating agency banding appears wide and inconsistent.

In the wider financial system, there are credits with lower and higher distance to distress measures than shown here. Deutsche Bank and UBI, for example, scored at 1.63 and 1.27 respectively in January 2017. These are far weaker than one would expect for an A-2 rated bank.

Out of the portfolio group above, Mitsubishi stands out as being one of the weakest holdings, only being able to withstand 11 days before getting into distress. Correspondingly, the expected shortfall is also sensitive (daily movement in distance to distress given bad market conditions).

**CASH PORTFOLIO OPTIMISATION**

Given the rich information that CheckRisk Bank Fox provides, it is possible to optimise your cash portfolio. You can trade off the interest rates you are being paid on your deposits with the distance to distress and the interconnectedness of the portfolio.

This provides you with a 21st century solution to treasury management, enabling you to achieve superior risk-adjusted returns and manage liquidity risk effectively.
THE SOVEREIGN BANKING NEXUS
- A.K.A ‘THE DOOM LOOP’

RISK TRANSMISSION FROM THE GOVERNMENT TO THE BANKS AND FEEDBACK

An extension of standard CCA is to incorporate sovereign risk into the network. In the real world if a government gets into financial distress or defaults, it transmits risk to the broader financial system. For example, when the banking sector is holding a significant proportion of government securities, and there is a negative shock to the government financial position, it is likely to have a detrimental effect on the banks. A government’s implicit guarantee is also likely to increase. This, in turn, makes a government’s financial positions worse, and so on, creating a compounding effect. This is the so-called ‘doom loop’, which may result in a government’s failure to honour its guarantee obligations and cause a collapse of the banking system.

A similar process could occur if banks have significant lending denominated in foreign exchange and a weak government position causes a depreciation of the exchange rate. The depreciation worsens the positions of the banks raising the implicit guarantee, which in turn lowers government assets further. This means that the implicit guarantee moves higher yet again, and the situation may spiral out of control, resulting in the inability of a government to meet its guarantees and leading to a systemic financial crisis.

Similar pathologies can be seen in the transmission from other sectors to the government. For example, from the insurance or pension industry to the government.

HOW CHECKRISK BANK FOX HANDLES THIS:

Given the importance of the inclusion of the sovereign in a financial network, we include this risk in our modelling. However, we limit the outputs to those counterparties in your network, rather than a total regional financial system, and use market-implied risk transfers rather than explicitly modelling the balance sheets of sovereigns. The result is that we can attribute the discrete transfer of risk from the individual bank to the government in question and gain an understanding of the implicit guarantee. Using some of the key holdings from our previous portfolio example, we can see that using the market implied information from CDS that Mitsubishi would transfer 1.29% of debt to the government. Sumitomo would add 0.29%.

NETWORK RISK SYSTEM

If you are interested in getting a wider understanding of the true sovereign risks posed by the banking industry and other economic sectors, Checkrisk can offer this as part of our wider network risk system (CRNETS). This is an additional cost to standard Bank Fox.

CRNETS is “state of the art” macroeconomic network modelling. CRNETS illustrates the effect on GDP and other macroeconomic variables (inflation, unemployment, etc.). This is particularly useful for stress-testing, for example, the effects of a Eurozone break-up, and can be applied to portfolio and credit modelling as a result.

“Our network risk system is state of the art macroeconomic network modelling...”
CheckRisk Bank Fox is a step change in Treasury Risk Management. CheckRisk Bank Fox assists in knowing when you are being paid to take risk and when not. By quantifying risk, Bank Fox allows for cash portfolio optimisation, a broader understanding of the network risks of your portfolio, and a heads up when things are changing.

Using CheckRisk Bank Fox can reduce overall risks, enhance returns, provide better insight into a treasury portfolio, as well as being a building block to more complex scenario analysis and stress-testing.

**ADVANTAGES**

- Enhance treasury returns on cash against the level of counterparty risk.
- Quantify complex risks and present them simply so that anyone can understand.
- Track the counterparty risk of your cash portfolio against the wider financial system, and investigate areas that matter to you.
- Get more timely information with predictive value compared to the credit rating agencies. Spot anomalies between the two for further investigation.
- See the sensitivity of your portfolio to tail events in both benign and stressed conditions caused by institutional failure, or a systemic risk event.
- Meet and surpass Solvency II requirements for improved treasury management models.

**CHECKRISK NETWORK RISK SYSTEM**

Bank Fox forms part of our wider Network Risk System (CRNETS). This service is applicable if you would like to understand the sovereign banking nexus in greater detail, and also to perform state of the art agent-based economic modelling. This gives much greater flexibility than traditional methods and can be used by policy makers and asset managers to understand macroeconomic and credit risks in much greater detail than has hitherto been the case. It is a perfect complement to our Early Warning Risk System (CREWS) as it may be used to quantify the effect of the approaching risks picked up in that system.

**COSTS**

There are a number of variables that go in to establishing the cost of Bank Fox, for example, the method of delivery, frequency of reporting, and the number of peers to be tracked.

Therefore, the cost of the service depends on the breadth and extent to which our clients wish to customise it, and on how many end users will receive the information. It is typically between £100,000-£250,000 per annum.

If you are interested in arranging a quote, please contact us at info@check-risk.com or call (+44) (0)1225 422 583.
DISCLAIMER

This document is provided to you on a confidential basis for your information and discussion only. It is not a solicitation or an offer to buy or sell any security or other financial instrument. Any information including facts, opinions or quotations, may be condensed or summarized and is expressed as of the date of writing. The information may change without notice and CheckRisk LLP (“CheckRisk”) is under no obligation to ensure that such updates are brought to your attention.

The price and value of investments mentioned and any income that might accrue could fall or rise or fluctuate. Past performance is not a guide to future performance. If an investment is denominated in a currency other than the base currency, changes in the rate of exchange may have an adverse effect on value, price or income. This document and any related recommendations or strategies may not be suitable for you; you should ensure that you fully understand the potential risks and rewards and independently determine that it is suitable for your given objectives, experience, financial resources and any other relevant circumstances. You should consult with such advisor(s) as you consider necessary to assist you in making these determinations. Nothing in this document constitutes investment, legal, accounting or tax advice, or a representation that any investment or strategy is suitable or appropriate to your individual circumstances, or otherwise constitutes a personal recommendation to you.

This document may relate to investments or services of an entity/person outside the UK, or to other matters which are not regulated by the FCA, or in respect of which the protections of the FCA for retail clients and/or the UK Financial Services Compensation Scheme may not be available. Further details as to where this may be the case are available on request in respect to this document. Certain information contained herein has been obtained from third party sources. While such information is believed to be reliable for the purposes used herein, no representations are made to the accuracy or completeness thereof and CheckRisk takes no responsibility for such information.

This document is intended only for the person to whom it is issued by CheckRisk. It may not be reproduced either in whole, or in part, without CheckRisk’s written permission. The distribution of this document and the offer and sale of the investment in certain jurisdictions may be forbidden or restricted by law or regulation.

Investments may have no public market or only a restricted secondary market. Where a secondary market exists, it is not possible to predict the price at which investments will trade in the market or whether such market will be liquid or illiquid. As such investments will not be listed or traded on any exchange, pricing information may be more difficult to obtain and the liquidity of the investments may be adversely affected. A holder may be able to realise value prior to an investment’s maturity date only at a price in an available secondary market.

CheckRisk LLP is authorised and regulated by the Financial Conduct Authority (Firm reference number: 490575). The registered address of CheckRisk LLP is 4 Miles’s Buildings, George Street, Bath, BA1 2QS (Company number: OC338765).
“A product so cunning, we pinned a tail on it and called it a fox!”

info@check-risk.com
01225 422 583

4 Miles’ Buildings
Bath
UK
BA1 2QS

CheckRisk LLP is authorised and regulated by the Financial Conduct Authority (Firm reference number: 490575)