



### Introducing Cassandra: Our early warning model for financial crises

- COVID-19 forced central banks to cut rates to record lows and delve deeper into QE. As economies recover, the environment is ripe for debt-fueled asset price booms that, at some point, will unwind, and in the past they have often done so abruptly.
- We combine the predictive power of our six parsimonious indicators by weighting them by the inverse of their noise-to-signal ratios, to produce our composite index, Cassandra.
- Cassandra correctly signalled two-thirds of the past 53 crises in our sample of 40 economies since the early 1990s.
- Cassandra is currently warning that half a dozen economies appear vulnerable to financial crises over the next 12 quarters, with the US most at risk.
- We incorporate climate change risk and an interest rate shock to Cassandra. This relegates a large group of 10 economies to near the vulnerability threshold, including seven EM economies.

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Fig. 1: Cassandra

**NOMURA**

Connecting Markets East &amp; West

# Cassandra

## Nomura's early warning model of financial crises



### Five early warning indicators that combine:

Private credit-to-GDP ratio, debt service ratio, real property price, real equity price, real effective exchange rate



### Covers 40 economies

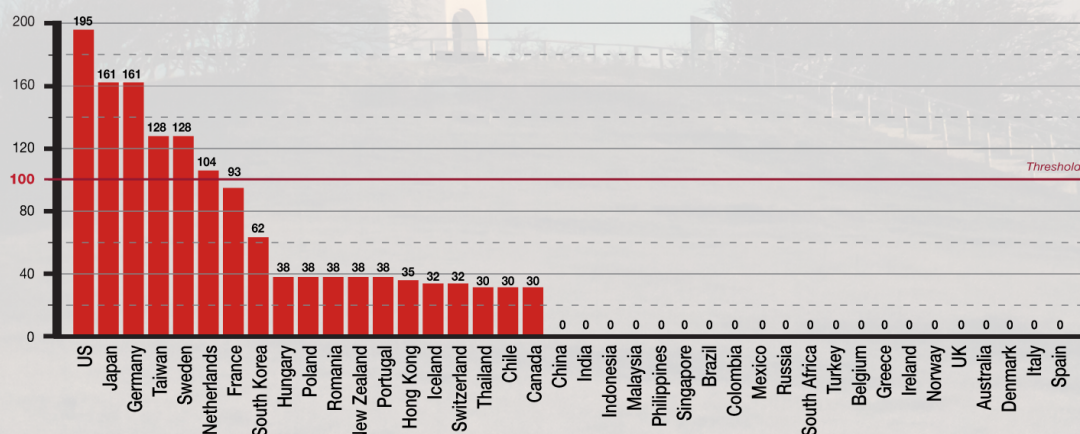
Whenever Cassandra exceeds 100, it is a warning that the economy is vulnerable to a financial crisis



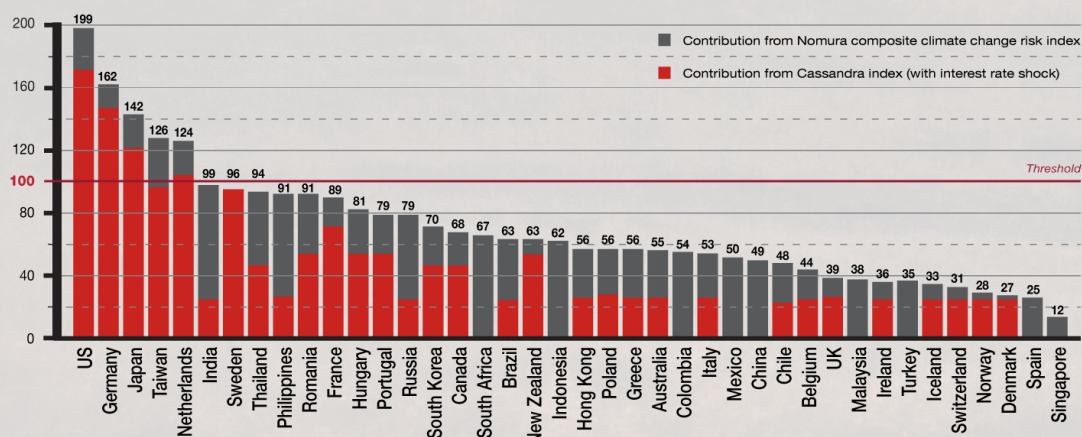
### Track record

Cassandra correctly signaled 66% of the past 53 financial crises in our sample since the early 1990s

### Latest Cassandra scores



### Cassandra adjusted for climate change risk and an interest rate shock



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# Executive summary

COVID-19 forced central banks to cut rates to record lows and delve deeper into QE, and most have maintained these extraordinary loose settings despite growing signs of economic recovery. This environment is ripe for debt-fueled asset price booms. At some point, however, the imbalances will unwind, usually abruptly, which can cause a credit crunch or, worse still, a financial crisis.

Perhaps it is human nature, but when the good times roll it can often be difficult to foresee a crisis. To quote the late Professor Rudiger Dornbusch, “a crisis takes a much longer time coming than you think, and then it happens much faster than you would have thought”. Accurately forecasting the timing of financial crises is likely to remain an elusive goal, but the vast literature shows that it is possible to build early warning systems that can help assess the build-up of risks and provide a useful wake-up call.

## The methodology behind Cassandra

To capture the build-up processes that, in the boom phase, sow the seeds of the subsequent financial crisis, we calculate deviations (or “gaps”) from long-run trends for five early warning indicators (EWIs): the ratio of private credit to GDP, the debt service ratio, real equity prices, real property prices and the real effective exchange rate.

Next, we assign thresholds to each EWI which, when breached, flash a signal of a crisis occurring within the next 12 quarters. The optimal threshold values are selected to minimise the noise-to-signal ratio; i.e., to minimise the risk of having too many false alarms (noise) and missing too many crises (signal). Importantly, we could further cut down the noise-to-signal ratio by combining some of the EWIs into joint indicators.

We combine the predictive power of our six parsimonious indicators by weighting them by the inverse of their noise-to-signal ratios, to produce our composite index, Cassandra.

## Results

Cassandra is designed so that whenever the index exceeds 100 it should be interpreted as a warning that the country is vulnerable to a financial crisis within the next 12 quarters. Setting a threshold of 100, Cassandra correctly signalled two-thirds of the past 53 crises in our sample of 40 countries since the early 1990s. Cassandra is currently warning that six economies – US, Japan, Germany, Taiwan, Sweden and Netherlands – appear vulnerable (scores above 100) to financial crises over the next 12 quarters.

### Interest rate shock

Cassandra’s latest results are positively influenced by very low interest rates that probably will not last. To this end, we stress test Cassandra to an interest rate shock. We do this by manually switching ‘on’ the signal for the debt service ratio in all 40 countries.

In the face of an interest rate shock, the economies that would appear vulnerable (scores above 100) to financial crises are the same six economies as above, but there is now a sizable group of five economies – France, Hungary, Romania, New Zealand and Portugal – with scores not too far from the 100 threshold.

### Climate change risk

There is increasing recognition that climate change risks have implications for financial stability. However, quantifying climate change risk is challenging. We took a metadata approach, relying on the consensus of data sources by aggregating the standardized scores of eight different climate change risk indicators, which themselves are composites of various data. The Nordic countries display the lowest climate change risk, whereas the countries with the highest risk – in fact, the top 13 – are all emerging market economies.

Finally, we combine climate change risk and an interest rate shock to Cassandra. Curiously, once Cassandra is augmented for climate change risk and an interest rate shock, the number of countries vulnerable to financial crises drops from six to five (Sweden falls below 100). However, the list of countries with scores between 70-100 lengthens to 10, including seven emerging market economies.

In the original Cassandra, the average score of the 40 countries was 35. When we augmented Cassandra with an interest rate shock or climate change risk, the average score rose to 52 and 57, respectively. The original Cassandra, when combined with an interest rate shock *and* climate change risk, raises the average score to 69.

In the 40 individual country pages, we present details of the Cassandra results and chart the Cassandra index against the local banking or financial sector equity index.

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## Introduction

**The tale of Cassandra** ~ Cassandra was a Trojan priestess of Apollo in Greek mythology cursed to utter true prophecies, but never to be believed. She foresaw the destruction of Troy, warning the Trojans against accepting the Greeks' gift of a giant wooden horse, in which the Greek warriors were hiding. Our early warning indicator of financial crises will henceforth be called Cassandra – one that warns and signals in advance of the economic Trojans' fate.

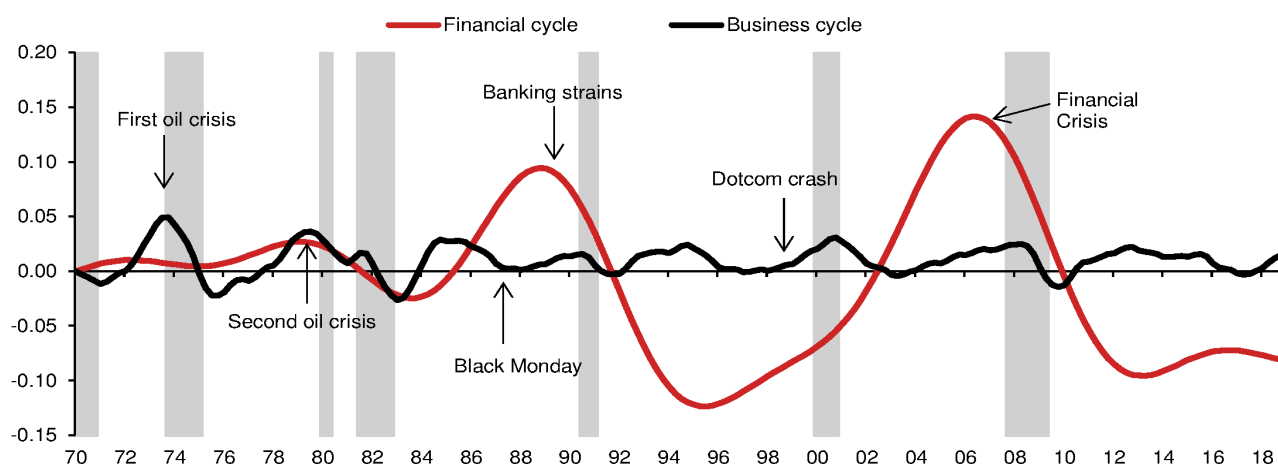
We built Cassandra to assess the risk of domestic credit crunches and financial crises, and it is a companion to Damocles, Nomura's early warning system of EM exchange rate crises (see *Special Report: Damocles: Our early warning indicator of EM exchange rate crises*, 10 February 2021).

A pure business-cycle view of the world, focusing on economic activity and inflation, has severe shortcomings in assessing the risk of financial crises. Financial crises are better viewed through the perspective of financial cycles, which can be loosely defined as the co-movement of medium-term cycles in credit and asset prices, particularly property prices. Accurately forecasting the timing of financial crises is likely to remain an elusive goal, but the vast literature now shows that it is possible to build early warning systems that can help assess the build-up of risks of future financial crises.

## Financial cycles versus business cycles

Financial cycles differ from business cycles in many respects. They have a longer duration, on average 14-18 years or about twice as long as business cycles (Figure 2). They are often associated with aggressive risk taking and can be self-fulfilling, as rapid credit growth drives up asset prices, which increases collateral values and, in turn, further increases the availability of credit. Financial cycles are driven by, but also feed, an unsustainable economic expansion, which manifests itself in unsustainable credit and asset price booms.

**Fig. 2: Estimating financial and business cycles in the US**



Note: The domestic financial cycle, as measured by a bandpass filter capturing medium-term cycles in real credit, the credit-to-GDP ratio and real house prices. The business cycle, as measured by a bandpass filter capturing fluctuations in real GDP over a possible window from one to eight years. The shaded areas are US recession periods dated by the US National Bureau of Economic Research.

Source: Claudio Borio, Ilhyock Shim and Hyun Song Shin, "Macro-financial stability frameworks: experience and challenges", BIS, May 2021 and Nomura Global Economics.

At some point, however, these imbalances unwind, usually abruptly, causing a credit crunch and often a financial crisis. The precise timing of the unwind is impossible to predict, but the longer the imbalances persist, the higher the likelihood of an abrupt reversal (Kindleberger (2000) and Minsky (1982)). When a financial cycle boom turns into a bust, the result is typically a much deeper and longer recession – a balance-sheet recession – than the garden variety business cycle recession. The 2007-08 financial crisis was on the more severe side, with the average recovery to pre-crisis levels taking 10 years.

Since the late 1980s, the world has witnessed an increase in the frequency and severity of financial crises, in both emerging market (EM) and developed market (DM) economies. Financial crises have also become more synchronised across economies. One explanation for these phenomena is the advent of global financial liberalisation, giving rise to the free movement of ever-increasing capital flows and advancements in financial engineering, including derivative instruments and complex securitised products. Another

is central banks' steadfast commitment to their CPI inflation targets, come hail or shine, which meant that, so long as inflation was within target they, unwittingly, disregarded overheating in the form of oversized financial cycles (i.e., credit and asset price booms and overstretched balance sheets), until it was too late.

During his 1987-2006 tenure at the Fed, former Chairman Greenspan famously claimed that it was very difficult to definitively identify an asset price bubble and hence rather than leaning against asset price booms it was better for monetary policy to 'clean up' afterwards by cutting interest rates and providing ample liquidity, which the Fed duly did after the 1987 stock market crash, the 2000 dotcom crash and the 2008 housing market crash. This led to asymmetric monetary policy responses (cutting rates more than hiking them), breeding moral hazard, or what is sometimes referred to as the "Greenspan, Bernanke, Yellen and Powell puts." This monetary policy asymmetry has led to a substantive build-up of debt globally; after all, the interest rate setting is the universal price of leverage. With policy rates already at their effective lower bound, COVID-19 forced central banks to delve deeper into unconventional monetary policies – notably QE – which has further amplified the build-up of private sector debt. Intuitively, this environment seems ripe for fueling outsized financial cycles, but how do we measure them?

## Methodology

Ironically, it was the Bank for International Settlements – the central banks' central bank – which led a rearguard action against former Fed Chairman Greenspan's claim that, in practice, it was impossible to identify bubbles before they burst. The BIS's motivation started almost twenty years ago in pioneering research by Borio and Lowe (2002a), which argued that:

*"it may be possible to recognise the build-up of one set of vulnerabilities that foreshadows banking distress with a reasonable degree of confidence, although the exact timing of the crises remains unpredictable".*

They found that it is possible to construct two indicators – the deviation from trend, or "gaps", in private sector credit-to-GDP and real equity prices – that predict financial crises fairly well. In a follow up study, the authors (2002b) in a sample of 34 countries (21 DMs and 13 EMs) over 1960-99, covering 40 crises, found that combining indicators cuts the noise substantially. Specifically, with a three-year horizon, a credit gap of 4% together with a real equity gap of 40% predicted 60% of the crises with a noise-to-signal ratio of only 0.06. Since 2002, a rich literature on early warning indicators of financial crises has developed, and of increasing sophistication. Accurately forecasting the timing of financial crises is likely to remain an elusive goal, but the vast literature now shows that it is possible – and prudent – to build early warning systems that can help assess the build-up of risks of future financial crises. This is the motivation behind Cassandra.

## Our dataset

Drawing on the rich literature, we chose five variables around which we construct our own early warning indicators (EWIs) of financial crises:

- Ratio of private credit to GDP
- Real (CPI-adjusted) equity prices
- Real (CPI-adjusted) property prices
- Private sector debt service ratio
- Real effective exchange rate

We collected quarterly data for 40 countries. The starting periods vary, depending on data availability, but for most variables, the time series span from at least the early 1990s to Q1 2021 (an exception is property prices in EM; for full details on data and sources; see [Appendix 1](#)).<sup>1</sup> Overall, our dataset has over 30,000 observations (five variables for 40 countries with data from at least the early 1990s).

1. Appendix 1 has full details, but briefly: private credit is credit to the household and private non-financial corporate sectors, sourced mostly from the BIS database; equity price is the main stock exchange index of each country; property price covers residential property prices, obtained mostly from the BIS database; debt service ratio is a macro measure of interest payments plus amortisations of the household and non-financial private corporate sectors as a ratio to gross disposable income, obtained mostly from the BIS database; and the real effective exchange rate measures the strength of a currency against a basket of other currencies weighted by trade shares and adjusted for inflation differentials, obtained mostly from the BIS database.

## Constructing the EWIs

To capture the cumulative, build-up processes that, in the boom phase, sow the seeds of the subsequent financial crisis, we calculate deviations (or “gaps”) of the above five variables from their long-run trend over the entire sample period. For example, if the credit-to-GDP ratio or the debt service ratio rises well above its long-run trend (opening up a large positive gap), it could be an early warning indicator (EWI) that borrowers are overextended. Similarly, if real property or equity prices rise significantly above trend, it could indicate frothiness in asset markets; or if the real effective exchange rate appreciates sharply above trend, it could signal a loss of competitiveness or too-strong capital inflows fueling excess liquidity and overheating in the domestic economy. Specifically, we derive the gap measures by calculating deviations from a two-sided Hodrick-Prescott trend, in which we set the value of the smoothing parameter ( $\lambda$ ) at 400,000 to ensure a high degree of smoothing to better capture the gradual and cumulative build-up of financial imbalances.<sup>21</sup>

## Defining crises

The underlying idea of Cassandra is straightforward: when one of the EWIs breaches a predefined vulnerability threshold, it is a warning signal of a possible crisis within a specified period of time; hence, the next important step is to define and date the past financial crises in our sample of 40 countries.

To determine the start dates of banking crises, we draw on the work of Laeven and Valencia (2018). They set two conditions for an event to be classified as a crisis: First, if there are significant signs of financial distress in the banking system (e.g., significant bank runs, losses in the banking system or bank liquidations); and second, if there are significant policy interventions in response to the financial distress. We also draw on banking crises classified by Reinhart and Rogoff (2008) and Drehmann, Borio and Tsatsaronis (2011), who use their own judgment and engaged in correspondence with central banks to determine some of the dates more precisely. Finally, some countries have experienced significant financial sector stress but avoided banking crises. Hong Kong in 1998 is a good example. In an attempt to capture these episodes, we include our own measure of financial crises which we define as the year-on-year growth in the banking (financial) sector equity sub-index declining by more than two standard deviations below its long-run average. Combining the various definitions of crises, our sample of 40 countries contains 60 crises since 1990, including those in Japan and the Nordic countries in the early 1990s, LatAm in the mid-1990s, the Asian financial crisis in 1997-98 and the GFC in 2007-08 (for more detail see [Appendix 2](#)).

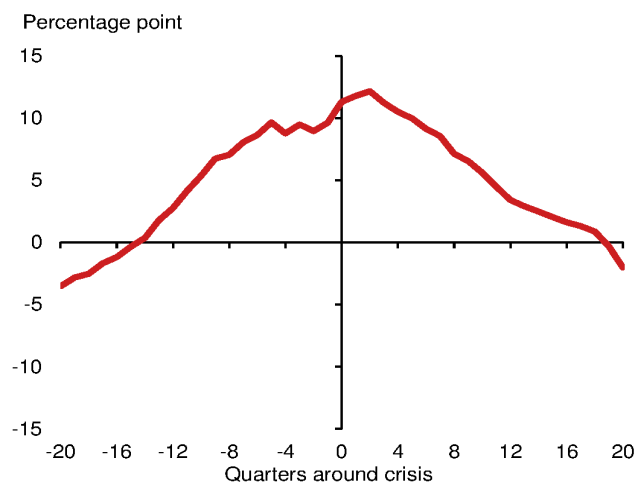
Before conducting our statistical tests, it is useful to descriptively observe how our five EWIs behave around the time of the past 60 financial crises. Below Picture Book summarises the average behaviour of the EWIs during a window of 20 quarters before and after financial crises (time  $t=0$ , vertical line) for the sample of 40 countries. Consistent with the literature, all five EWIs rise sharply to elevated levels in the lead up to crises.

2. Typically a  $\lambda$  of 1600 is used for quarterly data, but given credit cycles are, on average, about four times longer than business cycles,  $\lambda$  should be equal to  $4 \times 1600$ , giving a  $\lambda$  of roughly 400,000.

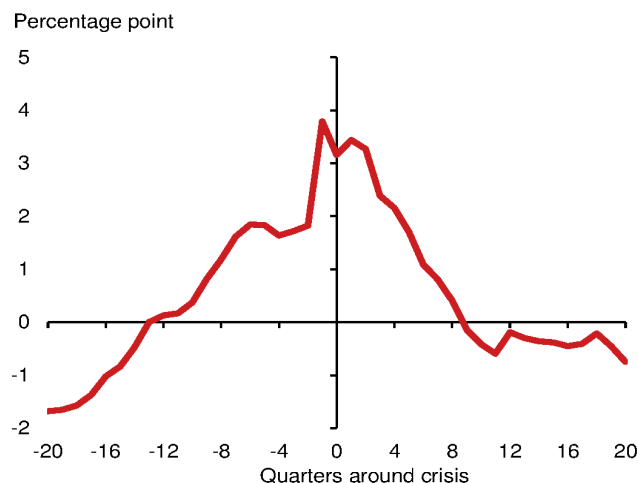


## Picture book: Behaviour of EWIs around the 60 financial crises

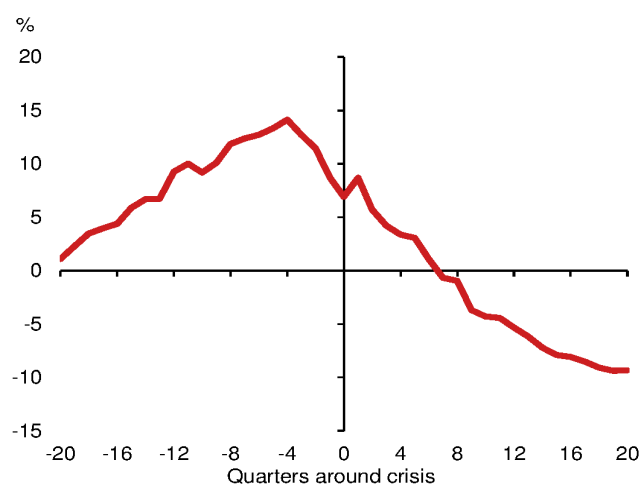
**Fig. 3: Credit gap**



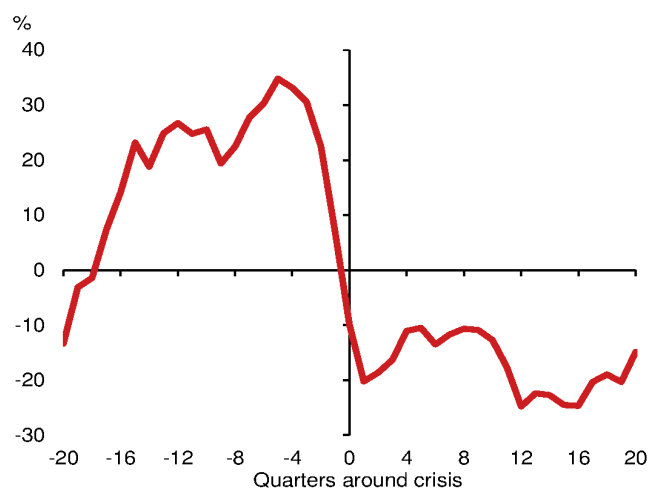
**Fig. 4: Debt service ratio gap**



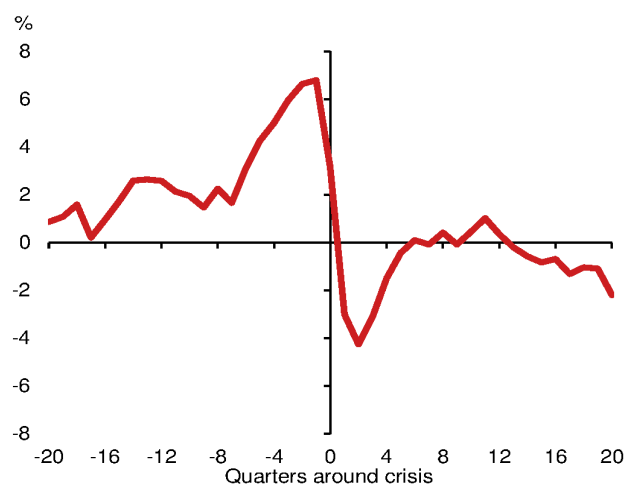
**Fig. 5: Property gap**



**Fig. 6: Equity gap**



**Fig. 7: REER gap**



Note: The horizontal axis denotes quarters around financial crises, with the start date set at zero.

Source: BIS, IMF, Bloomberg, CEIC and Nomura Global Economics.

## Signaling horizon

An EWI issues a signal of an impending crisis when it breaches a predefined vulnerability threshold. When an EWI sends a signal, we have to determine if a crisis happens within a reasonable period of time thereafter. There is a trade-off. The signalling horizon needs to be long enough not to penalise EWIs that give valuable early warnings, but not too long that, from a fundamental perspective, it would be difficult to connect the signal to the crisis. We set the maximum time interval between the signal and the crisis at 12 quarters. That is, any signal given by an EWI within the 12-quarter period before the beginning of the crisis is labelled a true signal; any other signal outside the 12-quarter window is a false alarm, or noise. Given a financial crisis can last two to three years, once in a crisis it makes no sense to predict another crisis: the EWI has already done its job. We therefore switch off the signals (i.e., exclude the observations) of the EWIs in the two years after the beginning of a crisis.

## Thresholds

The next step is to assign thresholds for the EWIs. If the threshold is breached, the EWI sends a crisis signal. Choosing the optimal threshold involves a trade-off: if it is too lax, the EWI is likely to catch most, if not all, crises, but at the cost of generating a lot of false alarms; by contrast, if it is too stringent, then the EWI misses all but the most severe crises, but it has very few false alarms. Take for example our credit-to-GDP gap. In tranquil, non-crisis periods, the credit-to-GDP gap should be close to zero. In our sample of 40 countries, if we assign a low threshold of 1pp, the credit-to-GDP gap sends signals for 66% of the total possible crisis observations, but because the threshold is so low (too lax) it sends a lot of false alarms (i.e., it incorrectly signals crises for 34% of non-crisis observations), or what is known as a Type-2 error. By contrast, if we assign a very high threshold of 15pp to our credit-to-GDP gap, it now signals only 19% of the total possible crisis observations but it has very few false alarms (i.e., it incorrectly signals a crisis for only 5% of non-crisis observations), giving minimal Type-2 errors. However, the cost of setting such a high, stringent threshold is that it has missed all but the most severe of the crises (i.e., it fails to signal a crisis for 63% of possible crisis period observations), or what is known as a Type-1 error.

To choose the optimal threshold level that minimises the trade-off between Type-1 errors (no signal is issued but a crisis occurs) and Type-2 errors (a signal is issued but no crisis occurs), we compute the threshold for each EWI that minimises the noise-to-signal ratio. The calculation can be intuitively explained by the matrix in Figure 8.

**Fig. 8: Matrix for calculating the noise-to-signal ratio**

|                  | Crisis (within next 12 quarters) | No crisis (within next 12 quarters) |
|------------------|----------------------------------|-------------------------------------|
| Signal issued    | A                                | B                                   |
| No signal issued | C                                | D                                   |

Source: Nomura Global Economics, adapted from Reinhart, Kaminsky and Lizondo, "Leading indicator of currency crisis", March 1998.

A is the number of quarters in which the EWI issues a true signal; B is the number of quarters in which the EWI issues a false alarm; C is the number of quarters in which the EWI fails to signal a crisis; and D is the number of quarters in which the EWI correctly gives no signal of a crisis. A perfect EWI would have entries only in A and D. An unreliable, noisy EWI would have most of its entries in B and C. The noise-to-signal ratio is computed as follows,  $[B/(B+D)]/[A/(A+C)]$ , essentially measuring the fraction of false alarms relative to the fraction of correct signals.<sup>[3]</sup> EWIs with lower noise-to-signal ratios are more powerful predictors of crises. However, simply minimising the noise-to-signal ratio can still result in missing too many crises. Our approach, therefore, is to grid search for the optimal threshold that keeps the noise-to-signal ratio to a minimum subject to predicting at least two-thirds of the past crises. In other words, for at least two-thirds of the past crises, the EWI must produce at least one signal in the 12 quarters leading up to the crisis. Overall, the lower the noise-to-signal ratio of an EWI, the more accurate it is in calling at least two-thirds of crises.<sup>[4]</sup>

3. More precisely, the noise-to-signal ratio is obtained by dividing false signals measured as a proportion of quarters in which false signals could have been issued, by true signals measured as a proportion of quarters in which true signals could have been issued.
4. In other words, we attach more importance to minimising Type-1 errors, missing a crisis, than to Type-2 errors, calling a crisis that does not materialize.

# Performance

Having explained the noise-to-signal approach to compute the optimal vulnerability thresholds for our five EWIs we are now in a position to assess their performance in predicting crises up to 12 quarters ahead. The different profiles of our EWIs suggest there could be added predictive power by combining them. Therefore, we also consider joint – and even triple – indicators where a warning signal is “on” if, and only if, the thresholds for the joint indicators are *simultaneously* breached. The logic is that excessive debt buildups are more susceptible to crises if they are associated with rapid growth in asset prices (i.e., debt-fueled asset bubbles).

In summary, to narrow the selection of our best-performing single, double or triple EWIs, our methodology is to choose indicators and thresholds that minimise the noise-to-signal ratio subject to the secondary requirement that the indicator predicts at least two-thirds of the crises. Figure 9 shows various metrics on the performance of the five single EWIs and, after considerable testing, our preferred six EWIs (highlighted in grey) – one single, three joint and two triple EWIs – in predicting past financial crises up to 12 quarters ahead in our sample of 40 countries.

**Fig. 9: Gauging the predictive performance of the EWIs**

| Column: 1                             | 2   | 3  | 4   | 5   | 6                       | 7  | 8                                   | 9   | 10  |
|---------------------------------------|---|--|---|---|-------------------------|--|-------------------------------------|---|---|
|                                       | Number of crises for which there are data | Percentage of crises correctly signalled | False alarms: Percentage of tranquil observations <sup>1</sup> where a signal was given | True signals: Percentage of crisis observations <sup>1</sup> where a signal was given | Noise-to-signal ratio   | Probability of crisis conditional on signal being issued | Unconditional probability of crisis | Persistence: average # of true signals given in the 12 quarters ahead of a crisis | Lead time: average # of quarters ahead of a crisis when the first signal occurs |
|                                       |   |  | B/(B+D)   | A/(A+C)   | $[B/(B+D)] / [A/(A+C)]$ | A/(A+B)  | $(A+C) / (A+B+C+D)$                 |   |   |
| <b>Single EWIs</b>                    |   |  |   |   |                         |  |                                     |   |   |
| Credit (8)                            | 54  | 64.8                                     | 12.8  | 40.4  | 0.32                    | 35.7   | 15.0                                | 7.3   | 8.9   |
| REER (6)                              | 38  | 65.8                                     | 17.9  | 33.4  | 0.54                    | 22.2   | 13.3                                | 6.1   | 7.8   |
| Debt service ratio (DSR) (2)          | 48  | 62.5                                     | 8.9   | 29.9  | 0.30                    | 35.1   | 13.9                                | 5.8   | 7.3   |
| Property (12)                         | 39  | 66.7                                     | 7.9   | 48.1  | 0.16                    | 48.8   | 13.5                                | 8.6   | 10.0  |
| Equity (29)                           | 52  | 71.2                                     | 11.6  | 37.7  | 0.31                    | 36.3   | 15.0                                | 6.2   | 9.5   |
| <b>Joint EWIs</b>                     |   |  |   |   |                         |  |                                     |   |   |
| Credit (3) and Property (4)           | 39  | 64.1                                     | 8.5   | 41.0  | 0.21                    | 43.0   | 13.5                                | 7.4   | 8.7   |
| REER (3) and DSR (1)                  | 35  | 62.9                                     | 4.8   | 27.2  | 0.18                    | 45.2   | 12.7                                | 5.4   | 7.0   |
| DSR (0.5) and Equity (2)              | 46  | 65.2                                     | 6.8   | 35.3  | 0.19                    | 45.5   | 13.9                                | 6.5   | 8.3   |
| <b>Triple EWIs</b>                    |   |  |   |   |                         |  |                                     |   |   |
| Credit (2), REER (1) and Equity (3)   | 37  | 64.9                                     | 3.9   | 39.3  | 0.10                    | 59.7   | 12.9                                | 7.2   | 8.7   |
| REER(1), Equity (17) and Property (5) | 31  | 67.7                                     | 2.1   | 35.2  | 0.06                    | 71.5   | 12.9                                | 5.7   | 8.6   |
| <b>Cassandra</b>                      | <b>53</b>                                 | <b>66.0</b>                              | <b>4.8</b>  | <b>48.3</b>   | <b>0.10</b>             | <b>60.8</b>  | <b>13.3</b>                         | <b>7.7</b>  | <b>9.6</b>  |

Note: EWIs are expressed as gaps (deviations from long-run trends). The number (in brackets) beside each indicator is the critical threshold that the indicator has to breach for a signal to be issued. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. Tranquil observations = observations not followed by a crisis within next 12 quarters; Crisis observations = observations followed by a crisis within the next 12 quarters. Noise-to-signal ratio is the ratio of false alarms to true signals. The lower the noise-to-signal ratio, the better the indicator in predicting crises while minimising false alarms. Lead time refers to the average # of quarters in advance of the crisis when the first signal was given. Persistence is the average # of true signals given in the 12 quarters before a crisis happens, when at least one signal is given. Probabilities here are expressed as a proportion of 100. The EWIs highlighted in grey are used to construct the Cassandra index.

Source: BIS, IMF, Bloomberg, CEIC and Nomura Global Economics.

## True signals and false alarms

The first column in Figure 9 lists the five single EWIs and the best performing joint and triple EWIs and alongside them in brackets are their optimal vulnerability thresholds. For example, ‘credit (8)’ is the private credit-to-GDP ratio gap with a threshold of 8pp, meaning the credit gap sends a signal whenever it is more than 6pp above its long-run trend. Consistent with more recent studies we found the predictive power increases when combining EWIs, and so we show five of the best performing joint or triple EWIs. The second column shows the number of financial crises since 1990 in our sample of 40 countries for each indicator. The number varies depending on the sample size of our EWIs, which is subject to data availability. The range is from 54 crises for the credit gap to 38 for the REER gap, which only starts from Q1 1994.

The third column shows the percentage of crises correctly signalled. It is defined as the number of crises for which the indicator issued a signal in at least one of the 12 quarters before the eruption of the crisis, expressed as the percentage of the total number of crises for which data on the indicator are available. As discussed earlier, we have set a criterion in computing the optimal thresholds that each single EWI must predict at least two-thirds of the crises.

The fourth column measures the extent to which indicators send false alarms, or Type-2 errors. During tranquil, non-crisis periods, the “cry wolf” problem is rare as false alarms are issued less than 10% of the time for our preferred property, joint and triple EWIs.

The fifth column measures the extent to which indicators send true signals. It is a much more stringent measure than that of column three and it is a useful measure of the persistence of good signals. It calculates the number of true signals issued by the indicator, expressed as a percentage of the number of quarters in which true signals could have been issued,  $A/(A+C)$  in the matrix in Figure 8. While obtaining 100% in column three would require that at least one signal be issued within 12 quarters prior to each crisis, a 100% reading in the column six requires a signal to be issued in every single quarter in the 12 quarter window prior to each crisis. The results in column five are encouraging. On average, in past crises, property and credit EWIs send warning signals in about 40-48% of the 12 quarters before the crisis erupts. Interestingly, combining the EWIs does not significantly increase the persistence of their signals.

## Minimizing the noise-to-signal ratio

The sixth column is the noise-to-signal ratio, the most important metric which combines the information about the indicators’ ability to avoid false alarms (column four) and issue true signals (column five). The lower the noise-to-signal ratio, the more reliable the indicator. To put these results in perspective, an indicator that issues signals randomly (i.e., has no predictive power) would have a noise-to-signal ratio equal to one, or in other words, a value of one indicates that the EWI performs just as well as a coin toss.

Promisingly, the noise-to-signal ratios in column six are all below 0.60, and the property and debt service ratio single EWIs stand out with the lowest values, of 0.16 and 0.30, respectively. Furthermore, combining the EWIs lowers the noise-to-signal ratio even further, with most below 0.10, supporting the hypothesis that joint indicators can increase predictive power.

## Lead time and persistence

Another way to gauge the performance of the indicators is to calculate the probability of a crisis conditional on a signal from the indicator,  $A/(A+B)$  in our matrix in Figure 8, against the unconditional probability of a crisis (regardless of whether a signal is issued),  $(A+C)/(A+B+C+D)$ . These are shown in columns seven and eight (and expressed as a percentage). To the extent that an indicator has useful predictive properties, the conditional probability would be higher than the unconditional one. The conditional probability of having a crisis within the next 12 quarters when a signal is issued is around 23-49% for the single EWIs and 43-72% for the joint EWIs. Reassuringly, the conditional probabilities are typically more than twice as high as the unconditional probability of a crisis occurring for the single EWIs, more than three times as high for the joint EWIs and more than four times as high for the triple EWIs.

Another desirable property of an indicator is the persistence of correct signals. An indicator that flashes a signal 12 quarters before the crisis and continues flashing in each of the next 11 quarters is more valuable than one that flashes in the first quarter but then sends no signals in the next 11 quarters. Column 9 calculates persistence as the average number of true signals sent per crisis. The indicator with the strongest persistence in correctly signalling crises is the property EWI, emitting on average 8.6 true signals out of the maximum of 12 before a crisis, and bettering the joint and triple EWIs.

The lead time signal of an indicator is also important. An indicator that flashes strong warning signals 2-4 quarters before the crisis erupts is more useful than one that only offers a signal when a crisis is imminent. Column 10 calculates for each indicator the average number of quarters ahead of the crisis from when the first signal occurs. Reassuringly, none of the indicators are coincident; in fact, they all have a long lead time of 7-10 quarters. The property EWI has the longest lead time of 10 quarters.



# Construction of Cassandra

Having assessed the performance of our single EWIs and their various combinations, we have settled on six indicators that can predict, up to 12 quarters in advance, two thirds of past financial crises since the early 1990s reasonably accurately, based on low noise-to-signal ratios and other performance metrics (Figure 10).

**Fig. 10: The six indicators that comprise Cassandra and their weightings**

| Indicators                               | Noise-to-signal ratio | Weighting |
|--|-----------------------|-----------|
| <b>Single EWIs</b>                       |                       |           |
| 1) Property (12)                         | 0.16                  | 0.13      |
| <b>Joint EWIs</b>                        |                       |           |
| 2) Credit (3) and Property (4)           | 0.21                  | 0.10      |
| 3) REER (3) and DSR (1)                  | 0.18                  | 0.12      |
| 4) DSR (0.5) and Equity (2)              | 0.19                  | 0.11      |
| <b>Triple EWIs</b>                       |                       |           |
| 5) Credit (2), REER (1) and Equity (3)   | 0.10                  | 0.20      |
| 6) REER(1), Equity (17) and Property (5) | 0.06                  | 0.35      |

Note: All indicators are expressed as gaps (deviations from long-run trend). The number (in brackets) beside each indicator is the critical threshold that the indicator has to breach for a signal to be issued. A signal is issued for joint and triple indicators if, and only if, the thresholds are simultaneously breached. The weightings are calculated as the inverse of their noise-to-signal ratios.

Source: BIS, IMF, Bloomberg, CEIC and Nomura Global Economics.

A neat way to assess Cassandra's past performance is to look at the model's results in the lead up to the Asian and Great Financial crises. [Appendix 3](#) shows the six indicators that comprise Cassandra for the 40 countries in the form of heat maps at three different snapshots in time – the 12 quarters before the 1997 Asian crisis, the 12 quarters before the 2008 Global Financial crisis and the latest 12 quarters to Q1 2021 – with red cells highlighting when an indicator sends a signal (i.e., it has breached its threshold). Before the Asian crisis, the preponderance of red warning cells were in Asia ex-Japan, where 278 of the 720 cells (39%) were flashing red. Fast forward to the 12 quarters before the Global Financial Crisis and the warning signals migrated to the DM economies, with 594 of the 1,440 cells (41%) flashing red. In the most recent 12 quarters, the warning signals are more evenly distributed between DM and EM and more sparse, with 174 of the total 2,880 cells (6%) flashing red but, as we discuss below, this is in an environment of exceptionally low interest rates that probably will not last.

To further enhance the predictive power, we combine the predictive power of our six indicators into a single summary measure, our Cassandra index. This involves three simple steps.

## Step one

First, an indicator is assigned binary values: whenever it breaches its vulnerability threshold and sends a signal it is assigned a value of one; otherwise it has a value of zero.

## Step two

Next we weight the six indicators to arrive at a composite Cassandra index for each country<sup>[5]</sup>. The weighting for each indicator is based on its performance in predicting past crises by using the inverse of the noise-to-signal ratio, so the more reliable the indicator, the higher its weighting (Figure 10).

## Step three

We now have all the inputs to construct Cassandra. For each country,  $C_{xt}$  is Cassandra for country  $x$  in month  $t$ ,  $S_{ixt}$  is the signal from indicator  $i$  of country  $x$  in month  $t$ , and  $w_i$  is the weighting of indicator  $i$ , calculated as the inverse of the noise-to-signal ratio of indicator  $i$  ( $NSR_i$ ), divided by the sum of the inverse of noise-to-signal ratios for all six indicators, thus giving a heavier weighting to indicators that have the strongest predictive power (those with smaller NSRs). For ease of interpretation, the Cassandra weighted values are re-indexed so that the Cassandra index ranges from zero (none of the six indicators are sending a signal) to 300 (all six of the indicators are flashing warning signals).

- For the earlier history of Cassandra scores, if for some countries the components that comprise the six indicators are not all available, we use a smaller subset of the indicators but with a criteria that at least two of the indicators have data.

$$C_{xt} = \sum_{i=1}^6 w_i S_{ixt} * 300, \text{ where } w_i = \frac{1}{NSR_i} / \sum_{i=1}^6 \frac{1}{NSR_i}$$

In interpreting Cassandra, the key question is: How high does the Cassandra index need to go to embody a serious risk of a financial crisis? Clearly, the higher the cut-off value of Cassandra, the lower the possibility that it will falsely call a crisis (quadrant B in Figure 8, or Type 2 error). On the other hand, if the cut-off value is set too high, there is a high risk that Cassandra will miss signalling a crisis (quadrant C in Figure 8, or Type 1 error).

With this trade-off in mind, we analyse the performance of Cassandra in predicting past crises in our sample by conducting a grid search of the Cassandra index that keeps the noise-to-signal ratio to a minimum subject to Cassandra correctly signalling at least two-thirds of past crises. From this, we find that, whenever the Cassandra index exceeds the cut-off level of 100, it should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters, particularly if the reading is persistently above 100. Setting a threshold of 100, Cassandra correctly signalled 66% of the past 53 crises with a noise-to-signal ratio of 0.10 (Figure 11). A Cassandra reading above 200 is a starker warning that a crisis could erupt at any time.

**Fig. 11: Predictive performance of Cassandra at a threshold level of 100**

|  |              |
|--|--------------|
| Number of crises   | 53           |
| <b>Percentage of crises correctly signalled</b>  | <b>66.0%</b> |
| True signals: Percent of months in signalling horizon where a signal was given A/(A+C)             | 48.3%        |
| False alarms: Percentage of months outside the signalling horizon where a signal was given B/(B+D) | 4.8%         |
| <b>Noise-to-signal ratio [B/(B+D)] / [A/(A+C)]</b>   | <b>0.10</b>  |
| Probability of a crisis happening conditional on a signal being issued A/(A+B)                     | 60.8%        |
| Unconditional probability of a crisis happening (A+C) / (A+B+C+D)                                  | 13.3%        |
| Lead time  | 9.6          |
| Persistence  | 7.7          |

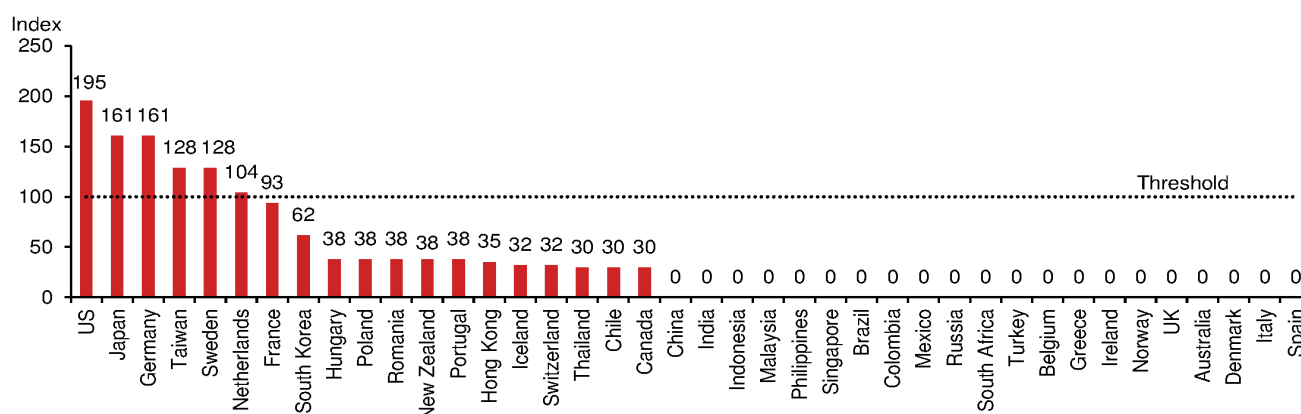
Note: This is the predictive performance of Cassandra when the threshold level is set at 100. i.e., Cassandra sends a signal of a crisis happening in the next 12 quarters when it breaches 100 (out of a total possible score of 300).  
Source: Nomura Global Economics.

## Results

We have established that Cassandra has reliably signaled, up to 12 quarters in advance, two thirds of the past 53 financial crises in our sample of 40 countries since the early 1990s.

Figure 12 shows the latest Cassandra results using data up to Q1 2021, or the latest available. Cassandra is warning that six economies – US, Japan, Germany, Taiwan, Sweden and Netherlands – currently appear vulnerable (scores above 100) to domestic credit crunches and financial crises over the next 12 quarters. On the other hand, over half of the 40 countries have Cassandra scores of zero, indicating very low risk of systemic credit crunches and financial crises.

**Fig. 12: Cassandra scores, latest data available**



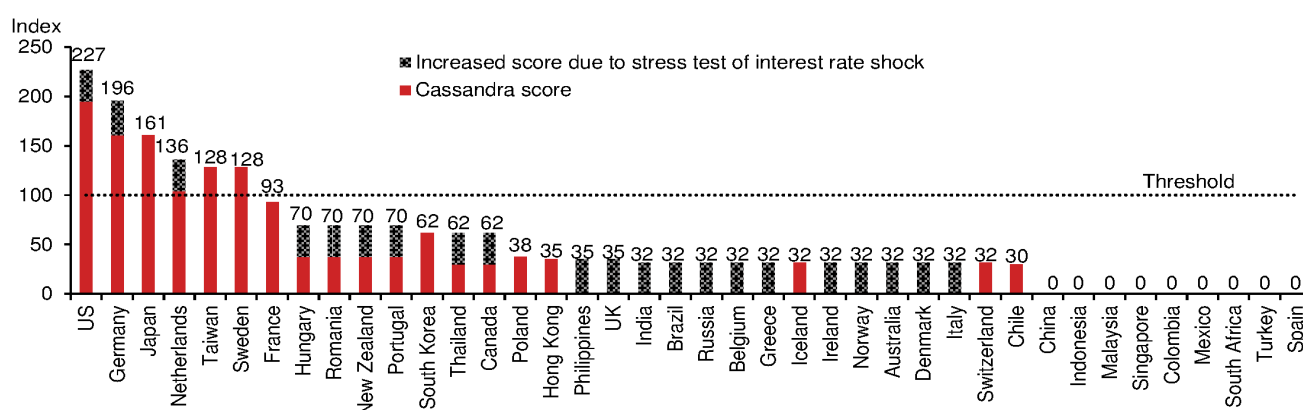
Note: A Cassandra score above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters.  
Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

# Stress testing Cassandra to an interest rate shock

Cassandra's latest results are positively influenced by very low interest rates that will probably not last. Rising and lower quality corporate debt was already a cause for concern in many countries before the pandemic, and there is no doubt that the extraordinary global monetary and fiscal policy response and regulatory forbearance to the COVID-19 crisis enhanced the ability of firms and households to service (or defer) their debt obligations. This allowed most to avoid the specter of default and bankruptcy but it has come at the expense of a further increase in private sector debt levels in most countries and a further deterioration in credit quality. According to the OECD's latest *Economic Outlook report*, around 30% of the non-financial corporate debt stock currently rated by Standard & Poor's sits in entities rated as "speculative", and 40% in entities with only a BBB rating, the lowest rating in the investment grade category (around USD5trn and USD8trn, respectively).<sup>16</sup>

Overly generous policy support has kept some unviable firms alive – the so-called 'zombies' that, left to fend for themselves, would have insufficient operating income to meet interest payments – but has also heightened the risk of financial vulnerabilities further down the road, particularly if there is an interest rate shock say, for example, if the rise in inflation turns out to be more persistent. To this end, we stress test Cassandra to an interest rate shock. We do this by manually switching 'on' the signal for the private sector debt service ratio in all 40 countries. Figure 13 shows the results, with Cassandra warning that in the face of an interest rate shock, the same six economies – US, Japan, Germany, Taiwan, Sweden and Netherlands – the most vulnerable, but with the scores increasing further for the US, Germany and the Netherlands. There is also now a sizable group of five countries – France, Hungary, Romania, New Zealand and Portugal – with scores not too far away from the 100 threshold.

Fig. 13: Cassandra scores under the stress test of an interest rate shock



Note: We stress test Cassandra to an interest rate shock by manually switching 'on' the signal for the private sector debt service ratio for all countries. A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

## Incorporating climate change risk into Cassandra

Catalyzed by the COVID-19 crisis, there is increasing recognition among government officials – and to a lesser extent investors – that dealing with climate change is a source of physical and transition risks for the financial sector that will most likely have significant implications for financial stability.

- This analysis draws on 2,800 public and private non-financial companies operating in OECD countries and major (non-OECD) emerging-market economies with an active S&P issuer rating. The sample consists mainly of large publicly listed firms incorporated in advanced economies, but also includes private firms (30%) and/or firms in emerging-market economies (13%). Collectively, these firms represent USD 20 trillion of non-financial corporate debt. US firms account for 40% and firms in emerging-market economies for 20% of the USD13 trillion of non-financial corporate debt currently rated either as speculative or BBB.

Climate change physical risks involve extreme weather events – storms, floods, wildfires, landslides and droughts – that can cause large economic and capital losses, not to mention loss of life. In line with global warming, the frequency and severity of climatic hazards is increasing, as is the economic cost. For example, since the 1980s the number of registered weather-related loss events has tripled; and inflation-adjusted insurance losses from these events have increased from an annual average of around USD10bn in the 1980s to around USD50bn over the past decade (*Mark Carney, 2015*). The financial sector is exposed to climate change physical risks through underwriting activity (insurers), lending activity (mostly banks) and market value of affected securities (all financial firms). The other kind of risk is the transition risk to a greener economy which includes ‘dirty’ assets becoming stranded; reputational damage to companies, industries and even the sovereign; and market-driven financial distress of polluters. One example is energy companies. If government policies were to change in line with the Paris Agreement, then two thirds of the world’s known fossil fuel reserves could not be burned. This could lead to changes in the value of investments held by banks and insurance companies in sectors like coal, oil and gas.

Standard asset pricing theory suggests that investors should demand a premium for holding assets exposed to climate change risk. But, because the nature of the risk is new and long term – similar to financial cycles – markets may not price future climate change risk correctly. Market mispricing of climate change risk today heightens the danger of a sharp, sudden re-pricing of this risk at some point in the future, which could trigger financial crises.

There is not strong evidence that financial risks related to climate change are fully reflected in asset valuations. For example, the *IMF*, in a major empirical study last year, concluded that aggregate equity valuations as of 2019 did not reflect climate change risk; thus, equity investors may be paying insufficient attention to climate variables. The *Network for Greening the Financial System*, a group of 83 central banks and financial supervisors, warn that research on the impact of climate change risks on the financial system is still in its infancy and is one of the most urgent and prominent issues, given the paucity of data and given the contagion and feedback effects from a re-pricing of climate-related financial risks could be potentially large. To quantify climate change risk at the sovereign level is challenging because of the patchy, partial and sometimes conflicting data measures, and so we took a metadata approach, relying on the consensus of data sources. To construct a composite index, we first take the sum of the standardized Z-scores of the below eight independent climate change risk indicators, which themselves are composites of various data (See *Appendix 4* for more detail).

### Climate change physical risk

1. The Germanwatch global climate risk index, 1999-2018
2. The University of Notre Dame vulnerability index, 2018
3. IMF climate-driven INFORM risk indicator, 2020

### Climate change transition risk

4. United Nations Sustainability Development Goals Index, 2020
5. The University of Notre Dame resilience index, 2018
6. IMF exposure index to low-carbon economy transition, 2019
7. IMF resilience index to low-carbon economy transition, 2019
8. IIF carbon efficiency scorecard, 2020

To arrive at a composite Z-score for each country ( $Z_i$ ) that has the same range as Cassandra’s scores, we rescale the Z-scores from 0 to 300 following the Min-Max Normalization approach to get a composite climate change risk index for each country ( $CCR_i$ ):

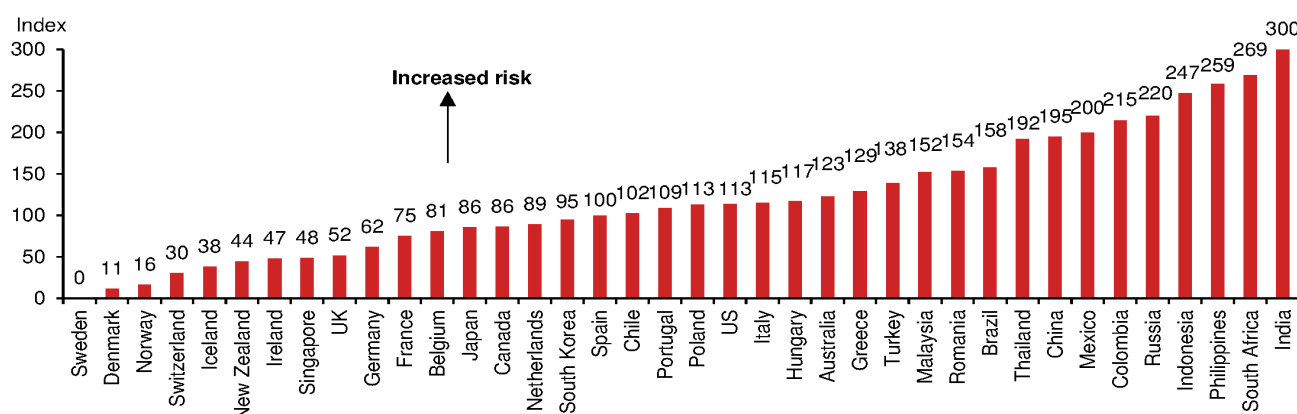
$$CCR_i = \frac{Z_i - \min(Z)}{\max(Z) - \min(Z)} * 300$$

Figure 14 shows the results of the Nomura composite climate change risk index for 38 of the 40 economies (Hong Kong and Taiwan are omitted due to the paucity of data), where the higher the index the greater the climate change risk. There is a wide range of outcomes. The Nordic countries of Sweden, Denmark and Norway display the lowest



climate change risk with index readings close to 0, whereas India, South Africa and the Philippines appear most at risk with index reading over 250. It is also noteworthy that the countries with the highest climate change risk – in fact, the top 13 – are all emerging market economies.

**Fig. 14: Nomura composite climate change risk index**

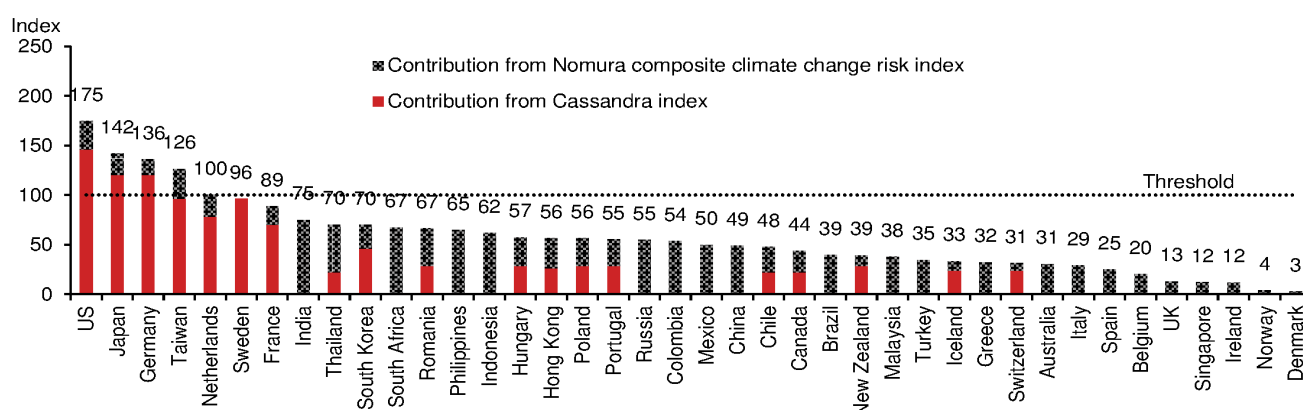


Note: To arrive at the composite climate change risk index for each country, we first take the sum of the standardized Z-scores of the eight independent climate change risk indicators from the sources to get a composite Z-score, and then rescale the Z-scores to 300 following the Min-Max Normalization approach.

Source: The Germanwatch global climate risk index, 1999-2018; The University of Notre Dame vulnerability index, 2018; IMF climate-driven INFORM risk indicator, 2020; United Nations Sustainability Development Goals Index, 2020; The University of Notre Dame resilience index, 2018; IMF exposure index to low-carbon economy transition, 2019; IMF resilience index to low-carbon economy transition, 2019; IIF carbon efficiency scorecard, 2020, and Nomura Global Economics (for more details, see Appendix 4).

The next step is to incorporate climate change risk into Cassandra. In the budding literature on assessing the effects of climate change-related risks on financial stability there seems to be the best of our knowledge little consensus on how to do this, in part because of uncertainties and measurement issues. Our approach is to simply apply a one-quarter weighting to the Nomura composite climate change risk index and a three-quarters weighting to the Cassandra scores, and the sum of the two weighted series produces Cassandra scores augmented for climate change risk (Figure 15).<sup>7</sup> Compared to the original Cassandra scores (see Figure 12), the scores for Cassandra adjusted for climate change risk are, by design, higher for most countries. While only four economies – US, Japan, Germany and Taiwan – stand out as clearly vulnerable (scores above 100) to financial crises, there is a sizable group of six countries – Netherlands, Sweden, France, India, Thailand and South Korea – that are close to being at risk with scores between 70-100.

**Fig. 15: Cassandra augmented for climate change risk**



Note: Cassandra augmented for climate change risk is constructed by assigning a one quarter weighting to the Nomura composite climate change risk index and a three-quarters weighting to the Cassandra scores. For countries missing a climate change risk index (Hong Kong and Taiwan), we use the mean of the Nomura composite climate change risk index across countries instead (120).

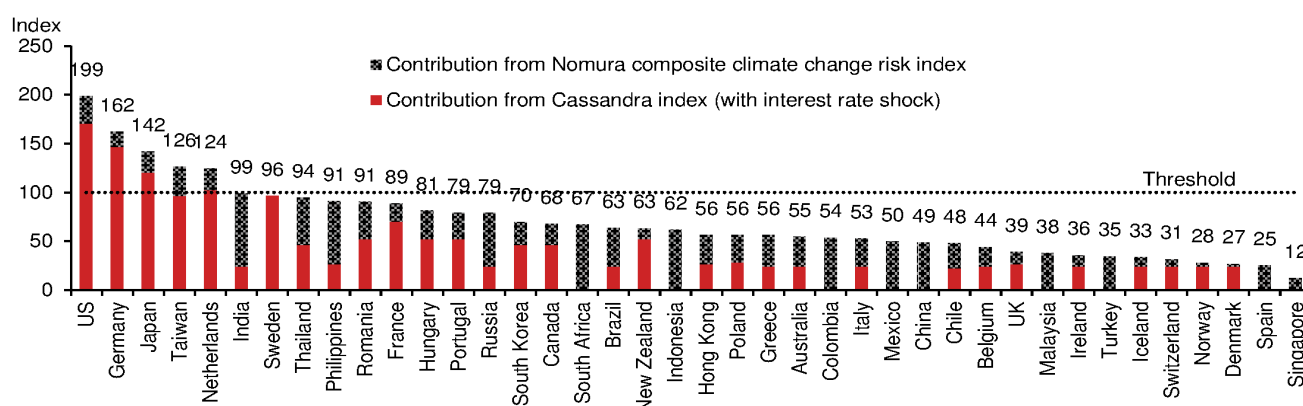
Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

- Hong Kong and Taiwan are not available for most of the global indicators on climate change risk, and so are not in the Nomura composite climate change risk index. To include Hong Kong and Taiwan in the analysis, we assume their climate change risk is equal to the average (100) of the other 38 countries comprising Nomura composite climate change risk index.

As a final exercise, we consider a worse-case scenario by combining climate change risk and an interest rate shock to Cassandra. As before, we reflect the interest rate shock by switching 'on' the signal for the private sector debt service ratio in all 40 countries and assign a three-quarters weighting to the resulting Cassandra scores (Figure 13), to which we add the Nomura composite climate change risk index, with a one-quarter weighting. The original Cassandra warned of six economies – US, Japan, Germany, Taiwan, Sweden and Netherlands – vulnerable (scores above 100) to financial crises, while curiously Figure 16 shows that, once Cassandra is adjusted for climate change risk and an interest rate shock, drops from six to five, as Sweden falls below the 100 mark. However, the list of countries with scores between 70-100 has lengthened to 10, including seven emerging market economies.

In the original Cassandra, the average score of the 40 countries was 35. When we adjusted it with an interest rate shock or climate change risk, the average score rose to 52 and 57, respectively. The original Cassandra combined with an interest rate shock *and* climate change risk raises the average score to 69.

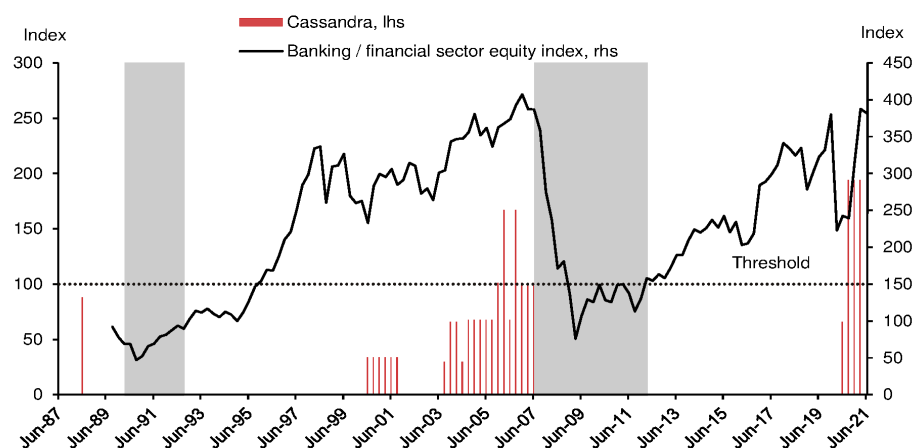
**Fig. 16: Cassandra adjusted for climate change risk and an interest rate shock**



Note: Cassandra augmented for climate change risk is constructed by assigning a one quarter weighting to the Nomura composite climate change risk index and a three-quarter weighting to the Cassandra scores under the stress test of an interest rate shock. For countries missing a climate change risk index (Hong Kong and Taiwan), we use the mean of the index across countries instead (120).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

The last section details the results of the original Cassandra in easy-to-read country pages for each of the 40 countries. To understand how to interpret the results, Figure 17 gives an example, charting the Cassandra index for the US against the ratio of the banking sector equity index of the country. The grey shaded areas display the financial-crisis periods (1990-92, 2007-11) as determined by studies in the literature that date financial crises (see [Appendix 2](#)). The red bars are the Cassandra readings when they are not zero, and a Cassandra reading above 100 (black dotted line) should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. In the case of the US, Cassandra did a poor job in signaling the financial crisis in the early 1990s, but it successfully warned of the sub-prime crisis in early 2006, and it is currently sending warning signals again.

**Fig. 17: Cassandra index for Unites States**

Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Finally, before turning to the individual country pages, some words of caution in interpreting Cassandra. No early warning system is fully reliable, and it would be foolish to make any exaggerated claims. The nature of financial crises can change over time and there are many variables that quantitatively are too difficult to measure, such as political systems and policy responses. That said, the advantage of Cassandra lies in its objective nature in letting the data speak – it is not clouded by conventional misperceptions or biases based on past experiences – and the results we have achieved are encouraging.



# Australia

2020 Nominal GDP: USD 1,359bn  
2020 GDP per capita: USD 52,825

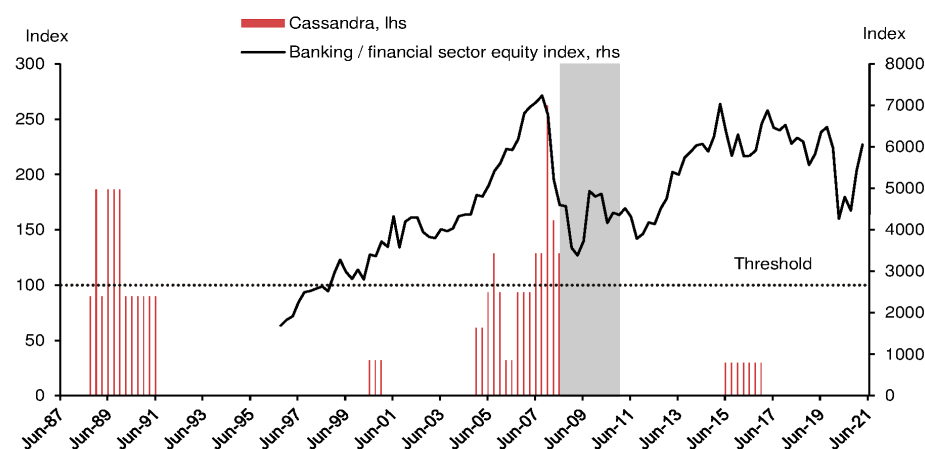
**Fig. 18: Vital statistics at a glance**

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F        | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|--------------|-------------|
| Real GDP, % y-o-y                    | 2.6  | 2.3  | 2.7  | 2.4  | 2.9  | 1.9  | -2.4 | <b>4.6</b>   | <b>3.2</b>  |
| CPI, % y-o-y                         | 2.5  | 1.5  | 1.3  | 1.9  | 1.9  | 1.6  | 0.9  | <b>2.0</b>   | <b>1.8</b>  |
| Current account, % GDP               | -3.1 | -4.6 | -3.3 | -2.6 | -2.1 | 0.7  | 2.5  | <b>2.4</b>   | <b>1.0</b>  |
| Fiscal balance, % GDP                | -2.9 | -2.8 | -2.4 | -1.7 | -1.2 | -3.8 | -9.9 | <b>-10.4</b> | <b>-6.8</b> |
| Official interest rate, %            | 2.50 | 2.00 | 1.50 | 1.50 | 1.50 | 0.75 | 0.10 | 0.10         |             |
| Sovereign FCY credit rating: S&P     | AAA  | AAA  | AAA  | AAA  | AAA  | AAA  | AAA  | AAA          |             |
| Sovereign FCY credit rating: Moody's | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa          |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 19: Cassandra index for Australia**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 20: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators     | Threshold                                  | 2013 | 2014 | 2015       | 2016       | 2017 | 2018 | 2019  | 2020 | Latest |
|------------------------------|--|------|------|------------|------------|------|------|-------|------|--------|
| <b>Single EWIs</b>           |  |      |      |            |            |      |      |       |      |        |
| Credit                       |  | -4.1 | -0.6 | 6.8        | 5.8        | -1.7 | -4.7 | -11.1 | -9.4 | -12.4  |
| REER                         |  | 6.7  | 2.7  | -6.5       | -1.2       | -2.2 | -6.3 | -10.7 | -7.6 | -3.9   |
| Debt service ratio (DSR)     |  | -0.9 | -0.6 | 0.0        | 0.2        | -0.2 | 0.1  | -1.1  | -3.6 | -3.6   |
| 1) Property                  | >12  | -2.3 | 0.3  | 4.8        | 8.8        | 9.7  | 0.1  | -1.3  | -0.6 | -1.1   |
| Equity                       |  | -1.3 | -3.3 | -6.5       | -2.3       | 2.5  | -7.6 | 7.2   | 6.1  | 7.8    |
| <b>Joint EWIs</b>            |  |      |      |            |            |      |      |       |      |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No   | No   | <b>Yes</b> | <b>Yes</b> | No   | No   | No    | No   | No     |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No   | No   | No         | No         | No   | No   | No    | No   | No     |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No   | No   | No         | No         | No   | No   | No    | No   | No     |
| <b>Triple EWIs</b>           |  |      |      |            |            |      |      |       |      |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No   | No         | No         | No   | No   | No    | No   | No     |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No   | No         | No         | No   | No   | No    | No   | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.





# Belgium

2020 Nominal GDP: USD 513bn  
2020 GDP per capita: USD 44,529

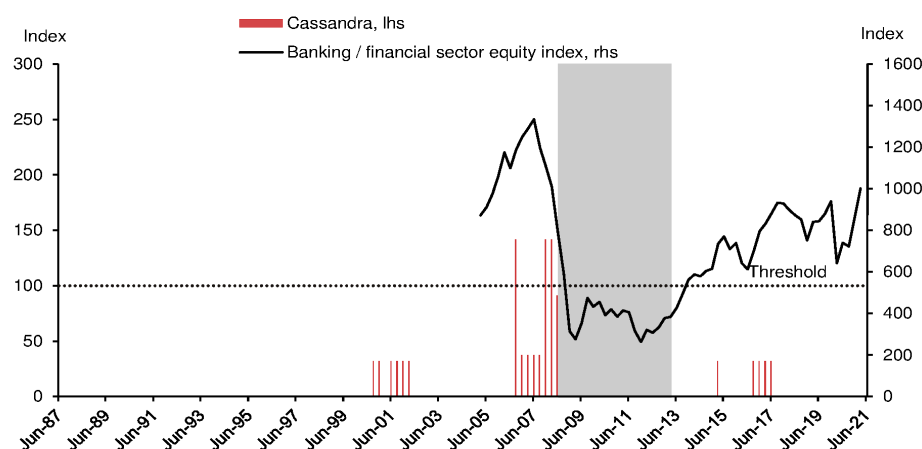
**Fig. 21: Vital statistics at a glance**

| Vital statistics                     | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 1.6   | 2.0   | 1.3   | 1.7   | 1.5   | 1.8   | -6.3  | <b>4.4</b>  | <b>3.5</b>  |
| CPI, % y-o-y                         | 0.3   | 0.6   | 2.0   | 2.1   | 2.1   | 1.5   | 0.7   | <b>1.6</b>  | <b>1.5</b>  |
| Current account, % GDP               | 0.8   | 1.4   | 0.6   | 0.7   | -0.8  | 0.3   | -0.7  | <b>-0.9</b> | <b>-1.5</b> |
| Fiscal balance, % GDP                | -3.1  | -2.4  | -2.4  | -0.7  | -0.8  | -1.9  | -10.2 | <b>-7.3</b> | <b>-5.0</b> |
| Official interest rate, %            | -0.20 | -0.30 | -0.40 | -0.40 | -0.40 | -0.50 | -0.50 | -0.50       |             |
| Sovereign FCY credit rating: S&P     | AA    | AA    | AA    | AA    | AA    | AA    | AA    | AA          |             |
| Sovereign FCY credit rating: Moody's | Aa3   | Aa3   | Aa3   | Aa3   | Aa3   | Aa3   | Aa3   | Aa3         |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 22: Cassandra index for Belgium**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 23: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators     | Threshold                                  | 2013  | 2014 | 2015 | 2016       | 2017 | 2018  | 2019  | 2020 | Latest |
|------------------------------|--|-------|------|------|------------|------|-------|-------|------|--------|
| <b>Single EWIs</b>           |  |       |      |      |            |      |       |       |      |        |
| Credit                       |  | 2.8   | 0.1  | -2.6 | 13.3       | -3.6 | -13.4 | -20.1 | 0.5  | 1.2    |
| REER                         |  | 1.6   | -1.3 | -3.4 | -2.0       | 0.8  | 1.7   | -0.8  | 2.1  | 1.6    |
| Debt service ratio (DSR)     |  | 0.1   | 0.2  | -0.1 | 1.9        | 0.1  | -0.7  | -2.3  | -1.1 | -1.2   |
| 1) Property                  | >12  | -0.2  | -0.9 | -2.5 | -3.3       | -3.5 | -5.1  | -2.6  | 0.9  | 0.5    |
| Equity                       |  | -12.1 | -1.0 | 10.1 | 5.4        | 14.0 | -9.3  | 10.2  | 0.4  | 7.5    |
| <b>Joint EWIs</b>            |  |       |      |      |            |      |       |       |      |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No    | No   | No   | No         | No   | No    | No    | No   | No     |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No    | No   | No   | No         | No   | No    | No    | No   | No     |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No    | No   | No   | <b>Yes</b> | No   | No    | No    | No   | No     |
| <b>Triple EWIs</b>           |  |       |      |      |            |      |       |       |      |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No   | No   | No         | No   | No    | No    | No   | No     |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No   | No   | No         | No   | No    | No    | No   | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Brazil

2020 Nominal GDP: USD 1,434bn  
2020 GDP per capita: USD 6,783

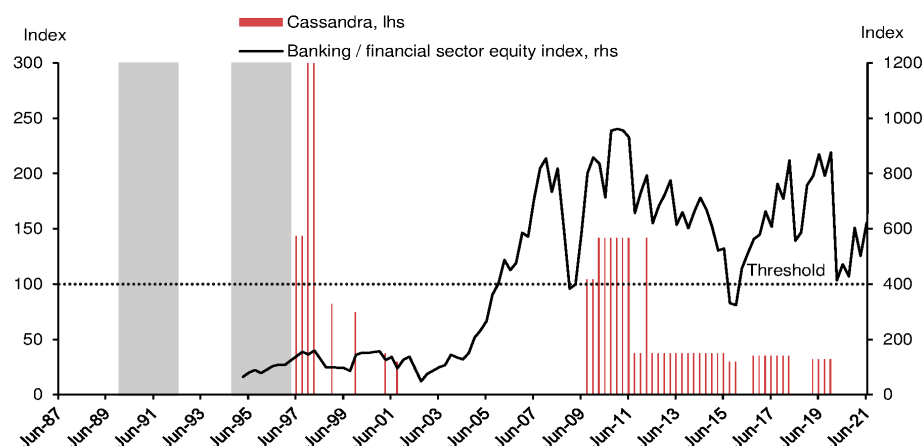
**Fig. 24: Vital statistics at a glance**

| Vital statistics                     | 2014  | 2015  | 2016  | 2017 | 2018 | 2019 | 2020  | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|------|------|------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 0.5   | -3.5  | -3.3  | 1.3  | 1.8  | 1.4  | -4.1  | <b>4.0</b>  | <b>2.3</b>  |
| CPI, % y-o-y                         | 6.3   | 9.0   | 8.8   | 3.5  | 3.7  | 3.7  | 3.2   | <b>5.5</b>  | <b>4.0</b>  |
| Current account, % GDP               | -4.1  | -3.0  | -1.3  | -0.7 | -2.2 | -2.7 | -0.9  | <b>-0.6</b> | <b>-0.8</b> |
| Fiscal balance, % GDP                | -6.0  | -10.3 | -9.0  | -7.9 | -7.1 | -5.9 | -13.4 | <b>-8.3</b> | <b>-7.2</b> |
| Official interest rate, %            | 11.75 | 14.25 | 13.75 | 7.00 | 6.50 | 4.50 | 2.00  | 4.25        |             |
| Sovereign FCY credit rating: S&P     | BBB-  | BB+   | BB    | BB   | BB-  | BB-  | BB-   | BB-         |             |
| Sovereign FCY credit rating: Moody's | Baa2  | Baa3  | Ba2   | Ba2  | Ba2  | Ba2  | Ba2   | Ba2         |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 25: Cassandra index for Brazil**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 26: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators     | Threshold                                  | 2013        | 2014        | 2015       | 2016       | 2017       | 2018  | 2019       | 2020  | Latest |
|------------------------------|--|-------------|-------------|------------|------------|------------|-------|------------|-------|--------|
| <b>Single EWIs</b>           |  |             |             |            |            |            |       |            |       |        |
| Credit                       |  | 1.4         | 2.0         | 4.9        | 5.1        | 1.4        | 0.4   | 1.4        | 9.0   | 8.3    |
| REER                         |  | 7.3         | 6.9         | -16.5      | 6.8        | 5.3        | -1.9  | -6.0       | -27.2 | -27.8  |
| Debt service ratio (DSR)     |  | -2.4        | -0.8        | 4.6        | 7.0        | 2.2        | 0.7   | 1.1        | -0.5  | -0.5   |
| 1) Property                  | >12  | <b>28.3</b> | <b>22.7</b> | 6.5        | -5.8       | -11.5      | -15.8 | -16.8      | -15.0 | -15.5  |
| Equity                       |  | -15.3       | -24.0       | -41.6      | -25.8      | -9.2       | -0.9  | 24.0       | 19.4  | 13.8   |
| <b>Joint EWIs</b>            |  |             |             |            |            |            |       |            |       |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No          | No          | <b>Yes</b> | No         | No         | No    | No         | No    | No     |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No          | No          | No         | <b>Yes</b> | <b>Yes</b> | No    | No         | No    | No     |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No          | No          | No         | No         | No         | No    | <b>Yes</b> | No    | No     |
| <b>Triple EWIs</b>           |  |             |             |            |            |            |       |            |       |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No          | No          | No         | No         | No         | No    | No         | No    | No     |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No          | No          | No         | No         | No         | No    | No         | No    | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Canada

2020 Nominal GDP: USD 1,643bn  
2020 GDP per capita: USD 43,278

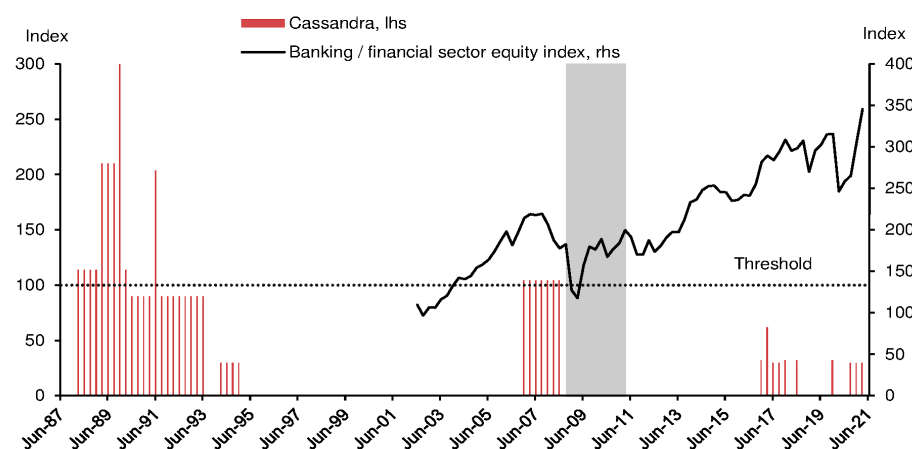
**Fig. 27: Vital statistics at a glance**

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020  | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 2.9  | 0.7  | 1.0  | 3.0  | 2.4  | 1.9  | -5.3  | <b>6.2</b>  | <b>4.1</b>  |
| CPI, % y-o-y                         | 1.9  | 1.1  | 1.4  | 1.6  | 2.3  | 1.9  | 0.7   | <b>2.6</b>  | <b>2.2</b>  |
| Current account, % GDP               | -2.3 | -3.5 | -3.1 | -2.8 | -2.3 | -2.1 | -1.9  | <b>-0.8</b> | <b>-1.3</b> |
| Fiscal balance, % GDP                | 0.2  | -0.1 | -0.5 | -0.1 | 0.3  | 0.5  | -10.7 | <b>-7.8</b> | <b>-3.9</b> |
| Official interest rate, %            | 1.00 | 0.50 | 0.50 | 1.00 | 1.75 | 1.75 | 0.25  | 0.25        |             |
| Sovereign FCY credit rating: S&P     | AAA  | AAA  | AAA  | AAA  | AAA  | AAA  | AAA   | AAA         |             |
| Sovereign FCY credit rating: Moody's | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa   | Aaa         |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 28: Cassandra index for Canada**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 29: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators            | Threshold                                  | 2013 | 2014 | 2015  | 2016       | 2017       | 2018  | 2019       | 2020       | Latest     |
|-------------------------------------|--|------|------|-------|------------|------------|-------|------------|------------|------------|
| <b>Single EWIs</b>                  |  |      |      |       |            |            |       |            |            |            |
| Credit                              |  | -3.1 | -3.9 | 6.9   | 6.8        | 1.9        | 0.4   | -0.7       | 19.1       | 15.3       |
| REER                                |  | 6.1  | 1.0  | -9.6  | -7.9       | -4.9       | -6.7  | -5.9       | -5.7       | -3.5       |
| Debt service ratio (DSR)            |  | -0.5 | -0.1 | 1.4   | 1.7        | 1.0        | 1.1   | 1.4        | -0.1       | -0.2       |
| 1) <b>Property</b>                  | >12  | -5.0 | -5.5 | -4.7  | 3.0        | 6.4        | 3.3   | 0.7        | 8.1        | 7.3        |
| Equity                              |  | 0.7  | 4.2  | -10.3 | 2.2        | 4.6        | -11.0 | 2.2        | 1.9        | 7.8        |
| <b>Joint EWIs</b>                   |  |      |      |       |            |            |       |            |            |            |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No   | No   | No    | No         | No         | No    | No         | <b>Yes</b> | <b>Yes</b> |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No   | No   | No    | No         | No         | No    | No         | No         | No         |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No   | No   | No    | <b>Yes</b> | <b>Yes</b> | No    | <b>Yes</b> | No         | No         |
| <b>Triple EWIs</b>                  |  |      |      |       |            |            |       |            |            |            |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No   | No    | No         | No         | No    | No         | No         | No         |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No   | No    | No         | No         | No    | No         | No         | No         |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Chile

2020 Nominal GDP: USD 253bn  
2020 GDP per capita: USD 12,990

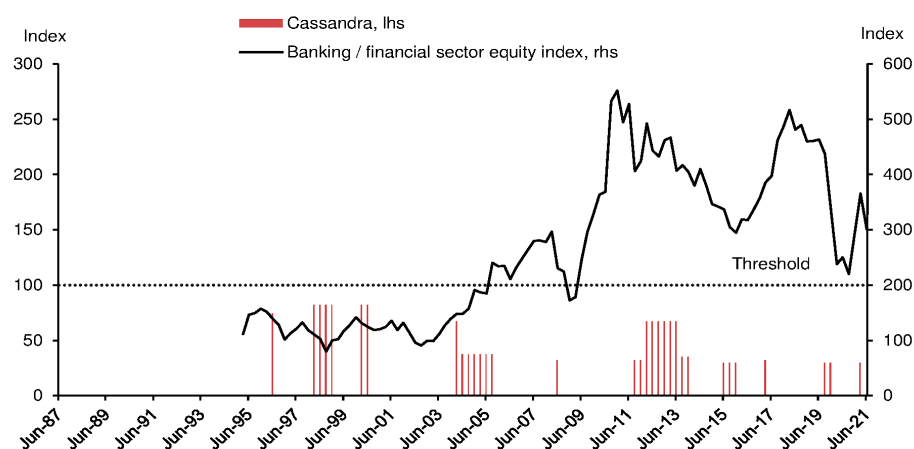
**Fig. 30: Vital statistics at a glance**

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 1.8  | 2.3  | 1.7  | 1.2  | 3.7  | 0.9  | -5.8 | <b>6.5</b>  | <b>3.2</b>  |
| CPI, % y-o-y                         | 4.7  | 4.3  | 3.8  | 2.2  | 2.4  | 2.6  | 3.1  | <b>3.4</b>  | <b>3.0</b>  |
| Current account, % GDP               | -2.0 | -2.4 | -2.0 | -2.3 | -3.9 | -3.7 | 1.4  | <b>0.3</b>  | <b>-0.6</b> |
| Fiscal balance, % GDP                | -1.5 | -2.1 | -2.7 | -2.6 | -1.5 | -2.7 | -7.1 | <b>-2.3</b> | <b>-2.9</b> |
| Official interest rate, %            | 3.00 | 3.50 | 3.50 | 2.50 | 2.75 | 1.75 | 0.50 | 0.50        |             |
| Sovereign FCY credit rating: S&P     | AA-  | AA-  | AA-  | A+   | A+   | A+   | A+   | A           |             |
| Sovereign FCY credit rating: Moody's | Aa3  | Aa3  | Aa3  | Aa3  | A1   | A1   | A1   | A1          |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 31: Cassandra index for Chile**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 32: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators            | Threshold                                  | 2013       | 2014 | 2015       | 2016 | 2017 | 2018 | 2019       | 2020  | Latest     |
|-------------------------------------|--|------------|------|------------|------|------|------|------------|-------|------------|
| <b>Single EWIs</b>                  |  |            |      |            |      |      |      |            |       |            |
| Credit                              |  | -3.0       | 4.3  | 11.9       | 5.3  | -3.7 | -0.8 | 7.5        | 10.0  | 7.4        |
| REER                                |  | 3.3        | -3.1 | -6.6       | 1.6  | 3.5  | 2.3  | -5.8       | -5.9  | -2.0       |
| Debt service ratio (DSR)            |  | 2.2        | 1.9  | 1.9        | 1.2  | -0.4 | 0.4  | 1.0        | 0.1   | 0.1        |
| 1) <b>Property</b>                  | >12  | -4.9       | 0.8  | 4.4        | -3.2 | 0.3  | 2.7  | 5.9        | 3.6   | 6.4        |
| Equity                              |  | -3.1       | -6.6 | -16.1      | -9.9 | 16.1 | 1.7  | -11.1      | -24.0 | -12.3      |
| <b>Joint EWIs</b>                   |  |            |      |            |      |      |      |            |       |            |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No         | No   | <b>Yes</b> | No   | No   | No   | <b>Yes</b> | No    | <b>Yes</b> |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | <b>Yes</b> | No   | No         | No   | No   | No   | No         | No    | No         |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No         | No   | No         | No   | No   | No   | No         | No    | No         |
| <b>Triple EWIs</b>                  |  |            |      |            |      |      |      |            |       |            |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No         | No   | No         | No   | No   | No   | No         | No    | No         |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No         | No   | No         | No   | No   | No   | No         | No    | No         |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.





# China

2020 Nominal GDP: USD 14,723bn  
2020 GDP per capita: USD 10,484

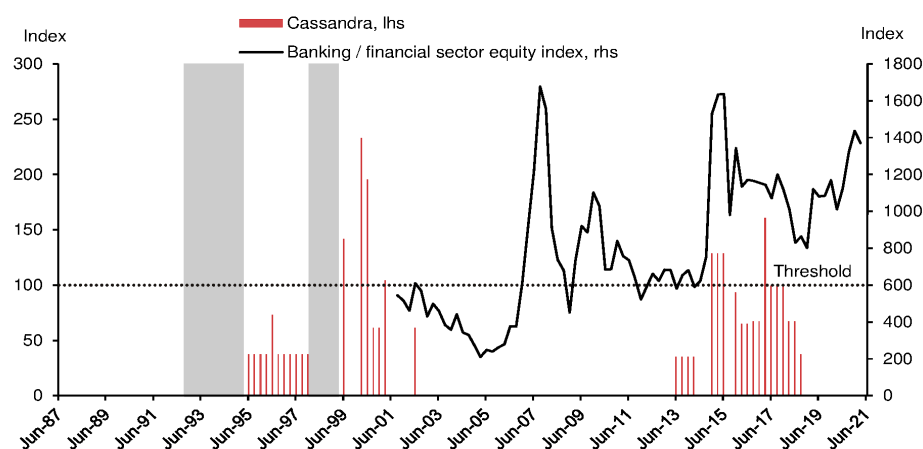
Fig. 33: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020  | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 7.4  | 7.0  | 6.9  | 6.9  | 6.7  | 6.0  | 2.3   | <b>8.5</b>  | <b>5.5</b>  |
| CPI, % y-o-y                         | 2.0  | 1.4  | 2.0  | 1.6  | 2.1  | 2.9  | 2.5   | <b>1.5</b>  | <b>2.3</b>  |
| Current account, % GDP               | 2.2  | 2.7  | 1.8  | 1.6  | 0.2  | 1.0  | 2.0   | <b>1.6</b>  | <b>1.3</b>  |
| Fiscal balance, % GDP                | -0.9 | -2.8 | -3.7 | -3.8 | -4.7 | -6.3 | -11.4 | <b>-9.6</b> | <b>-8.7</b> |
| Official interest rate, %            | 4.10 | 2.25 | 2.25 | 2.50 | 2.55 | 2.50 | 2.20  | 2.20        |             |
| Sovereign FCY credit rating: S&P     | AA-  | AA-  | AA-  | A+   | A+   | A+   | A+    | A+          |             |
| Sovereign FCY credit rating: Moody's | Aa3  | Aa3  | Aa3  | A1   | A1   | A1   | A1    | A1          |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available. Policy rate for China refers to 7D reverse repo rate.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 34: Cassandra index for China



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 35: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013       | 2014       | 2015       | 2016        | 2017        | 2018  | 2019  | 2020 | Latest |
|------------------------------|--|------------|------------|------------|-------------|-------------|-------|-------|------|--------|
| <b>Single EWIs</b>           |  |            |            |            |             |             |       |       |      |        |
| Credit                       |  | 1.4        | 5.6        | 14.9       | 14.7        | 8.8         | -1.7  | -3.5  | 6.7  | 1.5    |
| REER                         |  | 4.7        | 7.9        | 11.5       | 2.9         | 0.9         | -2.2  | -2.7  | -1.1 | 0.5    |
| Debt service ratio (DSR)     |  | 1.2        | 1.4        | 1.0        | 1.0         | 0.5         | -0.5  | -0.6  | 0.4  | 0.3    |
| 1) Property                  | >12  | -4.1       | -12.9      | -1.9       | <b>22.5</b> | <b>21.0</b> | 9.2   | -0.6  | 2.3  | 5.4    |
| Equity                       |  | -26.0      | 10.5       | 18.2       | 0.8         | 4.8         | -23.2 | -10.4 | 1.3  | -0.1   |
| <b>Joint EWIs</b>            |  |            |            |            |             |             |       |       |      |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No         | No         | No         | <b>Yes</b>  | <b>Yes</b>  | No    | No    | No   | No     |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | <b>Yes</b> | <b>Yes</b> | No         | No          | No          | No    | No    | No   | No     |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No         | <b>Yes</b> | <b>Yes</b> | No          | <b>Yes</b>  | No    | No    | No   | No     |
| <b>Triple EWIs</b>           |  |            |            |            |             |             |       |       |      |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No         | <b>Yes</b> | <b>Yes</b> | No          | No          | No    | No    | No   | No     |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No         | No         | No         | No          | No          | No    | No    | No   | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Colombia

2020 Nominal GDP: USD 271bn  
2020 GDP per capita: USD 5,336

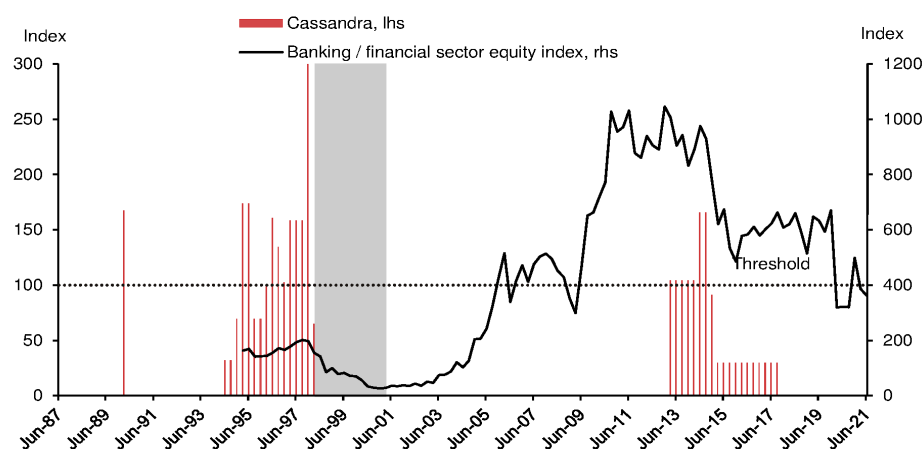
Fig. 36: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 4.4  | 3.1  | 2.0  | 1.8  | 2.5  | 3.3  | -6.8 | <b>5.1</b>  | <b>3.8</b>  |
| CPI, % y-o-y                         | 2.9  | 5.0  | 7.5  | 4.3  | 3.2  | 3.5  | 2.5  | <b>2.6</b>  | <b>3.0</b>  |
| Current account, % GDP               | -5.3 | -6.6 | -4.5 | -3.4 | -4.1 | -4.4 | -3.3 | <b>-3.8</b> | <b>-3.9</b> |
| Fiscal balance, % GDP                | -1.7 | -3.5 | -2.3 | -2.5 | -4.7 | -2.5 | -6.9 | <b>-8.3</b> | <b>-3.6</b> |
| Official interest rate, %            | 4.50 | 5.75 | 7.50 | 4.75 | 4.25 | 4.25 | 1.75 | 1.75        |             |
| Sovereign FCY credit rating: S&P     | BBB  | BBB  | BBB  | BBB  | BBB- | BBB- | BBB- | BB+         |             |
| Sovereign FCY credit rating: Moody's | Baa2 | Baa2 | Baa2 | Baa2 | Baa2 | Baa2 | Baa2 | Baa2        |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 37: Cassandra index for Colombia



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 38: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators            | Threshold                                  | 2013       | 2014       | 2015       | 2016       | 2017 | 2018  | 2019 | 2020  | Latest |
|-------------------------------------|--|------------|------------|------------|------------|------|-------|------|-------|--------|
| <b>Single EWIs</b>                  |  |            |            |            |            |      |       |      |       |        |
| Credit                              |  | -0.3       | 4.4        | 8.2        | 5.6        | 2.4  | 0.7   | -2.0 | 2.7   | 3.5    |
| REER                                |  | 14.0       | 7.2        | -12.4      | -5.0       | -5.2 | -5.4  | -9.3 | -15.0 | -13.2  |
| Debt service ratio (DSR)            |  | -0.9       | 0.1        | 1.4        | 2.9        | 1.3  | 0.9   | 0.5  | 0.4   | 0.4    |
| 1) <b>Property</b>                  | >12  | 5.6        | 6.0        | 6.1        | 6.9        | 7.0  | 4.3   | 4.0  | 1.3   | 0.6    |
| Equity                              |  | 24.7       | 11.2       | -21.6      | -14.7      | -9.3 | -24.0 | -9.2 | -23.5 | -31.0  |
| <b>Joint EWIs</b>                   |  |            |            |            |            |      |       |      |       |        |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No         | <b>Yes</b> | <b>Yes</b> | <b>Yes</b> | No   | No    | No   | No    | No     |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No         | No         | No         | No         | No   | No    | No   | No    | No     |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No         | No         | No         | No         | No   | No    | No   | No    | No     |
| <b>Triple EWIs</b>                  |  |            |            |            |            |      |       |      |       |        |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No         | <b>Yes</b> | No         | No         | No   | No    | No   | No    | No     |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | <b>Yes</b> | No         | No         | No         | No   | No    | No   | No    | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Denmark

2020 Nominal GDP: USD 352bn  
2020 GDP per capita: USD 60,494

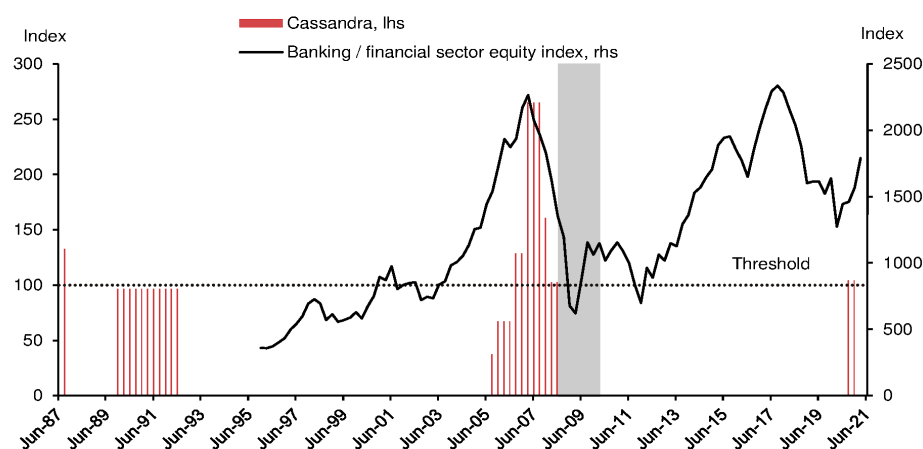
**Fig. 39: Vital statistics at a glance**

| Vital statistics                     | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 1.6   | 2.4   | 3.3   | 2.8   | 2.2   | 2.9   | -2.7  | <b>3.0</b>  | <b>3.2</b>  |
| CPI, % y-o-y                         | 0.6   | 0.5   | 0.3   | 1.2   | 0.8   | 0.8   | 0.4   | <b>1.1</b>  | <b>1.2</b>  |
| Current account, % GDP               | 8.9   | 8.2   | 7.8   | 8.0   | 7.0   | 8.9   | 7.9   | <b>8.0</b>  | <b>7.8</b>  |
| Fiscal balance, % GDP                | 1.1   | -1.3  | -0.1  | 1.8   | 0.7   | 3.8   | -3.5  | <b>-1.8</b> | <b>-1.8</b> |
| Official interest rate, %            | -0.05 | -0.75 | -0.65 | -0.65 | -0.65 | -0.75 | -0.60 | -0.50       |             |
| Sovereign FCY credit rating: S&P     | AAA   | AAA   | AAA   | AAA   | AAA   | AAA   | AAA   | AAA         |             |
| Sovereign FCY credit rating: Moody's | Aaa   | Aaa   | Aaa   | Aaa   | Aaa   | Aaa   | Aaa   | Aaa         |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 40: Cassandra index for Denmark**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 41: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators            | Threshold                                  | 2013  | 2014  | 2015 | 2016 | 2017  | 2018  | 2019  | 2020       | Latest |
|-------------------------------------|--|-------|-------|------|------|-------|-------|-------|------------|--------|
| <b>Single EWIs</b>                  |  |       |       |      |      |       |       |       |            |        |
| Credit                              |  | 7.9   | 5.1   | -0.3 | -6.2 | -15.9 | -19.0 | -13.7 | -18.1      | -11.8  |
| REER                                |  | 0.4   | -0.6  | -3.1 | -2.1 | -0.1  | -0.5  | -2.0  | 1.1        | 0.2    |
| Debt service ratio (DSR)            |  | 1.0   | 0.4   | -1.0 | -1.3 | -1.2  | -1.5  | -1.1  | -1.9       | -1.8   |
| 1) <b>Property</b>                  | >12  | -11.8 | -10.0 | -5.2 | -3.2 | -2.0  | -1.3  | -1.1  | 6.5        | 6.1    |
| Equity                              |  | -13.4 | -2.2  | 24.8 | 2.1  | 10.4  | -9.7  | 8.5   | 32.7       | 31.1   |
| <b>Joint EWIs</b>                   |  |       |       |      |      |       |       |       |            |        |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No    | No    | No   | No   | No    | No    | No    | No         | No     |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No    | No    | No   | No   | No    | No    | No    | No         | No     |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No    | No    | No   | No   | No    | No    | No    | No         | No     |
| <b>Triple EWIs</b>                  |  |       |       |      |      |       |       |       |            |        |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No    | No   | No   | No    | No    | No    | No         | No     |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No    | No   | No   | No    | No    | No    | <b>Yes</b> | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

# France

2020 Nominal GDP: USD 2,599bn  
2020 GDP per capita: USD 39,907

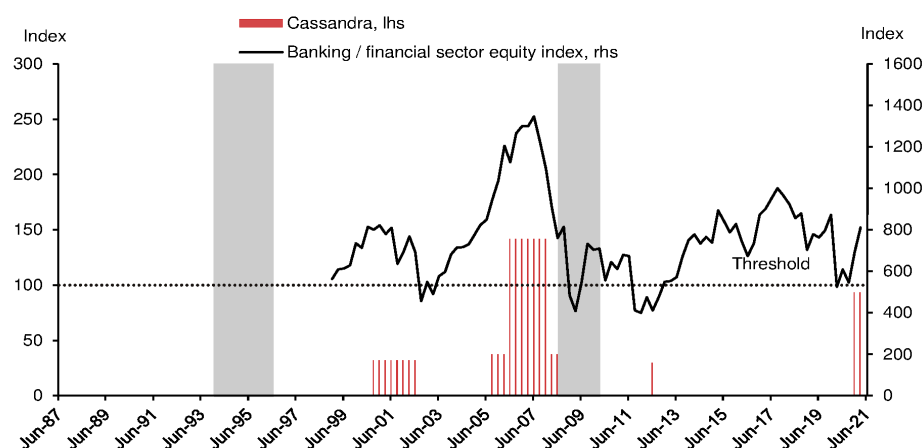
Fig. 42: Vital statistics at a glance

| Vital statistics                     | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 1.0   | 1.1   | 1.1   | 2.3   | 1.9   | 1.8   | -7.9  | <b>5.7</b>  | <b>4.0</b>  |
| CPI, % y-o-y                         | 0.6   | 0.1   | 0.3   | 1.2   | 2.1   | 1.3   | 0.5   | <b>1.5</b>  | <b>1.3</b>  |
| Current account, % GDP               | -1.0  | -0.4  | -0.5  | -0.8  | -0.6  | -0.7  | -2.3  | <b>-2.1</b> | <b>-1.8</b> |
| Fiscal balance, % GDP                | -3.9  | -3.6  | -3.6  | -2.9  | -2.3  | -3.0  | -9.9  | <b>-7.2</b> | <b>-4.4</b> |
| Official interest rate, %            | -0.20 | -0.30 | -0.40 | -0.40 | -0.40 | -0.50 | -0.50 | -0.50       |             |
| Sovereign FCY credit rating: S&P     | AA    | AA    | AA    | AA    | AA    | AA    | AA    | AA          |             |
| Sovereign FCY credit rating: Moody's | Aa1   | Aa2   | Aa2   | Aa2   | Aa2   | Aa2   | Aa2   | Aa2         |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 43: Cassandra index for France



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 44: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators            | Threshold                                  | 2013 | 2014  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020       | Latest     |
|-------------------------------------|--|------|-------|------|------|------|------|------|------------|------------|
| <b>Single EWIs</b>                  |  |      |       |      |      |      |      |      |            |            |
| Credit                              |  | -4.1 | -2.8  | -1.4 | 1.0  | -2.2 | -1.3 | -0.2 | 23.2       | 20.8       |
| REER                                |  | 0.7  | -1.0  | -3.6 | -2.8 | -0.3 | 0.6  | -0.4 | 2.5        | 2.1        |
| Debt service ratio (DSR)            |  | 0.1  | 0.2   | -0.1 | 0.1  | 0.0  | -0.1 | -0.2 | 1.5        | 1.4        |
| 1) <b>Property</b>                  | >12  | -1.3 | -5.2  | -6.9 | -7.0 | -6.3 | -6.3 | -5.0 | -0.5       | -0.8       |
| Equity                              |  | -9.0 | -10.0 | -2.7 | 1.1  | 8.7  | -5.4 | 17.7 | 8.7        | 18.0       |
| <b>Joint EWIs</b>                   |  |      |       |      |      |      |      |      |            |            |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No   | No    | No   | No   | No   | No   | No   | No         | No         |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No   | No    | No   | No   | No   | No   | No   | No         | No         |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No   | No    | No   | No   | No   | No   | No   | <b>Yes</b> | <b>Yes</b> |
| <b>Triple EWIs</b>                  |  |      |       |      |      |      |      |      |            |            |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No    | No   | No   | No   | No   | No   | <b>Yes</b> | <b>Yes</b> |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No    | No   | No   | No   | No   | No   | No         | No         |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Germany

2020 Nominal GDP: USD 3,803bn  
2020 GDP per capita: USD 45,733

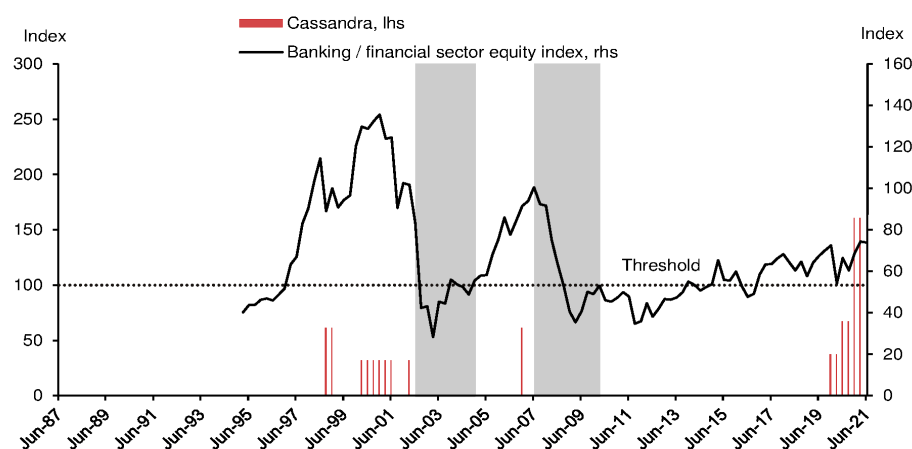
Fig. 45: Vital statistics at a glance

| Vital statistics                     | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 2.2   | 1.5   | 2.2   | 2.6   | 1.3   | 0.6   | -4.8  | <b>3.4</b>  | <b>4.2</b>  |
| CPI, % y-o-y                         | 0.8   | 0.7   | 0.4   | 1.7   | 1.9   | 1.4   | 0.4   | <b>2.5</b>  | <b>1.5</b>  |
| Current account, % GDP               | 7.2   | 8.6   | 8.5   | 7.8   | 7.4   | 7.1   | 7.1   | <b>7.6</b>  | <b>7.0</b>  |
| Fiscal balance, % GDP                | 0.6   | 1.0   | 1.2   | 1.4   | 1.8   | 1.5   | -4.2  | <b>-5.5</b> | <b>-0.4</b> |
| Official interest rate, %            | -0.20 | -0.30 | -0.40 | -0.40 | -0.40 | -0.50 | -0.50 | -0.50       | -0.50       |
| Sovereign FCY credit rating: S&P     | AAA   | AAA   | AAA   | AAA   | AAA   | AAA   | AAA   | AAA         | AAA         |
| Sovereign FCY credit rating: Moody's | Aaa   | Aaa   | Aaa   | Aaa   | Aaa   | Aaa   | Aaa   | Aaa         | Aaa         |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 46: Cassandra index for Germany



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 47: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019        | 2020        | Latest      |
|------------------------------|--|------|------|------|------|------|------|-------------|-------------|-------------|
| <b>Single EWIs</b>           |  |      |      |      |      |      |      |             |             |             |
| Credit                       |  | -3.8 | -8.8 | -8.2 | -7.3 | -5.9 | -3.0 | 0.1         | 11.3        | 12.3        |
| REER                         |  | 0.8  | -0.8 | -3.5 | -2.1 | 0.9  | 2.1  | 0.7         | 3.7         | 4.1         |
| Debt service ratio (DSR)     |  | -0.2 | -0.4 | -0.5 | -0.5 | -0.4 | -0.1 | 0.2         | 0.9         | 1.0         |
| 1) Property                  | >12  | -8.7 | -7.2 | -3.4 | 2.3  | 5.7  | 8.6  | <b>12.6</b> | <b>20.3</b> | <b>19.9</b> |
| Equity                       |  | 5.2  | 3.1  | 8.0  | 9.9  | 17.4 | -9.3 | 8.5         | 8.7         | 16.5        |
| <b>Joint EWIs</b>            |  |      |      |      |      |      |      |             |             |             |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No   | No   | No   | No   | No   | No   | No          | <b>Yes</b>  | <b>Yes</b>  |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No   | No   | No   | No   | No   | No   | No          | No          | No          |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No   | No   | No   | No   | No   | No   | No          | <b>Yes</b>  | <b>Yes</b>  |
| <b>Triple EWIs</b>           |  |      |      |      |      |      |      |             |             |             |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No   | No   | No   | No   | No   | No          | <b>Yes</b>  | <b>Yes</b>  |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No   | No   | No   | No   | No   | No          | No          | No          |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.





# Greece

2020 Nominal GDP: USD 189bn  
2020 GDP per capita: USD 17,670

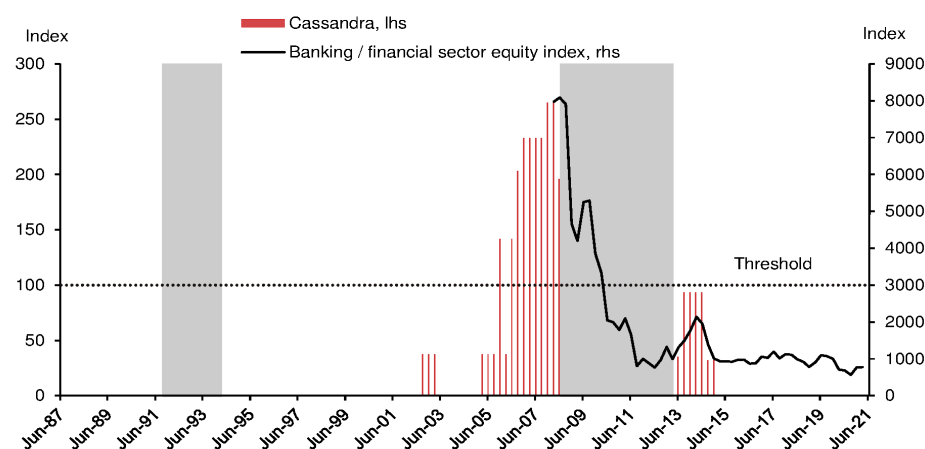
**Fig. 48: Vital statistics at a glance**

| Vital statistics                     | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 0.7   | -0.4  | -0.5  | 1.3   | 1.6   | 1.8   | -8.1  | <b>3.5</b>  | <b>5.0</b>  |
| CPI, % y-o-y                         | -1.4  | -1.1  | 0.0   | 1.1   | 0.8   | 0.5   | -1.3  | <b>0.0</b>  | <b>0.9</b>  |
| Current account, % GDP               | -2.4  | -1.5  | -2.4  | -2.6  | -3.6  | -2.2  | -7.4  | <b>-6.6</b> | <b>-3.5</b> |
| Fiscal balance, % GDP                | -4.1  | -2.8  | 0.6   | 1.1   | 0.9   | 0.6   | -9.9  | <b>-8.9</b> | <b>-2.6</b> |
| Official interest rate, %            | -0.20 | -0.30 | -0.40 | -0.40 | -0.40 | -0.50 | -0.50 | -0.50       | -0.50       |
| Sovereign FCY credit rating: S&P     | B     | CCC+  | B-    | B-    | B+    | BB-   | BB-   | BB          | BB          |
| Sovereign FCY credit rating: Moody's | Caa1  | Caa3  | Caa3  | Caa2  | B3    | B1    | Ba3   | Ba3         | Ba3         |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 49: Cassandra index for Greece**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 50: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators     | Threshold                                  | 2013       | 2014       | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | Latest |
|------------------------------|--|------------|------------|-------|-------|-------|-------|-------|-------|--------|
| <b>Single EWIs</b>           |  |            |            |       |       |       |       |       |       |        |
| Credit                       |  | 16.2       | 11.8       | 5.9   | 0.7   | -8.7  | -12.8 | -23.8 | -12.6 | -10.9  |
| REER                         |  | 2.7        | -1.0       | -3.6  | -3.7  | -1.9  | -1.4  | -3.3  | -2.5  | -4.5   |
| Debt service ratio (DSR)     |  | 2.6        | 1.7        | 0.8   | 0.2   | -0.9  | -1.3  | -2.5  | -1.5  | -1.5   |
| 1) Property                  | >12  | -16.8      | -18.1      | -19.9 | -18.2 | -17.2 | -12.7 | -3.4  | 4.4   | 5.3    |
| Equity                       |  | 38.6       | 3.3        | -23.2 | -21.5 | 0.3   | -17.1 | 29.1  | 22.0  | 35.4   |
| <b>Joint EWIs</b>            |  |            |            |       |       |       |       |       |       |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No         | No         | No    | No    | No    | No    | No    | No    | No     |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No         | No         | No    | No    | No    | No    | No    | No    | No     |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | <b>Yes</b> | <b>Yes</b> | No    | No    | No    | No    | No    | No    | No     |
| <b>Triple EWIs</b>           |  |            |            |       |       |       |       |       |       |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | <b>Yes</b> | No         | No    | No    | No    | No    | No    | No    | No     |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No         | No         | No    | No    | No    | No    | No    | No    | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Hong Kong

2020 Nominal GDP: USD 349bn  
2020 GDP per capita: USD 46,753

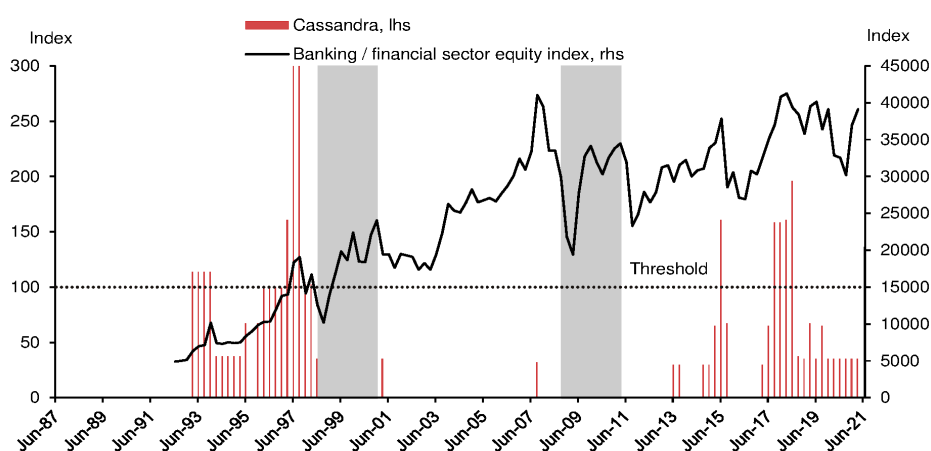
**Fig. 51: Vital statistics at a glance**

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020  | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 2.8  | 2.4  | 2.2  | 3.8  | 2.8  | -1.7 | -6.1  | <b>6.1</b>  | <b>3.0</b>  |
| CPI, % y-o-y                         | 4.4  | 3.0  | 2.4  | 1.5  | 2.4  | 2.9  | 0.3   | <b>1.6</b>  | <b>2.0</b>  |
| Current account, % GDP               | 1.4  | 3.3  | 4.0  | 4.6  | 3.7  | 6.0  | 6.5   | <b>5.5</b>  | <b>5.0</b>  |
| Fiscal balance, % GDP                | 3.6  | 0.6  | 4.4  | 5.5  | 2.4  | -0.6 | -10.0 | <b>-4.7</b> | <b>-0.1</b> |
| Official interest rate, %            | 0.50 | 0.75 | 1.00 | 1.75 | 2.75 | 2.49 | 0.50  | 0.50        |             |
| Sovereign FCY credit rating: S&P     | AAA  | AAA  | AAA  | AA+  | AA+  | AA+  | AA+   | AA+         |             |
| Sovereign FCY credit rating: Moody's | Aa1  | Aa1  | Aa1  | Aa2  | Aa2  | Aa2  | Aa3   | Aa3         |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. Data and forecasts for fiscal balance are presented on a fiscal year basis. For the official interest rate and sovereign credit ratings, historical data refer to end-of period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 52: Cassandra index for Hong Kong**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 53: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators     | Threshold                                  | 2013 | 2014       | 2015  | 2016  | 2017       | 2018       | 2019       | 2020       | Latest     |
|------------------------------|--|------|------------|-------|-------|------------|------------|------------|------------|------------|
| <b>Single EWIs</b>           |  |      |            |       |       |            |            |            |            |            |
| Credit                       |  | 2.5  | 13.7       | 4.3   | 2.8   | 16.7       | -0.5       | 5.6        | 25.7       | 42.3       |
| REER                         |  | -7.0 | 0.3        | 8.4   | 9.9   | 5.4        | 9.2        | 9.9        | 6.1        | 5.0        |
| Debt service ratio (DSR)     |  | -0.8 | 0.2        | -0.5  | -0.3  | 1.4        | 1.1        | 2.4        | 3.3        | 3.1        |
| 1) Property                  | >12  | 5.0  | 7.6        | 2.3   | 3.7   | 11.6       | 5.9        | 3.8        | 0.0        | 0.5        |
| Equity                       |  | 1.8  | -3.2       | -13.2 | -14.9 | 12.6       | -6.2       | -1.7       | -5.8       | -2.9       |
| <b>Joint EWIs</b>            |  |      |            |       |       |            |            |            |            |            |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No   | <b>Yes</b> | No    | No    | <b>Yes</b> | No         | No         | No         | No         |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No   | No         | No    | No    | <b>Yes</b> | <b>Yes</b> | <b>Yes</b> | <b>Yes</b> | <b>Yes</b> |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No   | No         | No    | No    | <b>Yes</b> | No         | No         | No         | No         |
| <b>Triple EWIs</b>           |  |      |            |       |       |            |            |            |            |            |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No         | No    | No    | <b>Yes</b> | No         | No         | No         | No         |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No         | No    | No    | No         | No         | No         | No         | No         |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

# Hungary

2020 Nominal GDP: USD 155bn  
2020 GDP per capita: USD 15,820

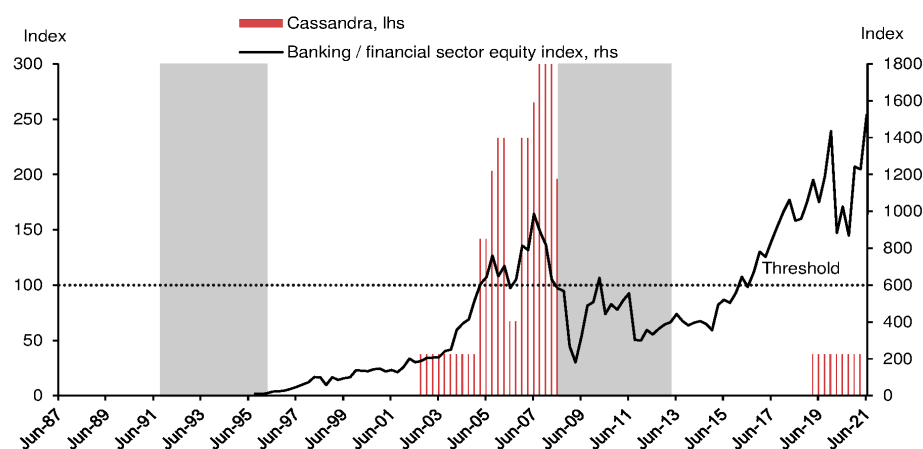
Fig. 54: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 4.3  | 3.9  | 2.1  | 4.3  | 5.4  | 4.7  | -4.8 | <b>4.9</b>  | <b>5.1</b>  |
| CPI, % y-o-y                         | -0.2 | -0.1 | 0.4  | 2.3  | 2.9  | 3.4  | 3.3  | <b>4.1</b>  | <b>3.3</b>  |
| Current account, % GDP               | 1.2  | 2.3  | 4.5  | 2.0  | 0.3  | -0.2 | -0.2 | <b>-0.4</b> | <b>-0.3</b> |
| Fiscal balance, % GDP                | -2.8 | -2.0 | -1.8 | -2.4 | -2.1 | -2.0 | -8.5 | <b>-6.5</b> | <b>-4.8</b> |
| Official interest rate, %            | 2.10 | 1.35 | 0.90 | 0.90 | 0.90 | 0.90 | 0.60 | 0.90        |             |
| Sovereign FCY credit rating: S&P     | BB   | BB+  | BBB- | BBB- | BBB- | BBB  | BBB  | BBB         |             |
| Sovereign FCY credit rating: Moody's | Ba1  | Ba1  | Baa3 | Baa3 | Baa3 | Baa3 | Baa3 | Baa3        |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 55: Cassandra index for Hungary



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 56: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019        | 2020        | Latest      |
|------------------------------|--|-------|-------|-------|-------|-------|-------|-------------|-------------|-------------|
| <b>Single EWIs</b>           |  |       |       |       |       |       |       |             |             |             |
| Credit                       |  | 9.1   | 5.3   | -5.1  | -10.4 | -16.7 | -18.4 | -18.6       | -11.5       | -9.2        |
| REER                         |  | 2.2   | -4.0  | -7.1  | -4.9  | -3.2  | -4.8  | -6.5        | -9.4        | -9.0        |
| Debt service ratio (DSR)     |  | 1.5   | 0.1   | -1.4  | -2.0  | -2.6  | -2.5  | -2.1        | -1.0        | -0.9        |
| 1) Property                  | >12  | -28.7 | -23.5 | -14.2 | -7.1  | 0.6   | 10.3  | <b>18.1</b> | <b>15.9</b> | <b>15.4</b> |
| Equity                       |  | -30.1 | -39.0 | -15.6 | 7.8   | 25.6  | 17.1  | 29.2        | 11.3        | 14.3        |
| <b>Joint EWIs</b>            |  |       |       |       |       |       |       |             |             |             |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No    | No    | No    | No    | No    | No    | No          | No          | No          |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No    | No    | No    | No    | No    | No    | No          | No          | No          |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No    | No    | No    | No    | No    | No    | No          | No          | No          |
| <b>Triple EWIs</b>           |  |       |       |       |       |       |       |             |             |             |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No    | No    | No    | No    | No    | No          | No          | No          |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No    | No    | No    | No    | No    | No          | No          | No          |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Iceland

2020 Nominal GDP: USD 22bn  
2020 GDP per capita: USD 59,634

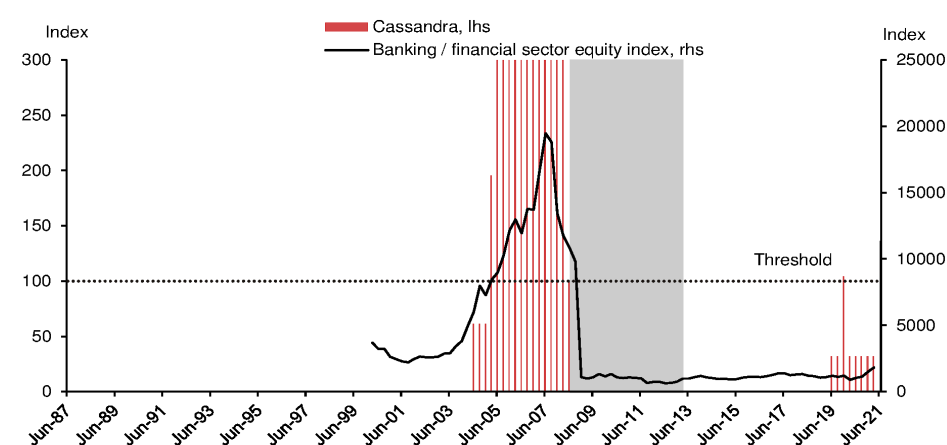
Fig. 57: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F        | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|--------------|-------------|
| Real GDP, % y-o-y                    | 1.6  | 4.5  | 6.2  | 4.3  | 4.8  | 2.6  | -6.6 | <b>3.3</b>   | <b>4.5</b>  |
| CPI, % y-o-y                         | 2.0  | 1.6  | 1.7  | 1.7  | 2.7  | 3.0  | 2.8  | <b>4.0</b>   | <b>2.5</b>  |
| Current account, % GDP               | 4.4  | 5.6  | 8.1  | 4.2  | 3.8  | 6.4  | 1.1  | <b>1.0</b>   | <b>1.7</b>  |
| Fiscal balance, % GDP                | 0.3  | -0.4 | 12.5 | 1.0  | 0.9  | -1.5 | -7.3 | <b>-10.2</b> | <b>-8.9</b> |
| Official interest rate, %            | 4.50 | 5.75 | 5.00 | 4.25 | 4.50 | 3.00 | 0.75 | 1.00         |             |
| Sovereign FCY credit rating: S&P     | BBB- | BBB  | BBB+ | A    | A    | A    | A    | A            |             |
| Sovereign FCY credit rating: Moody's | Baa3 | Baa2 | A3   | A3   | A3   | A2   | A2   | A2           |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 58: Cassandra index for Iceland



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 59: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019       | 2020       | Latest     |
|------------------------------|--|-------|-------|-------|-------|-------|-------|------------|------------|------------|
| <b>Single EWIs</b>           |  |       |       |       |       |       |       |            |            |            |
| Credit                       |  | -26.0 | -35.1 | -37.9 | -36.6 | -29.6 | -20.9 | -19.3      | -3.2       | 1.4        |
| REER                         |  | -13.2 | -8.8  | -2.1  | 16.1  | 17.1  | 6.9   | 7.3        | -3.5       | -0.8       |
| Debt service ratio (DSR)     |  | -0.2  | -1.5  | -1.1  | -1.0  | -0.8  | 0.4   | 0.3        | 1.3        | 1.8        |
| 1) Property                  | >12  | -15.9 | -14.2 | -10.4 | -1.7  | 8.3   | 9.3   | 8.5        | 10.3       | 9.6        |
| Equity                       |  | -61.5 | -54.2 | -31.8 | -30.6 | -19.9 | -16.6 | 17.7       | 68.5       | 92.4       |
| <b>Joint EWIs</b>            |  |       |       |       |       |       |       |            |            |            |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No    | No    | No    | No    | No    | No    | No         | No         | No         |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No    | No    | No    | No    | No    | No    | No         | No         | No         |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No    | No    | No    | No    | No    | No    | No         | <b>Yes</b> | <b>Yes</b> |
| <b>Triple EWIs</b>           |  |       |       |       |       |       |       |            |            |            |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No    | No    | No    | No    | No    | No         | No         | No         |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No    | No    | No    | No    | No    | <b>Yes</b> | No         | No         |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# India

2020 Nominal GDP: USD 2,790bn  
2020 GDP per capita: USD 1,965

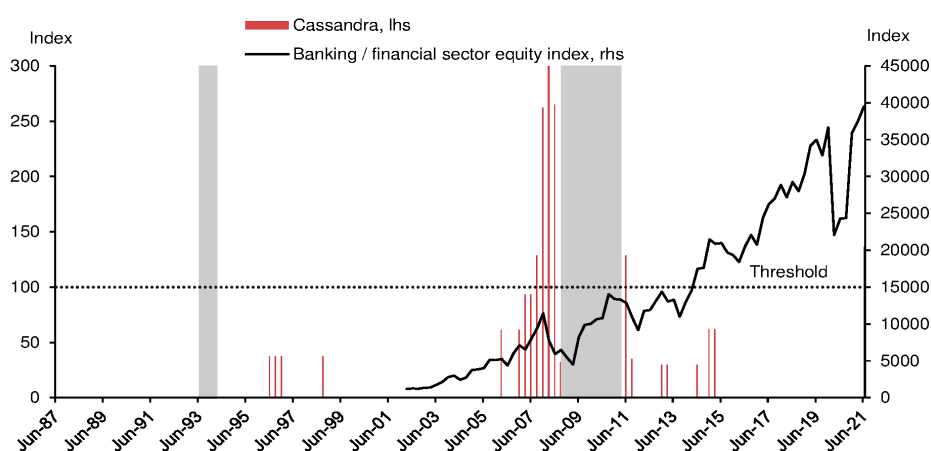
**Fig. 60: Vital statistics at a glance**

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020  | 2021F        | 2022F       |
|--------------------------------------|------|------|------|------|------|------|-------|--------------|-------------|
| Real GDP, % y-o-y                    | 7.4  | 8.0  | 8.3  | 6.8  | 6.5  | 4.0  | -7.3  | <b>9.6</b>   | <b>6.9</b>  |
| CPI, % y-o-y                         | 5.8  | 4.9  | 4.5  | 3.6  | 3.4  | 4.8  | 6.2   | <b>4.9</b>   | <b>4.1</b>  |
| Current account, % GDP               | -1.3 | -1.1 | -0.6 | -1.8 | -2.1 | -0.9 | 1.0   | <b>-1.2</b>  | <b>-1.6</b> |
| Fiscal balance, % GDP                | -7.1 | -7.2 | -7.1 | -6.4 | -6.3 | -7.4 | -12.3 | <b>-10.0</b> | <b>-9.1</b> |
| Official interest rate, %            | 8.00 | 6.75 | 6.25 | 6.00 | 6.50 | 5.15 | 4.00  | 4.00         |             |
| Sovereign FCY credit rating: S&P     | BBB- | BBB- | BBB- | BBB- | BBB- | BBB- | BBB-  | BBB-         |             |
| Sovereign FCY credit rating: Moody's | Baa3 | Baa3 | Baa3 | Baa2 | Baa2 | Baa2 | Baa3  | Baa3         |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. Data and forecasts for those four indicators are presented on a fiscal year basis. For the official interest rate and sovereign credit ratings, historical data refer to end-of period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 61: Cassandra index for India**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 62: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators     | Threshold                                  | 2013  | 2014       | 2015 | 2016  | 2017  | 2018  | 2019  | 2020  | Latest |
|------------------------------|--|-------|------------|------|-------|-------|-------|-------|-------|--------|
| <b>Single EWIs</b>           |  |       |            |      |       |       |       |       |       |        |
| Credit                       |  | 11.2  | 6.8        | 2.5  | -4.7  | -10.0 | -11.8 | -12.4 | -5.4  | -5.2   |
| REER                         |  | -9.9  | -3.6       | 1.3  | 2.7   | 5.4   | -2.2  | 3.0   | 1.8   | -0.4   |
| Debt service ratio (DSR)     |  | 2.7   | 2.1        | 1.0  | -0.5  | -1.5  | -1.6  | -1.8  | -1.7  | -1.7   |
| 1) Property                  | >12  | -1.0  | 6.3        | 6.1  | 6.4   | 4.9   | 3.5   | -2.8  | -10.8 | -11.5  |
| Equity                       |  | -14.0 | 4.0        | -9.2 | -13.5 | 2.7   | 2.9   | 8.1   | 14.4  | 19.0   |
| <b>Joint EWIs</b>            |  |       |            |      |       |       |       |       |       |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No    | <b>Yes</b> | No   | No    | No    | No    | No    | No    | No     |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No    | No         | No   | No    | No    | No    | No    | No    | No     |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No    | <b>Yes</b> | No   | No    | No    | No    | No    | No    | No     |
| <b>Triple EWIs</b>           |  |       |            |      |       |       |       |       |       |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No         | No   | No    | No    | No    | No    | No    | No     |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No         | No   | No    | No    | No    | No    | No    | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.





# Indonesia

2020 Nominal GDP: USD 1,060bn  
2020 GDP per capita: USD 3,922

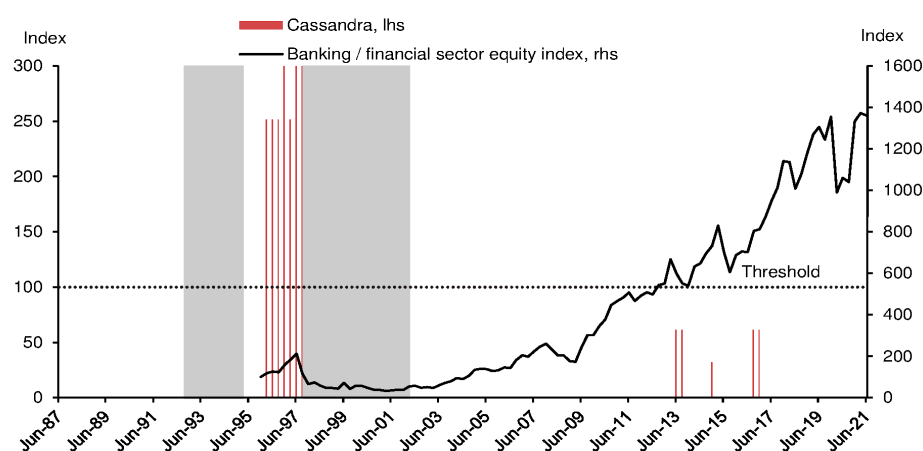
**Fig. 63: Vital statistics at a glance**

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 5.0  | 4.9  | 5.0  | 5.1  | 5.2  | 5.0  | -2.0 | <b>4.3</b>  | <b>5.3</b>  |
| CPI, % y-o-y                         | 6.4  | 6.4  | 3.5  | 3.8  | 3.2  | 2.8  | 2.0  | <b>2.2</b>  | <b>2.9</b>  |
| Current account, % GDP               | -3.1 | -2.0 | -1.8 | -1.6 | -2.9 | -2.7 | -0.4 | <b>-1.3</b> | <b>-1.4</b> |
| Fiscal balance, % GDP                | -2.1 | -2.6 | -2.5 | -2.5 | -1.8 | -2.2 | -5.9 | <b>-6.1</b> | <b>-4.4</b> |
| Official interest rate, %            | 7.75 | 7.50 | 4.75 | 4.25 | 6.00 | 5.00 | 3.75 | 3.50        |             |
| Sovereign FCY credit rating: S&P     | BB+  | BB+  | BB+  | BBB- | BBB- | BBB  | BBB  | BBB         |             |
| Sovereign FCY credit rating: Moody's | Baa3 | Baa3 | Baa3 | Baa3 | Baa2 | Baa2 | Baa2 | Baa2        |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of period and 2021 data are for the latest data available. Flag from <http://www.all-flags-world.com/country-flag/flag-indonesia.php>.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 64: Cassandra index for Indonesia**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 65: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators     | Threshold                                  | 2013 | 2014       | 2015 | 2016       | 2017 | 2018 | 2019 | 2020 | Latest |
|------------------------------|--|------|------------|------|------------|------|------|------|------|--------|
| <b>Single EWIs</b>           |  |      |            |      |            |      |      |      |      |        |
| Credit                       |  | 4.3  | 3.9        | 3.9  | 2.6        | 0.3  | 0.3  | -1.6 | -2.0 | -2.4   |
| REER                         |  | -4.9 | -1.7       | -2.3 | 3.8        | -0.1 | -4.9 | 0.6  | -3.7 | -3.7   |
| Debt service ratio (DSR)     |  | 0.3  | 0.5        | 0.7  | 0.4        | 0.0  | 0.2  | 0.1  | -0.1 | -0.1   |
| 1) Property                  | >12  | 0.3  | 1.8        | 3.3  | 3.9        | 5.6  | 6.8  | 7.5  | 9.0  | 9.1    |
| Equity                       |  | 8.6  | 19.8       | -3.2 | 4.2        | 16.7 | 6.5  | 2.2  | -7.4 | -8.7   |
| <b>Joint EWIs</b>            |  |      |            |      |            |      |      |      |      |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No   | No         | No   | No         | No   | No   | No   | No   | No     |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No   | No         | No   | No         | No   | No   | No   | No   | No     |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No   | <b>Yes</b> | No   | No         | No   | No   | No   | No   | No     |
| <b>Triple EWIs</b>           |  |      |            |      |            |      |      |      |      |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No         | No   | <b>Yes</b> | No   | No   | No   | No   | No     |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No         | No   | No         | No   | No   | No   | No   | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



2020 Nominal GDP: USD 419bn  
2020 GDP per capita: USD 83,850

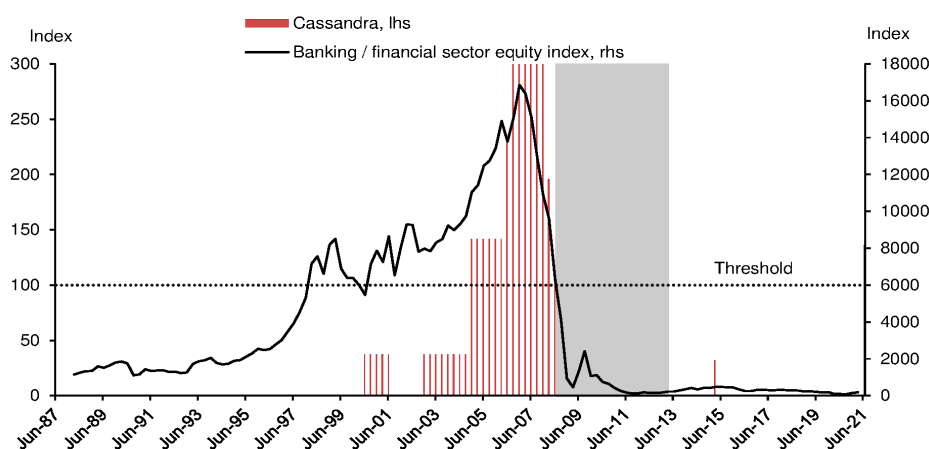
Fig. 66: Vital statistics at a glance

| Vital statistics                     | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 8.7   | 25.2  | 2.0   | 9.2   | 8.8   | 5.6   | 3.4   | <b>4.0</b>  | <b>4.5</b>  |
| CPI, % y-o-y                         | 0.3   | 0.0   | -0.2  | 0.3   | 0.7   | 0.9   | -0.5  | <b>1.3</b>  | <b>1.3</b>  |
| Current account, % GDP               | 1.1   | 4.4   | -4.2  | 0.5   | 6.0   | -11.4 | 4.6   | <b>7.0</b>  | <b>6.9</b>  |
| Fiscal balance, % GDP                | -3.6  | -2.0  | -0.7  | -0.3  | 0.1   | 0.5   | -5.3  | <b>-5.5</b> | <b>-2.8</b> |
| Official interest rate, %            | -0.20 | -0.30 | -0.40 | -0.40 | -0.40 | -0.50 | -0.50 | -0.50       | -0.50       |
| Sovereign FCY credit rating: S&P     | A     | A+    | A+    | A+    | A+    | AA-   | AA-   | AA-         | AA-         |
| Sovereign FCY credit rating: Moody's | Baa1  | Baa1  | A3    | A2    | A2    | A2    | A2    | A2          | A2          |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 67: Cassandra index for Ireland



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 68: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators            | Threshold                                  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | Latest |
|-------------------------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| <b>Single EWIs</b>                  |  |       |       |       |       |       |       |       |       |        |
| Credit                              |  | 68.9  | 72.7  | -19.9 | -32.3 | -55.5 | -54.0 | -70.1 | -84.6 | -84.3  |
| REER                                |  | 1.9   | -1.9  | -6.9  | -5.7  | -2.8  | -3.7  | -5.4  | -3.0  | -2.9   |
| Debt service ratio (DSR)            |  | 6.1   | 6.5   | -2.6  | -3.7  | -5.6  | -4.3  | -5.6  | -7.2  | -7.1   |
| 1) <b>Property</b>                  | >12  | -19.9 | -16.7 | -10.2 | -4.6  | 4.6   | 8.3   | 5.8   | 7.6   | 7.6    |
| Equity                              |  | -20.2 | -8.7  | 18.0  | 12.5  | 19.9  | -8.1  | 18.2  | 21.8  | 31.9   |
| <b>Joint EWIs</b>                   |  |       |       |       |       |       |       |       |       |        |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No    | No    | No    | No    | No    | No    | No    | No    | No     |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No    | No    | No    | No    | No    | No    | No    | No    | No     |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No    | No    | No    | No    | No    | No    | No    | No    | No     |
| <b>Triple EWIs</b>                  |  |       |       |       |       |       |       |       |       |        |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No    | No    | No    | No    | No    | No    | No    | No     |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No    | No    | No    | No    | No    | No    | No    | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



2020 Nominal GDP: USD 1,885bn  
2020 GDP per capita: USD 31,288

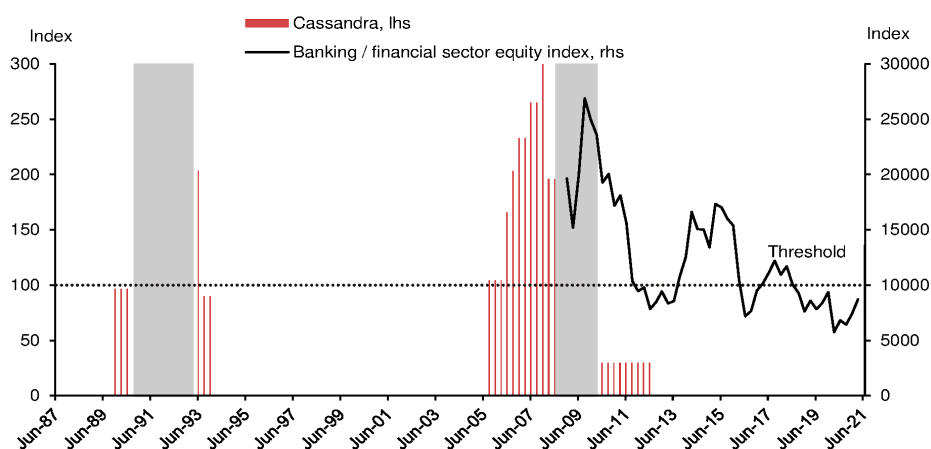
Fig. 69: Vital statistics at a glance

| Vital statistics                     | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 0.0   | 0.8   | 1.3   | 1.7   | 0.9   | 0.3   | -8.9  | <b>4.6</b>  | <b>4.0</b>  |
| CPI, % y-o-y                         | 0.2   | 0.1   | -0.1  | 1.3   | 1.3   | 0.7   | -0.2  | <b>1.3</b>  | <b>1.0</b>  |
| Current account, % GDP               | 1.9   | 1.4   | 2.6   | 2.6   | 2.5   | 3.0   | 3.6   | <b>3.5</b>  | <b>3.4</b>  |
| Fiscal balance, % GDP                | -3.0  | -2.6  | -2.4  | -2.4  | -2.2  | -1.6  | -9.5  | <b>-8.8</b> | <b>-5.5</b> |
| Official interest rate, %            | -0.20 | -0.30 | -0.40 | -0.40 | -0.40 | -0.50 | -0.50 | -0.50       | -0.50       |
| Sovereign FCY credit rating: S&P     | BBB-  | BBB-  | BBB-  | BBB   | BBB   | BBB   | BBB   | BBB         | BBB         |
| Sovereign FCY credit rating: Moody's | Baa2  | Baa2  | Baa2  | Baa2  | Baa3  | Baa3  | Baa3  | Baa3        | Baa3        |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 70: Cassandra index for Italy



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 71: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators            | Threshold                                  | 2013  | 2014  | 2015 | 2016  | 2017 | 2018  | 2019  | 2020 | Latest |
|-------------------------------------|--|-------|-------|------|-------|------|-------|-------|------|--------|
| <b>Single EWIs</b>                  |  |       |       |      |       |      |       |       |      |        |
| Credit                              |  | 9.1   | 5.6   | 0.1  | -5.3  | -9.5 | -12.4 | -14.9 | -5.0 | -3.2   |
| REER                                |  | 1.6   | -0.6  | -3.2 | -3.2  | -1.1 | -0.7  | -3.0  | -0.2 | -0.4   |
| Debt service ratio (DSR)            |  | 1.2   | 0.7   | 0.2  | -0.4  | -0.9 | -1.1  | -1.1  | -0.5 | -0.5   |
| 1) <b>Property</b>                  | >12  | -3.7  | -7.5  | -8.5 | -7.3  | -8.0 | -8.5  | -7.3  | -4.2 | -3.9   |
| Equity                              |  | -22.7 | -19.1 | -4.8 | -10.6 | 5.7  | -8.1  | 23.8  | 24.1 | 38.2   |
| <b>Joint EWIs</b>                   |  |       |       |      |       |      |       |       |      |        |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No    | No    | No   | No    | No   | No    | No    | No   | No     |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No    | No    | No   | No    | No   | No    | No    | No   | No     |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No    | No    | No   | No    | No   | No    | No    | No   | No     |
| <b>Triple EWIs</b>                  |  |       |       |      |       |      |       |       |      |        |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No    | No   | No    | No   | No    | No    | No   | No     |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No    | No   | No    | No   | No    | No    | No   | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Japan

2020 Nominal GDP: USD 5,049bn  
2020 GDP per capita: USD 40,146

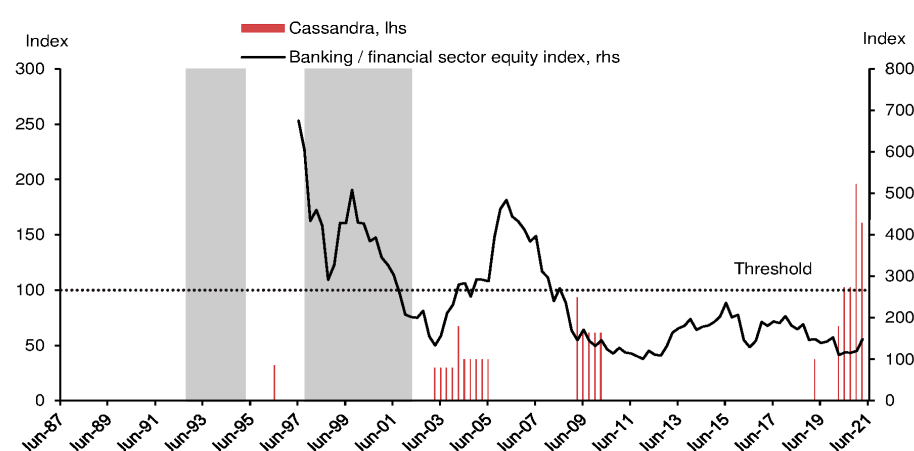
**Fig. 72: Vital statistics at a glance**

| Vital statistics                     | 2014 | 2015 | 2016  | 2017  | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|------|------|-------|-------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 0.3  | 1.6  | 0.8   | 1.7   | 0.6   | 0.0   | -4.7  | <b>2.6</b>  | <b>2.4</b>  |
| CPI, % y-o-y                         | 2.7  | 0.8  | -0.1  | 0.5   | 1.0   | 0.5   | 0.0   | <b>0.1</b>  | <b>0.6</b>  |
| Current account, % GDP               | 0.8  | 3.1  | 4.0   | 4.1   | 3.5   | 3.7   | 3.3   | <b>3.6</b>  | <b>3.2</b>  |
| Fiscal balance, % GDP                | -5.9 | -3.9 | -3.8  | -3.3  | -2.7  | -3.1  | -12.6 | <b>-9.4</b> | <b>-3.8</b> |
| Official interest rate, %            | 0.10 | 0.10 | -0.10 | -0.10 | -0.10 | -0.10 | -0.10 | -0.10       | -0.10       |
| Sovereign FCY credit rating: S&P     | AA-  | A+   | A+    | A+    | A+    | A+    | A+    | A+          | A+          |
| Sovereign FCY credit rating: Moody's | A1   | A1   | A1    | A1    | A1    | A1    | A1    | A1          | A1          |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available. Flag from <http://www.all-flags-world.com/country-flag/Japan/national-japanese-flag.php>.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 73: Cassandra index for Japan**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 74: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators     | Threshold                                  | 2013 | 2014  | 2015  | 2016 | 2017 | 2018 | 2019 | 2020        | Latest      |
|------------------------------|--|------|-------|-------|------|------|------|------|-------------|-------------|
| <b>Single EWIs</b>           |  |      |       |       |      |      |      |      |             |             |
| Credit                       |  | -1.9 | -3.6  | -7.9  | -5.4 | -4.9 | -1.5 | 2.5  | 21.2        | 17.8        |
| REER                         |  | -8.9 | -14.6 | -12.6 | 0.7  | -5.2 | -0.8 | 4.3  | 5.9         | 2.8         |
| Debt service ratio (DSR)     |  | -0.6 | -0.4  | -0.9  | -0.5 | -0.5 | -0.1 | 0.6  | 2.2         | 2.2         |
| 1) Property                  | >12  | -0.4 | 0.6   | 5.1   | 7.4  | 11.5 | 10.3 | 11.3 | <b>16.5</b> | <b>18.8</b> |
| Equity                       |  | 14.9 | 9.5   | 9.6   | 1.5  | 11.8 | -8.8 | 0.7  | 11.0        | 16.1        |
| <b>Joint EWIs</b>            |  |      |       |       |      |      |      |      |             |             |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No   | No    | No    | No   | No   | No   | No   | <b>Yes</b>  | <b>Yes</b>  |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No   | No    | No    | No   | No   | No   | No   | <b>Yes</b>  | No          |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No   | No    | No    | No   | No   | No   | No   | <b>Yes</b>  | <b>Yes</b>  |
| <b>Triple EWIs</b>           |  |      |       |       |      |      |      |      |             |             |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No    | No    | No   | No   | No   | No   | <b>Yes</b>  | <b>Yes</b>  |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No    | No    | No   | No   | No   | No   | No          | No          |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Malaysia

2020 Nominal GDP: USD 338bn  
2020 GDP per capita: USD 10,270

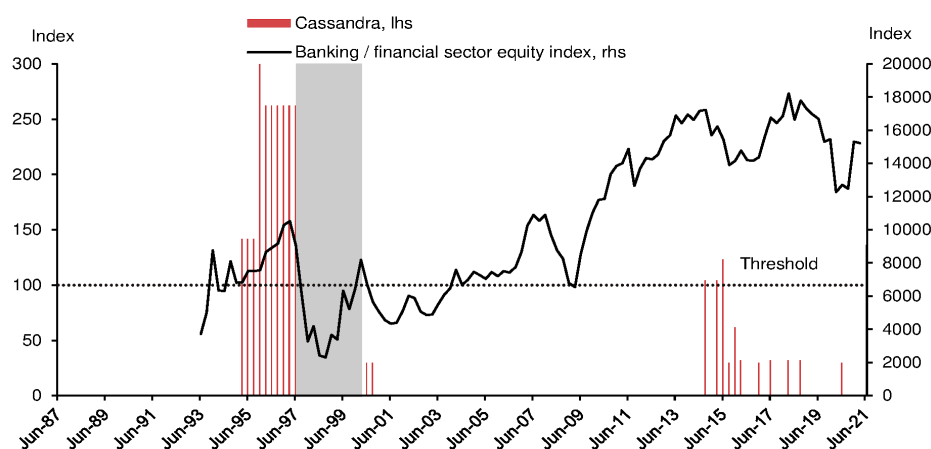
Fig. 75: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 6.0  | 5.1  | 4.5  | 5.7  | 4.7  | 4.3  | -5.6 | <b>5.5</b>  | <b>5.5</b>  |
| CPI, % y-o-y                         | 3.2  | 2.1  | 2.1  | 3.8  | 1.0  | 0.7  | -1.1 | <b>2.3</b>  | <b>1.8</b>  |
| Current account, % GDP               | 4.3  | 3.0  | 2.4  | 2.8  | 2.2  | 3.4  | 4.4  | <b>3.8</b>  | <b>3.7</b>  |
| Fiscal balance, % GDP                | -2.6 | -2.5 | -2.6 | -2.4 | -2.6 | -2.2 | -5.1 | <b>-4.4</b> | <b>-3.4</b> |
| Official interest rate, %            | 3.25 | 3.25 | 3.00 | 3.00 | 3.25 | 3.00 | 1.75 | 1.75        |             |
| Sovereign FCY credit rating: S&P     | A-   | A-   | A-   | A-   | A-   | A-   | A-   | A-          |             |
| Sovereign FCY credit rating: Moody's | A3   | A3   | A3   | A3   | A3   | A3   | A3   | A3          |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 76: Cassandra index for Malaysia



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 77: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators            | Threshold                                  | 2013 | 2014 | 2015       | 2016       | 2017 | 2018 | 2019  | 2020 | Latest |
|-------------------------------------|--|------|------|------------|------------|------|------|-------|------|--------|
| <b>Single EWIs</b>                  |  |      |      |            |            |      |      |       |      |        |
| Credit                              |  | -1.3 | 0.7  | 3.8        | 3.5        | -1.1 | 2.1  | 1.6   | 14.3 | 15.2   |
| REER                                |  | 6.3  | 8.3  | -6.6       | -5.4       | -2.0 | 0.1  | 0.2   | -2.6 | -1.5   |
| Debt service ratio (DSR)            |  | -0.3 | 0.2  | 0.8        | 0.8        | 0.4  | 0.9  | 0.9   | 1.5  | 1.5    |
| 1) <b>Property</b>                  | >12  | 2.2  | 4.3  | 4.6        | 6.5        | 5.7  | 4.7  | 2.3   | 2.1  | -1.0   |
| Equity                              |  | 24.6 | 12.8 | 4.4        | -1.5       | 3.0  | -4.4 | -11.9 | -9.2 | -14.0  |
| <b>Joint EWIs</b>                   |  |      |      |            |            |      |      |       |      |        |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No   | No   | <b>Yes</b> | <b>Yes</b> | No   | No   | No    | No   | No     |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No   | No   | No         | No         | No   | No   | No    | No   | No     |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No   | No   | <b>Yes</b> | No         | No   | No   | No    | No   | No     |
| <b>Triple EWIs</b>                  |  |      |      |            |            |      |      |       |      |        |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No   | No         | No         | No   | No   | No    | No   | No     |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No   | No         | No         | No   | No   | No    | No   | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.





# Mexico

2020 Nominal GDP: USD 1,076bn  
2020 GDP per capita: USD 8,421

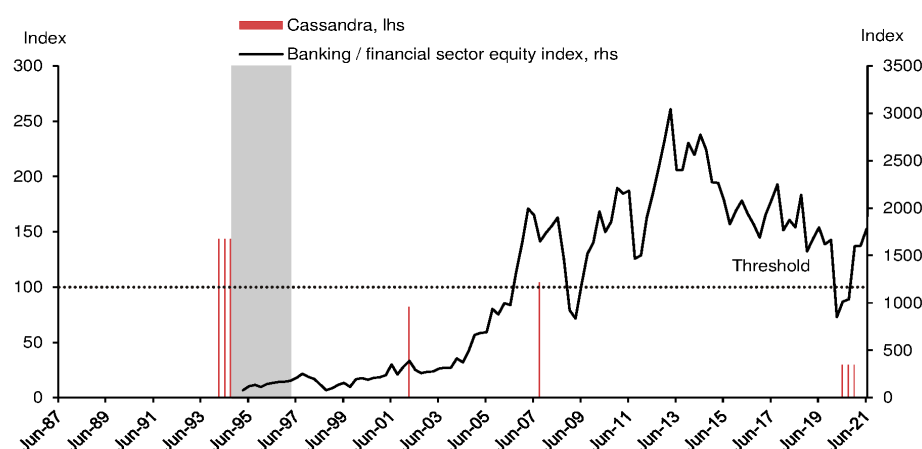
Fig. 78: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F | 2022F |
|--------------------------------------|------|------|------|------|------|------|------|-------|-------|
| Real GDP, % y-o-y                    | 2.9  | 3.3  | 2.6  | 2.1  | 2.2  | -0.3 | -8.2 | 5.1   | 2.7   |
| CPI, % y-o-y                         | 4.0  | 2.7  | 2.8  | 6.0  | 4.9  | 3.6  | 3.4  | 4.7   | 3.5   |
| Current account, % GDP               | -1.9 | -2.7 | -2.3 | -1.8 | -2.1 | -0.3 | 2.5  | 1.8   | 1.0   |
| Fiscal balance, % GDP                | -4.5 | -4.0 | -2.8 | -1.1 | -2.2 | -2.3 | -4.6 | -3.4  | -2.6  |
| Official interest rate, %            | 3.00 | 3.25 | 5.75 | 7.25 | 8.25 | 7.25 | 4.25 | 4.00  |       |
| Sovereign FCY credit rating: S&P     | BBB+ | BBB+ | BBB+ | BBB+ | BBB+ | BBB+ | BBB  | BBB   | BBB   |
| Sovereign FCY credit rating: Moody's | A3   | A3   | A3   | A3   | A3   | A3   | Baa1 | Baa1  |       |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 79: Cassandra index for Mexico



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 80: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators            | Threshold                                  | 2013 | 2014 | 2015 | 2016  | 2017 | 2018  | 2019  | 2020       | Latest |
|-------------------------------------|--|------|------|------|-------|------|-------|-------|------------|--------|
| <b>Single EWIs</b>                  |  |      |      |      |       |      |       |       |            |        |
| Credit                              |  | 0.2  | 0.7  | 3.0  | 5.1   | 3.9  | 2.2   | 0.5   | 3.2        | 0.8    |
| REER                                |  | 6.4  | 7.5  | -4.0 | -15.3 | -7.4 | -5.4  | 0.8   | -2.5       | -0.8   |
| Debt service ratio (DSR)            |  | -0.4 | -0.5 | -0.4 | 0.0   | 0.4  | 0.5   | 0.4   | 0.3        | 0.3    |
| 1) <b>Property</b>                  | >12  | -4.9 | -6.9 | -1.6 | -1.0  | -1.0 | 1.4   | 4.1   | 4.1        | 3.6    |
| Equity                              |  | 17.3 | 10.4 | 4.7  | 5.0   | 4.1  | -18.0 | -18.4 | -21.8      | -18.1  |
| <b>Joint EWIs</b>                   |  |      |      |      |       |      |       |       |            |        |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No   | No   | No   | No    | No   | No    | No    | <b>Yes</b> | No     |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No   | No   | No   | No    | No   | No    | No    | No         | No     |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No   | No   | No   | No    | No   | No    | No    | No         | No     |
| <b>Triple EWIs</b>                  |  |      |      |      |       |      |       |       |            |        |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No   | No   | No    | No   | No    | No    | No         | No     |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No   | No   | No    | No   | No    | No    | No         | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# The Netherlands

2020 Nominal GDP: USD 910bn  
2020 GDP per capita: USD 52,248

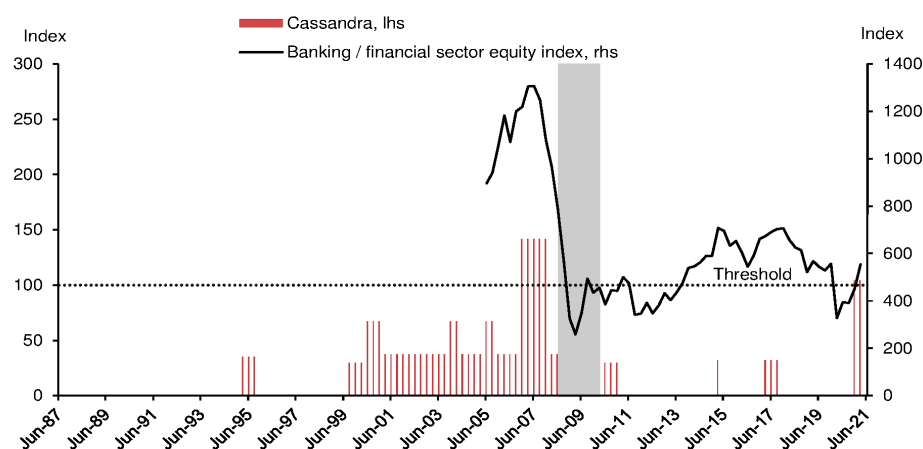
**Fig. 81: Vital statistics at a glance**

| Vital statistics                     | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 1.4   | 2.0   | 2.2   | 2.9   | 2.4   | 1.7   | -3.7  | <b>2.9</b>  | <b>3.0</b>  |
| CPI, % y-o-y                         | 1.0   | 0.6   | 0.3   | 1.4   | 1.7   | 2.6   | 1.3   | <b>1.7</b>  | <b>1.6</b>  |
| Current account, % GDP               | 8.2   | 6.3   | 8.1   | 10.8  | 10.8  | 9.9   | 10.0  | <b>9.0</b>  | <b>8.9</b>  |
| Fiscal balance, % GDP                | -2.2  | -2.0  | 0.0   | 1.3   | 1.4   | 2.5   | -5.6  | <b>-4.3</b> | <b>-2.5</b> |
| Official interest rate, %            | -0.20 | -0.30 | -0.40 | -0.40 | -0.40 | -0.50 | -0.50 | -0.50       | -0.50       |
| Sovereign FCY credit rating: S&P     | AA+   | AAA   | AAA   | AAA   | AAA   | AAA   | AAA   | AAA         | AAA         |
| Sovereign FCY credit rating: Moody's | Aaa   | Aaa   | Aaa   | Aaa   | Aaa   | Aaa   | Aaa   | Aaa         | Aaa         |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 82: Cassandra index for Netherlands**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 83: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators            | Threshold                                  | 2013  | 2014  | 2015  | 2016  | 2017 | 2018  | 2019  | 2020       | Latest     |
|-------------------------------------|--|-------|-------|-------|-------|------|-------|-------|------------|------------|
| <b>Single EWIs</b>                  |  |       |       |       |       |      |       |       |            |            |
| Credit                              |  | 14.8  | 18.6  | 13.6  | 10.6  | -2.2 | -14.7 | -28.3 | -29.5      | -33.7      |
| REER                                |  | 0.6   | -0.9  | -3.4  | -2.9  | -0.8 | -0.2  | -0.3  | 3.3        | 2.4        |
| Debt service ratio (DSR)            |  | 1.5   | 3.0   | 2.1   | 1.9   | 0.3  | -1.8  | -1.8  | -2.8       | -2.8       |
| 1) <b>Property</b>                  | >12  | -17.8 | -17.4 | -14.8 | -10.9 | -5.2 | 0.8   | 3.9   | 11.1       | 10.9       |
| Equity                              |  | -13.6 | -9.6  | -6.7  | 1.0   | 11.8 | -2.2  | 17.4  | 19.6       | 33.3       |
| <b>Joint EWIs</b>                   |  |       |       |       |       |      |       |       |            |            |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No    | No    | No    | No    | No   | No    | No    | No         | No         |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No    | No    | No    | No    | No   | No    | No    | No         | No         |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No    | No    | No    | No    | No   | No    | No    | No         | No         |
| <b>Triple EWIs</b>                  |  |       |       |       |       |      |       |       |            |            |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No    | No    | No    | No   | No    | No    | No         | No         |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No    | No    | No    | No   | No    | No    | <b>Yes</b> | <b>Yes</b> |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# New Zealand

2020 Nominal GDP: USD 209bn  
2020 GDP per capita: USD 41,127

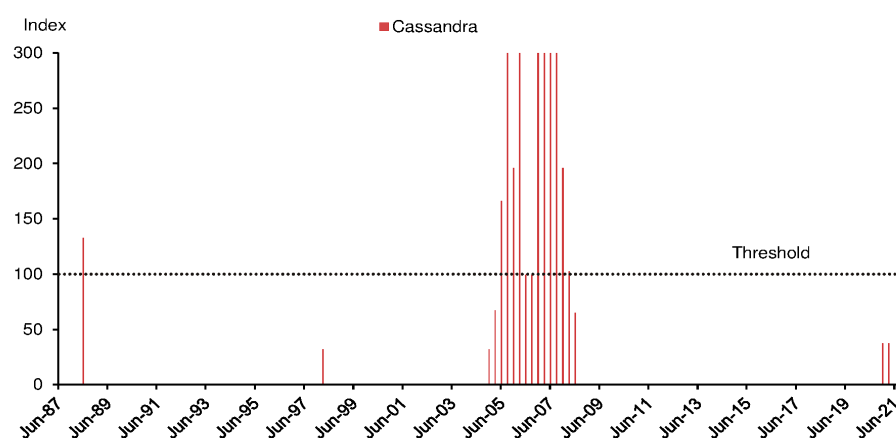
Fig. 84: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 3.2  | 4.2  | 4.4  | 4.0  | 4.4  | 3.0  | -1.2 | <b>4.5</b>  | <b>3.3</b>  |
| CPI, % y-o-y                         | 1.2  | 0.3  | 0.6  | 1.9  | 1.6  | 1.7  | 1.7  | <b>2.0</b>  | <b>1.8</b>  |
| Current account, % GDP               | -3.1 | -2.9 | -2.2 | -3.0 | -4.2 | -3.3 | -0.8 | <b>-2.1</b> | <b>-2.1</b> |
| Fiscal balance, % GDP                | -0.4 | 0.3  | 1.0  | 1.3  | 1.1  | -2.3 | -5.7 | <b>-5.1</b> | <b>-3.9</b> |
| Official interest rate, %            | 3.50 | 2.50 | 1.75 | 1.75 | 1.75 | 1.00 | 0.25 | 0.25        |             |
| Sovereign FCY credit rating: S&P     | AA   | AA   | AA   | AA   | AA   | AA   | AA   | AA+         |             |
| Sovereign FCY credit rating: Moody's | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa         |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 85: Cassandra index for New Zealand



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 86: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013  | 2014  | 2015 | 2016 | 2017 | 2018  | 2019  | 2020        | Latest      |
|------------------------------|--|-------|-------|------|------|------|-------|-------|-------------|-------------|
| <b>Single EWIs</b>           |  |       |       |      |      |      |       |       |             |             |
| Credit                       |  | -4.1  | -6.7  | -5.7 | -4.6 | -8.7 | -10.4 | -12.7 | -9.3        | -8.3        |
| REER                         |  | 7.7   | 5.9   | -3.1 | 3.8  | -2.3 | -3.1  | -6.5  | -3.8        | -1.2        |
| Debt service ratio (DSR)     |  | -1.1  | -0.2  | -0.8 | -0.8 | -0.7 | -0.7  | -1.3  | -1.7        | -1.6        |
| 1) Property                  | >12  | -10.1 | -8.1  | -0.5 | 8.0  | 6.6  | 4.2   | 3.5   | <b>13.1</b> | <b>12.2</b> |
| Equity                       |  | -19.5 | -11.9 | -6.0 | -4.9 | 7.8  | 5.0   | 27.5  | 36.1        | 27.9        |
| <b>Joint EWIs</b>            |  |       |       |      |      |      |       |       |             |             |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No    | No    | No   | No   | No   | No    | No    | No          | No          |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No    | No    | No   | No   | No   | No    | No    | No          | No          |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No    | No    | No   | No   | No   | No    | No    | No          | No          |
| <b>Triple EWIs</b>           |  |       |       |      |      |      |       |       |             |             |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No    | No   | No   | No   | No    | No    | No          | No          |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No    | No   | No   | No   | No    | No    | No          | No          |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Norway

2020 Nominal GDP: USD 362bn  
2020 GDP per capita: USD 67,176

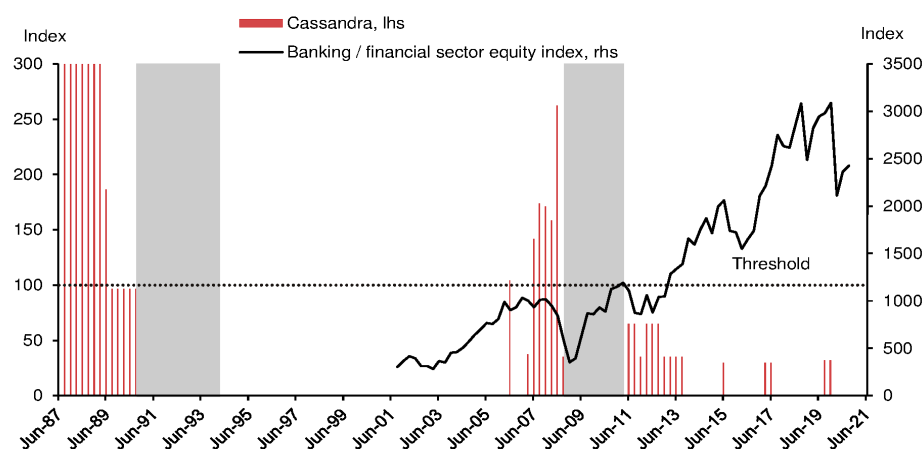
**Fig. 87: Vital statistics at a glance**

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F      |
|--------------------------------------|------|------|------|------|------|------|------|-------------|------------|
| Real GDP, % y-o-y                    | 2.0  | 2.0  | 1.1  | 2.4  | 1.1  | 0.8  | -0.8 | <b>3.5</b>  | <b>3.5</b> |
| CPI, % y-o-y                         | 2.1  | 2.2  | 3.6  | 1.9  | 2.8  | 2.2  | 1.3  | <b>2.8</b>  | <b>1.9</b> |
| Current account, % GDP               | 10.8 | 8.0  | 4.5  | 4.6  | 8.0  | 2.5  | 2.5  | <b>5.4</b>  | <b>4.8</b> |
| Fiscal balance, % GDP                | 8.6  | 6.0  | 4.1  | 5.0  | 6.9  | 5.6  | -7.0 | <b>-0.2</b> | <b>1.4</b> |
| Official interest rate, %            | 1.25 | 0.75 | 0.50 | 0.50 | 0.75 | 1.50 | 0.00 | 0.00        |            |
| Sovereign FCY credit rating: S&P     | AAA  | AAA  | AAA  | AAA  | AAA  | AAA  | AAA  | AAA         |            |
| Sovereign FCY credit rating: Moody's | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa         |            |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 88: Cassandra index for Norway**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 89: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators     | Threshold                                  | 2013 | 2014 | 2015 | 2016 | 2017 | 2018  | 2019       | 2020 | Latest |
|------------------------------|--|------|------|------|------|------|-------|------------|------|--------|
| <b>Single EWIs</b>           |  |      |      |      |      |      |       |            |      |        |
| Credit                       |  | -4.2 | -2.8 | 12.5 | 15.5 | -0.7 | -17.6 | -7.8       | 9.9  | 9.6    |
| REER                         |  | 2.1  | -1.3 | -9.3 | -1.3 | -4.2 | -1.1  | -5.1       | -7.3 | -2.4   |
| Debt service ratio (DSR)     |  | 0.3  | -0.9 | -1.0 | -0.3 | -0.8 | -1.6  | 1.1        | -0.7 | -0.7   |
| 1) Property                  | >12  | 0.2  | 0.6  | -0.5 | 2.7  | -0.8 | -4.5  | -6.2       | -3.3 | -3.9   |
| Equity                       |  | 3.3  | -0.2 | -4.8 | 0.2  | 13.3 | 4.3   | 12.0       | 8.0  | 15.4   |
| <b>Joint EWIs</b>            |  |      |      |      |      |      |       |            |      |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No   | No   | No   | No   | No   | No    | No         | No   | No     |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No   | No   | No   | No   | No   | No    | No         | No   | No     |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No   | No   | No   | No   | No   | No    | <b>Yes</b> | No   | No     |
| <b>Triple EWIs</b>           |  |      |      |      |      |      |       |            |      |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No   | No   | No   | No   | No    | No         | No   | No     |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No   | No   | No   | No   | No    | No         | No   | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Philippines

2020 Nominal GDP: USD 362bn  
2020 GDP per capita: USD 3,330

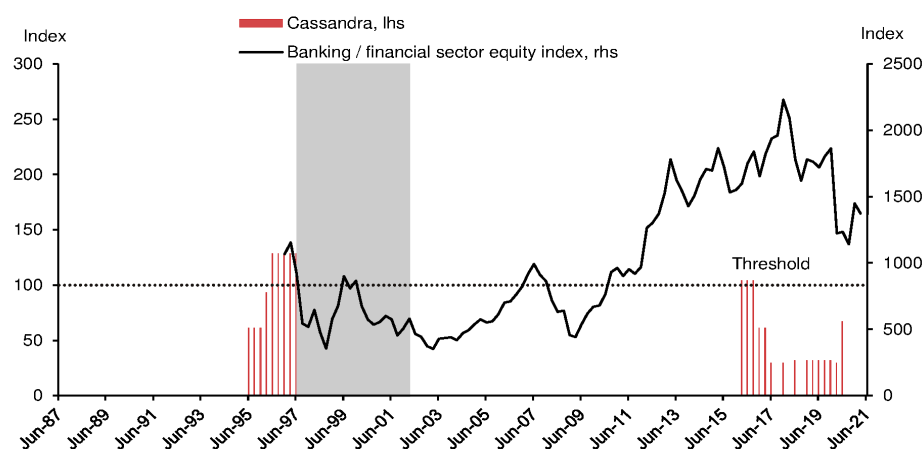
Fig. 90: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 6.2  | 6.1  | 6.9  | 6.7  | 6.3  | 6.1  | -9.6 | <b>5.5</b>  | <b>6.7</b>  |
| CPI, % y-o-y                         | 3.6  | 0.7  | 1.3  | 2.9  | 5.2  | 2.5  | 2.6  | <b>4.1</b>  | <b>3.0</b>  |
| Current account, % GDP               | 3.6  | 2.4  | -0.4 | -0.7 | -2.6 | -0.9 | 3.2  | <b>-0.4</b> | <b>-2.2</b> |
| Fiscal balance, % GDP                | 0.8  | 0.6  | -0.4 | -0.4 | -1.6 | -1.8 | -5.5 | <b>-7.4</b> | <b>-5.5</b> |
| Official interest rate, %            | 4.00 | 4.00 | 3.00 | 3.00 | 4.75 | 4.00 | 2.00 | 2.00        |             |
| Sovereign FCY credit rating: S&P     | BBB  | BBB  | BBB  | BBB  | BBB  | BBB+ | BBB+ | BBB+        |             |
| Sovereign FCY credit rating: Moody's | Baa2 | Baa2 | Baa2 | Baa2 | Baa2 | Baa2 | Baa2 | Baa2        |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 91: Cassandra index for Philippines



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 92: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators            | Threshold                                  | 2013 | 2014 | 2015 | 2016       | 2017       | 2018       | 2019       | 2020  | Latest |
|-------------------------------------|--|------|------|------|------------|------------|------------|------------|-------|--------|
| <b>Single EWIs</b>                  |  |      |      |      |            |            |            |            |       |        |
| Credit                              |  | -2.7 | -0.4 | 1.0  | 3.0        | 4.7        | 5.6        | 4.9        | 7.8   | 6.1    |
| REER                                |  | 4.8  | 7.2  | 8.1  | 2.6        | -3.5       | -2.5       | -0.1       | 3.8   | 4.0    |
| Debt service ratio (DSR)            |  | -0.4 | -0.1 | 0.0  | 0.2        | 0.5        | 1.0        | 0.8        | -0.1  | -0.1   |
| 1) <b>Property</b>                  | >12  | -5.4 | -2.0 | 4.2  | 6.6        | 6.0        | -2.3       | 3.3        | -1.7  | -2.4   |
| Equity                              |  | 9.8  | 26.3 | 16.9 | 9.0        | 28.2       | 2.3        | 2.4        | -11.8 | -22.8  |
| <b>Joint EWIs</b>                   |  |      |      |      |            |            |            |            |       |        |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No   | No   | No   | No         | <b>Yes</b> | No         | No         | No    | No     |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No   | No   | No   | No         | No         | No         | No         | No    | No     |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No   | No   | No   | No         | No         | <b>Yes</b> | <b>Yes</b> | No    | No     |
| <b>Triple EWIs</b>                  |  |      |      |      |            |            |            |            |       |        |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No   | No   | <b>Yes</b> | No         | No         | No         | No    | No     |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No   | No   | No         | No         | No         | No         | No    | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.





# Poland

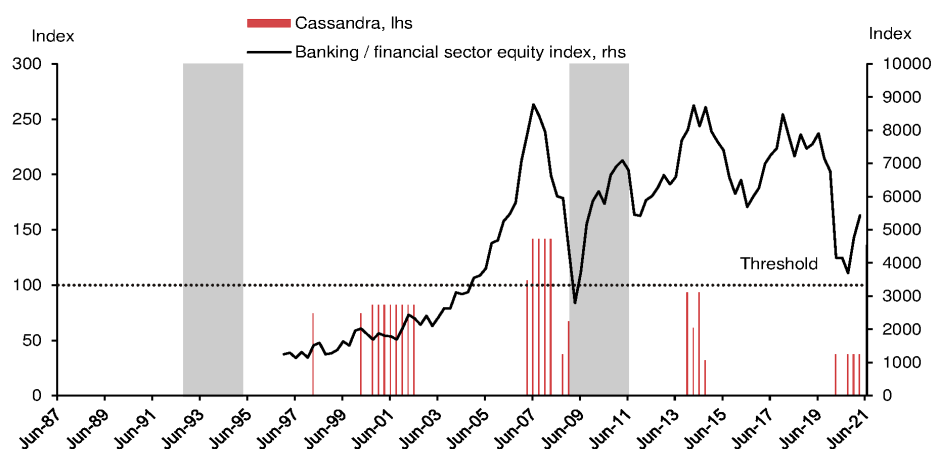
2020 Nominal GDP: USD 594bn  
2020 GDP per capita: USD 15,654

**Fig. 93: Vital statistics at a glance**

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 3.3  | 3.8  | 3.1  | 4.8  | 5.4  | 4.7  | -2.7 | <b>4.3</b>  | <b>4.9</b>  |
| CPI, % y-o-y                         | 0.0  | -0.9 | -0.6 | 2.0  | 1.7  | 2.3  | 3.4  | <b>3.8</b>  | <b>3.1</b>  |
| Current account, % GDP               | -2.6 | -0.9 | -0.8 | -0.4 | -1.3 | 0.5  | 3.5  | <b>2.0</b>  | <b>1.3</b>  |
| Fiscal balance, % GDP                | -3.7 | -2.6 | -2.4 | -1.5 | -0.2 | -0.7 | -8.2 | <b>-4.7</b> | <b>-2.6</b> |
| Official interest rate, %            | 2.00 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 0.10 | 0.10        |             |
| Sovereign FCY credit rating: S&P     | A-   | A-   | BBB+ | BBB+ | A-   | A-   | A-   | A-          |             |
| Sovereign FCY credit rating: Moody's | A2   | A2   | A2   | A2   | A2   | A2   | A2   | A2          |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of period and 2021 data are for the latest data available. Flag from <http://www.all-flags-world.com/country-flag/flag-poland.php>. Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 94: Cassandra index for Poland**



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report. Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

**Fig. 95: Cassandra early warning indicators – values which have breached thresholds are in bold**

| Early warning indicators     | Threshold                                  | 2013       | 2014  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020        | Latest      |
|------------------------------|--|------------|-------|------|------|------|------|------|-------------|-------------|
| <b>Single EWIs</b>           |  |            |       |      |      |      |      |      |             |             |
| Credit                       |  | 4.8        | 5.5   | 4.5  | 5.2  | -1.7 | -4.2 | -9.5 | -9.5        | -11.0       |
| REER                         |  | 1.1        | -1.9  | -6.3 | -8.4 | -2.4 | -3.5 | -3.0 | -2.7        | -2.8        |
| Debt service ratio (DSR)     |  | 0.6        | 0.5   | 0.3  | 0.4  | -0.1 | -0.1 | -0.4 | -0.6        | -0.6        |
| 1) Property                  | >12  | -10.8      | -11.5 | -7.1 | -4.3 | -4.1 | 4.1  | 10.8 | <b>15.8</b> | <b>17.5</b> |
| Equity                       |  | 3.2        | 1.7   | -9.4 | -1.5 | 16.3 | 1.7  | -2.5 | -8.2        | -8.8        |
| <b>Joint EWIs</b>            |  |            |       |      |      |      |      |      |             |             |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No         | No    | No   | No   | No   | No   | No   | No          | No          |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No         | No    | No   | No   | No   | No   | No   | No          | No          |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | <b>Yes</b> | No    | No   | No   | No   | No   | No   | No          | No          |
| <b>Triple EWIs</b>           |  |            |       |      |      |      |      |      |             |             |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | <b>Yes</b> | No    | No   | No   | No   | No   | No   | No          | No          |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No         | No    | No   | No   | No   | No   | No   | No          | No          |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Portugal

2020 Nominal GDP: USD 231bn  
2020 GDP per capita: USD 22,489

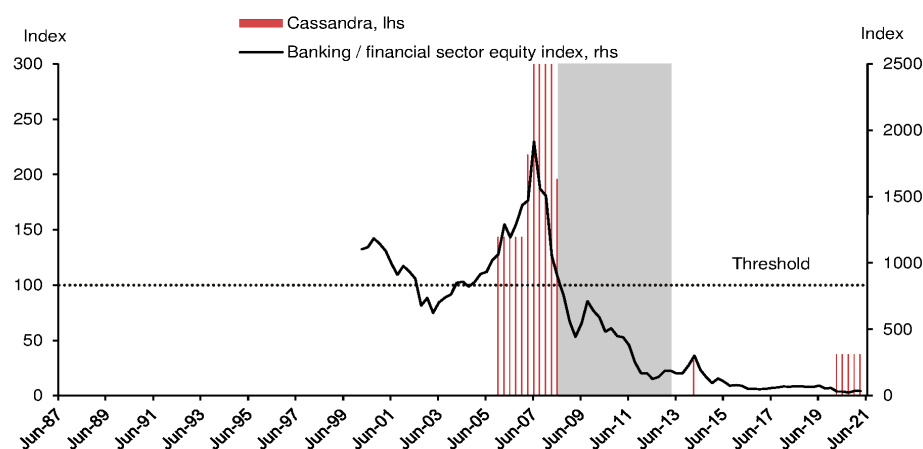
Fig. 96: Vital statistics at a glance

| Vital statistics                     | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 0.8   | 1.8   | 2.0   | 3.5   | 2.8   | 2.5   | -7.6  | <b>4.0</b>  | <b>5.0</b>  |
| CPI, % y-o-y                         | -0.2  | 0.5   | 0.6   | 1.6   | 1.2   | 0.3   | -0.1  | <b>0.9</b>  | <b>1.1</b>  |
| Current account, % GDP               | 0.2   | 0.2   | 1.2   | 1.3   | 0.6   | 0.4   | -1.2  | <b>-0.6</b> | <b>0.3</b>  |
| Fiscal balance, % GDP                | -7.3  | -4.4  | -1.9  | -3.0  | -0.3  | 0.1   | -6.1  | <b>-5.0</b> | <b>-1.9</b> |
| Official interest rate, %            | -0.20 | -0.30 | -0.40 | -0.40 | -0.40 | -0.50 | -0.50 | -0.50       | -0.50       |
| Sovereign FCY credit rating: S&P     | BB    | BB+   | BB+   | BBB-  | BBB-  | BBB   | BBB   | BBB         | BBB         |
| Sovereign FCY credit rating: Moody's | Ba1   | Ba1   | Ba1   | Ba1   | Baa3  | Baa3  | Baa3  | Baa3        | Baa3        |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 97: Cassandra index for Portugal



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 98: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020        | Latest      |
|------------------------------|--|-------|-------|-------|-------|-------|-------|-------|-------------|-------------|
| <b>Single EWIs</b>           |  |       |       |       |       |       |       |       |             |             |
| Credit                       |  | 25.5  | 12.6  | 0.3   | -12.6 | -20.5 | -30.3 | -36.8 | -26.0       | -23.4       |
| REER                         |  | 0.3   | -1.1  | -1.9  | -1.3  | -0.1  | -0.6  | -2.0  | -0.5        | -1.7        |
| Debt service ratio (DSR)     |  | 1.8   | 1.0   | 0.1   | -1.1  | -1.5  | -1.7  | -1.9  | -1.6        | -1.6        |
| 1) Property                  | >12  | -14.7 | -14.6 | -12.7 | -8.8  | -2.8  | 3.0   | 9.5   | <b>16.6</b> | <b>16.0</b> |
| Equity                       |  | -4.7  | -26.3 | -14.1 | -20.2 | -3.4  | -9.8  | 6.9   | 9.0         | 12.5        |
| <b>Joint EWIs</b>            |  |       |       |       |       |       |       |       |             |             |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No    | No    | No    | No    | No    | No    | No    | No          | No          |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No    | No    | No    | No    | No    | No    | No    | No          | No          |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No    | No    | No    | No    | No    | No    | No    | No          | No          |
| <b>Triple EWIs</b>           |  |       |       |       |       |       |       |       |             |             |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No    | No    | No    | No    | No    | No    | No          | No          |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No    | No    | No    | No    | No    | No    | No          | No          |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Romania

2020 Nominal GDP: USD 247bn  
2020 GDP per capita: USD 12,797

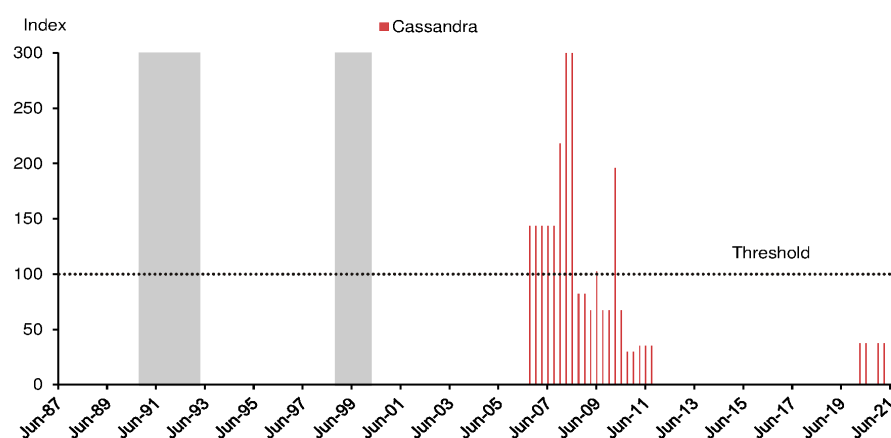
Fig. 99: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 3.7  | 3.0  | 4.7  | 7.2  | 4.5  | 4.2  | -3.7 | <b>5.4</b>  | <b>4.7</b>  |
| CPI, % y-o-y                         | 1.1  | -0.6 | -1.5 | 1.3  | 4.6  | 3.8  | 2.6  | <b>3.4</b>  | <b>3.0</b>  |
| Current account, % GDP               | -0.2 | -0.6 | -1.4 | -2.8 | -4.4 | -4.7 | -5.1 | <b>-5.0</b> | <b>-4.7</b> |
| Fiscal balance, % GDP                | -1.7 | -1.4 | -2.4 | -2.8 | -2.8 | -4.6 | -9.7 | <b>-7.1</b> | <b>-6.3</b> |
| Official interest rate, %            | 2.75 | 1.75 | 1.75 | 1.75 | 2.50 | 2.50 | 1.50 | 1.25        |             |
| Sovereign FCY credit rating: S&P     | BBB- | BBB- | BBB- | BBB- | BBB- | BBB- | BBB- | BBB-        |             |
| Sovereign FCY credit rating: Moody's | Baa3 | Baa3 | Baa3 | Baa3 | Baa3 | Baa3 | Baa3 | Baa3        |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 100: Cassandra index for Romania



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 101: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013  | 2014  | 2015  | 2016 | 2017 | 2018  | 2019 | 2020        | Latest      |
|------------------------------|--|-------|-------|-------|------|------|-------|------|-------------|-------------|
| <b>Single EWIs</b>           |  |       |       |       |      |      |       |      |             |             |
| Credit                       |  | 3.6   | 0.2   | -1.4  | -3.6 | -5.6 | -6.6  | -7.9 | -6.9        | -6.3        |
| REER                         |  | 0.8   | 0.3   | -3.8  | -6.0 | -5.8 | -4.5  | -6.0 | -3.8        | -3.5        |
| Debt service ratio (DSR)     |  | 0.2   | -0.3  | -0.6  | -0.8 | -0.7 | -0.4  | -0.4 | -0.2        | -0.2        |
| 1) Property                  | >12  | -16.9 | -16.0 | -10.2 | -1.3 | 3.2  | 6.9   | 10.0 | <b>12.0</b> | <b>12.6</b> |
| Equity                       |  | -8.3  | -3.2  | -5.0  | -5.4 | -1.6 | -11.3 | 13.2 | 6.9         | 19.0        |
| <b>Joint EWIs</b>            |  |       |       |       |      |      |       |      |             |             |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No    | No    | No    | No   | No   | No    | No   | No          | No          |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No    | No    | No    | No   | No   | No    | No   | No          | No          |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No    | No    | No    | No   | No   | No    | No   | No          | No          |
| <b>Triple EWIs</b>           |  |       |       |       |      |      |       |      |             |             |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No    | No    | No   | No   | No    | No   | No          | No          |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No    | No    | No   | No   | No    | No   | No          | No          |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Russia

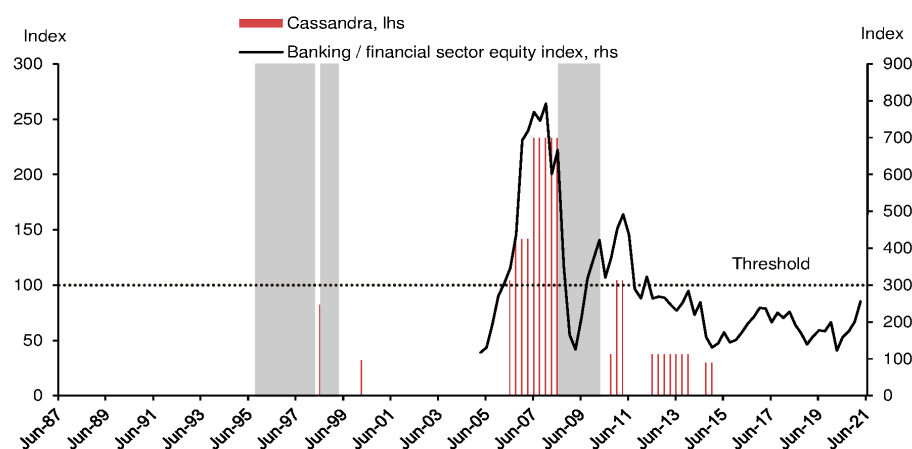
2020 Nominal GDP: USD 1,474bn  
2020 GDP per capita: USD 10,037

Fig. 102: Vital statistics at a glance

| Vital statistics                     | 2014  | 2015  | 2016  | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|------|------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 0.7   | -2.0  | 0.2   | 1.8  | 2.8  | 2.0  | -3.0 | <b>3.3</b>  | <b>2.5</b>  |
| CPI, % y-o-y                         | 7.8   | 15.6  | 7.1   | 3.7  | 2.9  | 4.5  | 3.4  | <b>5.3</b>  | <b>4.0</b>  |
| Current account, % GDP               | 2.8   | 5.0   | 1.9   | 2.0  | 7.0  | 3.8  | 2.2  | <b>3.9</b>  | <b>3.3</b>  |
| Fiscal balance, % GDP                | -1.1  | -3.4  | -3.7  | -1.5 | 2.9  | 1.9  | -4.1 | <b>-0.8</b> | <b>-0.3</b> |
| Official interest rate, %            | 17.00 | 11.00 | 10.00 | 7.75 | 7.75 | 6.25 | 4.25 | 5.50        |             |
| Sovereign FCY credit rating: S&P     | BBB-  | BB+   | BB+   | BB+  | BBB- | BBB- | BBB- | BBB-        |             |
| Sovereign FCY credit rating: Moody's | Baa2  | Ba1   | Ba1   | Ba1  | Ba1  | Baa3 | Baa3 | Baa3        |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of period and 2021 data are for the latest data available. Flag from: <http://www.all-flags-world.com/country-flag/flag-russia.php>. Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 103: Cassandra index for Russia



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 104: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013        | 2014       | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | Latest |
|------------------------------|--|-------------|------------|-------|-------|-------|-------|-------|-------|--------|
| <b>Single EWIs</b>           |  |             |            |       |       |       |       |       |       |        |
| Credit                       |  | 1.6         | 14.0       | 15.6  | 7.0   | 2.5   | -3.4  | -8.8  | 7.1   | 0.9    |
| REER                         |  | 17.6        | -7.0       | -17.2 | -7.0  | -4.2  | -11.0 | -3.9  | -19.9 | -18.1  |
| Debt service ratio (DSR)     |  | -0.7        | 4.4        | 5.0   | 2.4   | 0.4   | -0.6  | -1.9  | -1.4  | -1.5   |
| 1) Property                  | >12  | <b>13.0</b> | 8.8        | -7.5  | -14.5 | -17.3 | -16.4 | -15.3 | -10.4 | -10.0  |
| Equity                       |  | -12.5       | -26.9      | -20.5 | -5.9  | -14.5 | -8.7  | 11.9  | 14.2  | 20.0   |
| <b>Joint EWIs</b>            |  |             |            |       |       |       |       |       |       |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No          | <b>Yes</b> | No    | No    | No    | No    | No    | No    | No     |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No          | No         | No    | No    | No    | No    | No    | No    | No     |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No          | No         | No    | No    | No    | No    | No    | No    | No     |
| <b>Triple EWIs</b>           |  |             |            |       |       |       |       |       |       |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No          | No         | No    | No    | No    | No    | No    | No    | No     |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No          | No         | No    | No    | No    | No    | No    | No    | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Singapore

2020 Nominal GDP: USD 340bn  
2020 GDP per capita: USD 58,902

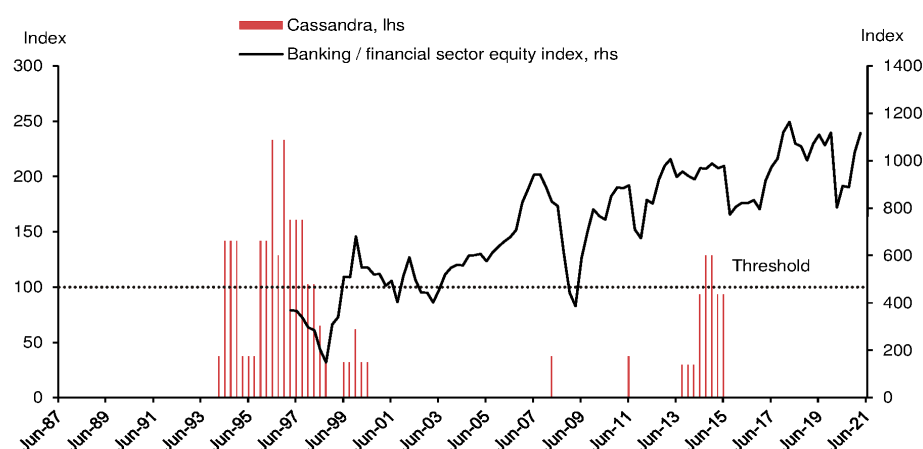
Fig. 105: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 3.9  | 2.9  | 3.0  | 3.7  | 3.5  | 1.4  | -5.4 | <b>6.4</b>  | <b>4.0</b>  |
| CPI, % y-o-y                         | 1.0  | -0.5 | -0.5 | 0.6  | 0.4  | 0.6  | -0.2 | <b>1.4</b>  | <b>1.2</b>  |
| Current account, % GDP               | 18.0 | 18.7 | 17.6 | 17.3 | 15.4 | 14.3 | 17.6 | <b>14.6</b> | <b>14.4</b> |
| Fiscal balance, % GDP                | 4.6  | 2.9  | 3.7  | 5.3  | 3.7  | 3.8  | -8.9 | <b>-0.2</b> | <b>3.1</b>  |
| Official interest rate, %            | 0.73 | 1.84 | 1.34 | 1.25 | 1.91 | 1.49 | 0.19 | 0.26        |             |
| Sovereign FCY credit rating: S&P     | AAA  | AAA  | AAA  | AAA  | AAA  | AAA  | AAA  | AAA         |             |
| Sovereign FCY credit rating: Moody's | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa         |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. Data and forecasts for fiscal balance are presented on a fiscal year basis. For the official interest rate and sovereign credit ratings, historical data refer to end-of period and 2021 data are for the latest data available. Policy rate for Singapore refers to 6M SOR. Flag from <http://www.all-flags-world.com/country-flag/Singapore/national-singaporean-flag.php>.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 106: Cassandra index for Singapore



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 107: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013       | 2014       | 2015 | 2016 | 2017 | 2018 | 2019 | 2020  | Latest |
|------------------------------|--|------------|------------|------|------|------|------|------|-------|--------|
| <b>Single EWIs</b>           |  |            |            |      |      |      |      |      |       |        |
| Credit                       |  | 6.6        | 11.9       | 10.9 | 6.6  | 2.2  | -4.2 | 3.2  | 20.6  | 34.3   |
| REER                         |  | 8.7        | 6.7        | 3.3  | 1.8  | 0.8  | 0.2  | -0.8 | -4.0  | -4.4   |
| Debt service ratio (DSR)     |  | 0.8        | 1.0        | 0.5  | 0.6  | 0.0  | -0.3 | -0.2 | 0.6   | 0.8    |
| 1) Property Equity           | >12  | 5.8        | 0.6        | -3.3 | -7.2 | -7.5 | -1.6 | -0.4 | 1.0   | 3.3    |
|                              |  | 1.0        | 6.8        | -8.3 | -8.8 | 7.0  | -4.4 | -0.5 | -12.4 | -3.3   |
| <b>Joint EWIs</b>            |  |            |            |      |      |      |      |      |       |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | <b>Yes</b> | No         | No   | No   | No   | No   | No   | No    | No     |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No         | <b>Yes</b> | No   | No   | No   | No   | No   | No    | No     |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No         | <b>Yes</b> | No   | No   | No   | No   | No   | No    | No     |
| <b>Triple EWIs</b>           |  |            |            |      |      |      |      |      |       |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No         | <b>Yes</b> | No   | No   | No   | No   | No   | No    | No     |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No         | No         | No   | No   | No   | No   | No   | No    | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# South Africa

2020 Nominal GDP: USD 302bn  
2020 GDP per capita: USD 5,067

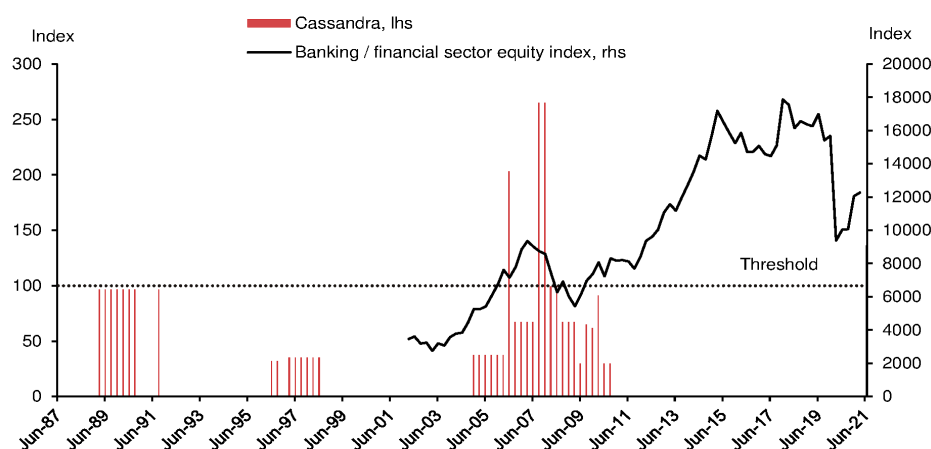
Fig. 108: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020  | 2021F        | 2022F       |
|--------------------------------------|------|------|------|------|------|------|-------|--------------|-------------|
| Real GDP, % y-o-y                    | 1.9  | 1.2  | 0.4  | 1.4  | 0.8  | 0.1  | -7.0  | <b>4.3</b>   | <b>2.2</b>  |
| CPI, % y-o-y                         | 6.1  | 4.6  | 6.3  | 5.3  | 4.6  | 4.1  | 3.3   | <b>4.2</b>   | <b>4.3</b>  |
| Current account, % GDP               | -5.1 | -4.6 | -2.9 | -2.5 | -3.5 | -3.0 | 2.2   | <b>-0.4</b>  | <b>-1.5</b> |
| Fiscal balance, % GDP                | -4.3 | -4.8 | -4.1 | -4.4 | -4.1 | -5.3 | -12.2 | <b>-10.6</b> | <b>-8.3</b> |
| Official interest rate, %            | 5.75 | 6.25 | 7.00 | 6.75 | 6.75 | 6.50 | 3.50  | 3.50         |             |
| Sovereign FCY credit rating: S&P     | BBB- | BBB- | BBB- | BB   | BB   | BB   | BB-   | BB-          |             |
| Sovereign FCY credit rating: Moody's | Baa2 | Baa2 | Baa2 | Baa3 | Baa3 | Baa3 | Ba2   | Ba2          |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 109: Cassandra index for South Africa



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 110: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013 | 2014 | 2015  | 2016 | 2017 | 2018  | 2019 | 2020 | Latest |
|------------------------------|--|------|------|-------|------|------|-------|------|------|--------|
| <b>Single EWIs</b>           |  |      |      |       |      |      |       |      |      |        |
| Credit                       |  | -1.1 | -2.1 | 0.8   | -1.7 | -2.7 | -2.3  | -2.0 | -1.6 | 0.0    |
| REER                         |  | -5.1 | -4.1 | -13.2 | -3.3 | -1.4 | 1.9   | 3.3  | -2.1 | 1.6    |
| Debt service ratio (DSR)     |  | -1.1 | -0.9 | -0.2  | 0.1  | 0.3  | 0.6   | 0.7  | 0.0  | 0.0    |
| 1) Property                  | >12  | 1.4  | 0.8  | 0.5   | -2.5 | -4.6 | -6.6  | -8.1 | -9.1 | -9.3   |
| Equity                       |  | 19.1 | 15.5 | 11.2  | -3.2 | 7.8  | -11.0 | -9.1 | -8.1 | 1.1    |
| <b>Joint EWIs</b>            |  |      |      |       |      |      |       |      |      |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No   | No   | No    | No   | No   | No    | No   | No   | No     |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No   | No   | No    | No   | No   | No    | No   | No   | No     |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No   | No   | No    | No   | No   | No    | No   | No   | No     |
| <b>Triple EWIs</b>           |  |      |      |       |      |      |       |      |      |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No   | No    | No   | No   | No    | No   | No   | No     |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No   | No    | No   | No   | No    | No   | No   | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.





# South Korea

2020 Nominal GDP: USD 1,631bn  
2020 GDP per capita: USD 31,497

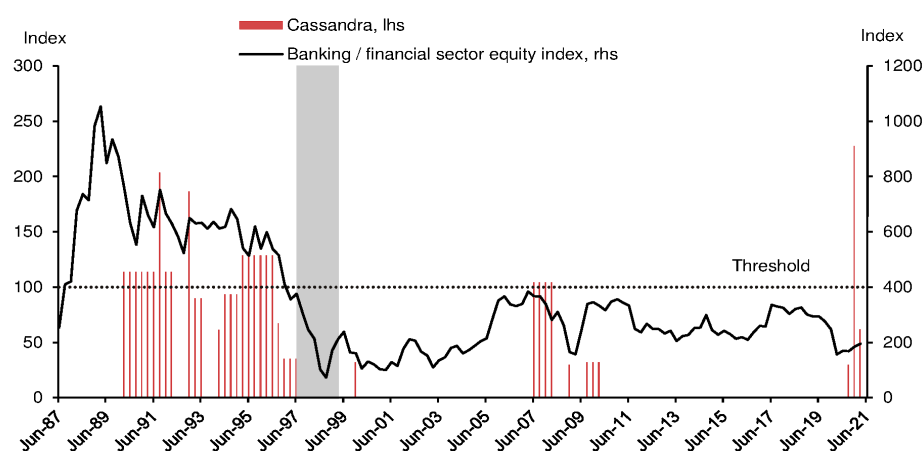
Fig. 111: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 3.2  | 2.8  | 3.0  | 3.2  | 2.9  | 2.2  | -0.9 | <b>3.9</b>  | <b>3.0</b>  |
| CPI, % y-o-y                         | 1.3  | 0.7  | 1.0  | 2.0  | 1.5  | 0.4  | 0.7  | <b>1.7</b>  | <b>1.5</b>  |
| Current account, % GDP               | 5.6  | 7.2  | 6.5  | 4.6  | 4.5  | 3.6  | 4.6  | <b>4.2</b>  | <b>4.0</b>  |
| Fiscal balance, % GDP                | 0.4  | 0.5  | 1.6  | 2.2  | 2.6  | 0.4  | -2.8 | <b>-2.9</b> | <b>-2.4</b> |
| Official interest rate, %            | 2.00 | 1.50 | 1.25 | 1.50 | 1.75 | 1.25 | 0.50 | 0.50        |             |
| Sovereign FCY credit rating: S&P     | A+   | AA-  | AA   | AA   | AA   | AA   | AA   | AA          |             |
| Sovereign FCY credit rating: Moody's | Aa3  | Aa2  | Aa2  | Aa2  | Aa2  | Aa2  | Aa2  | Aa2         |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of period and 2021 data are for the latest data available. Flag from <http://www.all-flags-world.com/country-flag/flag-south-korea.php>.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 112: Cassandra index for South Korea



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 113: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013 | 2014 | 2015 | 2016 | 2017 | 2018  | 2019 | 2020 | Latest |
|------------------------------|--|------|------|------|------|------|-------|------|------|--------|
| <b>Single EWIs</b>           |  |      |      |      |      |      |       |      |      |        |
| Credit                       |  | -0.7 | -0.1 | -1.7 | -3.9 | -6.6 | -4.1  | 2.6  | 17.4 | 19.9   |
| REER                         |  | -0.9 | 1.0  | 1.6  | 3.1  | 4.5  | 5.7   | -0.2 | 1.5  | 0.8    |
| Debt service ratio (DSR)     |  | -0.3 | -0.3 | -0.7 | -0.8 | -0.6 | 0.1   | 0.8  | 1.8  | 1.8    |
| 1) Property                  | >12  | -0.2 | 0.2  | 2.9  | 2.0  | 1.1  | 1.6   | 0.8  | 7.9  | 10.6   |
| Equity                       |  | 5.4  | -3.0 | -4.0 | -4.5 | 12.0 | -11.0 | -6.5 | 19.1 | 24.7   |
| <b>Joint EWIs</b>            |  |      |      |      |      |      |       |      |      |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No   | No   | No   | No   | No   | No    | No   | Yes  | Yes    |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No   | No   | No   | No   | No   | No    | No   | No   | No     |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No   | No   | No   | No   | No   | No    | No   | Yes  | Yes    |
| <b>Triple EWIs</b>           |  |      |      |      |      |      |       |      |      |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No   | No   | No   | No   | No    | No   | Yes  | No     |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No   | No   | No   | No   | No    | No   | Yes  | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Spain

2020 Nominal GDP: USD 1,278bn  
2020 GDP per capita: USD 27,132

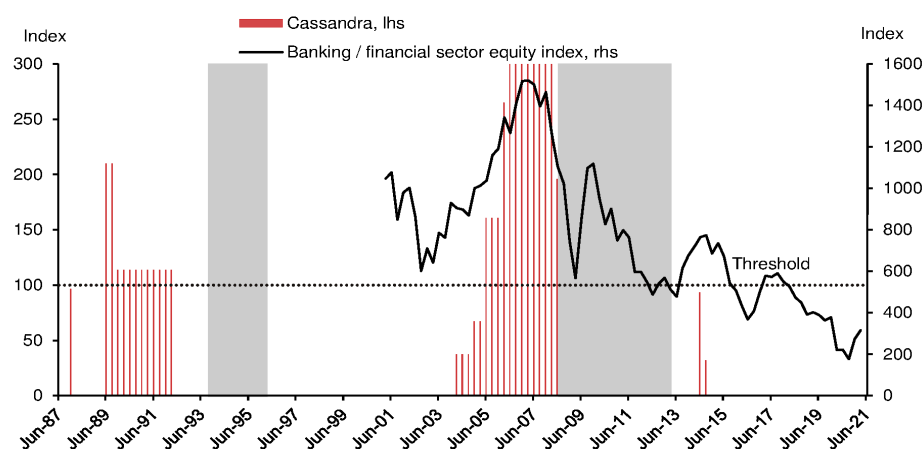
Fig. 114: Vital statistics at a glance

| Vital statistics                     | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 1.4   | 3.8   | 3.0   | 3.0   | 2.4   | 2.0   | -10.8 | <b>5.9</b>  | <b>5.6</b>  |
| CPI, % y-o-y                         | -0.2  | -0.6  | -0.4  | 2.0   | 1.7   | 0.8   | -0.3  | <b>1.6</b>  | <b>1.2</b>  |
| Current account, % GDP               | 1.7   | 2.0   | 3.2   | 2.8   | 1.9   | 2.1   | 0.7   | <b>1.0</b>  | <b>1.9</b>  |
| Fiscal balance, % GDP                | -5.9  | -5.2  | -4.3  | -3.0  | -2.5  | -2.9  | -11.5 | <b>-9.0</b> | <b>-5.8</b> |
| Official interest rate, %            | -0.20 | -0.30 | -0.40 | -0.40 | -0.40 | -0.50 | -0.50 | -0.50       | -0.50       |
| Sovereign FCY credit rating: S&P     | BBB   | BBB+  | BBB+  | BBB+  | A-    | A     | A     | A           | A           |
| Sovereign FCY credit rating: Moody's | Baa2  | Baa2  | Baa2  | Baa2  | Baa1  | Baa1  | Baa1  | Baa1        | Baa1        |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 115: Cassandra index for Spain



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 116: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators            | Threshold                                  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | Latest |
|-------------------------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| <b>Single EWIs</b>                  |  |       |       |       |       |       |       |       |       |        |
| Credit                              |  | 16.0  | 3.4   | -9.8  | -19.0 | -28.0 | -34.5 | -38.8 | -18.6 | -18.0  |
| REER                                |  | 2.6   | -0.4  | -3.4  | -2.4  | -0.4  | 0.0   | -2.0  | -0.5  | -1.5   |
| Debt service ratio (DSR)            |  | 0.9   | 0.0   | -1.1  | -2.0  | -2.5  | -2.6  | -2.9  | -1.0  | -0.9   |
| 1) <b>Property</b>                  | >12  | -22.7 | -20.7 | -16.8 | -13.6 | -8.3  | -3.5  | 0.1   | 2.9   | 3.0    |
| Equity                              |  | -5.5  | 0.3   | -4.8  | -5.6  | 2.1   | -12.6 | -0.4  | -13.1 | -7.2   |
| <b>Joint EWIs</b>                   |  |       |       |       |       |       |       |       |       |        |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No    | No    | No    | No    | No    | No    | No    | No    | No     |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No    | No    | No    | No    | No    | No    | No    | No    | No     |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No    | No    | No    | No    | No    | No    | No    | No    | No     |
| <b>Triple EWIs</b>                  |  |       |       |       |       |       |       |       |       |        |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No    | No    | No    | No    | No    | No    | No    | No     |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No    | No    | No    | No    | No    | No    | No    | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Sweden

2020 Nominal GDP: USD 538bn  
2020 GDP per capita: USD 51,796

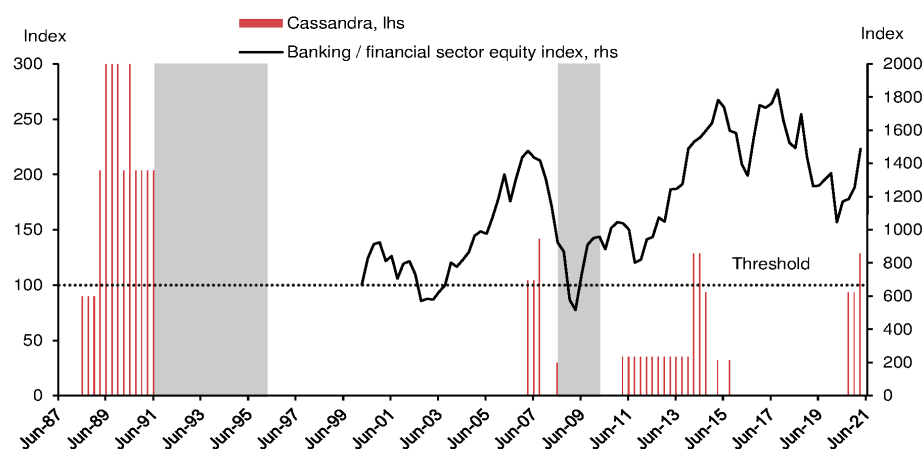
Fig. 117: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015  | 2016  | 2017  | 2018  | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|------|-------|-------|-------|-------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 2.8  | 4.3   | 1.9   | 2.8   | 2.1   | 2.0  | -2.9 | <b>3.6</b>  | <b>3.1</b>  |
| CPI, % y-o-y                         | -0.2 | -0.1  | 1.0   | 1.8   | 2.0   | 1.8  | 0.5  | <b>1.6</b>  | <b>1.4</b>  |
| Current account, % GDP               | 4.2  | 3.3   | 2.4   | 3.0   | 2.6   | 5.1  | 5.2  | <b>5.0</b>  | <b>4.7</b>  |
| Fiscal balance, % GDP                | -1.5 | 0.0   | 1.0   | 1.4   | 0.8   | 0.5  | -4.0 | <b>-3.9</b> | <b>-1.8</b> |
| Official interest rate, %            | 0.00 | -0.35 | -0.50 | -0.50 | -0.25 | 0.00 | 0.00 | 0.00        | 0.00        |
| Sovereign FCY credit rating: S&P     | AAA  | AAA   | AAA   | AAA   | AAA   | AAA  | AAA  | AAA         | AAA         |
| Sovereign FCY credit rating: Moody's | Aaa  | Aaa   | Aaa   | Aaa   | Aaa   | Aaa  | Aaa  | Aaa         | Aaa         |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 118: Cassandra index for Sweden



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 119: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013       | 2014 | 2015 | 2016 | 2017 | 2018  | 2019 | 2020       | Latest     |
|------------------------------|--|------------|------|------|------|------|-------|------|------------|------------|
| <b>Single EWIs</b>           |  |            |      |      |      |      |       |      |            |            |
| Credit                       |  | 6.1        | 1.9  | 0.1  | -6.0 | -6.9 | -6.2  | -3.0 | 6.6        | 8.1        |
| REER                         |  | 7.1        | 1.1  | -0.5 | -2.8 | 0.5  | -2.7  | -5.1 | 2.7        | 3.5        |
| Debt service ratio (DSR)     |  | 1.3        | 0.5  | 0.1  | -0.3 | -0.6 | -0.1  | 0.4  | 2.8        | 2.7        |
| 1) Property                  | >12  | -6.0       | -0.5 | 8.9  | 9.8  | 6.6  | 1.3   | -0.8 | 0.5        | -0.3       |
| Equity                       |  | 2.0        | 8.6  | 3.8  | 4.0  | 3.0  | -12.6 | 5.0  | 7.6        | 24.6       |
| <b>Joint EWIs</b>            |  |            |      |      |      |      |       |      |            |            |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No         | No   | No   | No   | No   | No    | No   | No         | No         |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | <b>Yes</b> | No   | No   | No   | No   | No    | No   | No         | <b>Yes</b> |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No         | No   | No   | No   | No   | No    | No   | <b>Yes</b> | <b>Yes</b> |
| <b>Triple EWIs</b>           |  |            |      |      |      |      |       |      |            |            |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No         | No   | No   | No   | No   | No    | No   | <b>Yes</b> | <b>Yes</b> |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No         | No   | No   | No   | No   | No    | No   | No         | No         |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Switzerland

2020 Nominal GDP: USD 747bn  
2020 GDP per capita: USD 86,489

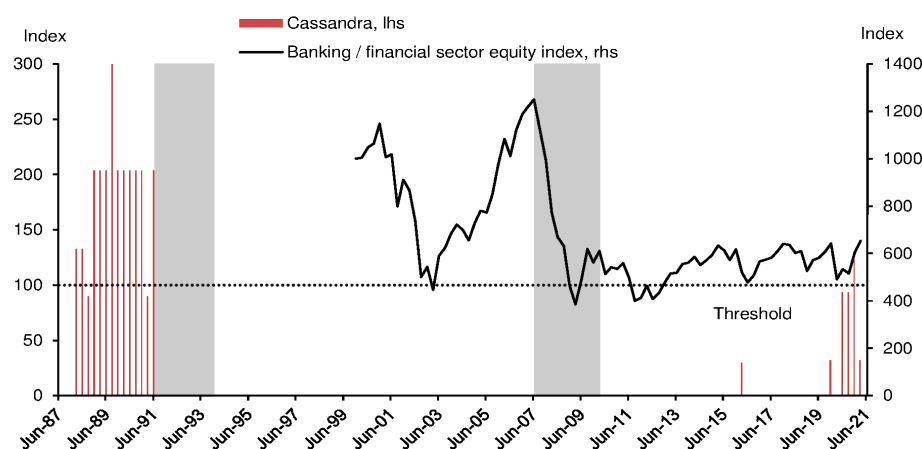
Fig. 120: Vital statistics at a glance

| Vital statistics                     | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 2.4   | 1.6   | 2.0   | 1.7   | 3.0   | 1.2   | -2.7  | <b>3.4</b>  | <b>2.8</b>  |
| CPI, % y-o-y                         | 0.0   | -1.1  | -0.4  | 0.5   | 1.0   | 0.4   | -0.7  | <b>0.3</b>  | <b>0.5</b>  |
| Current account, % GDP               | 8.1   | 10.3  | 9.0   | 7.2   | 6.7   | 6.7   | 3.8   | <b>6.7</b>  | <b>7.5</b>  |
| Fiscal balance, % GDP                | -0.2  | 0.5   | 0.2   | 1.1   | 1.3   | 1.4   | -2.6  | <b>-3.4</b> | <b>-0.7</b> |
| Official interest rate, %            | -0.25 | -0.75 | -0.75 | -0.75 | -0.75 | -0.75 | -0.75 | -0.75       | -0.75       |
| Sovereign FCY credit rating: S&P     | AAA   | AAA   | AAA   | AAA   | AAA   | AAA   | AAA   | AAA         | AAA         |
| Sovereign FCY credit rating: Moody's | Aaa   | Aaa   | Aaa   | Aaa   | Aaa   | Aaa   | Aaa   | Aaa         | Aaa         |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 121: Cassandra index for Switzerland



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 122: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators            | Threshold                                  | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019       | 2020       | Latest     |
|-------------------------------------|--|------|------|------|------|------|------|------------|------------|------------|
| <b>Single EWIs</b>                  |  |      |      |      |      |      |      |            |            |            |
| Credit                              |  | -1.1 | -1.0 | -0.8 | 2.4  | 7.7  | -3.9 | 9.0        | 19.1       | 25.1       |
| REER                                |  | 1.8  | -0.2 | 4.3  | 3.4  | -2.6 | -1.8 | -2.0       | 1.2        | -1.0       |
| Debt service ratio (DSR)            |  | 0.0  | 0.0  | -0.3 | -0.1 | 0.4  | -0.5 | 0.7        | 1.6        | 1.6        |
| 1) <b>Property</b>                  | >12  | 5.9  | 6.1  | 5.9  | 1.9  | 2.1  | 1.2  | 0.9        | 4.4        | 3.7        |
| Equity                              |  | -0.2 | 6.9  | 3.9  | -5.2 | 5.0  | -8.6 | 12.7       | 11.9       | 14.7       |
| <b>Joint EWIs</b>                   |  |      |      |      |      |      |      |            |            |            |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No   | No   | No   | No   | No   | No   | No         | <b>Yes</b> | No         |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No   | No   | No   | No   | No   | No   | No         | No         | No         |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No   | No   | No   | No   | No   | No   | <b>Yes</b> | <b>Yes</b> | <b>Yes</b> |
| <b>Triple EWIs</b>                  |  |      |      |      |      |      |      |            |            |            |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | No   | No   | No   | No   | No   | No         | <b>Yes</b> | No         |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No   | No   | No   | No   | No   | No         | No         | No         |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Taiwan

2020 Nominal GDP: USD 669bn  
2020 GDP per capita: USD 28,306

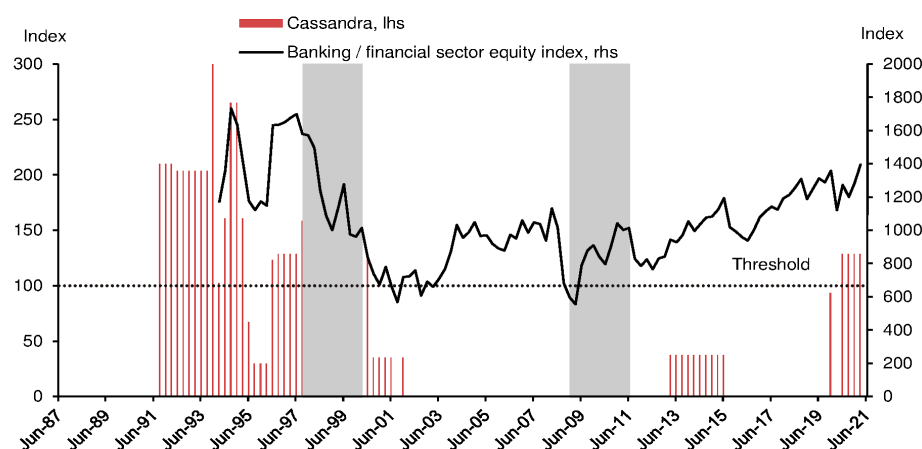
Fig. 123: Vital statistics at a glance

| Vital statistics                     | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 4.7   | 1.5   | 2.2   | 3.3   | 2.8   | 3.0   | 3.1   | <b>5.5</b>  | <b>3.0</b>  |
| CPI, % y-o-y                         | 1.2   | -0.3  | 1.4   | 0.6   | 1.3   | 0.6   | -0.2  | <b>1.5</b>  | <b>1.4</b>  |
| Current account, % GDP               | 11.3  | 13.6  | 13.1  | 14.1  | 11.6  | 10.6  | 14.1  | <b>14.5</b> | <b>14.4</b> |
| Fiscal balance, % GDP                | -2.7  | -1.8  | -2.2  | -2.0  | -1.9  | -1.8  | -4.3  | <b>-2.8</b> | <b>-1.6</b> |
| Official interest rate, %            | 1.875 | 1.625 | 1.375 | 1.375 | 1.375 | 1.375 | 1.125 | 1.125       |             |
| Sovereign FCY credit rating: S&P     | AA-   | AA-   | AA-   | AA-   | AA-   | AA-   | AA-   | AA          |             |
| Sovereign FCY credit rating: Moody's | Aa3   | Aa3   | Aa3   | Aa3   | Aa3   | Aa3   | Aa3   | Aa3         |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 124: Cassandra index for Taiwan



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 125: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013        | 2014        | 2015  | 2016 | 2017 | 2018 | 2019 | 2020 | Latest |
|------------------------------|--|-------------|-------------|-------|------|------|------|------|------|--------|
| <b>Single EWIs</b>           |  |             |             |       |      |      |      |      |      |        |
| Credit                       |  | 0.8         | -1.6        | -5.0  | -5.6 | -1.8 | 0.6  | 3.2  | 8.2  | 7.8    |
| REER                         |  | -2.4        | -2.1        | -1.1  | 4.0  | 6.1  | 5.8  | 6.5  | 10.1 | 10.1   |
| Debt service ratio (DSR)     |  | -0.1        | -0.2        | -0.3  | -0.4 | 0.1  | 0.5  | 0.8  | 1.2  | 1.2    |
| 1) Property                  | >12  | <b>21.1</b> | <b>18.0</b> | 8.8   | 1.8  | -0.3 | -2.2 | -2.9 | 0.3  | 3.3    |
| Equity                       |  | -4.6        | 0.1         | -12.5 | -6.6 | 4.6  | -6.9 | 11.5 | 34.0 | 47.9   |
| <b>Joint EWIs</b>            |  |             |             |       |      |      |      |      |      |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No          | No          | No    | No   | No   | No   | No   | No   | No     |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No          | No          | No    | No   | No   | No   | No   | Yes  | Yes    |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No          | No          | No    | No   | No   | No   | Yes  | Yes  | Yes    |
| <b>Triple EWIs</b>           |  |             |             |       |      |      |      |      |      |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No          | No          | No    | No   | No   | No   | Yes  | Yes  | Yes    |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No          | No          | No    | No   | No   | No   | No   | No   | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# Thailand

2020 Nominal GDP: USD 502bn  
2020 GDP per capita: USD 7,190

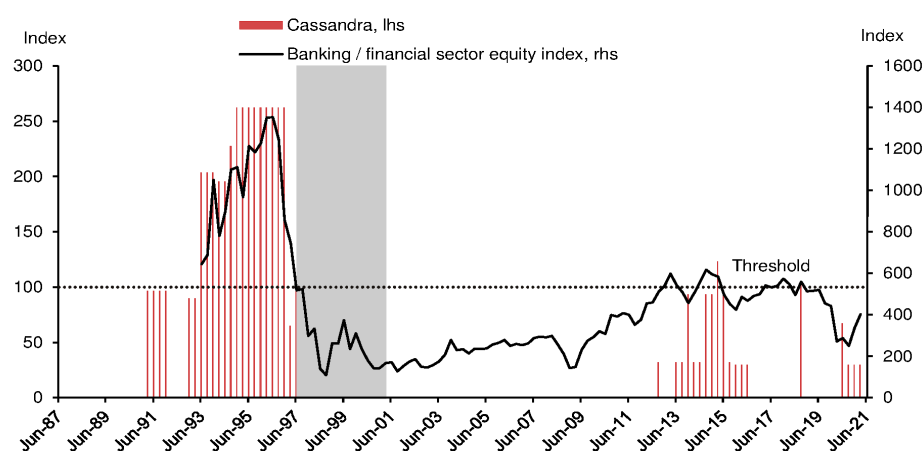
Fig. 126: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|------|------|------|-------------|-------------|
| Real GDP, % y-o-y                    | 1.0  | 3.1  | 3.4  | 4.2  | 4.2  | 2.3  | -6.1 | <b>2.4</b>  | <b>4.7</b>  |
| CPI, % y-o-y                         | 1.9  | -0.9 | 0.2  | 0.7  | 1.1  | 0.7  | -0.8 | <b>1.1</b>  | <b>1.2</b>  |
| Current account, % GDP               | 2.9  | 6.9  | 10.5 | 9.6  | 5.6  | 7.0  | 3.3  | <b>0.5</b>  | <b>2.6</b>  |
| Fiscal balance, % GDP                | -0.8 | 0.1  | 0.6  | -0.4 | 0.1  | -0.8 | -4.7 | <b>-4.9</b> | <b>-1.5</b> |
| Official interest rate, %            | 2.00 | 1.50 | 1.50 | 1.50 | 1.75 | 1.25 | 0.50 | 0.50        |             |
| Sovereign FCY credit rating: S&P     | BBB+ | BBB+ | BBB+ | BBB+ | BBB+ | BBB+ | BBB+ | BBB+        |             |
| Sovereign FCY credit rating: Moody's | Baa1 | Baa1 | Baa1 | Baa1 | Baa1 | Baa1 | Baa1 | Baa1        |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. Data and forecasts for fiscal balance are presented on a fiscal year basis. For the official interest rate and sovereign credit ratings, historical data refer to end-of period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 127: Cassandra index for Thailand



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 128: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013       | 2014       | 2015       | 2016 | 2017 | 2018 | 2019 | 2020       | Latest     |
|------------------------------|--|------------|------------|------------|------|------|------|------|------------|------------|
| <b>Single EWIs</b>           |  |            |            |            |      |      |      |      |            |            |
| Credit                       |  | 4.2        | 6.7        | 8.4        | 5.3  | 2.2  | 1.7  | 0.5  | 15.2       | 16.2       |
| REER                         |  | 1.5        | 2.2        | -2.2       | -2.4 | 0.5  | 2.0  | 8.0  | 1.5        | 0.0        |
| Debt service ratio (DSR)     |  | 0.9        | 0.9        | 0.6        | 0.2  | -0.2 | -0.3 | -0.4 | 0.4        | 0.4        |
| 1) Property                  | >12  | -1.2       | 3.1        | 4.2        | 0.4  | 2.8  | 4.4  | 7.7  | 8.7        | 10.0       |
| Equity                       |  | 5.8        | 17.1       | -1.4       | 13.9 | 24.7 | 7.3  | 5.1  | -5.7       | 2.9        |
| <b>Joint EWIs</b>            |  |            |            |            |      |      |      |      |            |            |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No         | No         | <b>Yes</b> | No   | No   | No   | No   | <b>Yes</b> | <b>Yes</b> |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No         | No         | No         | No   | No   | No   | No   | No         | No         |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | <b>Yes</b> | <b>Yes</b> | No         | No   | No   | No   | No   | No         | No         |
| <b>Triple EWIs</b>           |  |            |            |            |      |      |      |      |            |            |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | <b>Yes</b> | <b>Yes</b> | No         | No   | No   | No   | No   | No         | No         |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No         | No         | No         | No   | No   | No   | No   | No         | No         |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.





# Turkey

2020 Nominal GDP: USD 720bn  
2020 GDP per capita: USD 8,548

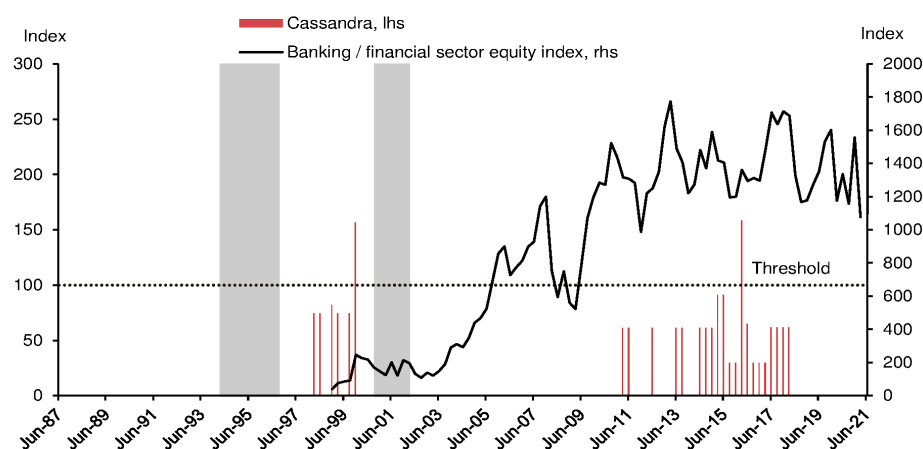
Fig. 129: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018  | 2019  | 2020  | 2021F       | 2022F       |
|--------------------------------------|------|------|------|------|-------|-------|-------|-------------|-------------|
| Real GDP, % y-o-y                    | 4.9  | 6.0  | 3.3  | 7.5  | 3.1   | 1.0   | 1.6   | <b>5.3</b>  | <b>3.7</b>  |
| CPI, % y-o-y                         | 8.9  | 7.7  | 7.8  | 11.1 | 16.2  | 15.5  | 12.3  | <b>15.8</b> | <b>11.5</b> |
| Current account, % GDP               | -4.1 | -3.2 | -3.1 | -4.8 | -2.8  | 0.9   | -5.1  | <b>-3.4</b> | <b>-2.2</b> |
| Fiscal balance, % GDP                | -1.4 | -1.3 | -2.3 | -2.2 | -3.7  | -5.6  | -5.4  | <b>-5.7</b> | <b>-6.1</b> |
| Official interest rate, %            | 8.25 | 7.50 | 8.00 | 8.00 | 24.00 | 12.00 | 17.00 | 19.00       |             |
| Sovereign FCY credit rating: S&P     | BB+  | BB+  | BB   | BB   | B+    | B+    | B+    | B+          |             |
| Sovereign FCY credit rating: Moody's | Baa3 | Baa3 | Ba1  | Ba1  | Ba3   | B1    | B2    | B2          |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 130: Cassandra index for Turkey



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 131: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators     | Threshold                                  | 2013 | 2014       | 2015       | 2016       | 2017       | 2018  | 2019  | 2020  | Latest |
|------------------------------|--|------|------------|------------|------------|------------|-------|-------|-------|--------|
| <b>Single EWIs</b>           |  |      |            |            |            |            |       |       |       |        |
| Credit                       |  | 6.4  | 5.8        | 7.1        | 8.5        | 4.3        | -0.7  | -7.4  | -1.1  | -2.3   |
| REER                         |  | 4.5  | 9.2        | 2.2        | 0.1        | -8.8       | -19.9 | -14.7 | -30.7 | -24.2  |
| Debt service ratio (DSR)     |  | -1.8 | -1.0       | 1.3        | 0.8        | 1.7        | 12.3  | -1.1  | 2.1   | 2.0    |
| 1) Property                  | >12  | -1.5 | 2.6        | 8.1        | 11.2       | 6.6        | -10.2 | -11.6 | 0.3   | 0.0    |
| Equity                       |  | 2.5  | 18.3       | -8.9       | -8.2       | 20.3       | -22.4 | -12.1 | -0.3  | -9.9   |
| <b>Joint EWIs</b>            |  |      |            |            |            |            |       |       |       |        |
| 2) Credit and Property       | >3 - Credit<br>>4 - Property               | No   | No         | <b>Yes</b> | <b>Yes</b> | <b>Yes</b> | No    | No    | No    | No     |
| 3) REER and DSR              | >3 - REER<br>>1 - DSR                      | No   | No         | No         | No         | No         | No    | No    | No    | No     |
| 4) DSR and Equity            | >0.5 - DSR<br>>2 - Equity                  | No   | No         | No         | No         | <b>Yes</b> | No    | No    | No    | No     |
| <b>Triple EWIs</b>           |  |      |            |            |            |            |       |       |       |        |
| 5) Credit, REER and Equity   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No   | <b>Yes</b> | No         | No         | No         | No    | No    | No    | No     |
| 6) REER, Equity and Property | >1 - REER<br>>17 - Equity<br>>5 - Property | No   | No         | No         | No         | No         | No    | No    | No    | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# United Kingdom

2020 Nominal GDP: USD 2,711bn  
2020 GDP per capita: USD 40,406

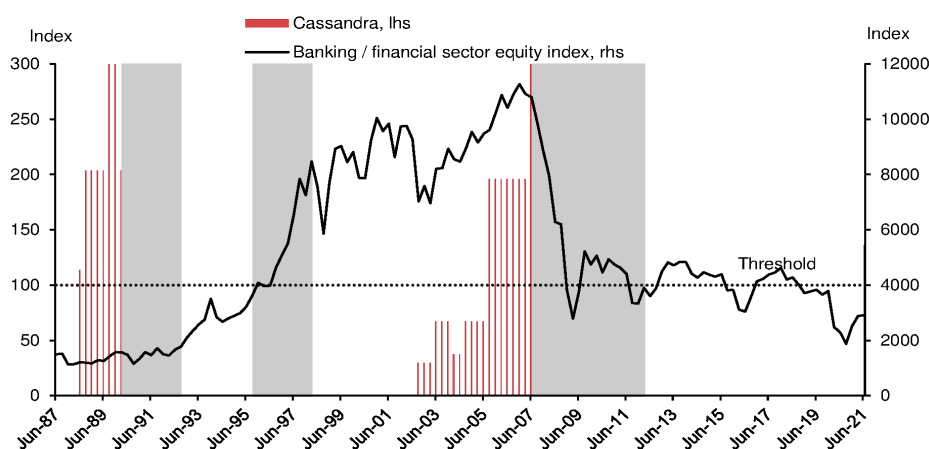
Fig. 132: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020  | 2021F        | 2022F       |
|--------------------------------------|------|------|------|------|------|------|-------|--------------|-------------|
| Real GDP, % y-o-y                    | 2.9  | 2.4  | 1.7  | 1.8  | 1.2  | 1.5  | -9.8  | <b>6.4</b>   | <b>5.4</b>  |
| CPI, % y-o-y                         | 1.5  | 0.0  | 0.7  | 2.7  | 2.5  | 1.8  | 0.9   | <b>1.6</b>   | <b>2.0</b>  |
| Current account, % GDP               | -4.9 | -5.0 | -5.4 | -3.8 | -3.7 | -3.1 | -3.9  | <b>-3.9</b>  | <b>-4.0</b> |
| Fiscal balance, % GDP                | -5.5 | -4.5 | -3.3 | -2.4 | -2.2 | -2.3 | -13.4 | <b>-11.8</b> | <b>-6.2</b> |
| Official interest rate, %            | 0.50 | 0.50 | 0.25 | 0.50 | 0.75 | 0.75 | 0.10  | 0.10         | 0.10        |
| Sovereign FCY credit rating: S&P     | AAA  | AAA  | AA   | AA   | AA   | AA   | AA    | AA           | AA          |
| Sovereign FCY credit rating: Moody's | Aa1  | Aa1  | Aa1  | Aa2  | Aa2  | Aa2  | Aa3   | Aa3          | Aa3         |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 133: Cassandra index for United Kingdom



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 134: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators            | Threshold                                  | 2013  | 2014  | 2015  | 2016 | 2017 | 2018 | 2019  | 2020 | Latest |
|-------------------------------------|--|-------|-------|-------|------|------|------|-------|------|--------|
| <b>Single EWIs</b>                  |  |       |       |       |      |      |      |       |      |        |
| Credit                              |  | -1.3  | -10.2 | -13.2 | -9.6 | -7.3 | -9.1 | -14.7 | -0.9 | 2.3    |
| REER                                |  | -1.3  | 4.2   | 10.9  | -6.6 | -3.2 | -1.3 | 1.4   | 1.1  | 3.7    |
| Debt service ratio (DSR)            |  | -0.1  | -0.8  | -1.4  | -0.6 | -0.5 | -0.5 | -0.9  | -0.1 | 0.0    |
| 1) <b>Property</b>                  | >12  | -11.1 | -6.0  | -1.7  | 0.6  | 0.6  | -0.8 | -2.9  | 1.3  | 0.9    |
| Equity                              |  | 3.4   | -0.3  | -5.4  | 6.8  | 12.0 | -3.8 | 6.6   | -9.1 | -5.7   |
| <b>Joint EWIs</b>                   |  |       |       |       |      |      |      |       |      |        |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No    | No    | No    | No   | No   | No   | No    | No   | No     |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No    | No    | No    | No   | No   | No   | No    | No   | No     |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No    | No    | No    | No   | No   | No   | No    | No   | No     |
| <b>Triple EWIs</b>                  |  |       |       |       |      |      |      |       |      |        |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No    | No    | No   | No   | No   | No    | No   | No     |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No    | No    | No   | No   | No   | No    | No   | No     |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.



# United States

2020 Nominal GDP: USD 20,933bn  
2020 GDP per capita: USD 63,416

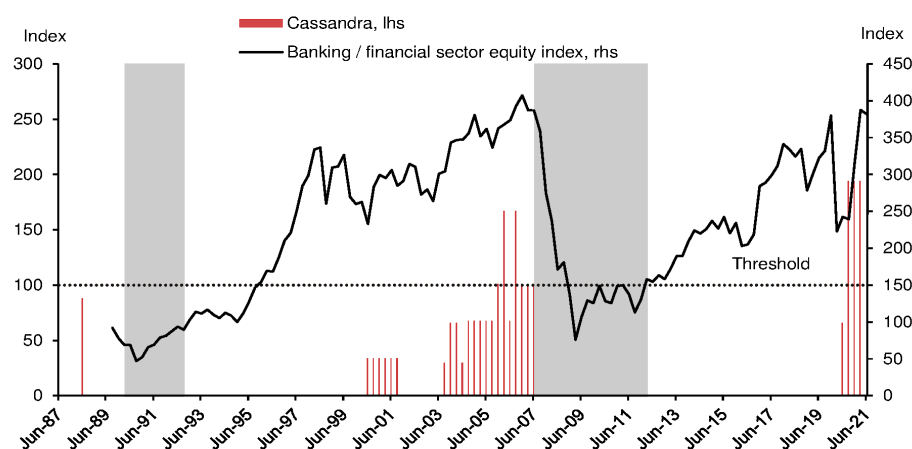
Fig. 135: Vital statistics at a glance

| Vital statistics                     | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020  | 2021F        | 2022F       |
|--------------------------------------|------|------|------|------|------|------|-------|--------------|-------------|
| Real GDP, % y-o-y                    | 2.5  | 3.1  | 1.7  | 2.3  | 3.0  | 2.2  | -3.5  | <b>6.6</b>   | <b>4.1</b>  |
| CPI, % y-o-y                         | 1.6  | 0.1  | 1.3  | 2.1  | 2.5  | 1.8  | 1.2   | <b>3.5</b>   | <b>2.5</b>  |
| Current account, % GDP               | -2.1 | -2.2 | -2.1 | -1.9 | -2.2 | -2.2 | -3.1  | <b>-3.9</b>  | <b>-3.1</b> |
| Fiscal balance, % GDP                | -4.1 | -3.5 | -4.3 | -4.6 | -5.4 | -5.7 | -15.8 | <b>-15.0</b> | <b>-6.1</b> |
| Official interest rate, %            | 0.13 | 0.38 | 0.63 | 1.38 | 2.38 | 1.63 | 0.13  | 0.13         |             |
| Sovereign FCY credit rating: S&P     | AA+  | AA+  | AA+  | AA+  | AA+  | AA+  | AA+   | AA+          |             |
| Sovereign FCY credit rating: Moody's | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa  | Aaa   | Aaa          |             |

Note: Real GDP, CPI, current account and fiscal balance are from the latest IMF WEO database or Bloomberg, while the figures in bold are Bloomberg forecasts (if unavailable we use IMF forecasts) for real GDP and CPI, and IMF forecasts for current account and fiscal balance. For the official interest rate and sovereign credit ratings, historical data refer to end-of-period and 2021 data are for the latest data available.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 136: Cassandra index for Unites States



Note: Grey shaded areas display financial crisis periods (see Appendix 2 for the dating of financial crises). A Cassandra reading above 100 should be interpreted as a warning signal that the country is vulnerable to a financial crisis in the next 12 quarters. For more detail, see the 'Construction of Cassandra' chapter in the report.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

Fig. 137: Cassandra early warning indicators – values which have breached thresholds are in bold

| Early warning indicators            | Threshold                                  | 2013  | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020       | Latest     |
|-------------------------------------|--|-------|------|------|------|------|------|------|------------|------------|
| <b>Single EWIs</b>                  |  |       |      |      |      |      |      |      |            |            |
| Credit                              |  | -5.2  | -7.1 | -7.8 | -6.3 | -5.0 | -6.3 | -6.6 | 6.7        | 4.8        |
| REER                                |  | -10.5 | -5.7 | 3.9  | 7.6  | 2.3  | 6.0  | 5.8  | 3.3        | 1.7        |
| Debt service ratio (DSR)            |  | -0.9  | -0.9 | -0.6 | -0.3 | 0.0  | -0.3 | 0.5  | 0.1        | 0.1        |
| 1) <b>Property</b>                  | >12  | -11.3 | -8.4 | -4.9 | -2.1 | 0.5  | 2.4  | 4.7  | 8.9        | 9.9        |
| Equity                              |  | -4.3  | 1.0  | -4.3 | -1.2 | 10.9 | -2.2 | 18.8 | 31.4       | 36.3       |
| <b>Joint EWIs</b>                   |  |       |      |      |      |      |      |      |            |            |
| 2) <b>Credit and Property</b>       | >3 - Credit<br>>4 - Property               | No    | No   | No   | No   | No   | No   | No   | <b>Yes</b> | <b>Yes</b> |
| 3) <b>REER and DSR</b>              | >3 - REER<br>>1 - DSR                      | No    | No   | No   | No   | No   | No   | No   | No         | No         |
| 4) <b>DSR and Equity</b>            | >0.5 - DSR<br>>2 - Equity                  | No    | No   | No   | No   | No   | No   | No   | No         | No         |
| <b>Triple EWIs</b>                  |  |       |      |      |      |      |      |      |            |            |
| 5) <b>Credit, REER and Equity</b>   | >2 - Credit<br>>1 - REER<br>>3 - Equity    | No    | No   | No   | No   | No   | No   | No   | <b>Yes</b> | <b>Yes</b> |
| 6) <b>REER, Equity and Property</b> | >1 - REER<br>>17 - Equity<br>>5 - Property | No    | No   | No   | No   | No   | No   | No   | <b>Yes</b> | <b>Yes</b> |

Note: Values refer to end-of-period except for Latest which is 1Q 2021 or otherwise Q4 2020. EWIs are expressed as gaps (deviations from long-run trends). For more detail on the data and the noise-to-signal approach to select the EWIs, see Appendix 1 and the 'Methodology' chapter in the report. A signal is issued for joint and triple EWIs if, and only if, the thresholds are simultaneously breached. EWIs in bold are the ones we used to construct the Cassandra index (for more detail, see the 'Construction of Cassandra' chapter in the report).

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

# Appendices

## Appendix 1: Definition and sources of our EWI

### Definition and sources of the variables that make up our early warning indicator

**Credit:** The ratio of outstanding credit (loans and debt securities) from all sources to the household and private non-financial corporate sectors at the end of each quarter, expressed as a percentage of nominal GDP. For most countries in our sample, this is taken from the BIS's "credit to the non-financial sector" database. For countries where credit data from the BIS are unavailable, we use "claims on private sector" data from the Financial Corporations Survey and/or Depository Corporations Survey compiled by the IMF in its International Financial Statistics database, and express this as a percentage of nominal GDP. For Taiwan, we use financial institutional loans to the private sector plus total debt securities to the private non-financial sector as a proxy for private sector credit, expressed as a percentage of nominal GDP.

**REER:** The average real effective exchange rate (broad indices) each quarter from the BIS REER database. The REER of a country indicates the strength of its currency against a unique trade-weighted basket of other currencies, adjusted for differences in inflation. The weightings of other currencies in a country's REER basket depend on the relative importance of a country's manufacturing trade flows (direct bilateral trade and third-market competition) with the home country. An increase in a country's REER indicates an appreciation of the country's currency against the currencies in its trade-weighted basket.

**Debt service ratio (DSR):** The average share of income required to service debt payments each quarter, for the household and private non-financial corporate sector (private non-financial sector). The BIS estimates debt service ratios for the private non-financial sector each quarter by dividing the quarterly debt service costs (quarterly interest payment and amortization on the existing stock of debt), by the quarterly income of the private non-financial sector, with the assumption that debt service costs are repaid in equal portions over the maturity of the loan instalments, calculated as follows:

$$DSR_t = \frac{i_t}{(1-(1+i_t)^{-S_t})} * \frac{D_t}{Y_t}$$

where for quarter t,  $D_t$  denotes the total stock of outstanding debt for the private non-financial sector,  $Y_t$  denotes the income of the private non-financial sector for that quarter,  $i_t$  denotes the average interest rate on the existing stock of debt for that quarter and  $S_t$  denotes the average remaining maturity of the debt, in quarters.

Wherever available, debt service ratios for the private non-financial sector are obtained from the BIS database. For countries where debt service ratios are unavailable from the BIS, we estimated them following the same methodology laid out by the BIS. We calculate the debt service ratio for quarter t in a country ( $DSR_t$ ) using credit to the private non-financial sector from the BIS database as the stock of outstanding private debt ( $D_t$ ), the average bank lending rate ( $i_t$ ) as the average interest rate to be applied on the existing stock of debt, nominal quarterly GDP ( $Y_t$ , expressed as a 4-quarter moving average) as a proxy for income of the private non-financial sector and 60 quarters (15 years) as the average remaining maturity of the outstanding debt ( $S_t$ ). Using our estimates, we also extended debt service ratios for countries with existing BIS data, to as far back as possible.

**Property:** Nominal residential property price index of a country at the end of each quarter, deflated by its average national consumer price index for that quarter. Each country's CPI-deflated property price index is indexed to 100 in Q4 2008. For China, Malaysia, Philippines, Indonesia and India, we extend the nominal residential property price index as far back as possible by splicing the housing component of CPI onto the residential property price index, before deflating with each country's national CPI. The data for nominal residential property price indices are from the CEIC database, while data for national CPI are from CEIC and the IMF's International Financial Statistics database. For countries where property price data are unavailable on CEIC, we use the real residential property price index from the BIS database.

**Equity:** The stock price index of the main stock exchange of a country at the end of each quarter, deflated by its average national consumer price index for that quarter. Each

country's CPI-deflated stock price index is indexed to 100 in Q4 2008. For countries where the main stock exchange does not begin before 1990, "share price index" data from the IMF's International Financial Statistics database is used to extend the main stock exchange back to Q1 1987. The data for stock price indices are from *Bloomberg*, while the data for national CPIs are from CEIC and the International Financial Statistics database.

### Transformation of variables into EWIs

Each EWI is expressed as a "gap" – the deviation of the actual level of the variable from its long-run trend. For the credit and debt service ratios, the gaps are calculated as the percentage point difference between their actual value (ratio) and their estimated long-run trend. For the REER, real property and real equity prices, the gaps are calculated as the percentage deviation from their actual values (level) and respective long-run trends..

The long-run trend for a variable is estimated using a two-sided Hodrick-Prescott filter, which uses all available data for that variable to calculate its long-run trend. The value of the smoothing parameter (lambda) is set at 400,000, which ensures a high level of smoothing to capture the build-up of imbalances during the lead up to crises. Typically, a lambda of 1,600 is used for quarterly data but given that credit cycles are, on average, about four times longer than business cycles, it is optimal for lambda to be set at 1,600 multiplied by the fourth power of the observation frequency, i.e.  $44 \times 1600 \approx 400,000$ .

Two separate trends are estimated for a variable that encounters a structural break in its data. One trend is estimated for the period up to the structural break, using data up to when the structural break occurs; the other is estimated for the period after the structural break and uses data starting from after the structural break (as opposed to estimating one long-run trend for the variable). This is done for the estimation of the trends for the credit variable in Indonesia, debt service ratio variable in Iceland, Indonesia, the Philippines, Thailand and Mexico, equity variable in Greece and all variables for Japan.

Extreme one-sided deviations in the data of a variable impose a significant bias and lower the integrity of the estimated trend. To prevent significant biasing of the trend, we exclude, from the trend estimation, a few periods during which variables exhibited extreme deviations. These periods are: Q3 1986 to Q4 1994 from Brazil's credit variable; Q1 1982 to Q4 1994 from Brazil's debt service ratio variable; Q4 1989 to Q1 1990 from Poland's debt service ratio variable; and Q3 1994 to Q4 1996 from Russia's debt service ratio variable.

Our sample is up to Q1 2021 and, if data are not yet available for this quarter, we proxy it. The latest credit data from the BIS database are only Q4 2020, however we extend the data to Q1 2021 using IIF Global Debt Monitor Database where available. For the rest of the indicators where Q1 2021 data are unavailable, we simply assume the EWI gap measures stay constant at their Q4 2020 level.

Fig. 138: Starting dates of the raw data for variables used to construct EWIs

|                            | Credit  | REER    | Debt service ratio (DSR) | Property | Equity  |
|----------------------------|---------|---------|--------------------------|----------|---------|
| <b>Asia ex-Japan</b>       |         |         |                          |          |         |
| China                      | Q1 1978 | Q1 1994 | Q4 1988                  | Q1 1993  | Q4 1990 |
| Hong Kong                  | Q4 1978 | Q1 1994 | Q4 1978                  | Q1 1993  | Q4 1980 |
| India                      | Q1 1960 | Q1 1994 | Q4 1978                  | Q2 1996  | Q2 1979 |
| Indonesia                  | Q1 1976 | Q1 1994 | Q1 1986                  | Q1 1996  | Q2 1983 |
| Malaysia                   | Q2 1964 | Q1 1994 | Q4 1969                  | Q1 1995  | Q1 1974 |
| Philippines                | Q4 1981 | Q1 1994 | Q4 1981                  | Q1 1988  | Q1 1987 |
| Singapore                  | Q4 1970 | Q1 1994 | Q1 1983                  | Q1 1975  | Q1 1985 |
| Korea                      | Q4 1962 | Q1 1994 | Q1 1980                  | Q1 1986  | Q1 1976 |
| Taiwan                     | Q1 1972 | Q1 1994 | Q1 1972                  | Q3 1991  | Q1 1981 |
| Thailand                   | Q4 1970 | Q1 1994 | Q1 1983                  | Q1 1991  | Q1 1976 |
| <b>Other EM economies</b>  |         |         |                          |          |         |
| Brazil                     | Q1 1996 | Q1 1994 | Q4 1996                  | Q1 2001  | Q1 1990 |
| Chile                      | Q4 1960 | Q1 1994 | Q1 1985                  | Q1 2004  | Q1 1989 |
| Colombia                   | Q1 1960 | Q1 1994 | Q1 1999                  | Q1 1988  | Q1 1994 |
| Hungary                    | Q4 1970 | Q1 1994 | Q4 1991                  | Q1 1998  | Q1 1991 |
| Mexico                     | Q4 1980 | Q1 1994 | Q4 1980                  | Q1 2005  | Q1 1988 |
| Poland                     | Q1 1992 | Q1 1994 | Q4 1995                  | Q3 2006  | Q2 1991 |
| Romania                    | Q4 1996 | Q1 1994 | Q4 1996                  | Q1 2009  | Q3 1997 |
| Russia                     | Q4 1993 | Q1 1994 | Q1 1997                  | Q1 2000  | Q3 1995 |
| South Africa               | Q1 1965 | Q1 1994 | Q1 1965                  | Q1 1966  | Q1 1987 |
| Turkey                     | Q1 1986 | Q1 1994 | Q1 1987                  | Q1 2010  | Q1 1988 |
| <b>Developed economies</b> |         |         |                          |          |         |
| Australia                  | Q2 1960 | Q1 1994 | Q4 1960                  | Q2 1986  | Q1 1960 |
| Belgium                    | Q4 1970 | Q1 1994 | Q2 1985                  | Q1 1970  | Q1 1987 |
| Canada                     | Q1 1960 | Q1 1994 | Q1 1985                  | Q1 1970  | Q1 1960 |
| Denmark                    | Q4 1966 | Q1 1994 | Q1 1985                  | Q1 1970  | Q4 1989 |
| France                     | Q4 1969 | Q1 1994 | Q4 1969                  | Q4 1994  | Q3 1987 |
| Germany                    | Q4 1960 | Q1 1994 | Q2 1977                  | Q1 1970  | Q1 1991 |
| Greece                     | Q4 1970 | Q1 1994 | Q4 1960                  | Q1 1994  | Q1 1994 |
| Iceland                    | Q4 1995 | Q1 1994 | Q4 1982                  | Q1 2000  | Q4 1992 |
| Ireland                    | Q2 1971 | Q1 1994 | Q1 1980                  | Q1 1978  | Q1 1983 |
| Italy                      | Q4 1960 | Q1 1994 | Q2 1989                  | Q1 1960  | Q4 1986 |
| Japan                      | Q4 1964 | Q1 1994 | Q4 1980                  | Q3 1993  | Q1 1970 |
| Netherlands                | Q1 1961 | Q1 1994 | Q4 1987                  | Q1 1970  | Q1 1983 |
| New Zealand                | Q4 1960 | Q1 1994 | Q1 1988                  | Q1 1970  | Q2 1993 |
| Norway                     | Q4 1960 | Q1 1994 | Q2 1982                  | Q1 1970  | Q1 1987 |
| Portugal                   | Q4 1960 | Q1 1994 | Q1 1990                  | Q1 2008  | Q1 1988 |
| Spain                      | Q1 1970 | Q1 1994 | Q1 1982                  | Q1 1971  | Q1 1987 |
| Sweden                     | Q1 1961 | Q1 1994 | Q1 1987                  | Q1 1970  | Q4 1986 |
| Switzerland                | Q4 1960 | Q1 1994 | Q4 1980                  | Q1 1970  | Q3 1988 |
| United Kingdom             | Q1 1963 | Q1 1994 | Q4 1969                  | Q2 1968  | Q4 1983 |
| United States              | Q1 1960 | Q1 1994 | Q2 1971                  | Q1 1975  | Q1 1960 |

Source: BIS, IMF, Bloomberg, CEIC and Nomura Global Economics.



## Appendix 2: Definition and dating of financial crises

To analyse the early warning properties of EWIs in the lead-up to financial crises, we examine a sample of 60 financial crises in 40 countries (10 from Asia ex-Japan, 10 from emerging economies outside Asia, and 20 from developed economies), occurring since the early 1990s. In this study, financial crises generally refer to banking crises as defined and dated by the literature. In a few cases Nomura's own dates of financial crises are derived from unusually large declines in a country's banking sector equity index.

We include all the banking crises episodes since the early 1990s that are listed in the following three studies.

**Reinhart and Rogoff (2008)** define the starting date of a banking crisis as the date when either of two types of events occur: 1) Bank runs that lead to the closure, merger or takeover by the public sector of one or more financial institutions; or 2) The closure, merger or takeover of, or large-scale government assistance to, an important financial institution (or group of institutions) that marks the start of a string of similar outcomes for other financial institutions, without the occurrence of a bank run.

**Drehmann, Borio and Tsatsaronis (2011)** draw on their own judgment and correspondence with central banks to determine starting dates of banking crises, in addition to following the dating detailed by Laeven and Valencia (2008, 2010) and Reinhart and Rogoff (2008).

**Laeven and Valencia (2018)** set two conditions for an event to be classified as a crisis: First, if there are significant signs of financial distress in the banking system (e.g., significant bank runs, losses in the banking system or bank liquidations); and second, if there are significant policy interventions in response to the financial distress.

If the starting quarter of a banking crisis is not specified (i.e., only a year is given), we set Q4 as the quarter that the banking crisis begins.

### Nomura's dating of financial crises

We also attempt to capture periods where countries experienced significant financial sector stress but avoided banking crises, as dated by the above three studies. We define the start date of a financial crisis as the quarter where year-on-year growth in banking (financial) sector equity index falls in excess of two standard deviations below its long-run average.

Once in a financial crisis and throughout the crisis period, it makes no sense to predict another crisis. Therefore, crises that materialise within two years of the start of a previous financial crisis are not included in our study. Combining the various definitions of crises, our sample of 40 countries contains 60 crises since 1990.

Fig. 139: Start dates of financial crises since 1990

|                            | Financial crises used for this study | Banking crises (Reinhart and Rogoff, 2008) | Banking crises (Drehmann, Borio and Tsatsaronis, 2011) | Banking crises (Laeven and Valencia, 2018) | Nomura's measure of financial crises |
|----------------------------|--------------------------------------|--|--|--|--------------------------------------|
| <b>Asia ex-Japan</b>       |                                      |  |  |  |                                      |
| China                      | Q4 1992, Q1 1998                     | 1992                                       | Q1 1998  | 1998                                       |                                      |
| Hong Kong                  | Q3 1998, Q4 2008                     |  |  |  | Q3 1998, Q4 2008                     |
| India                      | Q3 1993, Q4 2008                     | 1993                                       | Q3 1993  | 1993                                       | Q4 2008                              |
| Indonesia                  | Q4 1992, Q4 1997                     | 1992, 1997                                 | Q4 1997  | Q4 1997                                    | Q4 1997                              |
| Malaysia                   | Q3 1997                              | 1997                                       |  | Q3 1997                                    | Q4 1997                              |
| Philippines                | Q3 1997                              | 1997                                       |  | Q3 1997                                    |                                      |
| Singapore                  |                                      |  |  |  |                                      |
| South Korea                | Q3 1997                              | 1997                                       | Q3 1997  | Q3 1997                                    |                                      |
| Taiwan                     | Q4 1997, Q1 2009                     | 1997                                       |  |  | Q1 2009                              |
| Thailand                   | Q3 1997                              | 1996                                       |  | Q3 1997                                    | Q3 1998                              |
| <b>Other EM economies</b>  |                                      |  |  |  |                                      |
| Brazil                     | Q1 1990, Q4 1994                     | 1990, 1995                                 |  | Q1 1990, Q4 1994                           |                                      |
| Chile                      |                                      |  |  |  |                                      |
| Colombia                   | Q2 1998                              | 1998                                       |  | Q2 1998                                    |                                      |
| Hungary                    | Q4 1991, Q3 2008                     | 1991                                       |  | 1991, Q3 2008                              |                                      |
| Mexico                     | Q4 1994                              | 1994                                       | Q4 1994  | Q4 1994                                    |                                      |
| Poland                     | Q4 1992, Q1 2009                     | 1991                                       |  | 1992                                       | Q1 2009, Q3 2020                     |
| Romania                    | Q4 1990, Q4 1998                     |  |  | 1990, 1998                                 |                                      |
| Russia                     | Q4 1995, Q3 1998, Q3 2008            | 1995, 1998                                 |  | Q3 1998, Q3 2008                           |                                      |
| South Africa               |                                      |  |  |  | Q1 2020                              |
| Turkey                     | Q2 1994, Q4 2000                     | 1994                                       | Q4 2000  | Q4 2000                                    |                                      |
| <b>Developed economies</b> |                                      |  |  |  |                                      |
| Australia                  | Q3 2008                              |  | Q3 2008  |  | Q3 2008                              |
| Belgium                    | Q3 2008                              |  | Q3 2008  | Q3 2008                                    | Q4 2008                              |
| Canada                     | Q4 2008                              |  |  |  | Q4 2008                              |
| Denmark                    | Q3 2008                              |  | Q3 2008  | Q3 2008                                    | Q4 2008                              |
| France                     | Q1 1994, Q3 2008                     | 1994                                       | Q3 2008  | Q3 2008                                    | Q4 2008                              |
| Germany                    | Q3 2002, Q3 2007                     |  | Q3 2007  | Q3 2008                                    | Q3 2002, Q4 2008                     |
| Greece                     | Q4 1991, Q3 2008                     | 1991                                       | Q3 2008  | Q3 2008                                    |                                      |
| Iceland                    | Q3 2008                              |  |  | Q3 2008                                    |                                      |
| Ireland                    | Q3 2008                              |  | Q3 2008  | Q3 2008                                    |                                      |
| Italy                      | Q4 1990, Q3 2008                     | 1990                                       | Q3 1992  | Q3 2008                                    |                                      |
| Japan                      | Q4 1992, Q4 1997                     | 1992                                       | Q4 1992  | Q4 1997                                    |                                      |
| Netherlands                | Q3 2008                              |  | Q3 2008  | Q3 2008                                    | Q4 2008                              |
| New Zealand                |                                      |  |  |  |                                      |
| Norway                     | Q4 1990, Q4 2008                     |  | Q4 1990  | Q4 1991                                    | Q4 2008                              |
| Portugal                   | Q3 2008                              |  | Q3 2008  | Q3 2008                                    |                                      |
| Spain                      | Q4 1993, Q3 2008                     |  | Q4 1993, Q3 2008                                       | Q3 2008                                    |                                      |
| Sweden                     | Q3 1991, Q3 2008                     | 1991                                       | Q3 1991, Q3 2008                                       | Q3 1991, Q3 2008                           | Q4 2008                              |
| Switzerland                | Q3 1991, Q3 2007                     |  | Q3 1991, Q3 2007                                       | Q3 2008                                    | Q1 2003, Q4 2008                     |
| United Kingdom             | Q2 1990, Q4 1995, Q3 2007            | 1991, 1995, 2007                           | Q2 1990, Q3 2007                                       | Q3 2007                                    | Q4 2008, Q3 2020                     |
| United States              | Q2 1990, Q3 2007                     | 2007                                       | Q2 1990, Q3 2007                                       | Q4 2007                                    | Q3 1990, Q2 2008                     |

Source: Reinhart and Rogoff (2008), Drehmann, Borio and Tsatsaronis (2011), Laeven and Valencia (2018) and Nomura Global Economics.

**Fig. 140: Heat-map before the 1997 Asian crisis (red cell = signal given by EW)**

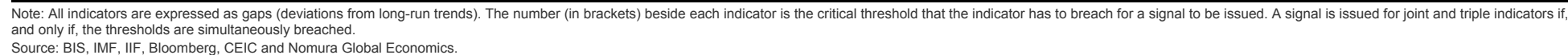


Fig. 141: Heat-map before the 2008 global financial crisis (red cell = signal given by EWI)

|                     | Single EWIs   |    |      |    |      |    |      |    | Joint EWIs               |    |      |    |                   |    |      |    | Triple EWIs           |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
|---------------------|---------------|----|------|----|------|----|------|----|--------------------------|----|------|----|-------------------|----|------|----|-----------------------|----|------|----|----------------------------------|----|------|----|-------------------------------------|----|------|----|------|----|------|----|----|----|----|----|----|----|----|----|--|--|--|--|--|--|
|                     | Property (12) |    |      |    |      |    |      |    | Credit (3), Property (4) |    |      |    | REER (3), DSR (1) |    |      |    | DSR (0.5), Equity (2) |    |      |    | Credit (2), REER (1), Equity (3) |    |      |    | REER (1), Equity (17), Property (5) |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
|                     | 2005          |    | 2006 |    | 2007 |    | 2008 |    | 2005                     |    | 2006 |    | 2007              |    | 2008 |    | 2005                  |    | 2006 |    | 2007                             |    | 2008 |    | 2005                                |    | 2006 |    | 2007 |    | 2008 |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
|                     | Q3            | Q4 | Q1   | Q2 | Q3   | Q4 | Q1   | Q2 | Q3                       | Q4 | Q1   | Q2 | Q3                | Q4 | Q1   | Q2 | Q3                    | Q4 | Q1   | Q2 | Q3                               | Q4 | Q1   | Q2 | Q3                                  | Q4 | Q1   | Q2 | Q3   | Q4 | Q1   | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 |  |  |  |  |  |  |
| Asia ex-Japan       |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| China               |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Hong Kong           |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| India               |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Indonesia           |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Malaysia            |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Philippines         |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Singapore           |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Korea               |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Taiwan              |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Thailand            |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Other EM economies  |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Brazil              |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Chile               |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Colombia            |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Hungary             |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Mexico              |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Poland              |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Romania             |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Russia              |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| South Africa        |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Turkey              |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Developed economies |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Australia           |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Belgium             |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Canada              |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Denmark             |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| France              |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Germany             |               |    |      |    |      |    |      |    |                          |    |      |    |                   |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |
| Greece              |               |    |      |    |      |    |      |    |                          |    |      |    | </                |    |      |    |                       |    |      |    |                                  |    |      |    |                                     |    |      |    |      |    |      |    |    |    |    |    |    |    |    |    |  |  |  |  |  |  |

Note: All indicators are expressed as gaps (deviations from long-run trends). The number (in brackets) beside each indicator is the critical threshold that the indicator has to breach for a signal to be issued. A signal is issued for joint and triple indicators if, and only if, the thresholds are simultaneously breached.

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

[illegible]

Source: BIS, IMF, IIF, Bloomberg, CEIC and Nomura Global Economics.

## Appendix 4: Nomura composite climate change risk index

The Nomura composite climate change risk index is the sum of the standardized Z-scores of the below eight independent climate change risk indexes, which in turn are composites of various indicators.

### Climate change physical risk

#### The Germanwatch global climate risk index, 1999-2018

The Germanwatch Global Climate Risk Index has one of the most consistent historical data sets, and analyses to what extent countries and regions have been affected by impacts of weather-related loss events (storms, floods, heatwaves etc.). The following indicators were analysed: 1) number of deaths; 2) number of deaths per 100 000 inhabitants; 3) sum of losses in US\$ in purchasing power parity (PPP); and 4) losses per unit of GDP. Each country's index score has been derived from a country's average ranking in all four indicating categories, according to the following weighting: death toll, 1/6; deaths per 100 000 inhabitants, 1/3; absolute losses in PPP, 1/6; losses per GDP unit, 1/3. The lower the CRI score, the more vulnerable to climate change physical risk.

Source: <https://www.germanwatch.org/en/19777>

#### The University of Notre Dame vulnerability index, 2018

The vulnerability index measures a country's exposure, sensitivity and capacity to adapt to the negative effects of climate change. Exposure is the degree to which a system is exposed to significant climate change from a biophysical perspective. It is a component of vulnerability independent of socio economic context. Sensitivity is the extent to which a country is dependent upon a sector negatively affected by climate hazard, or the proportion of the population particularly susceptible to a climate change hazard. Capacity is the availability of social resources for sector-specific adaptation. In some cases, these capacities reflect sustainable adaptation solutions. In other cases, they reflect capacities to put newer, more sustainable adaptations into place. The index is on a scale of 0-1, lower is less vulnerable to climate change physical risk. Source: <https://gain.nd.edu/our-work/country-index/>

#### IMF climate-driven INFORM Risk indicator, 2020

Climate-driven INFORM Risk indicator helps assess risk for climate-driven hazards. It has three dimensions: climate-driven hazard & exposure, vulnerability, and lack of coping capacity. It is produced based on the INFORM Risk Index, with IMF staff calculations to focus on climate-driven risks only. The Climate-driven Hazard & Exposure component reflects the probability of physical exposure associated with specific climate-driven hazards (i.e., flood, tropical cyclone, and drought). Vulnerability represents economic, political and social characteristics of the community that can be destabilized in case of a hazard event. Lack of coping capacity relates to the ability of a country to cope with disasters in terms of formal, organized activities and the effort of the country's government as well as the existing infrastructure which contribute to the reduction of disaster risk. The index is on a scale from 0-10. The higher the indicator the higher the climate change physical risk. Source: <https://climatedata.imf.org/pages/fi-indicators>

### Climate change transition risk

#### United Nations Sustainability Development Goals Index, 2020

The overall score measures a country's total progress towards achieving all 17 of the United Nations' Sustainability Development Goals (SDG). The 17 SDGs are: no poverty, zero hunger, good health and well-being, quality education, gender equality, clean water and sanitation, affordable clean energy, decent work and economic growth, industry, innovation and infrastructure, reduced inequalities, sustainable cities and communities, responsible consumption and production, climate action, life below water, life on land, peace, justice and strong institutions, partnerships for the goals. The score can be interpreted as the percentage of SDG achievement. The higher the score, the lower the climate change transition risk. A score of 100 indicates that all SDGs have been achieved (source: <https://dashboards.sdgindex.org/rankings>).

#### The University of Notre Dame resilience index, 2018

The readiness index measures a country's ability to leverage investments and convert them to adaptation actions. It has three components: economic readiness, governance



readiness and social readiness. Economic readiness captures the ability of a country's business environment to accept investment that could be applied to adaptation that reduces vulnerability (reduces sensitivity and improves adaptive capacity). Governance captures the institutional factors that enhance application of investment for adaptation. Social readiness captures the factors such as social inequality, ICT infrastructure, education and innovation that enhance the mobility of investment and promote adaptation actions. The index is on a scale of 0-1, higher is more ready (i.e., climate change transition risk; source: <https://gain.nd.edu/our-work/country-index/>).

#### **IMF exposure index to low-carbon economy transition, 2019**

The exposure index considers the following two dimensions: (i) type of exposed asset class: A country can be exposed because of its reliance on fossil fuel resources in the ground or its significant reliance on carbon intensive built capital, such as power or industrial plants; and (ii) timing of the exposure: A country can be exposed because it currently relies on carbon-intensive exports or is expected to rely on carbon-intensive rents and revenues in the future as a result of its large reserves of fossil fuels and the young age of its carbon-intensive infrastructure. The Index is on a scale from 0 (low exposure) to 1 (high exposure; source: <https://climatedata.imf.org/pages/fi-indicators>).

#### **IMF resilience index to low-carbon economy transition, 2019**

The resilience index is a composite indicator that reflects a country's capacity to adjust to the impacts and challenges associated with a structural transformation and to tap into some of the opportunities that such a transformation would offer. Resilience considers the following dimensions: (i) Built, human, and institutional assets; (ii) Macroeconomic and financial flexibility; (iii) Economic performance and complexity; (iv) Business environment; and (v) Position on the global supply curve. The index is on a scale from 0 (low exposure) to 1 (high exposure; source: <https://climatedata.imf.org/pages/fi-indicators>).

#### **IIF carbon efficiency scorecard, 2020**

This is a composite measure of five variables: energy intensity of the economy, emissions intensity of the energy supply, fuel exports, CO2 emissions embodied in imports and the share of renewables in energy production. Each variable is scored between 0 (worst) to 1. Weightings of 2/15 are assigned for the level, and 1/15 for the change so that the levels count twice as much as change, with the weightings summing to 1. Therefore the total scores for each country remain on a 0 (worst) to 1 scale. (source: <https://www.iif.com/Publications/ID/4303/Green-Weekly-Insight-Carbon-Efficiency-101-Emerging-Markets>).

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# Appendix A-1

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