



BANK ĊENTRALI TA' MALTA
EUROSISTEMA
CENTRAL BANK OF MALTA

A FINANCIAL STRESS INDEX FOR MALTA

BOX 7: A FINANCIAL STRESS INDEX FOR MALTA¹

One of the objectives of the Central Bank of Malta is to ensure the stability of the domestic financial system and to formulate and implement macro-prudential policies. The latter have become part of policy makers' toolkit, complementing traditional instruments with the aim of reducing financial pro-cyclicality and systemic risks.²

Developments in the aftermath of the global financial crisis of 2008-2009 and the sovereign debt crisis of 2012 constitute a prime example of how financial stress may ultimately spill over to the real economy. There are three main channels through which financial stress can adversely impact economic activity. First, the increase in uncertainty may cause firms to postpone hiring and investment decisions. Households may also cut back on spending as they become more uncertain about their future wealth prospects, especially if employment prospects deteriorate as well. Second, it can raise the cost of finance to firms and households, for instance, through higher risk premia, therefore further curtailing consumption and investment decisions. Finally, financial stress may adversely affect activity by causing banks to tighten their credit standards, such as non-interest rate charges or collateral requirements, thus making it harder for borrowers to qualify for a loan.

It is also likely that these channels can reinforce each other and, in the process, impact both the demand and the supply side of the economy. For instance, an increase in uncertainty that causes households to temporarily postpone spending may lead to a slowdown in demand. However, a prolonged period of uncertainty or tighter financial conditions that causes firms to delay investment or cut on research and development will adversely affect the capital stock, with longer lasting consequences on the economy's potential growth.

Against this background, this Box introduces a financial stress index for the Maltese economy. Since the economic and financial crisis, a number of studies have developed indices of financial stress to assist policy makers in gauging its impact on the economy. These indices differ from those that seek to measure financial conditions, whose cyclical nature is intended to summarize information on the future state of the economy from financial variables and asset prices.³

The proposed index is intended to enhance the ability of the Central Bank of Malta to monitor and assess the level of stress in the financial system, identify past episodes of stress and finally, to gauge the impact of policy measures directed towards mitigating systemic stress.

The rest of the Box is structured as follows. The next section describes the key features of financial stress and on how policy institutions have tried to develop indices to capture some of the salient features of stress. The subsequent section describes the financial stress

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² See the European Central Bank publication entitled "Macroprudential Bulletin", Issue 1/2016 for an overview of the macroprudential policy framework in the euro area and the instruments available.

³ Angelopoulou, E., Balfoussia, H. and Gibson, H., "Building a financial conditions index for the euro area and selected euro area countries: what does it tell us about the crisis?", *European Central Bank Working Paper No. 1541*, 2013.

index developed for Malta, including the methodology and the choice of variables used. The final section evaluates the impact of financial stress on economic activity.

Key features of financial stress

There is no exact definition of what constitutes ‘financial stress’, in part because each episode has its own defining features. However, these episodes almost always entail an interruption in the normal functioning of financial markets.

A study by the Federal Reserve of Kansas City lists a number of key phenomena that are usually prevalent in episodes of financial stress.⁴ These periods are characterised by increased uncertainty about the fundamental value of assets, which, in turn, translates into greater volatility in their market price. The uncertainty could reflect concerns about the outlook for the economy as a whole or for specific sectors, like the collapse of the high-tech bubble in 2001, the banking sector after the 2009 recession and stressed euro area sovereigns in 2012. Another form of uncertainty involves the behaviour of other investors, which could exacerbate asset price volatility.

Episodes of financial stress are characterised by increased information asymmetry between lenders and borrowers. This happens when one party in a transaction has more information than the other party about the true quality of a particular asset. These information gaps lead to problems of adverse selection or moral hazard, which raise the average cost of borrowing for households and businesses and depress asset prices on secondary markets. Information asymmetries are likely to be exacerbated during periods of financial stress as not only might the variation in the true quality of borrowers or financial assets increase but lenders may also lose confidence in the accuracy of their information on borrowers.

Another common sign of stress is the sharp decrease in investors’ willingness to hold risky or illiquid financial assets. The former, known as flight to quality, causes lenders and investors to demand higher returns on risky assets and lower returns on safe assets, widening the spread between the two rates of return and, in the process, increasing the cost of borrowing for relatively risky borrowers. Typical examples include the increase in the spread between investment grade corporate bonds and treasury bills or, as happened during the recent crisis, an increase in the spread between different sovereigns in the euro area. One possible explanation for this behaviour is the tendency of lenders and investors to underestimate risk during good times and, consequently, to overestimate risk during the downturn. Investors’ risk appetite may also wane during a recession, for instance, due to higher uncertainty about the economic outlook or job prospects, thereby requiring greater compensation to hold risky assets. Similarly, these episodes are generally characterised by a flight to liquidity, as investors become less willing to hold illiquid assets. This could be due, for instance, because the secondary market for the asset is thin so that the eventual selling of assets involves a large impact on its price.

The combination of these risks could exacerbate financial stress during turbulent times. For example, an increase in asset price volatility increases the probability that leveraged

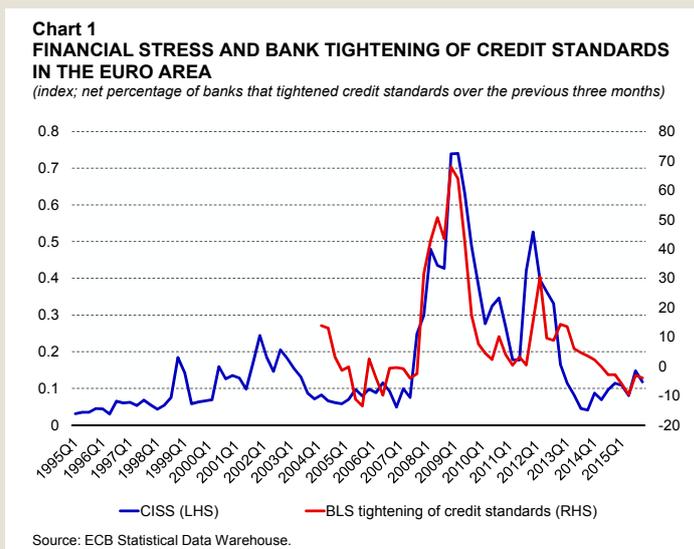
⁴ Hakkio, C. and Keeton, W. “Financial Stress: What Is It, How Can It Be Measured, and Why Does It Matter?”, Federal Reserve Bank of Kansas City, *Economic Review*, 2009.

investors, such as hedge funds, would have to liquidate some of their assets to meet margin calls or redemptions from clients. All these risks manifested themselves during the financial crisis of 2009, requiring the intervention of governments and central banks to stabilize financial markets and limit the devastating effects on economic activity.

In recent years, policy institutions have developed indices that are intended to capture features of financial stress. In part, this was motivated by the events of the 2009 financial crisis, which has shown that the macro-prudential aspects of financial supervision and regulation need to be significantly strengthened. For example, the European Systemic Risk Board was established to identify and assess emerging systemic risks, warn about material risks and make policy recommendations on how to contain them. The Single Supervisory Mechanism conferred supervisory responsibilities on the European Central Bank. In 2010, the European System of Central Banks launched the Macro-prudential Research Network (MaRS) with the objective of developing core conceptual frameworks, models and tools that provide research support to improve macro-prudential supervision in the European Union. This research network focused on the development of macro-financial models, early warning indicators and systemic risk indicators, as well as cross-border contagion risks.

One of the outcomes of this network was the Composite Index of Systemic Stress (CISS), an indicator intended to capture contemporaneous stress in the euro area's financial system.⁵ Chart 1 shows that the sharpest spikes in the CISS tend to occur around very well-known events which caused, at least temporarily, severe stress in the global financial system. The increased volatility in 1999 took place in the context of the global market reactions to the Russian debt crisis and the subsequent collapse of the hedge fund Long-Term Capital Management. The next period of stress is associated with the downturn in high-tech stocks in early 2000 and the terrorist attacks of 9/11 in 2001. None of these events, however, was able to push up the CISS towards levels reached during the financial crisis of 2009. The CISS reached its highest level in the aftermath of the collapse of Lehman Brothers and increased sharply again in 2012 due to the European sovereign debt crisis.

There is clear evidence that financial stress tends to move in tandem with a tightening of credit standards by banks (see Chart 1). The latter are derived from the Bank Lending Survey (BLS), which reports the net



⁵ Hollo, D., Kremer, M. and Lo Duca, M. "CISS – A composite indicator of systemic stress in the financial system", *European Central Bank Working Paper No. 1426*, 2012.

percentage of banks in the euro area that tightened credit standards over the previous three months. The contemporaneous correlation coefficient between the two measures for the period between 2005 and 2015 stands at 0.83.

A financial stress index for Malta

Given the evidence presented above, this section describes the variables used in the construction of the financial stress index for Malta. For the index to be relevant for policy makers, however, it must be tailored to the specific characteristics of the domestic financial system. Most of the stress indices in the literature rely heavily on developments in the interbank and equity markets, both of which, in the case of Malta, have different features and characteristics compared to other economies.⁶ For instance, contrary to similar institutions in the euro area, core banks in Malta do not rely on wholesale markets for funding but rather on deposits.⁷ Similarly, the capital market is relatively small and illiquid, with the Central Bank of Malta acting as a market-maker for Maltese government bonds in the secondary market to ensure adequate liquidity in these securities.

As a result, the financial stress index for Malta relies heavily on spreads and financial indicators from the banking sector, with five variables from the former and four from the latter. In addition, the index also includes two additional variables, the Malta Stock Exchange (MSE) index and the property price index. The latter, which is rarely used in similar indices in the literature, is intended to capture developments in the housing sector, given the exposure of domestic banks to this sector both in terms of loans and collateral.⁸ Table 1 lists the variables included in the index, all of which are available since 1995 on a quarterly frequency.

Table 1
VARIABLES USED IN THE FINANCIAL STRESS INDEX

Spreads

- Spread between lending and deposit rate
- Spread between lending rate and 3-month money market rate
- Spread between lending rate and 10-year government bond yield
- Spread between 10-year and 5-year government bond yield
- Spread between 10-year Maltese and German bund yield

Financial stability indicators of core banks

- Non-performing loans to total gross loans
- Regulatory capital to risk weighted assets
- Return on equity
- Liquid assets to total assets

Other asset prices

- Central Bank of Malta residential property price index
- Malta Stock Exchange index

Sources: Central Bank of Malta; Eurostat.

⁶ The same applies to the foreign exchange market. In the context of a fixed exchange rate regime, changes in the foreign exchange market are dictated by developments in the euro area as a whole rather than by domestic considerations. Before the adoption of the euro in 2008, the euro had a weight of 70% in Malta's currency basket, with the pound sterling and the US dollar having a weight of 20% and 10%, respectively.

⁷ Due to liquidity surplus, the interbank market in Malta before euro adoption was characterised by thin trading, with interbank rates set by the Central Bank of Malta on the basis of quotes received from participating banks. The reliance on bank deposits instead of wholesale funding was maintained even after the introduction of the euro.

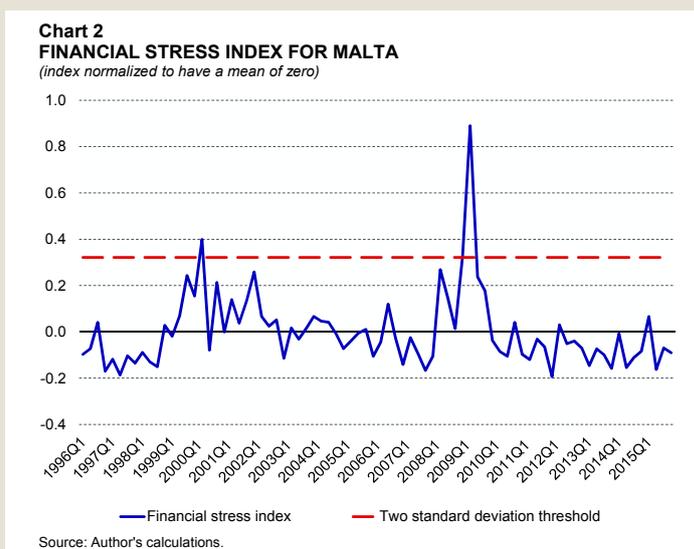
⁸ The resulting financial stress index is robust to the exclusion of the property price index.

The financial stress indicator is constructed by making a number of transformations to the data. First, variables are first-differenced, squared and square rooted. Second, the factor most responsible for the co-movement in the data is identified by the first principal component. Each variable is expressed in the same unit, that is, by subtracting the sample mean and dividing by the standard deviation. The general idea behind this approach is that the time-filtered square root of a growth rate should serve as a proxy for volatility.

Chart 2 plots the financial stress index for Malta for the period 1996–2015. The first step in assessing the plausibility of the index is to assess whether peaks have occurred in known periods of financial stress. There are two spikes in the index, one in the early 2000 and another one in 2009.

The first spike relates to the sharp increase in non-performing loans (NPL) as a result of regulatory changes with the introduction of Banking Rule BR/09 which clarified the definition of NPLs and required banks to make additional provisions, with an adverse impact on their capital and profitability. This asset review led the NPL ratio to double between the first quarter of 1999 and early 2000. More generally, the first years of the new millennium were characterised by higher than average stress in the financial system. For instance, in addition to the rise in NPLs and lower than average bank profitability, the MSE index declined by 51% from its peak in early 2000 until its trough at the end of 2002.⁹

The second and most pronounced spike occurred during the financial crisis of 2008-2009 following the collapse of Lehman Brothers and the subsequent stress in international financial markets. In this case, the increase was primarily driven by widening spreads. For instance, the spread between the bank lending rate and the short-term money market rate increased to 3.4 percentage points in 2009, up by 2.0 percentage points from a year earlier. During the same period, the spread between the domestic 10-year government bond yield and the Bund increased by around 50 basis points. The domestic index, however, returned to normal levels much rapidly compared to CISS, since contrary to other peripheral countries in the euro area, the domestic banking system emerged relatively unscathed from the financial crisis and was not affected by the sovereign debt crisis of 2012.



⁹ The drop in equity prices was driven primarily by the banking sector and a firm in the telecommunications industry.

The sharp increase in financial stress in 2009 makes it clear that it was a situation of major concern. Other episodes, however, may not be so obvious. This can be tackled by classifying episodes of financial stress as severe when the index exceeds the historical mean by a certain number of standard deviations. For instance, a study by the Bank of Canada uses a threshold of two standard deviations above the mean to classify episodes of high stress.¹⁰ Assuming a threshold of two standard deviations, the two spikes listed above would both be classified as high stress periods. On the contrary, the higher than average financial stress between 2001 and 2002 does not exceed the threshold value.

One possible limitation of this approach is that the number of standard deviations by which an index exceeds the mean can change significantly as more observations are added to the sample. To counter this limitation, one can classify financial stress as high whenever it exceeds the value of the index in a benchmark episode, say, early 2000. Using this approach would still leave the main results unchanged, as only the spike during the financial crisis exceeded the value of the index in the first quarter of 2000.

The impact of financial stress on economic activity

There is now a growing literature which documents that episodes of financial stress have a negative impact on economic activity.¹¹ As described above, the latter may be affected through higher uncertainty, an increase in borrowing costs and a tightening of bank credit standards. Investment is likely to be the most adversely affected from the aggregate demand components, which, through its impact on the capital stock, will also impact on the economy's supply potential. For instance, at the end of 2015, investment in the euro area remains 13% below the level prevailing at the beginning of 2008.

The impact of financial stress on economic activity is assessed quantitatively using a bivariate vector auto-regression (VAR) model. Two models are estimated, one with the real GDP growth as the measure of economic activity and another one with potential GDP growth. This distinction is made to test the hypothesis that financial stress can affect both the demand and the supply side of the economy. The estimates of potential output are derived using a production function approach and the models are estimated using quarterly data for the period 1996-2015.¹²

Charts 3 and 4 plot the response of real and potential GDP to a one standard deviation shock in the financial stress index.¹³ To compute the impulse responses, some assumptions must be made about the contemporaneous interaction between financial stress and the measures of activity. The impulse responses are based on the assumption that within any quarter, a shock to economic activity affects financial stress but a shock to stress has no contemporaneous

¹⁰ Illing, M. and Liu, Y. "Measuring financial stress in a developed country: an application to Canada", *Journal of Financial Stability*, Vol. 2, No. 3, 2006.

¹¹ European Commission, "Impact of the current economic and financial crisis on potential output", *European Economy Occasional Paper* No. 49, 2009.

¹² Grech, A. G. and Micallef, B., "Assessing the supply side of the Maltese economy using a production function approach", *Central Bank of Malta Quarterly Review* 2013:4.

¹³ The use of a one standard deviation shock is a common approach in the VAR literature. Since the model is linear, a two standard deviation shock, in line with the threshold adopted in the previous section, implies a doubling of the effects illustrated in Charts 3 and 4.

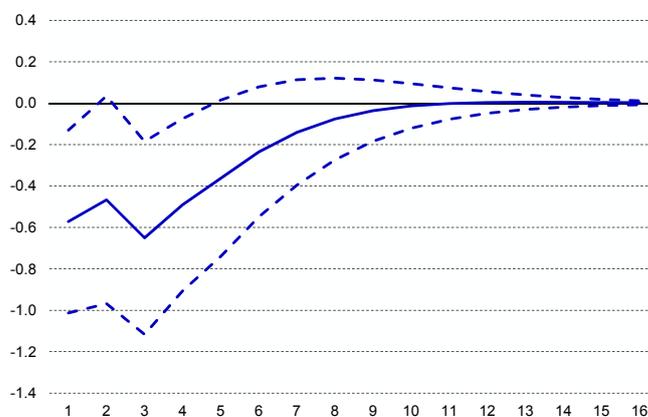
effect on activity.¹⁴ The dashed lines represent the 95 percent confidence bands for the estimates.

As expected, a one standard deviation shock to the financial stress index has a negative effect on both real GDP and potential output. The effect on real GDP is more pronounced on impact and remains statistically significant for slightly more than one year. The impact on potential GDP is much smaller compared to real GDP but also more gradual and persistent, lasting for around four years. The gradual impact on potential GDP growth could be due to the slower accumulation of capital stock from a decline in investment as a result of underutilized capacities or tighter credit conditions.¹⁵

One limitation of this approach is the use of a linear framework, that is, the assumption that there

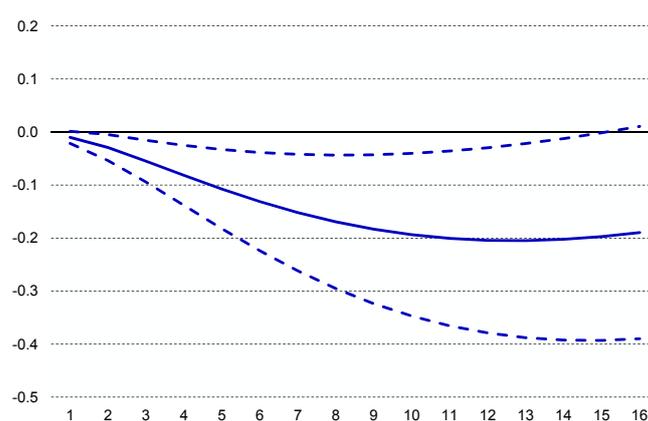
is no distinction between periods of low stress and those characterised by high financial distress. One particular study finds that the average size of financial stress on economic activity during periods of high stress is more than four times that prevailing in normal times.¹⁶ Hence, it is likely that the responses in Charts 3 and 4 understate the impact on

Chart 3
IMPACT OF STRESS ON REAL GDP GROWTH
(per cent deviation following a one standard deviation shock)



Source: Author's calculations.

Chart 4
IMPACT OF STRESS ON POTENTIAL GDP GROWTH
(per cent deviation following a one standard deviation shock)



Source: Author's calculations.

¹⁴ In other words, in terms of the Choleski ordering, financial stress is ordered first. The impulse responses are very similar when the ordering is reversed.

¹⁵ There are other factors in the literature that could have an impact on potential output. For instance, long unemployment spells can cause a permanent destruction in human capital, leading to a higher equilibrium unemployment rate. Similarly, a long recession may discourage some workers from seeking a job, thus reducing the potential labour force. However, these considerations are less relevant for Malta given the robust performance of the labour market.

¹⁶ Troy, D. and Hakkio, C., "What is the effect of financial stress on economic activity?" Federal Reserve Bank of Kansas City, *Economic Review*, 2010.

economic activity during periods of high financial stress and that, during these periods, the impact on growth is more pronounced.

Conclusion

The financial stress index introduced in this article is intended to complement the other tools used at the Central Bank of Malta for its regular analysis of the domestic financial system. The index is best suited to identify past historical episodes of stress and to gauge the impact of such events on economic activity. It is not designed to be used as an early warning indicator of stress as this would require the use of higher frequency data.

The index identified two episodes of financial stress that exceeded the two standard deviation threshold. The first episode took place in early 2000 following the sharp increase in NPLs due to a review of asset quality following regulatory changes. The second and most pronounced episode occurred in late 2008 and early 2009 during the global financial crisis. Contrary to the situation in the euro area, stress in the domestic system returned much more rapidly to normal levels in 2009 as the Maltese banking sector emerged relatively unscathed from the financial crisis and was not affected by the sovereign debt crisis of 2012.

Going forward, this index should prove useful for research on financial stability and its impact on economic activity. For instance, the distinction between different regimes of normal and high stress periods requires the use of a non-linear framework. The indicator of financial stress can also be introduced into an econometric model to trace the impact of stress not only on GDP but also on other variables of interest to policy makers, such as inflation and the unemployment rate, as well as spillovers from financial stress in other countries. Finally, the use of higher frequency statistics to construct such an index could potentially form the basis of an early warning indicator of potential instability in the financial system.