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Do debt service costs affect macroeconomic and financial stability?[1]

Excessive private sector debt can undermine economic stability. In this special feature, we propose the debt service ratio (DSR) as a measure of the financial constraints imposed by private sector indebtedness, and investigate its association with recessions and financial crises. We find that the DSR prior to economic slumps is related to the size of the subsequent output losses. Moreover, the DSR provides a very accurate early warning signal of impending systemic banking crises at horizons of up to one to two years in advance. We conclude that the DSR can serve as a useful supplementary indicator for the build-up of vulnerabilities in the real economy and financial sector.

JEL classification: E37, E44, G01, G21.

The global financial crisis has underlined the destabilising effects of excessive debt build-ups in the private sector. When households and firms are overextended, even small income shortfalls prevent them from smoothing consumption and making new investments. Larger shortfalls trigger a rise in defaults and bankruptcies. As a consequence, output volatility increases, thereby aggravating the repayment problems and increasing banks' losses.[2] When a large part of the private sector is overindebted, a full-scale banking crisis may result. In this special feature, we propose the debt service ratio (DSR) as a measure of the economic constraints imposed by private sector indebtedness.

Defined as interest payments and debt repayments divided by income, the DSR captures the burden imposed by debt more accurately than established leverage measures, such as the debt-to-GDP ratio. That is because the DSR explicitly accounts for factors such as changes in interest rates or maturities that affect borrowers' repayment capacity. This can easily be seen by

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[2] This is consistent with Juselius and Kim (2011), who show that US banking sector credit losses start to increase rapidly if private sector financial obligation ratios – a broader DSR measure – are high and the business cycle deteriorates.

considering a borrower with monthly disposable income of CHF 2,500 who takes out a 20-year mortgage of CHF 150,000 at a 2% variable annual interest rate. Assuming that the loan is paid off in equal shares per month, the borrower's debt servicing costs are approximately CHF 760 at the initial interest rate (see box) and his DSR is 30%. If the interest rate moves to 5%, the debt servicing costs rise to CHF 990 with a DSR of 40%. This clearly reduces the borrower's ability to consume and exposes him to possible future income shortfalls. Yet these effects cannot be deduced from the borrower's (annualised) debt-to-income ratio, which is 500% regardless of the interest rate. In fact, the DSR and the debt-to-income ratio will only provide identical information if interest rates and maturities remain constant.

To explore the DSR's properties, we construct it for the non-financial private sector in several advanced and selected emerging market economies. We find that the ratio's level prior to economic downturns explains a significant fraction of subsequent output losses. This finding is consistent with feedback between debt servicing problems and reductions in aggregate income, suggesting that economic policymakers should be mindful about rising DSRs.

We also find that the DSR produces a very reliable early warning signal ahead of systemic banking crises. DSRs tend to peak just before these materialise, reaching levels that are surprisingly similar across countries. At horizons of around one year before crises, the quality of the early warning signal issued by the DSR is even more accurate than that provided by the credit-to-GDP gap. The latter has been previously identified as the single best performing early warning indicator, which remains the case for horizons longer than two years. As such, the DSR can prove useful to policymakers as a supplementary tool for monitoring the build-up of financial vulnerabilities.

The DSR's explicit dependence on the interest rate establishes a direct link between monetary policy and financial stability. We explore this link by decomposing changes in the DSR around crisis dates into the interest rate-related component and the one related to debt-to-income. We find that the more volatile shifts in the DSR are driven primarily by changes in the short-term money market rate. Hence, this monetary transmission channel may represent an effective way of counteracting private sector debt problems, provided that these are recognised at an early stage.

We also construct separate DSRs for the household and for the business sectors, and find that vulnerabilities do not always build up simultaneously in both. If anything, the business sector has a slight tendency to become overindebted more regularly and more often than the household sector. This suggests that business sector debt problems have a closer link to the business cycle, whereas household indebtedness rises and falls over a longer cycle that is more closely aligned with infrequently occurring banking crises.

This special feature consists of six sections. First, we discuss the construction of DSRs and present the estimated series. In the following two sections, we formally test their association with impending recessions and systemic banking crises respectively. In the fourth section, we discuss the main drivers for DSRs around crisis dates. In the fifth section, we present sector-specific DSR estimates. The final section concludes.

Estimating the aggregate debt service ratio

Constructing DSRs at the aggregate level involves both estimation and calibration, as detailed loan-level data are generally not available. This box discusses the necessary steps.

We make the basic assumption that the debt service costs – interest payments and amortisations – on an aggregate debt stock are, for a given interest rate, repaid in equal portions over the maturity of the loan (instalment loans).[1] The justification is that the differences between the repayment structures of individual loans will tend to cancel out in the aggregate. For example, consider 10 loans of equal size for which the entire principal is due at maturity (bullet loans), each with 10 repayment periods and taken out in successive years over a decade. After 10 periods, when the first loan falls due, the flow of repayments on these 10 loans will jointly be indistinguishable from the repayment of a single instalment loan. Typically, a large share of private sector loans in most countries will in any case be instalment loans, eg household sector mortgage credit.

By using the standard formula for calculating the fixed debt service costs (*DSC*) of an instalment loan and dividing it by income – and interpreting terms as referring to aggregate quantities – we can calculate the DSR (*DSR*) at time *t* as

$$DSR_t = \frac{DSC_t}{Y_t} = \frac{i_t D_t}{(1-(1+i_t)^{-s_t})Y_t} \quad (1)$$

where D_t denotes an aggregate credit stock, i_t denotes the average interest rate per quarter on the stock, s_t denotes the average remaining maturity in quarters in the stock (ie for a five-year average maturity with quarterly down payments, s_t = 20) and Y_t denotes quarterly aggregate income.

While quarterly time series on aggregate income and credit are available for a wide range of countries, we have to estimate the average interest rate and remaining maturity in many countries. National central banks in a number of advanced economies have calculated the average interest rate on the stock of loans of monetary and financial institutions (MFIs) for the past decade or so. We extend these series backwards to the beginning of 1980 using an estimated relationship of the form

$$i_t = \mu + \alpha i_{t-1} + \beta_0 i_t^m + \beta_1 i_{t-1}^m + \beta_2 i_{t-3}^m + \beta_3 i_{t-12}^m + \varepsilon_t \quad (2)$$

where i_t^m denotes the short-term interest rate and ε_t is an error term. This procedure yields fairly accurate estimates to the extent that the proportions of various loan types, eg fixed or variable rate loans, have remained approximately constant. For the remaining countries, we construct the average lending rate as

$$i_t = \alpha i_{t-1} + (1-\alpha)(i_t^m + \mu) \quad (3)$$

starting from the initial value $i_0 = i_0^m + \mu$. We set $\alpha = 0.9$ and $\alpha = 0.8$ for advanced and emerging economies respectively.

Obtaining accurate estimates of the average remaining maturity, in particular over time, is more difficult due to data limitations. For this reason, we make the simplifying assumption that the maturity structure is constant,[2] ie we set $s_t = s$ in (1), even though we allow *s* to differ across countries. While this is the only practicable solution, this assumption is likely to be violated in our sample. For instance, factors such as rising life expectancy and declining inflation rates would all tend to raise the average remaining maturity. Hence, actual remaining maturities may have been lower at the start of our sample, and therefore DSRs would have been higher, than our estimates reveal. However, the effect of changes in the maturity parameter on the estimated DSRs is rather small, suggesting that this problem is more acute for countries that have experienced rapid economic development or hyperinflation in recent decades.[3] Furthermore, by demeaning DSRs with a 15-year rolling average, such slow changes should not affect our statistical results.

Our primary source for estimates of the maturity parameter is euro area data on MFI loans classified into three maturity tranches.[4] We supplement these data with similar OECD household sector data, as well as national data. The estimated maturities are reported in Table A. We note that estimates of household sector debt maturities tend to be higher and vary less across countries than

Estimated average maturity of the credit stock

In years

	Total private sector(s)	Household sector	Household real estate	Business sector
Australia	…	13.50	…	…
Austria	10.50	12.25	13.75	9.25
Belgium	…	13.75	…	…
Canada	…	10.75	…	…
Denmark	13.00	14.00	14.75	11.00
Finland	12.25	13.25	14.50	10.50
France	…	13.00	…	…
Germany	12.25	13.25	14.50	10.25
Greece	8.50	11.50	14.75	5.50
Ireland	…	13.00	…	…
Italy	7.75	10.50	14.75	6.00
Netherlands	11.00	14.00	15.00	9.25
Norway	9.00	14.00	…	…
Portugal	9.75	13.75	14.75	5.25
Spain	10.75	13.50	14.75	8.25
United Kingdom	…	12.00	…	…
United States	…	10.75	19.00	…
Mean	10.50	12.75	15.00	8.50
Std	1.73	1.24	1.43	2.24

Table A

their business sector counterparts. This implies that the relative shares of credit held by these two sectors will affect the average maturity in the total private sector credit stock. Hence, DSRs will generally not be directly comparable in absolute terms across countries. For the countries with missing entries in the first column, we used calibrated numbers from the household sector estimates. For other advanced or emerging market economies countries, we set m = 40 (10 years) and m = 30 (7.5 years) respectively.

[1] In an instalment loan, debt servicing costs are regularly paid in a series of equal instalments over the lifetime of the loan. The Fed uses a similar approach to calculate debt service costs for the household sector (Dynan et al (2003)). [2] This has the advantage that voluntary down payments on the principal will not affect the estimated ratios. [3] For this reason, we focus mainly on advanced economies or highly developed emerging market economies. We also exclude from the sample countries that have experienced hyperinflation. [4] The tranches are loans with a remaining maturity of less than one, between one and five, and above five years. We assume that the average maturity within the tranches is 0.5, 3 and 15 years respectively, and take a weighted average.

Constructing the aggregate debt service ratio

Ideally, the build-up of potential financial vulnerabilities in the private sector would be assessed by looking at the DSRs of households and firms that are highly indebted relative to their disposable income. As such data are unfortunately not publicly available, we have to rely on aggregated measures. Aggregation always entails the loss of some information: for example, not all households are indebted. However, as this article shows, even aggregated DSRs can provide very useful information about impending downturns and financial crises.

As discussed in detail in the box, the measurement of aggregated DSRs requires a credit aggregate, together with an appropriate measure of income and an associated average lending rate. In addition, we need at least some information on the average repricing and maturity structure of the credit aggregate.[3]

To capture financial constraints imposed by private non-financial sector debt, we construct DSRs …

We construct a quarterly time series of non-financial private sector DSRs for 27 countries, starting from the early 1980s where possible. These cover mainly advanced economies but also some emerging markets. We use total credit to households and firms as the relevant credit aggregate and GDP as a proxy of the combined income of these two groups. Average lending rate data for the non-financial private sector are available only for 12 advanced countries and relate only to the most recent decade.[4] We construct estimates of these series for the earlier years in our sample and for the remaining countries based on the association between lending rates and the short-term money market rate (see box).

To highlight general patterns in the DSRs in our sample, Graph 1 depicts the estimated DSRs for six representative countries. The vertical dark grey bars indicate the period between peaks and troughs in real GDP, whereas the red lines mark the initial dates of banking crises.[5] Three important properties stand out.

First, the DSRs have a tendency to rise prior to slumps and decline in their aftermath. However, as several factors, such as foreign demand or government spending, are relevant in shaping the business cycle, this relationship is clearly less than perfect.

Second, a more definite pattern is that most major peaks in the DSRs are associated with a crisis, suggesting that the ratio might serve as a reliable early warning indicator. One exception is Australia, but this has more to do with the rather stringent definition of systemic crises that we employ than the DSR's performance. In 1989, two banks experienced stress and received capital injections from the government (Reinhart and Rogoff (2008)). And in late 2008, the Australian authorities took action on several fronts to stabilise the banking system.[6]

Third, the DSRs' peak levels are surprisingly similar across countries and time despite different levels of financial development. As a broad rule of thumb,

[3] In the final section, we show that our method of constructing DSRs with relatively little information provides approximations that appear consistent when compared with IMF and Fed estimates.

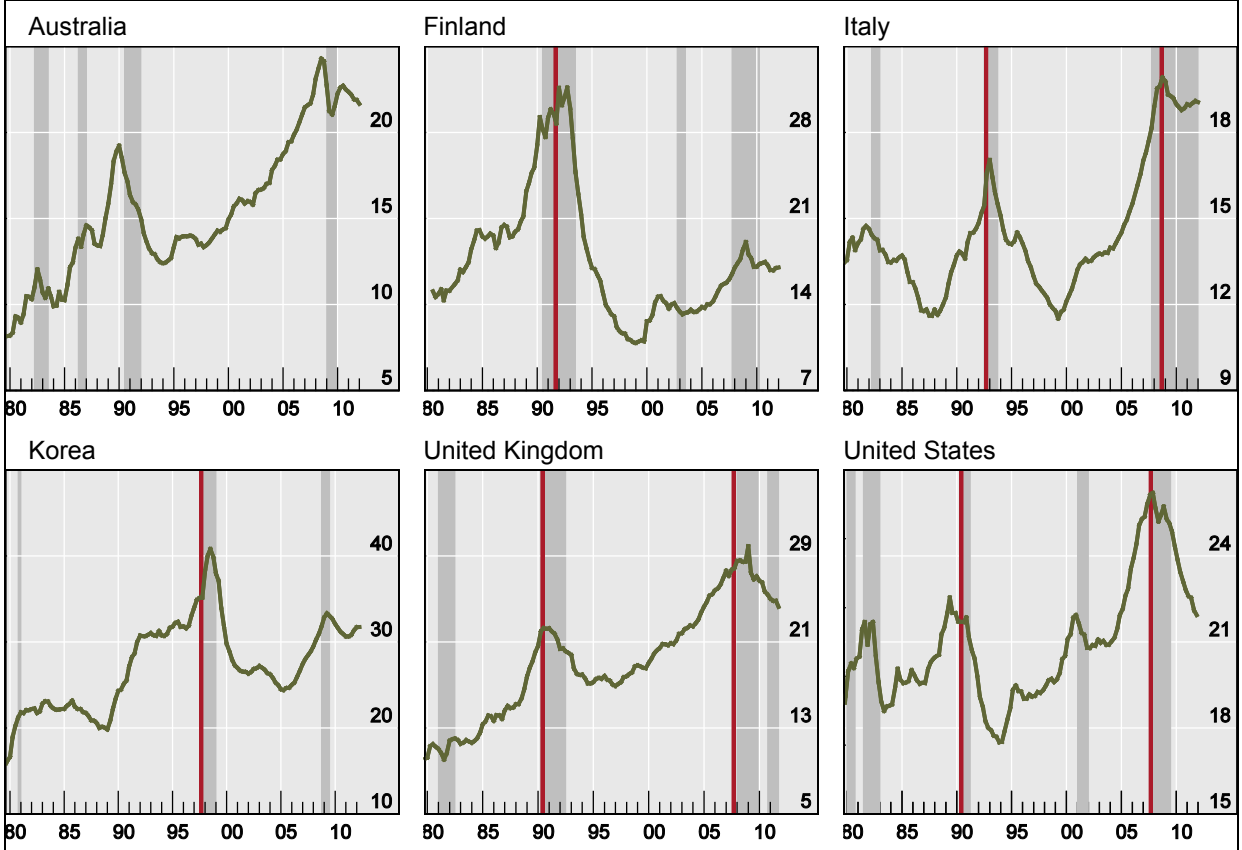
[4] The 12 countries for which average lending rates are available are Australia, Denmark, Finland, Germany, Greece, Italy, Japan, Norway, Portugal, Spain, the United Kingdom and the United States. The remaining countries are Belgium, Canada, the Czech Republic, France, Hungary, Ireland, Korea, Malaysia, the Netherlands, New Zealand, Poland, South Africa, Sweden, Switzerland and Thailand.

[5] Throughout the paper, crisis dates are based on Laeven and Valencia (2012). In addition, we have used judgment and drawn on correspondence with central banks to determine some of the crisis dates.

[6] In particular, the Australian authorities enhanced the deposit insurance scheme, introduced debt guarantees and intervened in the capital markets to buy residential mortgage-backed securities. These measures were framed as a response to international funding pressures.

DSRs and crisis dates

In percentage points



The red vertical lines indicate the initial date of a banking crisis. The shaded areas represent recession periods as identified by the algorithm suggested by Harding and Pagan (2002), except for the United States, where NBER recession dates are used.

Sources: NBER; national data; authors' calculations. Graph 1

the graph panels suggest that a DSR above 20–25% reliably signals the risk of a banking crisis. However, for some countries, such as Korea, the DSR typically exceeds this level without any crisis occurring. Equally, some countries, like Germany or Greece (not shown), have much lower values. This is likely to be driven by country-specific factors, such as the age distribution, the rate of home ownership, industrial structure and income inequality. An additional factor could be the assumptions that we have made in order to deal with countries where data are partly missing. To take such country-specific effects into account, we subtract 15-year rolling averages from the DSRs in what follows.

The debt service ratio and the severity of recessions

… which worsen economic downturns when they increase …

The discussion in the introduction suggests that the effects of negative shocks to income and rising interest rates are substantially amplified when the private sector is overindebted relative to its income. High DSRs prevent borrowers from smoothing consumption or undertaking profitable investments. If shocks are significant, large-scale defaults may result. Both effects increase output volatility.

To explore this question, we conduct simple regressions to evaluate how DSRs could affect the severity of recessions. A more complete assessment would account for potential non-linear interactions between DSRs and output volatility, but our analysis is intended as a first step towards illuminating the link between overindebtedness and output losses. We implement a two-stage procedure.

First, we identify the peaks and troughs of the real business cycle. Except for the United States, consensus dates are not available. We therefore use the computerised algorithm suggested by Harding and Pagan (2002). The algorithm involves (i) the identification of local maxima and minima in real GDP[7] and (ii) the imposition of censoring rules to ensure that each cycle has a minimum length of five quarters and that each phase (expansion or contraction) is at least two quarters long. Once the peaks and troughs are identified, we measure the severity of a recession by the relative fall in output from the peak to the following trough.

Second, we try to explain the severity of recessions by reference to the DSR and also to the credit-to-GDP gap, a more established measure for overindebtedness. The credit-to-GDP gap is the deviation of the (private sector) credit-to-GDP ratio from its long-term trend and can be interpreted as a rough measure of excessive private sector leverage (Borio and Lowe (2002)). In contrast to earlier work, we use a measure of total credit from all sources instead of bank credit when calculating the gaps, drawing on a new BIS database.

This step of the analysis follows Cecchetti et al (2009), who explored a broad range of explanatory variables, but found that only GDP growth preceding the peak and crisis indicators can robustly explain the severity of recessions. We therefore include these variables as controls.

… thereby helping to explain losses in recessions

Table 1 shows that higher DSRs significantly increase the severity of recessions. This is also the case for the credit-to-GDP gap, even though these effects disappear if the DSR is also included and they are economically much less important. In contrast, the effects of the DSR on the subsequent recession are economically important: if the DSR is 5 percentage points higher, the

Impact of indebtedness on the severity of recessions

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5
GDP growth	–0.22**	–0.20	–0.25**	–0.24*	–0.22*
DSR	–0.29***		–0.22***		–0.17*
Credit-to-GDP gap		–0.07***		–0.05**	–0.02
Banking crises			–1.29	–2.22***	–1.57*
Constant	–2.26***	–2.45***	–2.04***	–1.88***	–1.88***
R^2	0.19	0.16	0.22	0.26	0.28

Results are based on a panel regression using random effects. */**/*** indicates significance at the 10/5/1% confidence level.

Sources: National data; authors' calculations. Table 1

[7] A local maximum (minimum) is defined at time *t* if the value of real GDP is the highest (lowest) within the five-quarter window centred at *t*.

recession is about 25% more severe, as real output would on average drop by 5% rather than 4%. And, as seen from Graph 1, a 5 percentage point increase in the DSR is not uncommon.

The debt service ratio as an early warning indicator for crises

In this section, we formally test our initial impression, derived from Graph 1, that the DSR captures financial fragilities in the run-up to crises. We benchmark its performance against the credit-to-GDP gap, which has been identified from a wide range of alternatives as the best single early warning indicator for systemic banking crises (Borio and Lowe (2002) or Drehmann et al (2011)).[8]

DSRs tend to rise sharply before crises and decline rapidly in their aftermath …

As a first step, we look at the time profile for both indicator variables around systemic banking crises. Graph 2 summarises the behaviour of the variables during a window of 16 quarters before and after the onset of a crisis (time 0 in the graphs). For each variable, we show the median (solid line) as well as the 25th and 75th percentiles (dashed lines) of the distribution across episodes. In both cases, a value of zero corresponds to the average conditions outside the 33-quarter window.[9]

The graph shows that both the DSR and the credit-to-GDP gap are very high in the run-up to crises, albeit with different time profiles. The median DSR starts from a relatively low base and triples during the four years before a crisis, at which point it peaks. The credit-to-GDP gap, on the other hand, is already very high three to four years ahead of a crisis but rises much more slowly. These developments can be interpreted in terms of the slow and continuous build-up of leverage before the crisis. Ultimately, though, crises erupt when the incipient liquidity constraint captured by the DSR starts to bind. For early warning purposes, Graph 2 suggests that both indicators should be useful, but that the DSR may perform better over shorter horizons and the credit-to-GDP gap over longer ones.

To assess the early warning performance of each indicator, we use a signal extraction method as first proposed in this type of context by Kaminsky and Reinhart (1999). The underlying idea is simple: a particular indicator will give a signal if it breaches a predefined threshold. We consider a signal correct if a crisis occurs at any point within the following three years. Otherwise, we consider it incorrect (a false positive). The noise-to-signal ratio is the fraction of false positives relative to the fraction of correct signals. The lower this ratio, the better the signalling quality of the indicator. As the costs of false positives are much lower than those of failing to predict a crisis, we search across a wide range of thresholds to select the one that keeps the noise-to-signal ratio to a minimum while predicting at least two thirds of the crises.[10]

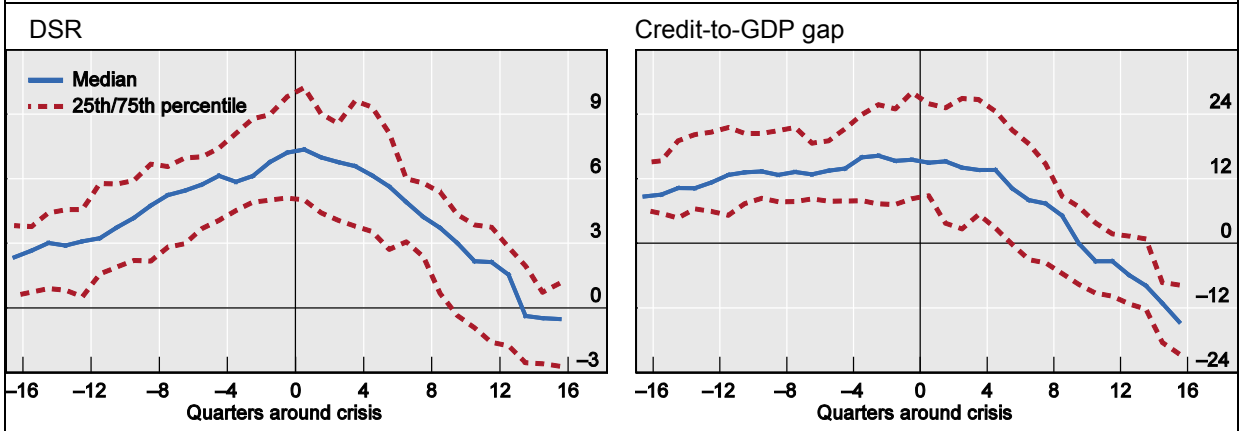
[8] Combining the credit-to-GDP gap with indicators that capture accelerating asset price growth such as the property price and equity price gaps can provide better early warning indicators (Borio and Drehmann (2009)).

[9] Outside the 33-quarter window, the DSR has a mean of –0.1 and the credit-to-GDP gap one of 1.2.

[10] See Borio and Drehmann (2009) for a more detailed discussion of this issue.

Debt servicing and credit behaviour around banking crises[1]

In percentage points



[1] The horizontal axis depicts plus/minus 16 quarters around a crisis, which is indicated by the vertical line. The historical dispersion of the relevant variable is taken at the specific quarter across crisis episodes in the sample.

Sources: National data; authors' calculations. Graph 2

… and hence can be used as a reliable early warning indicator

The upper panel of Table 2 shows that the DSR outperforms the credit-to-GDP gap as an early warning indicator when the full three-year horizon is used.[11] Shaded cells highlight the minimum noise-to-signal ratio for each indicator, always provided that two thirds or more of the crises are predicted. In the DSR's case, this noise-to-signal ratio is 5% compared with 17% for the credit-to-GDP gap. These noise-to-signal ratios are extremely low. In the large scale study by Drehmann et al (2011), the runners-up to the credit-to-GDP gap in terms of predictive performance had corresponding noise-to-signal ratios of about 30–40%.

The statistical tests also confirm the intuition that leverage builds up slowly before a crisis, but that the crisis itself is often precipitated by tightening liquidity constraints (Table 2, lower panels). To examine this proposition, we also consider the performance of both indicators in providing a warning only one, two or three years in advance of a crisis.[12] Thus, rather than assuming that a signal is correct if a crisis erupts in *any* of the three years after it is issued, we make the assumption that it is correct if a crisis breaks in a *specific* year (the first, second or third).

… in particular one to two years before crises, whereas measures of excessive leverage tend to pick up vulnerabilities as early as three years before crises

The DSR owes most of its predictive ability to the developments in the year immediately before a crisis. The performance here is exactly the same as for the full three-year horizon. When only year 2 or year 3 is considered, the minimum noise-to-signal ratio increases to 15% and 33% respectively, as we must lower the optimal thresholds in order to predict two thirds of the crises. In contrast, the credit-to-GDP gap performs consistently well during each of the three years leading up to a crisis. For example, for year 3, a credit-to-GDP gap

[11] The results discussed in this paper are robust to the use of data drawn solely from countries for which high-quality DSRs are available.

[12] Technically, when analysing a particular horizon (eg year 2), we take account only of signals emitted for that year and ignore signals emitted for the other two years in the three-year forecast horizon (eg in years 1 and 3).

Predictive performance of the DSR and the credit-to-GDP gap						
	DSR			Credit-to-GDP gap		
Horizon[4]	TH[1]	Pred[2]	NS[3]	TH[1]	Pred[2]	NS[3]
All years						
All three years	2.5	84	27	8.5	92	23
	4	80	13	9.5	84	22
	5	80	8	11	76	21
	6	68	5	14	72	17
Individual years						
Year 1	2.5	84	27	8.5	80	27
	4	80	13	9.5	68	28
	5	80	8	11	64	25
	6	68	5	14	60	20
Year 2	2.5	84	27	8.5	80	27
	4	68	15	9.5	80	24
	5	60	10	11	72	22
	6	52	6	14	48	25
Year 3	2.5	68	33	8.5	72	30
	4	56	18	9.5	72	26
	5	48	13	11	64	25
	6	28	11	14	52	23

Threshold with minimum noise-to-signal ratio given that more than two thirds of crises are predicted.

[1] Threshold. [2] Predicted. [3] Noise-to-signal ratio. [4] Indicates the horizon within which a crisis has to occur for the signal to be classified as correct. All three years: a signal is correct if a crisis erupts at any time within the next three years. Year 1 (2/3): a signal is correct if a crisis erupts in the first year after the prediction was made (or in the second/third year).

Sources: National data; authors' calculations. Table 2

greater than 12 percentage points predicts 72% of crises with a noise-to-signal ratio of 26%. And this optimal threshold does not change much when only year 1 or year 2 is considered.

Overall, the analysis indicates that the DSR and the credit-to-GDP gap provide complementary information. While the credit-to-GDP gap starts to signal impending vulnerabilities well in advance of a crisis, a rapid rise in the DSR above 6% (relative to a 15-year average) is a very strong indication that a crisis may be imminent.

Decomposing changes in the debt service ratio

The foregoing analysis has shown that the DSR has a clear tendency to increase rapidly a few years prior to financial crises and to fall off in their wake. What explains this dynamic? Two major factors can contribute to changes in the DSR: changes in the average lending rate and changes in the credit-to-GDP ratio.[13] In this section, we investigate the behaviour of these factors

[13] We do not consider changes in the average remaining maturity as a cause for short-term changes in the DSR. For example, banks may at times have incentives to temporarily extend

before and after crises, and discuss their implications for the monetary transmission channel.

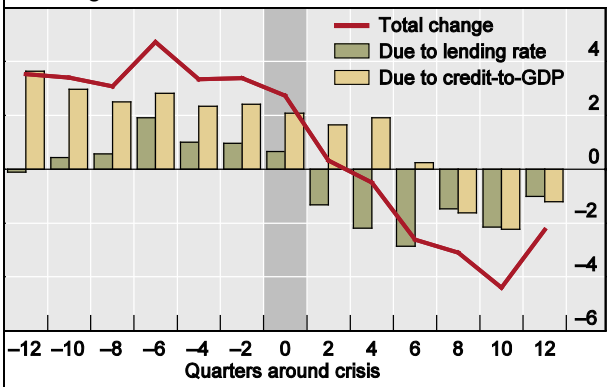
Sharp changes in DSRs around crises are mainly driven by changing short-term policy rates

While increases in the credit-to-GDP ratio induce steady and large increases in the DSR prior to a crisis, it is rising or falling lending rates that cause the sharpest changes. This can be seen from Graph 3 (left-hand panel), which decomposes the average changes in the DSR three years before and after a crisis into those due to changes in the lending rate and those arising from changes in the credit-to-GDP ratio. The contribution of the credit-to-GDP ratio is positive and quite steady (approximately 3% per half-year) ahead of a crisis. In contrast, the impact of the lending rate is more volatile. Three years ahead of a crisis, changes in lending rates contribute virtually nothing to rising DSRs. Their contributions then increase rapidly one or two years before a crisis, peaking at a semiannual rate of almost 2%. After a crisis, the DSR's decline over the first one and a half years is almost entirely due to falling lending rates, as the credit-to-GDP ratio adjusts only slowly.

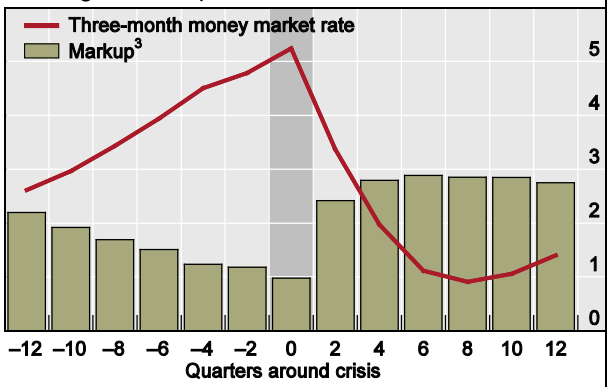
The rapid increase and decline in the lending rate around crisis dates is almost exclusively due to changes in the short-term policy rate rather than in lending spreads. This is evident from the right-hand panel of Graph 3, which compares the average markup in the lending rate with the average short-term money market rate.[14] Money market rates start to increase strongly about 12 quarters before a crisis but decline rapidly thereafter. In sharp contrast, the average markup in the lending rate falls in the run-up to a crisis but rises rapidly after the crisis erupts. Interestingly, this pattern is at odds with forward-looking behaviour, which would suggest that risk premia should increase before a crisis.

Decomposing DSRs and lending rates around banking crises[1]

Changes in DSRs[2]



Lending rate components



[1] The horizontal axis depicts plus/minus 12 quarters around the beginning of a crisis, which is indicated by the dark grey bar. The historical dispersion of the relevant variable is taken at the specific quarter across crisis episodes in the sample. [2] Semiannual percentage change in estimated DSRs around crises in advanced economies. [3] Deviation between the three-month money market rate and the average lending rate on loans to the private non-financial sector around the financial crisis in 2007–08; in per cent. Countries included: Denmark, Finland, Germany, Greece, Italy, Portugal and Spain.

Sources: National data; authors' calculations. Graph 3

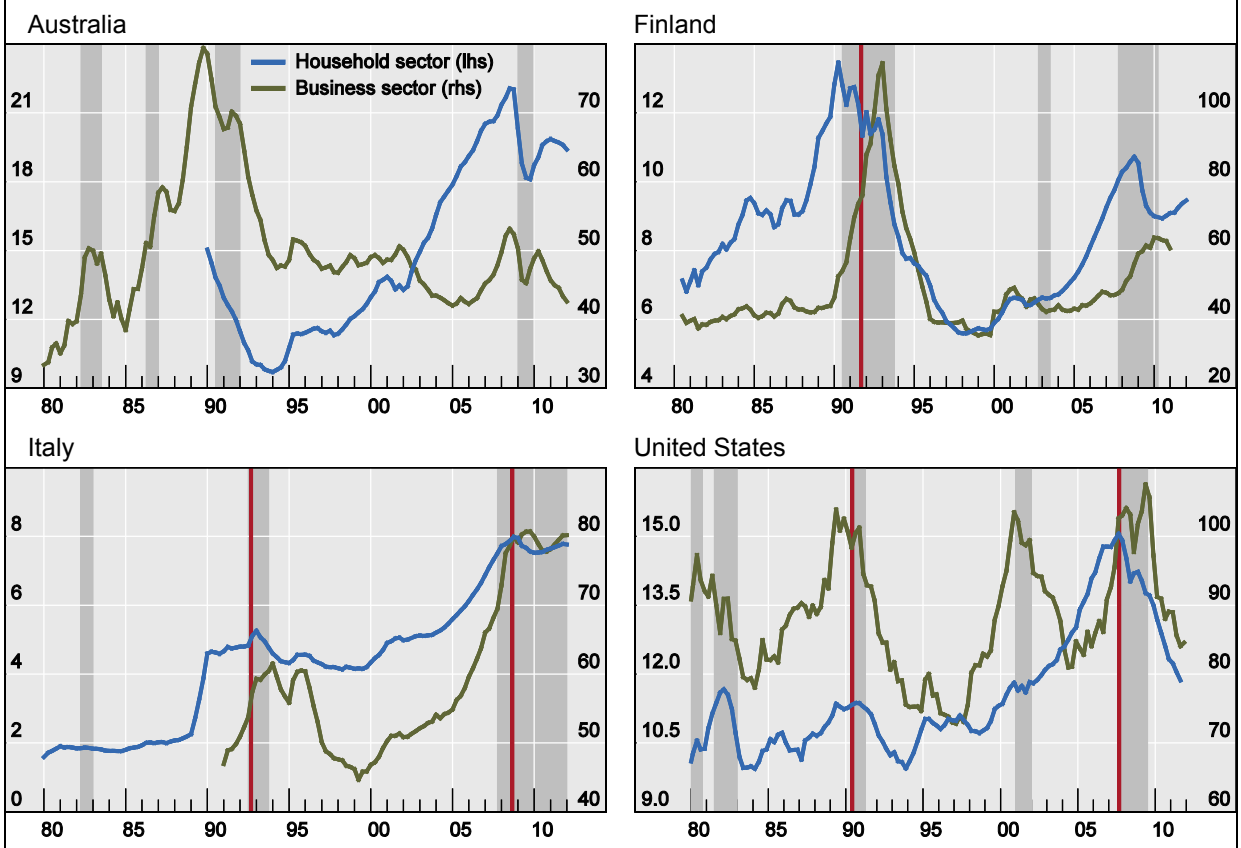
maturities for financially distressed borrowers. While it is conceivable that such changes occur, their net effect is nevertheless likely to be small.

[14] This decomposition can only be done around the recent crisis dates when high-quality data are available, as it requires more detailed information about lending rates.

These patterns suggest that the impact of interest rate changes on the DSR constitute an important additional way in which monetary policy is transmitted to the real economy. An increase (reduction) in nominal interest rates leads to higher (lower) lending rates that raise (lower) DSRs. As we have shown in the previous sections, high DSRs increase output volatility and can lead to a financial crisis. Of course, changing the policy stance may also influence both credit and income via other channels.[15] This will affect the DSR to the extent that the credit-to-income ratio changes. Because an interest rate change is only gradually transmitted to credit and income and tends to move them in the same direction, however, it may take considerable time before there is a notable impact on their ratio. This seems to be the case in Graph 3. The left-hand panel shows that the change in the credit-to-GDP ratio remains approximately constant until a crisis occurs (and a few quarters beyond) even though money market rates are steadily increasing over the same period (right-hand panel).

Household and business sector DSRs

In percentage points



The red vertical lines indicate the initial date of a banking crisis. The shaded areas represent recession periods as identified by the algorithm suggested by Harding and Pagan (2002), except for the United States, where NBER recession dates are used.

Sources: NBER; authors' calculations. Graph 4

[15] Mishkin (1996) provides an overview of the various channels of monetary transmission. In terms of Mishkin's terminology, the "debt cost" channel that we discuss here seems to belong under the more general "credit channel".

DSRs for the household and the business sector

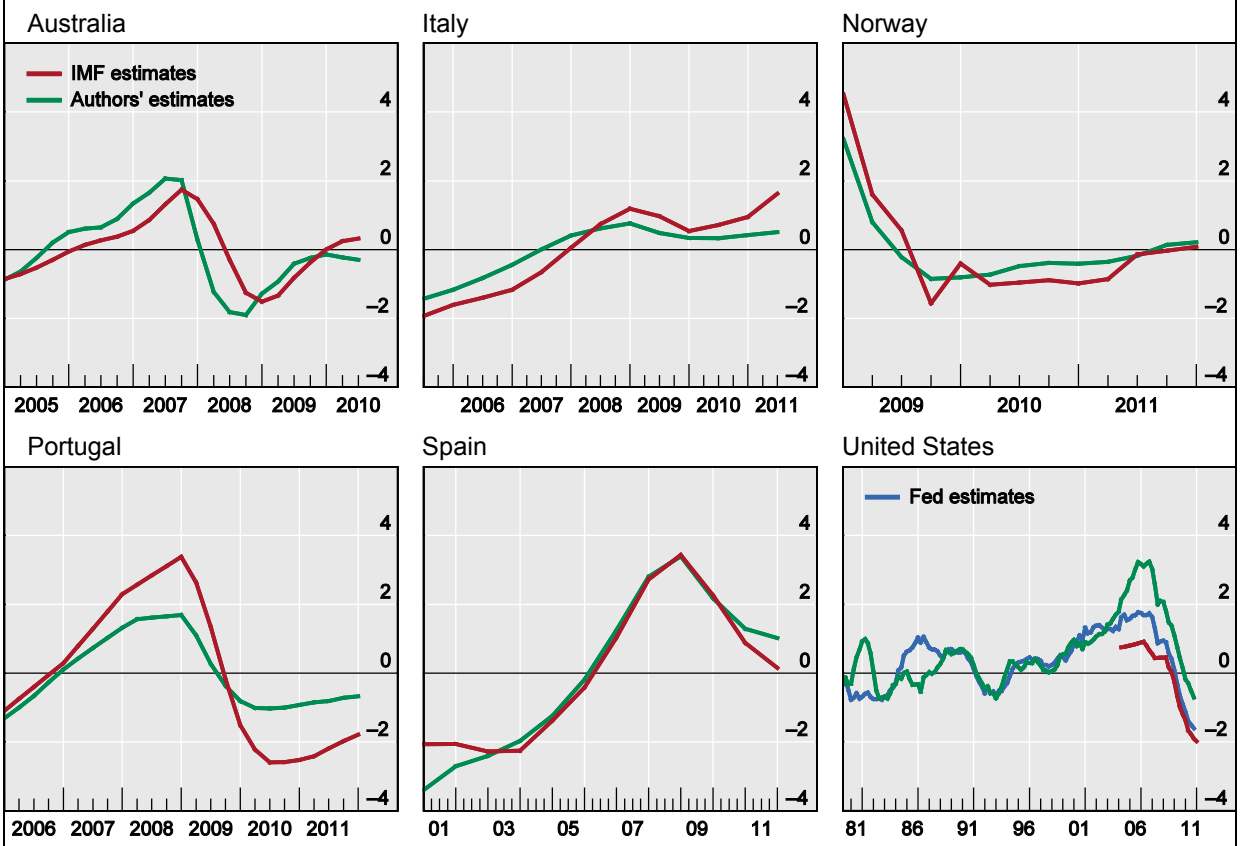
Sectoral DSRs are consistent with existing estimates and can reveal different vulnerabilities for the household and the business sector

To assess whether increases in aggregate DSRs are driven by the debt situation of households or businesses, this section derives separate DSRs for each sector. The data required to do so, however, are only available for a subset of countries.[16] An additional complication arises from the question of how to divide GDP between the two sectors. We sidestep this problem by using disposable income for the household sector and the corporate operating surplus for the business sector.

The sector-specific DSRs reveal that sectoral vulnerabilities may not always build up at the same time. As examples, Graph 4 depicts these ratios for Australia, Finland, Japan and the United States. The graph shows that the DSRs in the two sectors can, at times, display significantly different patterns. For instance, in the United States, the business sector DSR seems to be more closely linked to the standard business cycle, whereas household sector DSRs only peak ahead of a crisis. Also, the Australian business sector's DSR did not peak after the recent global crisis, in sharp contrast to the corresponding household sector pattern.

Comparison of DSR estimates

Deviations from mean in percentage points



Sources: US Federal Reserve System; IMF; national data; authors' calculations. Graph 5

[16] Sectoral DSRs can be constructed for Australia, Denmark, Finland, Italy, Japan, Norway, Portugal, Spain, the United Kingdom and the United States.

The household sector DSRs confirm that our method of constructing DSRs with relatively little information results in approximations that appear remarkably consistent when compared with estimates by the IMF and the Fed. In particular, the latter uses much more granular data (Dynan et al (2003)). The average difference between our US estimates and those of the Fed and the IMF are –0.41% and 0.84% respectively. For the remaining countries, the levels of DSR estimates provided by the IMF differ from ours. One likely explanation is that the IMF approximates credit by different series. The *cyclical* patterns, though, are exceptionally well aligned. This is clear from Graph 5, which shows the deviations of different household sector DSR estimates from their respective means in countries where such a comparison is possible.

Concluding remarks

In this special feature, we have discussed the DSR's capabilities as an indicator for private sector indebtedness. We have found that its level is associated with the loss of output in subsequent economic downturns and that it provides a fairly accurate signal for an impending financial crisis, albeit at shorter horizons than alternative measures.

This suggests the benefits of monitoring the debt service costs in the economy. It also indicates that policymakers should act early when choosing to lean against credit booms, before the DSR reaches critical levels.

Despite these promising results, several data-related issues need to be resolved before more accurate DSR estimates can be produced. Data for the average interest rate and remaining maturity of the outstanding credit stock would be particularly useful. Currently, this type of data exists only for the most recent decade and for a small set of industrialised countries. A broader coverage would permit a deeper characterisation of the linkages between short-run policy rates and the DSR. Such an analysis would potentially be useful for policy.

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