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Bank regulation, property prices and early warning systems for banking crises in OECD countries ☆

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ABSTRACT

Early warning systems (EWS) for banking crises generally omit bank capital, bank liquidity and property prices. Most work on EWS has been for global samples dominated by emerging market crises where time series data on bank capital adequacy and property prices are typically absent. We estimate logit crisis models for OECD countries, finding strong effects from capital adequacy and liquidity ratios as well as property prices, and can exclude traditional variables. Higher capital adequacy and liquidity ratios have a marked effect on the crisis probabilities, implying long-run benefits to offset some of the costs that such regulations may impose.

1. Introduction

There is a large literature on systemic banking crisis prediction via so-called early warning systems (EWSs) which utilise a range of estimators from panel logit (as in Demirgüc-Kunt and Detragiache, 2005; Davis and Karim, 2008a) to signal extraction (Kaminsky and Reinhart, 1999; Borio and Lowe, 2002; Borio and Drehmann, 2009) to binary recursive trees (Duttagupta and Cashin, 2008; Karim, 2008; Davis and Karim, 2008b).

These models' success at predicting crises varies, with the logit and binary trees outperforming signal extraction in terms of type I and type II errors.[1] Nevertheless, a shared feature of these previous studies has been their reliance on cross-sections of heterogeneous economies and a common set of explanatory variables to explain banking crises. Following Demirgüc-Kunt and Detragiache (1998), these typically include macroeconomic and financial variables such as real GDP growth, terms of trade and domestic real credit growth. The reliance on such generic indicators links to the dearth of data on more specific banking sector and asset price variables for many emerging market countries, that are nevertheless included in samples in order to boost the number of infrequent banking crisis observations.

We contend that the specifications of such models are undoubtedly inadequate for two reasons. Firstly, the triggers of a crisis depend on the type of economy and the nature of the banking system. For example, in advanced economies with high levels of banking intermediation and developed financial markets, shocks to terms of trade are less important crisis triggers than, say, property price bubbles.[2] This implies that focusing on a certain class of economies and selecting explanatory variables that are relevant to their banking structures and lending behaviour could improve EWS design.

Secondly, (and related to the previous point), the regulation of developed economy banking systems is more likely to employ liquidity and capital adequacy. Financial regulators are typically monitor such ratios to restrict instability, which implies these variables are at least used implicitly as EWSs. Previous EWSs failed to incorporate balance sheet variables as explicit banking crisis

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[1] See Davis and Karim (2008a) and Karim (2008).

[2] Beltratti and Morana (2010) analyse the wider relationship between house prices and macroeconomic fluctuations, both domestically and internationally.

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predictors, perhaps because of a lack of foresight on the part of regulators.[3] It is also possible that EWS design never evolved in this direction because banking crises in developed economies were viewed as highly unlikely over the past decade during the "Great Moderation" when this literature has developed. Hence, despite data availability, extant research has not assessed new leading indicators of crises for their explanatory power in developed countries.

In this paper, we address these deficiencies in EWS design. We develop an EWS which demonstrates that unweighted[4] banking sector capital adequacy[5] (often known as the leverage[6] ratio) and the banking sector liquidity ratio, alongside real house price growth, are the most important crisis determinants for OECD economies. Moreover, their importance remains invariant to different robustness tests and we can use the information they convey to predict the sub-prime episode out-of-sample. Since research has hitherto not examined these variables, our results have important policy implications for financial regulators and central banks; optimising the liquidity and capital adequacy[7] ratios of banks and suppressing rapid property price growth may well mitigate future OECD crises.

We structure the paper as follows, in Section 2 we outline the panel logit methodology we have adopted, and we introduce the dataset. In Section 3 we detail the results. In Section 4 we provide some analysis of the robustness of our results. Section 5 concludes and makes some suggestions regarding policy implications. We also include Appendices on patterns of marginal effects and on correlation of our right-hand side variables.

2. Methodology and data

Demirgüc-Kunt and Detragiache (1998) used the multivariate logit technique to relate the probabilities of systemic banking crises to a vector of explanatory variables. The banking crisis dependent variable, a binary banking crisis dummy, was defined in terms of observable stresses to a country's banking system, e.g. the ratio of non-performing loans to total banking system assets exceeds 10%[8], and it occurs in around 5% of all time and country observations in that paper. Demirgüc-Kunt and Detragiache (2005) updated the banking crises list to include more years, and more crises.

Such crisis dummies generate several problems. Firstly, the start and end dates are ambiguous. It could be a while after the onset of crisis before the crisis criteria are observably met, and the criteria themselves are static, revealing nothing about when the crisis terminates. Since the end dates are to some extent subjectively chosen there are potential endogeneity problems with estimation; ongoing crises will affect the explanatory variables. To mitigate this, in our core results we terminate our estimation before the sub-prime episode. Secondly, the timing of the crises is crude in the sense that for annual dummies, a crisis starting in December 2000 would generate a value of 1 in 2000 and zero in 2001. However we are concerned with predicting the *switch* between crisis and non-crisis states and accordingly we assume 1 year crisis duration. For the example given, we accept our dummy takes a value of 1 in 2000 and zero thereafter, although we will later relax this assumption and show our results remain robust.

Our dataset includes 14 systemic and non-systemic crises in 14 OECD countries. We take information concerning systemic banking crises from the IMF Financial Crisis Episodes database which covers the period of 1970–2007.[9] We collect non-systemic crises from the World Bank database of banking crises over the period of 1974–2002.[10] The sample covers[11]: Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Sweden, Spain, UK and the US over the period 1980–2007. Table 1 presents the matrix of crises, with bold observations indicating systemic crises. The frequency of crises in our data set is 3.2% which is marginally below the 5% in Demirgüc-Kunt and Detragiache (2005), but is well within acceptable bounds for the style of analysis.

Our variables cover the years 1980–2007, but we partition the sample into 1980–2006 for in-sample estimation whilst we use 2007 data for out-of-sample prediction. For bank-regulatory target variables, given the cross country dataset, we use the unweighted capital adequacy (leverage[12]) ratio and not an estimate of risk-adjusted capital adequacy for the estimation. The unweighted capital adequacy ratio is the ratio of capital and reserves for all banks to the end of year total assets as shown by the balance sheet. Our corresponding measure of bank liquidity is the ratio of the sum of cash and balances with central banks and securities for all banks over the end of year total assets as shown by the balance sheet. We construct unweighted capital adequacy and liquidity ratios using data from the OECD income statement and balance sheet database for all countries apart from the UK. We obtain any missing OECD database observations, as well as the data for 2006 and 2007, from individual Central Banks and the BankScope[13] database. The OECD database does not supply figures for the UK. For that country, we define the unweighted capital adequacy ratio as for other countries and construct it using Bank of England aggregate data. We also construct UK liquidity ratios using Financial Services Authority (FSA) data, where liquidity is defined as the ratio of liquid assets[14] over total assets. Finally house prices are obtained from the NIESR NiGEM database.

As regards the explanatory variables employed, Demirgüc-Kunt and Detragiache (2005), who had 77 crises in their sample, found that they were correlated with macroeconomic, banking sector and institutional indicators. Crises occurred in periods of low GDP growth, high interest rates and high inflation, as well as large fiscal deficits. On the monetary side, they found the ratio of broad money to foreign exchange reserves and the credit to the private

[3] The potential importance of such balance sheet variables is shown in a study of individual bank distress in Eastern European transition economies by Männasoo and Mayes (2009) which shows that fragile funding bases (related to low liquidity) as well as high exposure to market risk in an environment of reforms and macroeconomic disturbance are typical precursors of financial distress on the part of individual banks.

[4] We do not use the risk adjusted capital adequacy ratio partly for data reasons, since data on this ratio is not available for most of the countries and periods examined. But also we note that a number of commentators such as Shin (2009) and Turner Report from the Financial Services Authority (2009) have suggested that unadjusted capital adequacy was highly relevant in the run-up to the sub-prime crisis to complement the risk adjusted (Basel) measure.

[5] Jokipii and Milne (2008) note that capital adequacy of European banks has a negative co-movement with the cycle, which our work suggests exacerbates the risk of crises.

[6] Note this definition of the banking leverage ratio (i.e. capital/unadjusted assets) operates contrary to normal concepts of leverage, in the sense that a higher "leverage ratio" means lower "leverage" in an economic sense of debt-to-equity. Accordingly we prefer to use the term "unweighted capital adequacy" to avoid ambiguity.

[7] Note that although for data reasons we use the unweighted capital adequacy ratio, we expect that risk adjusted capital is also a crisis indicator. Our overall view is that both ratios need to be borne in mind in assessing crisis risk.

[8] Their actual criteria are: the proportion of non-performing loans to total banking system assets exceeded 10%, or the public bailout cost exceeded 2% of GDP, or systemic crisis caused large scale bank nationalisation, or extensive bank runs were visible and if not, emergency government intervention was visible.

[9] See Laeven and Valencia (2007).

[10] See Caprio and Klingebiel (2003).

[11] Choice of the countries is limited by the availability of the data for our time period.

[12] See Footnote 3.

[13] For the liquidity measure, we calculate the ratio of liquid assets to total assets for the top 200 banks in a country in question.

[14] These are the sum of cash, gold bullion and coin, central government and central bank loans, advances and bills held and central government and central bank investments (i.e. securities).