Box 14

BEYOND THE STRESS TESTING OF INDIVIDUAL BANKS: HOW SHOCK PROPAGATION THROUGHOUT THE ECONOMY MAY MULTIPLY INITIAL LOSSES

Stress tests aim at identifying weak points in financial systems by estimating the potential losses in individual financial institutions under various adverse but plausible scenarios. The majority of present methodologies are designed to capture the effect of stress on the capital buffers of the particular institution under examination. However, the assessment in many cases stops there, without considering potential knock-on effects on other institutions that might be interconnected with the institution under investigation. Such second-round effects might act as important amplifiers of stress in the financial system because in a modern economy bilateral financial interlinkages across various sectors are tight. As a result, financial stress in some sectors could cause a chain reaction in which the balance sheets of other financial and non-financial sectors might also be adversely affected.

Examination of the flow-of-funds data (from financial accounts) provides a way to assess the economic relevance of these interlinkages and can also provide information on the distribution of losses within the economy. A useful starting point is the observation that in the financial accounts each financial instrument issued has a counterparty. This means that if a sector experiences an adverse shock to the value of its assets, which is also reflected as a loss on its equity, this loss of equity value is transmitted to those sectors (or to other institutions within the sector itself) which hold that equity on the assets side of their balance sheets.[1] For example, when a banking sector in a given country faces loan impairments, the losses are reflected in lower equity values of that sector. Subsequently, other sectors holding the equity of the banking sector also suffer losses, which are proportionate to the size of the holdings of equity issued by banks. A process of shock propagation then kicks in, as the losses incurred by the other sectors are also reflected in their own equity values. Theoretically, the propagation process would continue as long as one of the following things happens: either some of the sectors report a positive earnings shock that more than offsets the initial shock that triggered the propagation, or, alternatively, the shock reaches a sector that either is not connected to any other sector[2] or is not subject to marking to market so that it does not need to deduct asset losses from its equity.[3]

Importantly, the overall losses and precise dynamics of the shock propagation mechanisms depend on the structural characteristics of the network of bilateral exposures. Charts A and B provide examples of the estimated bilateral exposure networks in one instrument category, quoted and unquoted shares, in two euro area countries. The banking system in country A is owned by domestic counterparties to a greater extent than in country B. As a result, a relatively larger proportion of bank impairment losses is passed into the spillover mechanism and overall losses tend to be higher. In country A, domestic sectors also invested in relatively large shares

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1   See O. Castrén and I. K. Kavonius, "Balance sheet interlinkages and macro-financial risk analysis in the euro area", *ECB Working Paper Series*, No 1124, 2009.

2   For instance, households and government sectors typically hold large amounts of equity issued by other sectors, but they do not issue their own equity; therefore, these sectors do not transmit the shocks further. The rest of the world sector can be expected to spread the shocks globally so that only a fraction would return back to the system that was initially affected. In the current assessment framework, it is assumed that the rest of the world does not transmit losses further.

3   Alternative shock propagation channels can be envisaged which originate from the liabilities side of a sector. For example, a liquidity shock may force the economic agents to curtail their asset holdings in order to maintain a specific balance sheet condition, such as a targeted leverage ratio. These asset reduction actions, in turn, have an impact on the liabilities side of the sectors that are the counterparties of the instrument positions which are subject to changes.

Chart A Quoted and unquoted share holdings in country A as reported in the financial accounts
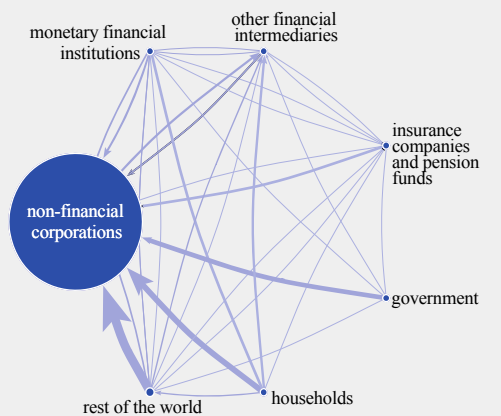
Sources: ECB and ECB calculations.
Notes: The direction of the arcs reflects the equity holdings of one sector by another sector, while the thickness of the arcs reflects the relative size of those holdings. The nodes reflect intra-sectoral holdings of equity.

Chart B Quoted and unquoted share holdings in country B as reported in the financial accounts
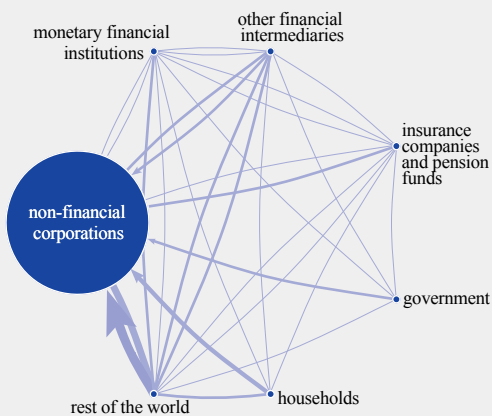
Sources: ECB and ECB calculations.
Notes: The direction of the arcs reflects the equity holdings of one sector by another sector, while the thickness of the arcs reflects the relative size of those holdings. The nodes reflect the intra-sectoral holdings of equity.

of equity which is issued by other sectors. In country B, in contrast, the structure of bilateral equity holdings features the rest of the world sector playing a more prominent role. Therefore, in country A, the spillover effects would tend to be concentrated in the domestic economy, while country B would "export" them abroad.

To illustrate these points, Charts C and D plot a hypothetical shock propagation and convergence process for countries A and B in the case where the shock is assumed to be a permanent impairment of MFI sector loans to households, non-financial corporations and the rest of the world.[4] The size of the shock was computed to be consistent with the results of the credit risk stress test under the uniform shock scenario (see Section 4.2.3).[5] The estimations indicate that the shock has largely converged in ten iterations.

The exercise reveals that there are important differences between the two economies in how losses are propagated. In particular, countries where shocks propagate mostly across the domestic financial and non-financial sectors are more severely hit by spillover effects. This is the case of country A where the cumulated loss of each domestic sector on average reaches 0.21 of its financial assets. In country B where the rest of the world sector acts as an important shock absorber, the average cumulative loss of domestic sectors remains at 0.05 of financial assets.

Overall, the analysis of financial networks at different levels of aggregation is rapidly gaining importance in financial stability assessment, as it allows for estimating how the adverse impact of a given financial disturbance might multiply along the bilateral linkages among firms and sectors. This makes it possible to rank alternative scenarios in terms of the losses that are generated in the subsequent rounds as a result of propagation effects. In addition, structural features of networks

4 The latter was included to approximate for the consolidated MFI balances as flow-of-funds statistics are reported on an unconsolidated basis.
5 The size of the shock was derived from the bank-specific stress-test output as the difference between the weighted average cumulative two-year loss rate under the adverse scenario and baseline scenario. In this vein, the unexpected component of the loan impairment loss, which should not be priced in equity, is captured.

Chart C Impact of the propagation of the shock through the country A economy

(Q1 2011; x-axis: number of propagation rounds;
y-axis: propagation losses measured as a percentage of financial assets of the sector; reported as a cumulative sum)

——— non-financial corporations
········· monetary financial institutions
– – – other financial intermediaries
——— insurance companies and pension funds
········· government
– – – households
–·–·– rest of the world
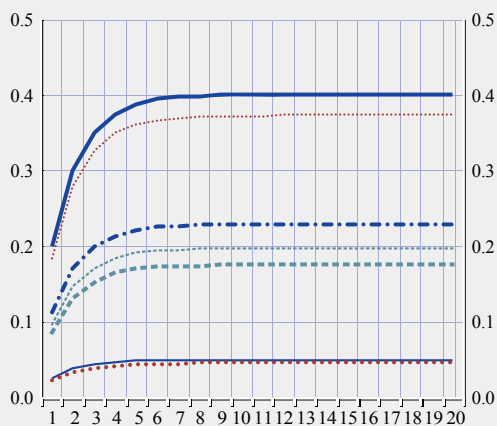
Sources: ECB and ECB calculations.

Chart D Impact of the propagation of the shock through the country B economy

(Q1 2011; x-axis: number of propagation rounds;
y-axis: propagation losses measured as a percentage of financial assets of the sector; reported as a cumulative sum)

——— non-financial corporations
········· monetary financial institutions
– – – other financial intermediaries
——— insurance companies and pension funds
········· government
– – – households
–·–·– rest of the world
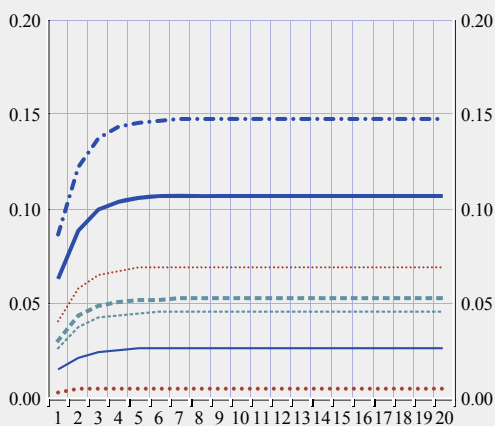
Sources: ECB and ECB calculations.

of bilateral linkages, which may not be fully understood, may be important factors in determining the overall losses from shock propagation. Analysis which highlights these features can therefore generate policy recommendations which focus on mitigating the adverse implications of these structural characteristics.