BRUSSELS—European Union finance ministers early Thursday agreed on new rules for dealing with failing banks in an effort to curtail the cost of taxpayer-funded bailouts.

After banking crises pushed several European countries to the brink of bankruptcy in recent years, most governments were eager to share the costs of downsizing or closing even big banks with their owners and creditors. The hope was also that predictable rules would push banks to take better precautions against risks and prevent the kinds of market shudders caused by unexpected losses for investors and savers in Spain and Cyprus over the past year.

But some governments were worried that overly rigid rules on imposing losses on investors and creditors—a so-called bail-in—could increase banks' funding costs and destabilize Europe at a time it is still trying to exit from a yearslong financial crisis.

Ministers stressed that depositors with less than €100,000 ($130,820) in their accounts would always be safe, while small and midsize companies and bigger savers would only be hit during the most severe bank failures. As an extra layer of protection for taxpayers, governments will have to start building up resolution funds by collecting levies from banks.

Michael Noonan, the Irish finance minister who led the negotiations, said he and his counterparts managed to strike a balance that would shield taxpayers but leave countries with enough flexibility to protect their economies.

"I welcome the fact that taxpayers are now going to be protected by a bail-in mechanism rather than a bailout mechanism," he told reporters after almost 10 hours of discussions.

Before national authorities can employ either money from their resolution funds or public purses, they have to impose losses on at least 8% of a bank's total liabilities.

Sweden, which had been one of the biggest opponents of the proposed rules, won an exception, that would allow it to limit losses to 20% of a bank's risk-weighted assets, giving it a bit more flexibility. In exchange, Sweden must set aside more money for its national-resolution and deposit-guarantee funds—totaling 3% of covered deposits, as opposed to 1.3% for other countries.

Even after this first round of losses, national-resolution funds will only be allowed to protect a maximum of 5% of a bank's total liabilities, although poor euro-zone governments can borrow money from the currency union's rescue fund, the European Stability Mechanism, to top up their own backstops.

Taxpayer-funded bailouts will only be allowed under "extraordinary circumstances," when it is technically impossible to impose losses on certain creditors in a rush or when a government is worried about effects on financial stability, officials said. Such exceptions will have to be authorized by the European Commission, the EU's executive arm.

Rich countries like Germany and Finland worked hard to make it as difficult as possible for poorer countries to tap the euro-zone rescue fund.

Ministers agreed that the common fund could eventually be used to recapitalize failing banks directly, but only to protect depositors—not shareholders or bondholders—and if the bank's home government has run out of money.
Joaquín Almunia, the EU’s antitrust chief, called the agreement a step toward ending Europe's recession and creating a Continentwide banking union.

Mr. Alumnia told a business forum in Madrid that the agreement would help break "the perverse link between risks that the markets attribute to the public debt of each country and the risks that the banks run because of the fragility of their balances."

The new law "will ensure the stability of the banking sector," said French Finance Minister Pierre Mocovici.

—Laurence Norman, Frances Robinson and Richard Boudreaux contributed to this article.