Staff Memo

Systemic surcharges and measures of systemic importance

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Systemic surcharges and measures of systemic importance[1]

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Abstract

There is an emerging consensus that systemically important banks should face stricter
regulations and systemic surcharges. To make this latter principle operational we need to
quantify the systemic importance of individual banks. This paper reviews the proposed measures
of systemic importance from the regulatory and research communities and discusses their merits
relative to how we would ideally wish to calibrate surcharges on systemically important banks.

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1. Introduction

The recent financial crisis has demonstrated that some banks are considered too important to fail. After the failure of Lehman Brothers in September 2008 rescue operations have taken place in many countries to prevent the failure of their most important banks and in some cases even other financial institutions. The expectation that this will also happen in the future is widespread, and is an important element in the credit evaluations of rating agencies. The stand alone ratings of large banks are typically several notches below the ratings that take expected government support into account; see e.g. Haldane (2010). Moody's has warned that if "living wills" effectively reduce the likelihood of a government bail-out, many large banks will be downgraded.[2]

Market perceptions of an implicit government guarantee creates a well known moral hazard problem routinely discussed in banking textbooks; see e.g. Greenbaum and Thakor (1995). The expected private downside for bank stakeholders of any risky bet is limited by the guarantee, whereas the expected upside is still intact. It will be rational for bank stakeholders to take on more risk than they would otherwise have chosen to do. The recent crisis has demonstrated how costly the downside can be to the government, and eventually to the economy. There is work under way to introduce special regulations for banks that are deemed too important to fail in at least some circumstances; see e.g. the progress report from the Financial Stability Board (2010).

A special regulatory regime for systemically important banks may have a number of different components, but one key element could be a systemic surcharge on top of the standard capital adequacy requirement. The purpose of such a surcharge should be to mitigate the risk-taking incentives that are implicit in the banks' importance to the economy. It can be interpreted as a Pigouvian tax, aiming to bring private profitability calculations in line with social profitability. The regulator's goal would be to calibrate the tax to provide correct private incentives for the risk-taking of bank stakeholders. The regulator thus needs to consider the divergence between the social and the private profitability of banks' activities. The divergence in incentives will most likely be bank-specific, depending inter alia on the perceived probability that the bank will be rescued in a crisis. To impose a systemic surcharge, regulators need to develop a methodology for calibrating measures of systemic importance across banks.

The private incentives for risk-taking at systemically important banks can also be reduced through other forms of regulation. Of particular interest is the work that is now being done on special resolution regimes for banks, including the "living will" idea introduced by Governor Merwyn King of the Bank of England[3]. "Living wills" are bank-specific recovery and resolution plans that banks will be required to produce. These plans should provide regulators with all the

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[2] Press release on 24 September 2009

[3] Speech at the Lord Mayor's Banquet for Bankers and Merchants of the City of London at the Mansion House on Wednesday 17 June 2009.

information needed for the resolution regime to work smoothly. The plans could also be used to initiate organisational changes where the existing structures are found to be too complex.[4]

Ideally, a special resolution regime should enable the regulator to maintain the systemically important part of any bank as a going concern through a crisis, while the bank stakeholders are covering the losses that have been incurred. Such a special resolution regime, facilitated by bank-specific resolution plans, could in principle be a first best solution to the moral hazard problem. It could eliminate the need for other special regulatory instruments: An ideal resolution regime would ensure that all banks can be wound down quickly without significant negative effects on the financial system and the economy, and with losses mainly borne by bank stakeholders. In that hypothetical scenario no bank would be systemically important, and the moral hazard problem related to any perceived guarantee would disappear.

Another potentially important regulation measure that is likely to be implemented is to force a large share of derivative contracts to be cleared by a central counterparty clearing house (CCP) and reported to a trade register. This would greatly enhance the transparency of these markets, reduce counterparty risks, and facilitate crisis resolution procedures for banks with a large portfolio of open derivative positions. Both the US and the European Union have recently introduced legislation that requires more contracts to be cleared through CCPs.

However, it seems highly unlikely that any feasible reform of resolution regimes and trading infrastructures will be able to fully eliminate the systemic importance of all banks. Even a very good special resolution regime cannot be expected to correct the moral hazard incentives of all stakeholders. It may allow the regulator to impose losses on shareholders and holders of hybrid capital; and possibly also some losses on senior creditors, although the latter is legally much more complicated given that at least part of the bank operations must be maintained without interruptions. The top management can certainly be replaced, but it seems unlikely that their bonuses or other success fees can be reclaimed. The additional complications raised by cross-border banking only reinforce these conclusions.

The consensus is that one should also introduce higher capital, liquidity and supervisory standards for systemically important banks, in order to further reduce their risk taking incentives and probabilities of failure, as discussed in the progress report from the Financial Stability Board (2010). But the need for such additional charges will be less the more effective is the resolution regime in place and the more transparent and risk-reducing are the trading infrastructures. Measures of the systemic importance of banks should thus depend on the regulatory regime.

In this paper, we first review measures of systemic importance that have been proposed by regulators and researchers. In section 2 we discuss sets of indicators proposed by the US and the UK authorities, as well as the IMF and the European Commission. In section 3 we look at the research literature, where more specific measures have been proposed. We focus our discussion

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[4] A thorough discussion of recovery and resolution plans can be found in Huertas (2010).

on the important contributions by Adrian and Brunnermeier (2009), Acharya (2009), Huang et al. (2010) and Tarashev et al. (2010).

In section 4 we discuss how the calibration of a systemic surcharge should ideally be done. We argue that there are four major caveats to the proposed measures of systemic importance which makes them less satisfactory as a basis for calibrating systemic surcharges on banks. First, the existing proposals do not consider what constitutes an optimal trade-off between the costs of regulation and the costs of bank failures. Second, the proposals do not take into account how the costs of bank failures depend on bank regulation and in particular on the bank resolution regime. Third, the measures proposed by the research community assume that outright failures occur, whereas some form of rescue may be more likely in practice. And fourth, all the proposed measures from the research community depend on market data, which are unlikely to provide unbiased information about the social costs of bank failures.

Having argued that the expected social costs of a rescue or resolution operation are relevant for determining systemic surcharge, we go on to take a closer look at the determinants of rescue costs in section 5. In section 6 we discuss the implications for how systemically important banks should be regulated. Section 7 concludes.

2. Regulators' approach to measurement

There are parallel international processes going on at the Financial Stability Board (FSB) and the Basel Committee for Banking Supervision (BCBS) to reform financial regulation. Both processes include efforts to develop practical measures of systemic importance. The FSB (2009) has issued a "Guidance to Assess the Systemic Importance of Financial Institutions, Markets and Instruments: Initial considerations." This guidance provides three key criteria for identifying the systemic importance of individual banks:
- Size as measured by e.g. the size of on and off balance sheet exposures.
- Lack of substitutability; how difficult it is for other banks to provide the same services.
- Interconnectedness; whether failure or malfunction would have substantial repercussions around the financial system.

The guidance suggests that regulators should use a scorecard based on these criteria to determine the degree of systemic importance of each bank. Final policy recommendations from the FSB have not yet been presented, though.

The BCBS (2009) has discussed pros and cons of a capital surcharge for systemically important banks. One likely solution is to require more buffer capital at such banks. No list of criteria for systemic importance has been published so far, but a scorecard approach along the lines discussed by the FSB seems likely.

There are also regulatory processes under way in the major jurisdictions. The US Treasury Secretary Geithner presented his proposals on June 17, 2009 for "Financial Regulatory Reform". One of the proposals would give the Federal Reserve Board a special responsibility for regulating and supervising systemically important banks, called "Tier 1 Financial Holding Companies" (Tier 1 FHCs) in the language of the report. The Treasury Report indicated that the systemic importance of a bank could be measured by:

- The impact that its failure would have on the financial system and the economy.
- Its size, leverage and reliance on short-term funding.
- Its importance as a source of credit for the real economy and as a source of liquidity for the financial sector.

The Treasury Report was vague on the special regulation of Tier 1 FHCs. The Report stated that there should be e.g. higher capital requirements and more rigorous liquidity requirements, but not how much higher they should be or how they should be graduated.

The US Congress approved the "Wall Street Reform and Consumer Protection Act" in July 2010. This Bill establishes a "Financial Stability Oversight Council" (FSOC) and authorizes the Federal Reserve to supervise systemic financial institutions. The bill requires all bank holding companies with total assets above USD 50 billion and other financial companies identified by the FSOC as systemically important to produce resolution plans. The Treasury is authorized to let FDIC take receivership of all failing banks, including breaking up systemically important bank holding companies and other large financial institutions. It is not clear how smoothly that can work in practice if one of the largest and most complex banks should be failing.

A special resolution regime for failing banks in the UK came into effect in February 2009. The regime is tailored for handling mainly deposit-taking banks, and it is not clear how useful it will be in cases where failing banks are very complex and have cross-border operations, confer Bank of England (2009a). The ability to resolve systemically important banks remains an open issue.

A discussion paper from the Bank of England (2009b) looked at the case for cross-section systemic capital surcharges. This discussion paper stated that the goal should be to reduce the default probabilities of institutions whose failure would cause great damage across the financial system. The paper presented an illustration of how the surcharges can be calibrated to equalise banks' marginal contribution to social risk. The calibration depends on three factors:

- Size, measured as total assets including off-balance sheet items.
- Connectivity, measured by the interbank liabilities.
- Fire sales impact, measured by the value of repo liabilities.

Each factor is measured as a share of the system total, and a composite indicator of systemic importance is computed by arbitrarily giving equal weight to each of these indicators. The level of the total surcharge should be set by requiring a "low probability" for system losses above a certain level. This probability is discussed on the implicit assumption that no rescue operations will take place.

The IMF (2010) discussed the implementation of a systemic surcharge in its April 2010 Global Financial Stability Report. This report proposed to sort all banks into a limited number of systemic risk buckets. For this purpose it used a network model where contagion is caused by interbank liabilities and common exposures, and measured the maximum loss that the failure of each bank would impose on other banks in any stage of the credit cycle. The discussion assumed that no rescue operation would take place. This maximum loss without government interference was taken to define the systemic importance of the bank.

The European Commission is also considering special regulation of systemically important banks. A background paper suggested that the following indicators might be useful for identifying the degree of systemic importance of individual banks:
- Total assets exclusive of derivative assets (TA).
- Borrowings to other banks relative to TA.
- Lending to other banks relative to TA.
- Trading book relative to TA.
- Fee and commission income relative to TA.

These indicators are very similar to those proposed by the FSB. They are meant to represent size, different aspects of interconnectedness, and substitutability. The Commission is still considering whether these indicators will be their final choice.

The general impression is that the regulatory community does have clear ideas about the characteristics of systemically important banks, but are less clear on how that can be compounded into a metric for imposing graduated systemic surcharges. Both the Bank of England and the IMF have published illustrations of how systemic importance can be graduated. However, the graduations do not include any explicit cost trade-offs and do not depend on the specific resolution regime in place. Moreover, they are based on scenarios where no government intervention will take place. Also, they are mere sketches and far from ready for actual implementation. In the US, where special regulation of systemic banks has been introduced, the sole indicator used in practice appears to be total assets, together with the subjective judgement of supervisors.

3. A brief review of some measures proposed by the recent research literature

Some contributions from the research community have been much more specific. Systemic risk and contributions to systemic risk have been discussed in the research community for a long time. But in the last few years we have seen a number of more specific proposals on how systemic surcharges on banks can become part of a regulatory reform.

We shall briefly review some of the main contributions from the research literature, starting with the influential work of Adrian and Brunnermeier (2008), presented at the height of the recent

financial crisis. They proposed to measure the contribution to systemic risk (ΔCoVaR) from each bank as the difference between the conditional value at risk (CoVaR) of the entire financial industry, given the failure of this particular bank, and the value at risk (VaR) of the bank as a stand-alone entity. They estimated the ΔCoVaR for a sample of US banks by computing how the change in stock market value of the industry depends on the change in stock market value of the particular bank. They used a quantile regression, which in this case essentially means using only data from the worst weeks of share price falls in their 23 year observation period.

Adrian and Brunnermeier (2008) went on to identify bank characteristics that can predict the future systemic risk contribution of each bank. They found that more leverage, more maturity mismatches, higher market to book value ratios and larger size are important determinants of systemic risk. They proposed to link financial regulation to these characteristics, rather than to the estimated ΔCoVaR, in order to make regulation more forward looking. They suggested that their coefficient estimates could provide guidelines for the weighting of these characteristics. However, their approach is open to criticism by not considering cost tradeoffs or the regulatory environment, by assuming outright failures and by relying on stock market data to identify social costs. Their contribution is still valuable by providing some rudimentary basis for identifying the characteristics of systemic banks.

Acharya (2009) presented a model where the correlation of bank failure probabilities depends on their common exposure to systemic risk factors. He showed that banks in general have an incentive to choose similar exposures, both because diversification opportunities are the same to all banks and because regulatory forbearance is more likely in situations where several banks are in trouble together. However, the socially optimal allocation of exposures is less correlated across banks than this equilibrium outcome. There is thus a case for higher capital requirements for banks with large exposures to common systemic risk factors. This would encourage banks to take on less systemic and more idiosyncratic risk. The calibration of such capital requirements is in principle no different from the portfolio approach to intra-bank risk in the Basel II capital adequacy regulations. But the information requirements are huge, and calibration will be a challenging and controversial task for the regulator. There will be plenty of scope for the individual bank to challenge the regulator's assumptions.

The same basic idea was further developed in two papers by Acharya et al. (2009, 2010), where the measurement problem was discussed in more detail. The first of these papers proposed that each bank's contribution to systemic risk can be measured as its marginal shortfall when aggregate losses in the industry are large. This could either be estimated from data on past crisis events, or it could be estimated from data on the portfolio of each bank. As a simplification, however, the authors proposed to look at the share price falls on the five per cent worst days in the stock market during a given period of time. In the second paper, they proposed a somewhat different systemic risk measure to more accurately represent extreme tail risk. Such risk is not observable from stock market data, but is inferred by assuming that asset returns follow a power law probability distribution in the tails of the distribution.

Assuming that systemic risk can be meaningfully measured, Acharya et al. (2010) proposed either to introduce a systemic surcharge on the capital requirements or on the deposit insurance premium. Their proposed measure of systemic risk is of course open to the same criticisms as the measure of Adrian and Brunnermeier. But as a complementary instrument they proposed to require banks to buy insurance coverage for a small percentage of their losses in a future general crisis. Establishing a private market for this would inform the supervisor about the fair premium to be charged for the remaining losses. The private insurance instrument is complementary because the premium would depend on the regulatory environment and be forward looking.

Zhou (2009) also focused on exposures to common risk factors. He proposed to measure the systemic importance of each bank by the expected number of other bank failures conditional on the failure of this particular bank. This is similar to the procedure proposed in the IMF (2010). With that definition he found that size is a less important determinant of systemic importance than the bank's exposure to common risk factors.

Huang et al. (2009, 2010) proposed to measure the risk of a financial system by the insurance premium that would be required to cover losses in a distressed situation: i.e. when total losses exceed a given threshold. This insurance market is highly unlikely to exist, but the authors argue that the hypothetical fair value insurance premium could be estimated using information from the credit default swap and equity markets. They derive one year probability of default and loss given default for each bank from the CDS market for its debt, and the asset return correlations are derived from equity return correlations. The portfolios of all banks are aggregated to obtain an estimate of the system-wide fair value insurance premium. We notice that CDS prices are likely to be even more severely biased estimators of social costs than stock prices.

The contribution of each bank is defined to be its expected loss conditional on aggregate system losses being above some given threshold. This decomposition implies that the sum of systemic risk contributions from all banks is equal to the total systemic risk measure. Applying the analytical framework to large banks in Asia and the Pacific, Huang et al. (2010) found that size is the main driver of contributions to systemic risk.

Tarashev et al. (2010) proposed an allocation procedure based on game theory. They applied the Shapley-value methodology from the theory of cooperative games, by looking at each bank's marginal contribution to a system risk measure in all possible sub-systems it could be part of, and take the average of these marginal contributions. This ensures that the contributions of all banks add up to total systemic risk. This procedure is different from that of Adrian and Brunnermeier (2008) by taking into account the marginal risk contributions to a set of sub-system portfolios and not only to the total system portfolio.

The authors argued that measuring expected losses in a pre-specified systemic event is mainly relevant for computing premiums for an insurance against losses in such an event. Looking at marginal contributions to systemic risk is more relevant for measuring individual banks'

systemic importance. Given their preferred procedure, they showed that relative size, exposure to a common risk factor and probability of default (PD) are important determinants of systemic importance. The importance of a large bank increases more than proportionally with its relative size. The PD becomes more important when banks are larger or more exposed to the common risk factor.

Additivity of contributions to systemic risk is a desirable property of a measure. Measuring systemic importance by each bank's share of expected total losses in a distress situation will produce an additive measure: The contributions from the individual banks add up to total systemic risk. This is the case for the measures proposed by Acharya et al (2009) and Huang et al. (2009). However, measures based on the marginal contribution of each bank to a total systemic risk measure will not necessarily be additive. The proposals of Adrian and Brunnermeier (2008) fall into this category. Yet, the similar proposal of Tarashev et al. (2010) retains the additivity property by including each bank's marginal contribution to the risk of each subsystem as well as to the total system. It is not clear though whether all these subsystems are relevant for a measure of systemic importance.

In sum, the existing research literature has provided some valuable contributions on how to deal with the issue of measuring systemic importance of financial institutions and the risk posed by them. In particular, the literature has identified bank characteristics that are relevant for measuring systemic importance. It has substantiated the relevance of characteristics proposed by the regulatory community and thus served to confirm the relevance of regulators' analysis.

However, the precise measures proposed by the research literature do not constitute fully satisfactory bases for calibrating systemic surcharges on banks. The main caveats of the reviewed literature can be summarized as follows:

First, there is never an explicit discussion of the trade-off between the social costs of regulation in normal times and the social costs of banking crises. Since the purpose of a systemic surcharge is to bring private profitability in line with social profitability, this aspect of social profitability considerations is essential for the calibration of a systemic surcharge. The social costs of banking crises depend inter alia on the resolution regime available to the regulators. We return to the social costs issue in more detail in the next section.

A second common feature of all numerical illustrations of systemic importance measures in the existing research literature is that they are based on market data, and thus on market participants' perception of risk exposures and of how banks are connected. It is not obvious that regulation should be based on market perceptions, not only because that perception may easily be misguided, but also because the market perception will depend on the regulation imposed and on the market expectations of how different classes of stakeholders will be protected in case of failure. As regulation and resolution regimes are changing, historical market prices will become less relevant. Moreover, existing market expectations of rescue operations will introduce a severe

bias if market prices are used to estimate expected losses in a worst case scenario. The bias could become very important for banks that the market considers to be highly systemically important.

A third common feature is that the measures try to quantify the probability and expected volume of losses at failing systemically important banks. But the very definition of a systemically important bank is that outright failure may not be allowed to happen. Instead the government may intervene to ensure that the systemically important parts of the bank can continue as going concerns, possibly after a government take-over and with losses taken at least partly by private bank stakeholders. The measures are thus considering a situation which the authorities may want to prevent from occurring. If there is a positive probability that certain banks will be maintained as going concerns, measures of systemically importance should also take into consideration the expected social costs of the potential rescue operation. This is a cost factor that the bank's stakeholders will not take into account unless it is imposed ex ante as a tax in some form.

A fourth common feature of the measures proposed in the research literature is that they mainly look at risk factors on the asset side of the balance sheet. An exception is the analysis of Adrian and Brunnermeier, who also point to maturity mismatches. Tarashev et al. point out that the focus on asset side risks may be misguided. They argue that it is at least as relevant to consider risks on the liability side of the balance sheet. This is where the contagion effects were more evident during the recent financial crisis. Some of the indicators proposed by regulators are from the liability side; this in particular includes measures of interbank liabilities and maturity mismatches.

A final common feature of most measures is that they fail to distinguish between the effects of common exposures and true spill-over effects. This has been pointed out by Iragorri and Ferrari (2010), who argue that only the spill-over component should be included in a useful measure of systemic importance. That would greatly reduce the scope of the concept, since most of the losses in a systemic event are likely to result from common exposures rather than spill-over effects, confer the literature on network modelling of contagion between banks as represented by for instance Elsinger et al. (2004).

4. The optimal systemic surcharge

In principle, a systemic surcharge should take into account the trade-off between the expected social costs of financial crises and the efficiency costs of regulation in normal times. The expected social costs of failures or near failures of systemically important banks are widely seen as being much too high, relative to the efficiency costs of lower profitability and higher lending

costs that would follow from stricter regulations of these banks.[5] While this trade-off is evident in principle, it is prohibitively difficult to quantify.

The Basel capital adequacy rules represent a similar trade-off. These rules are based on the premise that the probability of any bank losing all of its capital within one year should be less than 0.1 per cent. Similarly, the Bank of England has proposed that the macro trade-off can be derived by defining a similar acceptable probability of a systemic event. But that probability level would naturally be arbitrary. The calibration of the new capital adequacy framework of Basel III is tentatively based on a more explicit trade-off estimate.[6]

The research literature has not aimed to quantify the macro trade-off relevant to systemic banks. The aim has only been to allocate a given total burden on individual banks. This approach is not entirely satisfactory, because the systemic surcharge can come in different disguises. Alternative forms of the surcharge may be more or less intrusive and have different effects on different groups of banks. The calibration should thus depend on the exact form of the surcharge. It is not clear which form is preferable from a social point of view; it might very likely be a combination of different surcharges.

The research literature has focussed on the expected social costs of failures, and thus implicitly assumed that outright failure will be the consequence of any banking crisis. We would suggest that government rescue is a likely alternative in many cases. Thus, the expected social costs of a rescue or resolution operation are also relevant for the systemic cost side of the trade-off that we are trying to correct. The social costs of a rescue operation will partly be borne by the government and partly by deposit insurance funds, equity holders and creditors. The exact allocation of costs will depend on the resolution regime that is available. A deposit insurance scheme can ideally charge a membership fee that correctly reflects the expected future costs to the insurance fund. It also seems reasonable to assume that the expected costs to creditors and equity holders will be reflected in the remuneration paid on debt and equity.

The only parts of social costs that are not priced may be the expected costs to the government and the costs to the wider economy. A rescue operation should aim to minimise these indirect costs while retaining the systemically important operations of the bank as going concerns. The indirect costs will depend on the quality of the resolution regime in place. Reinhart and Rogoff (2009) have looked at these costs in historical crises and concluded that they have in most cases been substantial.

With a future high quality resolution regime in place, the interruption to financial services could be substantially smaller than in previous crises. In that case the government costs could perhaps

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[5] See e.g. Martin Wolf in the Financial Times on 20 April 2010, "The challenge of halting the financial doomsday machine".

[6] See Basel Committee on Banking Supervision (2010)

even become the dominant cost component that is not priced in the market. While this is certainly not true today, it may still be of some interest to explore the determinants of these expected government rescue costs. This is the topic of the next section.

5. Expected rescue costs

The government cost of a rescue operation is not a straightforward concept. First, the meaning of rescue will depend on the resolution regime that is in place in each case. More efficient resolution regimes will be less costly for the government to operate. Second, rescues will normally be a combination of capital injections, loans and guarantees to the troubled bank. Not all elements are necessarily included in each rescue package. The normal way of reporting rescue costs will be to add up at least the injections of equity and debt, whereas guarantees of bank liabilities are clearly different and tend to be reported separately.

The rescue could always be done exclusively through capital injections, and for an ex ante discussion of expected costs we shall for simplicity assume that this is the only instrument used. We furthermore assume that the treatment of existing equity holders and creditors is predetermined by a well defined resolution regime. During the recent crisis the normal order was that senior creditors were fully protected, whereas equity holders were watered down by the government capital injections. Predetermined rules for how stakeholders should be treated were not in place. With a future, more well-defined, resolution regime the costs borne by these stakeholders could naturally become different.

The question we want to pose is how large a capital injection will be required to maintain the systemically important parts of a bank as going concerns, given the limitations of the resolution regime and well defined rules for treatment of equity holders and creditors. If splitting the systemically important parts from the rest is possible, the rescue costs will be lower. With less favourable treatment of the private stakeholders, the government cost will clearly be reduced. With lower expected government costs the optimal systemic surcharge on the bank will also be lower.

The capital injection into a troubled bank will normally be a tradable instrument with a market price. The rescue involves providing the capital at below current market prices, and the subsidy element will be the immediate cost of the rescue. While this is in principle a clearly defined cost concept, it may be difficult to quantify empirically. Looking back at previous rescue operations we often find that the shares of the troubled banks did not trade in the market or only traded at fire-sale prices. It will often be reasonable to assume that capital is simply not available to the bank at any price, at least not if no government support is likely. That is equivalent to saying that the equity of the bank would have had zero value without the government intervention. Then the entire capital injection should be regarded as a government cost.

It is conceivable that the government can sell its capital instruments at a positive price at a later stage, and possibly also with a profit, as happened after the Norwegian banking crisis of the 1990's, see Vale (2004). But the ex ante costs were still substantial with very few investors willing to buy shares along with the government. It can be argued that this ex ante cost is the relevant measure of the rescue costs, because they reflect the subsidy relative to market valuations at the time.

In some cases the rescue costs to the government will be minimal or zero. Failures of small banks with standard banking activities can in most cases be handled by the deposit insurance scheme or some other institution that has been given resolution authorities. The solution will normally be a takeover by another bank or an orderly wind-down of the activities with customers given the time to find alternative suppliers. In the US the FDIC is performing such wind-downs on a regular basis and with all costs borne by a fund financed by the banking industry. Even relatively large banks, such as Washington Mutual with a balance sheet of approximately 300 billion USD, were resolved by the FDIC during the recent crisis. If the resolution regime can be expected to work smoothly for a bank, with no disruption in the rest of the financial system, this bank should obviously not face a systemic surcharge on its activities.

Turning to larger and more complex banks in trouble, the simple solutions organised by a deposit insurance fund or a similar institution may not be applicable. The need for capital injections may be substantial and beyond the means of an existing fund, and the resolution process may be too complicated to be carried out during a weekend. In these cases the government may need to step in if an outright failure is to be avoided. We shall assume that the government does this by injecting capital.

The costs of such a rescue operation will obviously depend on how undercapitalised the bank is, which is again primarily a function of accumulated deficits relative to the initial capital holdings. The size of losses mainly comes down to the size of the bank and the quality of its assets, which are the variables that has been extensively analysed in the academic research on systemic importance. Note, however, that the complexity and interconnectedness of the activities of the bank would be less relevant, given that these activities can be expected to continue as going concerns. The funding of the assets may be relevant, but only because the funding costs determines the earnings of the bank, and thus the expected degree of undercapitalisation.

Experiences from previous systemic events may provide some guidance as to what future rescue costs will be, but only to a limited extent. Systemic events are rare, banks are different, and the resolution regime may have been improved. Historical data may still provide some guidance for the future.

In the following we shall have a brief look at the resolution costs incurred during the Norwegian banking crisis of the early 1990s. Most of the troubled banks were handled by the deposit insurance funds. Only in a few cases did the government directly inject capital into banks. These

included three of the four largest banks of the country, which were all considered systemically important. In addition two medium-sized bank received government capital at an early stage of the crisis, when resolution procedures were not yet firmly in place. A third medium-sized bank received a small injection towards the end of the crisis when the insurance funds had no money left. In the first table below we only include the three systemically important banks.

Table 1: Rescue costs for large banks during the Norwegian banking crisis of 1988-93. Numbers are in millions NOK or per cent of pre-crisis total assets.

Bank	1987 total assets	1987 capital	Accumulated losses 1988-92	Capital injection from the government; total and in per cent of assets	
Den norske Bank	170 209	4.2 %	3.9 %	4 750	2.8 %
Kreditkassen/Sunnmørsbanken	106 099	4.3 %	7.8 %	8 914	8.4 %
Fokus Bank	35 477	4.4 %	12.8 %	1 845	5.6 %

Source: Statistics Norway and Government Report 39 (1993-94) to the Storting.

The three large banks that were rescued had very similar capital positions immediately before the crisis occurred, and somewhat higher than most banks of their size had prior to the recent crisis.

The table illustrates that capital injections were not proportional to the size of the banks. An alternative possible determinant of the rescue costs are the losses incurred during the last years before the crisis. The disproportionately high injection into the second largest bank (Kreditkassen) is related to the fact that it had taken over another troubled bank (Sunnmørsbanken) in 1988, and had probably borne part of its rescue costs. Taking this into account we may consider the data consistent with a view that expected accumulated losses in a crisis event is a relevant determinant of rescue costs. But conclusions can evidently not be drawn from only a couple of cases.

Table 2: Determinants of resolution costs during the Norwegian banking crisis 1988-93

Dependent variable:	Coefficients	t-values
Resolution costs 1988-93 (in NOK)		
Independent variables:		
Total assets 1987 (TA, in NOK)	-0.0048	-0.88
Bank equity 1987 (per cent of TA)	-10221	-1.97
Deposits 1987 (per cent of TA)	-1535	-2.11
Accumulated losses 1988-93 (in NOK)	0.8485	10.30
Intercept	1575	
R-square	0.966	

Data on the total resolution costs – i.e. for the deposit insurance funds and the government combined - for all the 23 failed banks are also available.[7] We use these data together with data for total assets, bank equity and deposit coverage before the crisis and accumulated losses during the crisis to run a simple linear regression, reported in the table above. Given this model specification, with resolution costs, total assets and accumulated losses all measured in absolute values, we find that the resolution costs mainly depended on the losses accumulated during the crisis. Total assets do not come out as statistically significant when accumulated losses are taken into account, and the variable even gets a negative sign. [8] As expected, higher bank equity and higher deposit coverage contributes to reduce the resolution costs.

6. Implications for the surcharge on systemic banks

If government rescue of systemically important banks carries a high probability, the expected costs of such rescue operations should be relevant for the calibration of any systemic surcharge. Below we discuss what implications the rescue option may have.

It is reasonable to assume that expected losses are the main determinant of expected rescue costs. A multiplicative surcharge on the normal capital adequacy requirement would be an appropriate regulatory instrument for the systemically important banks. The recommendation naturally rests on the assumption that the normal capital requirement correctly reflects the tail risk exposure of the bank, as it is intended to do.

A second factor that is possibly relevant for rescue costs is the complexity of the bank. This could determine whether splitting up the bank into systemically important and less important parts will be feasible. The multiplier on capital adequacy could thus depend on some measure of organisational complexity. That is one of the factors considered by the regulatory agencies, but also one that is hard to measure. A better alternative than requiring higher capital for complexity may thus be to impose direct restrictions on the organizational structure of banks. This could be part of the "living will" process.

The expected costs conditional on a rescue operation taking place is naturally only one component of the equation. Another essential component is the bank's probability of failure. This probability has been extensively studied in the research literature, with models for the probability of failure for individual banks generally estimated on accounting data; see e.g. Pettway and Sinkey (1980) for an early example. These early warning models are partial in the sense that they do not take into account the contagion effect from the rest of the financial system.

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[7] Government Report 39 (1993-94) to Storting (The Norwegian Parliament).
[8] Bank size is naturally highly correlated with resolution costs, with a correlation coefficient of 0.85. However, the correlation with accumulated losses before resolution became necessary is even higher, with a correlation coefficient of 0.98.

However, one can argue that contagion would be a less relevant issue in a setting where government rescue in some form is the normal solution for a troubled bank.

The probability of failure depends in most empirically calibrated models on the capital position, on the earnings and operating costs, on the asset quality, and on the liquidity position of the bank. Most of these variables are the same as those determining the expected cost of a rescue operation. The main additional variable is the liquidity position. The relevance of this variable has been evident during the recent crisis, with spectacular failures occurring in apparently well capitalised banks. But these banks had substantial maturity mismatches between long term illiquid assets and very short funding maturities. Crises were often triggered by banks being cut off from their normal funding sources.

Banks that are not individually systemic may still be systemic as part of a herd, as pointed out by for instance Brunnermeier et al (2009). This will indeed be the norm when a systemic crisis erupts: Common exposures will have been built up across a large number of financial institutions. The archetypal example is property lending fuelling a property price bubble, where a major part of the social costs are borne by third parties and not by bank stakeholders, and where rescue costs may not represent the major part of social costs not borne by market participants.

Acharya (2009) suggested that exposures to systemic risk factors should be a determinant of a bank differentiated systemic surcharge. But a capital surcharge may not be the best instrument in this case. This threat to financial stability could instead be handled by instruments targeting the exposures directly. In a property price bubble this would mean restricting lending to this particular market. Examples of possible instruments include restrictions on loans to value, imposing higher risk weights on mortgage loans, and making funding of the loan growth more expensive and thus increase loan costs. This should be done across the board with no special treatment of systemically important institutions, because they contribute to the price bubble only to the extent that they lend to or invest in this market.

7. Conclusions

The communiqué from the G20 Pittsburgh summit in September 2009 stated that regulatory "standards for large global banks should be commensurate with the cost of their failure". The G20 also stressed that "systemically important banks should develop internationally-consistent bank-specific contingency and resolution plans". This reflects the emerging consensus that the proper regulation of systemically important banks is essential for reducing the probability of major financial crises in the future.

Proposals from national and international organizations working on financial regulation list a number of characteristics of systemically important banks, with only ad hoc aggregation to one single measure of systemic importance. The implication is that the classification of banks

according to importance must be subject to supervisory judgement. The academic literature, however, has tried to be more precise, and a number of measurement proposals have been put forward. The measures are useful to the extent that they help identify and graduate the systemic importance of banks. One very important application of the measures would be the calibration of systemic surcharges.

For this purpose the measures have a number of caveats. The optimal surcharge should evidently depend on the trade-off between the social costs of regulation in non-crisis periods on the one hand and the social costs of a financial crisis on the other hand. The social costs of a crisis will depend on what instruments are available to handle the crisis, and on whether the government chooses to use these instruments to intervene. The measures proposed implicitly assume that outright failures will be permitted. The final caveat is that unbiased estimates of the social costs of bank failures are unlikely to be retrieved from market data.

In practical life there will be a significantly positive probability that distressed systemically important banks will be rescued by the government. This implies that the social costs of rescuing or resolving a systematically important bank should be a key determinant of any systemic surcharge. These costs will depend on the resolution regime as well as on bank characteristics. An improved resolution regime can make some banks easier to resolve and thus less systemically important, while the improvements may not be applicable to others. The proposed measures of systemic importance never try to take this into account.

Given the complexity of large banks and the present resolution regimes available to the regulator, rescue will in many cases mean rescue of the entire bank if some parts are deemed to be systemically important. With improved resolution regimes the splitting up of banks may become more tractable. This may allow the government to retain only the truly systemically important activities as going concerns, and to spin off less important activities. One precondition for this may be stricter supervisory rules for the organizational structure of banks.

We found that the characteristics of systemic importance listed by regulatory agencies include most of the characteristics that are likely to explain rescue costs. The list from the academic literature is similar, but with more focus on the asset side of banks' balance sheets. Our analysis deviates from this literature by assigning a significantly positive probability to government rescue of systemically important banks. We are thus placing less importance on the contagion and interconnectedness indicators of systemic importance, since these characteristics are less relevant when rescue is the expected resolution procedure. Complexity could retain its role as an important determinant of a systemic surcharge, to the extent that it is not eliminated by the requirements for a feasible recovery and resolution plan.

Part of the academic literature has stressed the risk exposures of banks to common risk factors as a key indicator of systemic importance and thus as an important determinant of a systemic surcharge. We have instead argued that such common exposure should be contained by more

direct regulatory measures. A prime example is lending to the housing and property sector, which could be counteracted by using macroprudential tools such as higher risk weightings on such loans or loan-to-value restrictions.

The empirical analysis of this paper is illustrative, but provides some indication that accumulated losses to a large extent determines the costs of government rescue operations. In our framework this implies that tail probability losses, say in a set of relevant stress scenarios, should be an important determinant of any systemic capital surcharge. This is what the standard capital requirement is meant to cover. A systemic surcharge could then take the form of a multiplier on the normal capital requirement, perhaps in the buffer component rather than in the minimum capital requirement.

The analysis in this paper is meant to be complementary to the mainstream academic discussion of a systemic surcharge on important banks. We do not argue that rescue should always be the solution to a crisis at an important bank, or that rescue should be a promise to banks paying a high systemic surcharge. We acknowledge that more focus on rescue costs may strengthen market expectations that rescue will be the normal solution, and thus counteract the very purpose of systemic surcharges. But market expectations are already very strong and experience suggests that this option is often used. Then the expected rescue costs must be relevant for the calibration of a systemic surcharge on the activities of systemically important banks. The work now being done on improved resolution regimes and bank-specific resolution plans will hopefully make rescue a less expensive option for the government and a less attractive option for bank stakeholders.

References:

Acharya, Viral V. (2009), *A theory of systemic risk and design of prudential bank regulation*. Journal of Financial Stability 5, 224-255.

Acharya, Viral. V., Lasse H. Pedersen, Thomas Philippon and Matthew Richardson (2009), *Regulating systemic risk*. Chapter 13 in: Acharya, Viral. V, and Matthew Richardson, "Restoring Financial Stability: How to repair a failed system." John Wiley & Sons.

Acharya, Viral. V., Lasse H. Pedersen, Thomas Philippon and Matthew Richardson (2010), *Measuring systemic risk*. Mimeo, May 2010.

Adrian, Tobias and Markus K. Brunnermeier (2008), *CoVaR*. Federal Reserve Bank of New York Staff Report 34 (Revised).

Bank of England (2009a), *The UK Special resolution regime for failing banks in an international context*. Financial Stability Paper No. 5.

Bank of England (2009b), *The role of macroprudential policy.* Discussion Paper.

Basel Committee for Banking Supervision (2009), *Strengthening the resilience of the banking sector - consultative document.* 17 December 2009.

Basel Committee for Banking Supervision (2010), *An assessment of the long-term economic impact of stronger capital and liquidity requirements.* 18 August 2010.

Brunnermeier, M.T., A. Crockett, C. Goodhart, A.D. Persaud and H. Shin (2009), *The Fundamental Principles of Financial Regulation.* Geneva Reports on the World Economy No. 11.

Department of the (US) Treasury (2009), *Financial Regulatory Reform.* Report published on 17 June 2009.

Elsinger, Helmut, Alfred Lehar and Martin Summer, *Risk Assessment for Banking Systems.* Management Science September 2006, 52(9), pp 1301-1314.

Financial Services Authority (2009), *A regulatory response to the global banking crisis.* Discussion Paper 09/2.

Financial Stability Board (2009), *Guidance to Assess the Systemic Importance of Financial Institutions, Markets and Instruments: Initial Considerations.* Report to G20 Finance Ministers and Governors.

Financial Stability Board (2010), *Reducing the moral hazard posed by systemically important financial institutions.* Interim report to G20 Leaders, 18 June.

Greenbaum, Stuart I. and Anjan V. Thakor (1995), *Contemporary Financial Intermediation.* The Dryden Press.

Haldane, Andrew G (2010), *The $100 billion question.* Speech 30 March 2010 published on the Bank of England website.

Huang, Xin, Hao Zhou and Haibin Zhu (2010), *Assessing the systemic risk of a heterogeneous portfolio of banks during the recent financial crisis.* BIS Working Paper No 296.

Huang, Xin, Hao Zhou and Haibin Zhu (2009), *A framework for assessing the systemic risk of major financial institutions.* Journal of Banking and Finance*, 33(11), 2036-2049.*

Huertas, Thomas (2010), *Resolution and Contagion.* Speech 26 February 2010 published on the Financial Supervision Agency website.

International Monetary Fund (2010), *Global Financial Stability Report 2010/1.*

Iragorri, C.C. and S. Ferrari (2010), *Measuring the systemic importance of financial institutions using market information.* Financial Stability Review 2010, National Bank of Belgium.

Pettway, R.H. and J.F. Sinkey (1980), *Establishing on-site examination priorities: An early warning system using accounting and market information*. Journal of Finance 35(1), 137-150.

Reinhart, C.M. and K.S. Rogoff (2009), *This time is different. Eight centuries of financial folly*. Princeton University Press.

Saunders, A., R.C. Smith and I. Walter (2009), *Enhanced Regulation of Large, Complex Financial Institutions*. Chapter 5 in: Acharya, V. and M. Richardson (eds.), *Restoring Financial Stability: How to Repair a Failed System*. John Wiley & Sons Inc.

Tarashev, Nikola, Claudio Borio and Kostas Tsatsaronis (2010), *Allocating systemic risk to individual institutions*. BIS Working Paper No 308.

Vale, Bent (2004), *The Norwegian banking crisis*. In Moe, Thorvald G, Jon Solheim and Bent Vale (eds.), The Norwegian Baking Crisis. Norges Bank Occasional Papers No. 33.

Zhou, Chen (2009), *Are banks too big to fail?* DNB Working Paper No. 232.