Institution: University of Leeds		
Unit of Assessment: 17 - Business and Management Studies		
Title of case study: Mitigating the risk and the effects of banking crises in Europe through the SYMBOL model		
Period when the underpinning research was undertaken: 2009 – 2013		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): Professor Francesco Vallascas	**Role(s) (e.g. job title):** Chair in Banking	**Period(s) employed by submitting HEI:** 01.08.10 – 01.06.20
Period when the claimed impact occurred: May 2014 – December 2020		
Is this case study continued from a case study submitted in 2014? No		

1. Summary of the impact (indicative maximum 100 words)

Research by **Vallascas**, in collaboration with the European Union (EU) Joint Research Centre and others, resulted in a model named SYMBOL (Systemic Model of Banking Originated Losses) that simulates the effects of bank failures in a financial system. The EU are increasingly developing policies supported by model-based evidence. The European Commission (EC) has adopted SYMBOL to assess *ex ante* ('before the event') policy options for banks. These assessments have helped to reform banking regulation to mitigate both the risk and possible effects of future financial crises. SYMBOL was used to assess proposals for legislative reforms for Europeans banks, including restrictions on bank leverage, and to provide evidence to better inform the decision-making behind regulatory changes that have enhanced European financial stability. It has also been used to monitor the European banking sector.

2. Underpinning research (indicative maximum 500 words)

The banking industry plays a pivotal role for the functioning of the economy. A stable banking system sustains economic growth by providing loans to corporations and households and ensuring that the payment system operates smoothly. There are significant economic and social costs to bank failure, in reduced loans, cancelled economic transactions, financial losses for bank creditors and costly government rescue packages. The 2007–2009 global financial crisis demonstrated the negative economic and social costs of such failure. The need to avoid these costs for the economy and society justify introducing a stringent regulatory framework on banks to ensure that they remain stable.

Professor Francesco **Vallascas** played a pivotal role in a research team that has worked in collaboration with the EC Joint Research Centre (JRC - https://ec.europa.eu/jrc/en/about/jrc-in-brief) since 2006. As part of this collaboration[1], the aim of the research team was to develop models that can contribute to the effective design of banking regulation to ensure a stable banking system. **Vallascas's** contributions relate to modelling and empirically examining bank regulation, governance and systemic risk of European banks.

The original mathematical model (later called SYMBOL), published in 2011 **[1]** specifies the model and sets out the principles underpinning its development. Specifically, **[1]** states that policy makers should consider the regulatory framework within which banks operate and

[1] Including academics from the University of Cagliari, members of the EC from the DG FISMA (the Directorate-General for Financial Stability, Financial Services and Capital Markets Union) and Francesca Campolongo, the Head of the Finance & Economy Unit of the JRC.

potential sources of systemic risk, such as the correlation between banks' assets and the risk of interbank contagion when estimating Deposit Insurance Scheme loss distributions.

The mathematical model in **[1** and **2]** came to be known as SYMBOL, a name given to it by the EC. It allows researchers and policymakers to simulate bank failures in a financial system and thereby estimate the default risk of banks, i.e. the risk that a bank will not be able to make its required debt payments, including to customers withdrawing their deposits or savings. SYMBOL can be used to simulate the joint failures of several banks in a system and quantify how costly it would be to refund the depositors of failed banks via an insurance system. It can also be used to measure the impact of bank failures on the public finances and thereby estimate the systemic importance of each bank in a system**.** The SYMBOL model was designed as the main tool for the assessment of the impact of banking regulatory changes. It can simulate alternative scenarios in an existing banking system linked to a whole raft of different policy options. Therefore, regulators can use the model to simulate the effect of new policies such as changes in capital regulation or imposing restrictions on a bank's business operation. Thus, SYMBOL is able to provide indications of the implications of different policy options with regard to financial stability and the robustness of public finances. Distinctive features include[2]:

- It allows estimation of potential bank losses within a Basel II compliant framework;
- It explicitly considers potential losses arising from contagion effects in the interbank market;
- It can be applied to a single regulatory measure or to the cumulative impact of a package of regulatory interventions;
- The macro and micro perspectives of regulation can be jointly assessed.

The model was tested with data from the Italian Banking Association **[1]**. **Vallascas** and the team tested the broader application of the model by employing it to assess the sustainability of the deposit insurance systems in Germany, Spain and the UK **[2]**. This research showed how the model can be used to quantify the optimal size of a deposit insurance fund in a country and the risk contribution of each bank to the overall risk in a banking system.

A key element of the model in **[1]** is a bank's default risk that is obtained by using the average quality of bank borrowers as a key input. This quality is derived from the regulatory formula that banks must apply to compute their capital requirements when they use Internal Ratings-Based (IRB) models[3]. Further work by **Vallascas** explored the potential benefits and costs of computing capital requirements using IRB models by banks under the Basel II framework. With the JRC team, he published a Scientific and Technical Report **[3]** that examined the implications of the IRB models for bank lending costs from a micro and macro perspective. In further work published in 2013, **Vallascas** and Hagendorff (University of Edinburgh) focused on one of the key assumptions of IRB models, namely, that capital requirements based on the use of IRB models properly reflect a bank's risk exposure and assessed its validity and limitations using an international sample of large banks between 2000 and 2010 **[4]**. It was found that risk-weighted assets (the regulatory measure of portfolio risk, which determines minimum capital requirements) are ill-calibrated to a market measure of bank portfolio risk **[4]**.

Vallascas and **Keasey** have extended the understanding of capital regulatory design by looking at Basel III (the modifications of the Basel II regulatory framework post the 2007-2009 crisis), drawing conclusions on the effects of regulatory changes on financial stability **[5]**. This study used a novel empirical approach and an extensive sample of listed European banks. The

[2] Campolongo, M., Marchesi, M. and De Lisa, R. (2012). The Potential Impact of Banking Crises on Public Finances: An Assessment of Selected EU Countries Using SYMBOL. OECD Journal: Financial Market Trends, 2011(2), 73–84. https://doi.org/10.1787/fmt-2011-5k9cswn0nhbr

[3] IRB models are models designed by banks and employed to estimate the riskiness of their borrowers. The estimated borrower risk, in addition to other parameters, is used to quantify how much capital a bank needs to hold (*capital requirements*) by employing a mathematical formula that is provided by regulators.

authors identified which bank characteristics offer a shelter from systemic shocks and compared the relative effects of several hypothetical prudential rules on a bank's risk exposure.

3. References to the research (indicative maximum of six references)

[1] De Lisa, R., Zedda, S., **Vallascas**, F., Campolongo, F. and Marchesi, M., (2011). Modelling deposit insurance scheme losses in a Basel 2 framework. *Journal of Financial Services Research.* 40, 123-141. https://doi.org/10.1007/s10693-010-0097-0. (An online version was published in 2010)

[2] De Lisa, R., Zedda, S., **Vallascas**, F., Campolongo, F. and Marchesi, M., (2010). *Deposit Insurance Schemes: Target Fund and Risk-Based Contributions in Line with Basel II Regulation*. JRC Scientific and Technical Report. https://doi.org/10.2788/72423.

[3] De Lisa, R., Galliani, C., Marchesi, M., **Vallascas**, F. and Zedda, S., (2012). *The Mitigation Role of Collaterals and Guarantees under Basel II*, JRC Scientific and Technical Report. http://dx.doi.org/10.2788/50944.

[4] **Vallascas**, F. and Hagendorff, J., (2013). The risk sensitivity of capital requirements: Evidence from an international sample of large banks. *Review of Finance.* 17(6), 1947-1988. https://doi.org/10.1093/rof/rfs042.

[5] **Vallascas**, F. and **Keasey**, K., (2012). Bank resilience to systemic shocks and the stability of banking systems: Small is beautiful. *Journal of International Money and Finance.* 31(6), 1745-1776. https://doi.org/10.1016/j.jimonfin.2012.03.011.

Grant

Vallascas, F., European Commission Research Centre (ISPRA), GBP11,000. 2013. Contagion via asset sales in the European banking industry.

4. Details of the impact (indicative maximum 750 words)

The use of the SYMBOL model developed by **Vallascas** and collaborators helps the EC to decide on the best policy options and the regulatory changes they should make, by giving better advice to EU policy makers (i.e. the European Parliament and Council). In the case of banking, the EC adopted the SYMBOL model to make impact assessments of different policy options for regulating the European banking industry **[A]**. These impact assessments are central to policy making and rely on modelling. An EC technical report reviews the SYMBOL model's strengths and confirms: *"The model can answer a number of relevant policy questions by providing quantitative estimates of the order of magnitude with respect to changes in a wide range of regulatory frameworks. - For example, it can provide an estimate of the order of magnitude of changes in the distribution of bank losses after salient changes in the bank regulation."* **[A]**. Consequently, the model helped the EC develop better policies with the common objective of lowering the risk of financial crises and providing a more stable European banking system.

SYMBOL has been used in a wide range of ex ante impact assessments to understand the implications of possible reforms of the financial architecture in the EU following the global financial crisis of 2007-2009 **[B]** and is still in use**.** Early examples of regulatory changes that followed the use of SYMBOL include the Capital Requirement Directive, the Bank Recovery Resolution Directive (adopted in Spring 2014) and initiatives to set up the Banking Union (CRD-IV) (2013) **[A**, **B]** that directly supervises the most important EU banks[4]. The strengthened rules and new supervisory system make the EU banking system much sounder and safer[5].

The JRC Head of Finance & Economy Unit confirms that they provide modelling support to EC services to the Directorate General for Financial Stability, Financial Markets and Capital Markets Union (DG FISMA), and that from 2007-2008 they cooperated with academia (Leeds and

[4] For a non-technical explanation see: https://www.youtube.com/watch?v=vo3SWSpHwzY

[5] For a non-technical explanation see: https://www.youtube.com/watch?v=sLFjz7u5e0o

Cagliari) and developed the SYMBOL model **[B]**. The Head of Finance & Economy states "*SYMBOL has been used to inform the European policy process with quantitative analyses on the impact of new Commission legislative proposals improving financial stability and setting up the Banking Union."* **[B]**. Furthermore, **"***SYMBOL analyses have also supported the whole policy process for the adoption of new legislative proposals by the European institutions, e.g. discussions between the Commission, the European Parliament and the Council."* **[B]**. The EC letter of support lists five regulatory examples of where SYMBOL has been used to conduct ex-ante assessments, three examples of where it has been used to monitor the European banking sector and one example of its use in support of financial regulation (since 2013) **[B]**. Three specific examples of the use of the SYMBOL model are detailed below.

i) ***Assessment of regulatory policy options*****:** SYMBOL was employed, in 2016, to conduct an 'effects analysis' on the proposal for a European Deposit Insurance Scheme (EDIS), a supranational insurance scheme to protect depositors in the Euro area when banks fail[6] and the third pillar of the Banking Union **[C].** The analysis aimed to complement an earlier impact assessment that led to the adoption of the Deposit Guarantee Scheme Directive (DGSD) in 2014 which provided EUR100,000 cover for bank deposits. The purpose of EDIS was to provide a stronger and more uniform degree of insurance cover in the Euro area. SYMBOL was used to assess the effects of three policy options for the design of the EDIS (the assessment is published on the EC website **[D]** and referenced in the EC Communication to the European Parliament). The assessment concluded that under all three options, a supranational deposit insurance scheme was preferable to separate national schemes thus offering support to the EDIS proposal.

ii) ***Quantify benefits of policy proposals:*** In November 2016, SYMBOL was used to quantify the benefits of adopting a minimum leverage ratio (the ratio of core capital to its total assets) in EU banks and of a Fundamental Review of the Trading Book (FRTB), which calculates the minimum capital requirements for bank trading activities. This assessment consisted of evaluating the potential costs and benefits of some modifications in the capital requirement framework that was adopted in response to the global financial crisis **[E]**. The SYMBOL model was used to measure the benefits of the proposed regulatory modifications. These modifications resulted in a decreased cost to public finances from bank defaults and their subsequent recapitalisation demands **[E]**. SYMBOL estimated that the introduction of the FRTB **[B]** and the leverage ratio reduces the impact on public finances after taking into account bail-ins and resolution funds from EUR5.49bn to EUR2.87bn (a 47.85% reduction) **[E** – p74**]**. The regulatory change in the leverage ratio has now become part of European banking regulation with the publication of the European banking package in June 2019 **[F]**. The package is described by the EC as a key milestone in the process of eliminating the regulatory gaps and weaknesses identified during the financial crisis. Following its approval in 2019, there was a phased introduction which will mean banks have to disclose the value of their capital requirements based on FRTB **[F]**.

iii) ***Monitoring the European banking sector*****:** In 2014 the EC implemented new quantitative analyses to assess the macroeconomic benefits of three pieces of the revised financial architecture: a) additional capital requirements of banks; b) the bail-in rules on unsecured debt; and c) the resolution fund provisions of the Bank Recovery and Resolution Directive (BRRD) **[G** pp75-88, **H** page 36 onwards**]**. The SYMBOL model found significant savings to public finances, in the event of bank failure, when these three pieces of the financial architecture are jointly considered. An EC Staff Working Document on Economic Review of the Financial Regulation Agenda states: *"The simulations show that the increased capital requirements result in a 22% reduction in the potential public finance costs associated with bank failure. Considering also the two additional tools, i.e. bail-in and resolution fund, the costs of public finances are reduced by 92%"* **[G** – page 88, box 4.2.6**]**. The EC Fiscal Sustainability Report states: *"SYMBOL has been used by the European Commission for the ex-ante quantitative impact assessment of several legislative proposals, … for the cumulative evaluation of the entire financial regulation agenda, … and for the estimation of*

[6] For a non-technical explanation see: https://www.youtube.com/watch?v=merLOXCSSBg

contingent liabilities linked to public support to the EU banking Sector" **[I** – page 83**]**. Annex A7 of this report provides a detailed estimate of the potential impact of simulated bank losses on public finances based on the SYMBOL model **[I** – page 181-185**]**. This report shows the distribution of losses for each of the EU Member States from the aggregated simulated individual bank losses as a result of a shock. This application of SYMBOL is ongoing - a similar analysis is provided in the Fiscal Sustainability Report 2018 **[J** – page 129**]**.

5. Sources to corroborate the impact (indicative maximum of 10 references)

[A] European Commission, Review of the SYMBOL model, JRC Technical Reports, 2018. http://publications.jrc.ec.europa.eu/repository/bitstream/JRC111667/review_of_the_symbol_model.pdf. [Page 10]

[B] Letter from the Head of Unit Finance & Economy, DG Joint Research Centre, European Commission. May 2019.

[C] European Commission "Effects analysis on the European Deposit Insurance Scheme", October 2016. https://ec.europa.eu/info/sites/info/files/161011-edis-effect-analysis_en.pdf

[D] Communication to the European Parliament, the Council, The European Central Bank, The European Economic and Social Committee and the Committee of the Regions on completing the Banking Union. https://ec.europa.eu/info/publications/171011-communication-banking-union_en.

[E] European Commission Staff Working Document, Impact Assessment, November 2016. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016SC0377R(01)&from=EN

[F] Regulation (EU) 2019/876 of the European Parliament and of the Council of 20 May 2019. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0876&from=EN

[G] Commission Staff Working Document, Economic Review of the Financial Regulation Agenda Chapters 1 to 4, May 2014. https://eur-lex.europa.eu/resource.html?uri=cellar:841b8a91-dc18-11e3-8cd4-01aa75ed71a1.0001.01/DOC_1&format=PDF [Page 88]

[H] Commission Staff Working Document, Economic Review of the Financial Regulation Agenda Bibliography and Annexes, May 2014. https://eur-lex.europa.eu/resource.html?uri=cellar:841b8a91-dc18-11e3-8cd4-01aa75ed71a1.0001.01/DOC_3&format=PDF [Annex 4]

[I] European Commission Fiscal Sustainability Report 2015, Institutional Paper 018, January 2016. https://ec.europa.eu/info/publications/economy-finance/fiscal-sustainability-report-2015_en

[J] European Commission Fiscal Sustainability Report 2018, Institutional Paper 094, January 2019. https://ec.europa.eu/info/publications/economy-finance/fiscal-sustainability-report-2018_en