Institution:
University of Cambridge

Unit of Assessment:
UoA18

Title of case study:
Long-Run Structural Macroeconomic Modelling / Economic and Financial Forecasting

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

The focus of this impact is the effect of the Global Vector Autoregressive (GVAR) project on international organisations such as the International Monetary Fund (IMF) and the European Central Bank (ECB) as well as its use by commercial organisations such as the Economist Intelligence Unit and the Asian Development Bank. The impact has enhanced the tools used by the ECB for communicating its policies. It has also allowed the IMF to demonstrate the effects of oil prices. The Economist Intelligence Unit found it an effective framework for assessing a wide-range of scenarios. The Asian Development Bank uses the GVAR model for forecasting in Asia.

2. Underpinning research (indicative maximum 500 words)

Hashem Pesaran has been a member of the Faculty of Economics at the University of Cambridge since 1979 and has held the position of Professor since 1988.

Between 1995 and 2000 Pesaran was PI on the ESRC research project "Structural Modelling of the UK Economy within a VAR Framework using Quarterly and Monthly Data". The outcome of this research was first published in an article in the Economic Journal [3.1], and in a book by Oxford University Press [3.2] (both co-authored with Garratt, Lee, and Shin: also employees of the University of Cambridge). The approach developed for the UK was then extended to construct a model of the global economy - the so-called GVAR. This was first published in an article in the Journal of Business Economics and Statistics [3.3] (co-authored with Schuermann (Federal Reserve Bank of New York) and Weiner (Alliance Capital Management)).

A GVAR model is a global model combining individual country vector error-correcting models, in which domestic variables are related to country-specific foreign variables in a consistent manner. The latter are constructed from the domestic variables so as to match the pattern of international trade or financial connections or any other desired pattern. The model relies exclusively on observables, which typically include macroeconomic aggregates and financial variables. Some key advantages of the GVAR modelling approach are that it allows for interdependence at a variety of levels (national and international) in a transparent way that can be empirically evaluated; it allows for long-run relationships consistent with economic theory and short-run relationships that are consistent with the data; it also provides a coherent, theory-consistent solution to the curse of dimensionality in global modelling. The global model can also incorporate forward looking behaviour, so it can also accommodate modern dynamic stochastic, general equilibrium models. The development of the GVAR involved also Schuermann (Federal Reserve Bank of New York), as well as Dees (ECB), Di Mauro (ECB), Pesaran, Smith (Cambridge) and Holly (Cambridge).

Amongst other things GVAR has been used for the international analysis of credit risk [3.4] an analysis of the international linkages of the Euro area [3.5] and the role of long run relationships in the global economy [3.6].

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

[3.1] Garratt, K. Lee, Pesaran, M.P. and Y. Shin, 2003, "A Long Run Structural Macroeconometric Model for the UK" *Economic Journal*, Vol.113, pp.412-455.

[3.2] Garratt, A., Lee, K,. Pesaran, M.P. and Shin, Y. 2006 *Global and National Macroeconometric Modelling: A Long Run Structural Approach*, Oxford University Press, ISBN 0-19-929685-5

[3.3] Pesaran, M.P., T. Schuermann and S. Weiner, 2004, "Modelling Regional Interdependencies using a Global Error-Correcting Macroeconometric Model", *Journal of Business and Economic Statistics*, Vol.22, No. 2, pp. 129-162.

[3.4] Pesaran, M.P., Til Schuermann, Björn-Jakob Treutler and Scott M. Weiner, 2006. "Macroeconomic Dynamics and Credit Risk: A Global Perspective", *Journal of Money Credit and Banking*, Vol. 38, No. 5, pp. 1211-1262

[3.5] Dees, S., F. Di Mauro, M.P. Pesaran and V. Smith, 2007. "Exploring the International Linkages of the Euro Area: a Global VAR Analysis", *Journal of Applied Econometrics*, Vol. 22, Issue 1, pp. 1-38

[3.6] Dees, S., S. Holly, M.P. Pesaran and V. Smith, 2007. "Long Run Macroeconomic Relations in the Global Economy", *Economics - The Open-Access, Open-Assessment E-Journal*, 2007-3.

Supporting Research Grants

Pesaran et al. ESRC grant for research on "Structural Modelling of the UK Economy within a VAR Framework using Quarterly and Monthly Data", June 1995 for five years. Ref: L116 25 1016. (£205,130) ESRC grading: *Outstanding*. End of Award Report: http://www.econ.cam.ac.uk/faculty/pesaran/svareoa.pdf

Sean Holly and Hashem M Pesaran. ECB grant for Project 'International economic linkages and synchronisation in business cycles' , June 2004 for one year (€60,000)

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

Use by the ECB

The impact of the GVAR on the ECB dates from 2004 when the ECB funded a Project at Cambridge on International Economic Linkages and the Synchronisation Of Business Cycles. This project, led by Hashem Pesaran and Sean Holly, allowed the ECB access to the GVAR and an updated version of the model was provided to the ECB. This became the basis for a number of studies carried out by the ECB up until the present, e.g.: "Modelling global trade flows: Results from a GVAR model" (2009) [5.1] and "External shocks and International inflation Linkage: A global VAR analysis" (2009) [5.2].

Since 2010 the main vehicle for the dissemination of the GVAR approach is via the GVAR Toolbox. This is a collection of MatLab (a high level computer language) procedures with an Excel-based interface, designed for GVAR modelling. This provides a general yet practical global modelling framework for the quantitative analysis of shocks to the world. This makes it a suitable tool for policy analysis, analysing credit risk and forecasting. This software package was made available and launched in December 2010, and sponsored by the ECB [5.3].

Observable impacts take the form of analysis that was carried out at these organisations based on the GVAR framework. Evidence of continuing impact is provided by a workshop in 2011. The Workshop was held on November 3 2011 at the Shanghai Advanced Institute of Finance where Dr. Di Mauro and Dr. Bianchi from the ECB gave presentations on the *Utilization of the GVAR Model in Global Macro-economic Research*. Dr. Bianchi, in the modelling session, explained and demonstrated policy simulations and scenario analysis by means of the GVAR model [5.4].
The Senior Advisor of the Research Department of the ECB has advised us in an email that "...the GVAR has been for years one of the most important tools used. First because of its capacity of incorporating global linkages; second because of its emphasis on financial links, often lacking in other more structured tools, and so widely seen now as critically important; third, because of its flexibility and the incredible number of applications it has generated" [5.5].

Use by the IMF

The GVAR model has also been used extensively by the IMF. A post 2008 example is in the form of an analysis published in IMF Country Report No. 11/185 [5.6], in July of 2011, where the GVAR framework is used to examine the spillover effects of the Euro crisis on the rest of the world.

Use by the Economist Intelligence Unit

The Economist Intelligence Unit is using the GVAR for forecasting purposes. The Director of Data Services at the Economist Intelligence Unit has noted in an email that "Over the past two years, we have successfully applied the GVAR framework to support our published quarterly forecasts for the

major economies. The system we implemented covers 28 countries across the euro area and G20 and has helped us in assessing both output and financial linkages within an increasing integrated Global economy. We have also found it an effective framework for assessing a wide-range of scenarios, most recently around a euro break-up" [5.7].

Use by the Asian Development Bank

The Asian Development Bank in Manila reports that "We have found the GVAR model to be useful for forecasting and estimating the impact of various shocks on the region's economy. The GVAR model is one of the tools we use for forecasting growth in Asian economies in my office. I have also used the GVAR methodology to quantify the effect of a Eurozone crisis on Asia's financial markets. We have also used it to provide with some estimates of oil price shocks to the region" [5.8].

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

[5.1] "Modelling global trade flows: Results from a GVAR model". Working Paper series, No 1087 / September 2009, by Matthieu Bussière, Alexander Chudik, and Giulia Sestieri. http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1087.pdf
[5.2] "External shocks and International inflation Linkage: A global VAR analysis", Working Paper series No 1062 / June 2009, by Alessandro Galesi, and Marco J. Lombardi. http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1062.pdf.
[5.3] Smith, L.V. and A. Galesi (2010), GVAR Toolbox 1.0, http://www.cfap.jbs.cam.ac.uk/research/gvartoolbox/index.html
[5.4] Shanghai Advanced Institute of Finance, 'European Central Bank Economist Talks about European Debt Crisis at SAIF' http://www.saif.sjtu.edu.cn/media/en/show.php?news_id=3080&sysc_id=1094
[5.5] Person 1 (Senior Advisor, Research Department, European Central Bank). Email received 19/6/2012.
[5.6] IMF Country Report No. 11/185, July 2011. http://www.imf.org/external/pubs/cat/longres.aspx?sk=25056.0
[5.7] Person 2 (Director Data Services, Economist Intelligence Unit). Email received 11/8/2012.
[5.8] Person 3 (Asian Development Bank). Email received 11/10/2012.