

Institution: University of Strathclyde		
Unit of Assessment: C17 Business and Management Studies		
Title of case study: Enhancing analytical capacity and knowledge through economic modelling to strengthen regional policy-making in Scotland, Northern Ireland and Europe.		
Period when the underpinning research was undertaken: 2000 - 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Graeme Roy	Professor of Practice	28/03/2016 – 28/02/2021
Peter McGregor	Professor; Consultant	01/10/1976 – 31/05/2015; 01/10/2017 - present
Kim Swales	Professor	01/01/1978 – 04/11/2013
Grant Allan	Senior Lecturer	01/10/2002 – present
Gioele Figus	Lecturer	01/04/2016 – present
Patrizio Lecca	Research Associate	30/09/2010 – 13/10/2015
Katerina Lisenkova	Research Fellow	12/07/2016 – 15/07/2018
Period when the claimed impact occurred: August 2013 – July 2020		
Is this case study continued from a case study submitted in 2014? No		
1. Summary of the impact		
<p>Through the advancement and application of Computable General Equilibrium (CGE) modelling, Strathclyde's Fraser of Allander Institute (FAI) has strengthened regional policy-making by enhancing analytical capacity and knowledge within Scotland (Scottish Government, City of Glasgow Council, Scottish Policy Foundation), Northern Ireland (Northern Ireland Executive) and Europe (European Commission). By enabling effective and efficient regional economic modelling and multi-sectoral analysis, this research has supported and strengthened evidence-based policy development in response to a range of pressing issues including climate change and Brexit.</p>		
2. Underpinning research		
<p>The shift toward decentralised economic policymaking across Europe over the last twenty years, including UK devolution in 1999, has required a significant upscaling in regional economic research modelling capacity. Responding to this need, Strathclyde's Fraser of Allander Institute (FAI) has developed and applied sophisticated macroeconomic models of regional economies to better understand how these economies work, the impact of policy choices on economic outcomes, and the links between rates of economic activity and wider objectives, such as CO2 emissions and household inequalities. By providing a rich picture of a local economy, its linkages to its near neighbours and the policy environment, Strathclyde's Computable General Equilibrium (CGE) models are ideally suited to the study of regional economies.</p> <p>Since 2000, three core strands of research have been undertaken leading to the:</p> <ul style="list-style-type: none"> • Advancement of CGE modelling to enable ever more accurate representations of regional economies. • Modification of general frameworks and application to pressing regional economic policy questions. • Creation of accurate frameworks that capture the interaction between policy choices over regional economic activity and wider society objectives. 		
Advancement of CGE modelling methods		
<p>Seeking to push the frontiers of CGE modelling to enable ever more accurate representations of regional economies, Strathclyde's fundamental research has enabled the creation of many of the tools now used by organisations across the world to understand regional economic trends. The Strathclyde research developed from establishing some of the very first imperfect competition models back in the 1990s, through to the latest sophisticated developments in the field including multi-regional modelling. Since 2000, this work has included incorporating insights from other branches of economics including forward looking expectations [R1], price-inflexibilities, and behavioural economics [R2]. In addition to pushing forward model sophistication and realism, these frameworks have been applied to a range of important regional economic issues such as</p>		

the importance of revenue flows from renewables for local economic development [R3], the impact of expectations and business confidence on economic resilience.

Multi-regional macroeconomic models to aid understanding of how national policies can impact upon regional outcomes have also been developed. Most recently, this includes modelling to explore the specific impact of the UK withdrawal from the European Union (Brexit) on Scotland. Here the spill-over effects from the impact of Brexit on the Scottish economy proved to be substantial relative to the direct effects from Scottish-REU trade linkages, so that a single-region analysis would have substantially underestimated the adverse impacts of Brexit on the Scottish economy [R4].

Modification and application of general frameworks

Motivated by engagement with experts and key stakeholders, a second research strand has modified these general frameworks and applied them to pressing regional economic policy questions. In particular, drawing upon wider expertise on regional public policy, modelling was undertaken to explore the implications of different fiscal structures at a regional level, in part motivated by the trend to decentralise more tax and spending powers to regional governments [R5]. Strathclyde's analysis demonstrated that with conventional wage bargaining and a strong migration response, fiscally neutral 'expansions' can lead to contractions in the host region unless government spending is sufficiently highly valued within the migration and wage bargaining processes. Analysis of a wide range of possible regional fiscal policies was subsequently undertaken and combined with microsimulation to identify the detailed effects of a Universal Basic Income.

Creation of frameworks to capture interdependence across policy domains

A third strand of research has focused on creating accurate frameworks that capture the interaction between policy choices over regional economic activity and wider society objectives. As concern with distributional, environmental and economic considerations has grown, Strathclyde's research has extended and developed regional models to capture these, with a particular focus upon sustainability and energy efficiency. This multisectoral approach is necessitated by the huge variation in energy and emissions intensities across sectors (and indeed within the electricity sector, given the focus on renewables); the composition of output really matters. Capturing aspects of inclusive growth required incorporation of disaggregated households. The resultant framework enabled the nature of any trade-offs or complementarities (double or higher dividends) among policy goals to be explored, including consideration of the conditions under which energy efficiency changes could potentially improve emissions, equity and the level of economic activity [R6].

3. References to the research (Strathclyde-affiliated authors in **bold**)

- R1 P. Lecca, P.G. McGregor, J.K. Swales** (2013). Forward-looking and myopic regional Computable General Equilibrium models: how significant is the distinction? *Economic Modelling* 31: 160-176 <https://doi.org/10.1016/j.econmod.2012.11.010>
- R2 G. Allan, G. Figus, P.G. McGregor, J.K. Swales**, (2020) Resilience in a behavioural/ Keynesian regional model. *Environment and Planning A: Economy and Space*, 0(0): 1-9 <https://doi.org/10.1177%2F0308518X20941775>
- R3 G. Allan, P. McGregor, K. Swales** (2011) The importance of revenue sharing for the local economic impacts of a renewable energy project: a social accounting matrix approach, *Regional Studies*, 45(9): 1171-1186 <https://doi.org/10.1080/00343404.2010.497132> [REF2 in 2014]
- R4 G. Figus, K. Lisenkova, P. McGregor, G. Roy, K. Swales** (2018) The long-term economic implications of Brexit for Scotland: an interregional analysis, *Papers in Regional Science*, 97(1): 91-115 <https://doi.org/10.1111/pirs.12349> - this article is based on a report for the Scottish Parliament which was recognised as closing a knowledge gap on Brexit [S1]
- R5 P. Lecca, P.G. McGregor, J.K. Swales**, Y.P. Yin (2014) Balanced budget multipliers for small open regions within a federal system: evidence from the Scottish variable rate of income tax, *Journal of Regional Science*, Vol. 54(3): 402-421 <https://doi.org/10.1111/jors.12113>
- R6 G. Figus, P. Lecca, P.G. McGregor, K. Turner** (2018) Energy Efficiency as an Instrument of regional development policy? The impact of regional fiscal autonomy, *Regional Studies*, 53: 815-825 <https://doi.org/10.1080/00343404.2018.1490012>

Notes on the quality of research: All outputs are published in peer-reviewed journals. This extensive body of research has been supported with competitively-won funding from various bodies including the Economic and Social Research Council (e.g. McGregor (PI), *The Constitutional Future of Scotland and the United Kingdom*, 01/10/2013–30/09/2015, GBP183,136) and Scottish Government (Allan (PI) and McGregor (CI), *Linking agriculture and eco-system models with CGEs*, 01/04/2016-31/03/2019, GBP333,671).

4. Details of the impact

Supporting regional policy-making through the advancement and application of Computable General Equilibrium (CGE) modelling, since 2014 Strathclyde's Fraser of Allander Institute (FAI) has:

- Informed the Scottish Government's Community Energy Policy Statement (2015), Energy Strategy (2017) and Community and Renewable Energy Scheme (CARES) which has contributed to the achievement of renewable energy targets.
- Shaped the Scottish Government's policy response and preparations for Brexit following the EU referendum in 2016, informing 'Scotland's Place in Europe' 2016 and 2018 position statements and the 2016 Scottish Parliament Culture, Tourism, Europe and External Affairs Committee inquiry.
- Enabled policy development within Glasgow City Council in relation to the Glasgow City Region deal, Brexit, Covid-19 and net-zero emissions targets.
- Facilitated third sector policy analysis and debate in partnership with the Scottish Policy Foundation, including influencing the David Hume Institute's *Wealth of the Nation* reports and supporting the establishment of CBI Scotland's new productivity index.
- Enhanced debate around the Northern Ireland Protocol and informed the Northern Ireland Executive's policy priorities and Brexit negotiations.
- Strengthened policy analysis and evaluations undertaken by the European Commission through the development of its RHOMOLO CGE model.

Scottish Government

According to the Scottish Government's Chief Economist, who leads a Directorate of approximately 100 staff providing economic, statistical and research advice on all issues relating to the economy, the embedding of Strathclyde's CGE model of the Scottish economy since 2011 has significantly enhanced their analytical capabilities and knowledge. With ongoing input from FAI researchers to build in-house modelling capacity and extend the original model, including 'research on a new two-region (Scotland/rUK), and variations that capture work on energy policy, agricultural policy and fiscal policy', the Government is 'now running the model fully and applying this approach in a number of areas' [S1]. This has enabled them to support 'policymaking at the highest level in the Scottish Government from migration issues, where it informed the [Scottish Government policy position on calling for further powers on migration](#), through to childcare, energy, labour market policy and citizen's basic income', which references the model throughout [S1]. This is acknowledged by the Head of Enterprise and Innovation, who led on developing the Government's evidence base to inform policy decisions on both energy and climate change. Confirming that the macroeconomic modelling framework 'was used extensively to explore different energy and low carbon policies', he notes the importance of Strathclyde's contribution: 'This work was supported by colleagues at Strathclyde who worked closely with our team on model developments. This included developing links between our own TIMES Climate Change model and the Strathclyde built CGE model. All this work and the analysis that followed helped to inform our 2017 Scottish Government Energy Strategy' [S2].

Analysis undertaken by Strathclyde has also directly informed policy development, a notable example being the 2016 report for the Scottish Parliament on the *Long-term Economic Implications of Brexit*. As outlined by the Chief Economist, the route from research to policy influence is clear: 'Following publication of FAI research into the potential impacts of Brexit on the Scottish economy in 2016, we worked with the FAI to incorporate their findings into our analytical work, including working with them on developing new scenarios for our own internal analysis where they offered valuable advice. This informed the policy position set out by Scottish Ministers in 'Scotland's Place in Europe' published in December 2016 and provided the analytical framework for our subsequent analysis and advice to Ministers in 'Scotland's Place in Europe: people, jobs and investment' published in January 2018' [S1].

This is also confirmed by the Director of External Affairs, who credits Strathclyde with enabling *'work on Brexit and Scotland's future population strategy'* which subsequently informed debate and decision-making [S3]. A key example of this is the 2018 *'Scotland's population needs and migration policy: discussion paper on evidence, policy and powers for the Scottish Parliament'*, which supplemented analysis undertaken by Strathclyde for the Scottish Parliament Culture, Tourism, Europe and External Affairs Committee in 2016. According to the Committee Convenor, the resulting report on the long-term implications of Brexit made *'a valuable contribution to understanding the specific impacts in Scotland, particularly in relation to our key economic sectors'* and convinced them of the need for additional work *'to promote a further understanding of the potential impacts of the different trade models in Scotland and the policy decisions that would best protect Scotland's interests'* [S4]

Alongside this, research published by Strathclyde as part of the ClimateXChange initiative [R3] played a key role in shaping energy policy. In the words of the Head of Enterprise and Innovation, it *'had a major influence upon our understanding of the scale of potential economic benefit from community and locally-owned energy. This was a key part of our evidence base in the Scottish Government's 'Community Energy Policy Statement' published in 2015, which set out our ambitions to support community energy projects'* [S2]. This was used to justify the Government's support for community energy, including through the Community and Renewable Energy Scheme (CARES), enabling Scotland to exceed its 2020 target of 500MW of community owned and locally owned renewable energy capacity [S2].

City of Glasgow Council

Recognised for its contribution to policy development at national level, Strathclyde's CGE modelling has also enhanced analytical capacity and knowledge within Glasgow City Council. As outlined by the Director of Regional Economic Growth for Glasgow City Council: *'In the context of the GBP1,100,000,000 Glasgow City Region deal, and the need for better understanding of the Glasgow City economy to support policy development, we commissioned the FAI to develop a city-region Computable General Equilibrium model'* [S5]. Developed in 2019 and now embedded in the analytical toolkit used by officials in the Council and City Region Intelligence Hub, *'this modelling framework has been used to not only inform our work on the Glasgow City Region Deal, but in other areas of work, including our response to Brexit and in assessing the impact of COVID-19 on the Glasgow economy'*. Stressing its ongoing importance, the Director affirms that *'the work of the FAI has played an important role in informing our long-term economic development strategy for Glasgow'* and that *'going forward, we will be using the model in a number of areas, including informing our goal of becoming the first net zero city within the UK'* [S5].

Scottish Policy Foundation

To extend the benefits of CGE modelling to the third sector, Strathclyde's model of the Scottish economy has been shared with various non-governmental bodies. The main thrust of this has been through the Scottish Policy Foundation (SPF), an independent, apolitical grant-making charitable foundation working to promote honest, insightful and objective policy research to the people of Scotland in order to inform public debate. As well as acknowledging FAI's *'major contribution to the quality of public debate in Scotland'* through its day-to-day work, including substantial engagement with the business and policy community, the SPF Director confirms the difference that the modelling framework has made since 2017: *'We have worked in partnership with the FAI to make their Computable General Equilibrium model of the Scottish economy available to think tanks for research purposes, boosting the analytical capacity of these organisations beyond recognition. This framework – alongside general analytical support from the FAI – means that think tanks can develop and test their policy ideas as never before. This partnership has already enabled the David Hume Institute, the Institute for Public Policy Research and Shelter Scotland to undertake research that has addressed some of the key challenges for the Scottish economy'* [S6]. Furthermore, they *'estimate that the monetary value of this research and modelling work that FAI has completed on behalf of the David Hume Institute, IPPR Scotland and Shelter Scotland is over GBP50,000'* [S6]

According to the Director of the David Hume Institute, gaining access to the macroeconomic modelling framework in 2018 enabled it to examine *'the different avenues through which productivity could have an impact on the economy'* [S10]. This resulted in the publication of two

reports, both of which acknowledge Strathclyde's substantial input: *Wealth of the Nation: Scotland's Productivity Challenge* (2018) and *Wealth of the Nation: Who will do the jobs?* (2019). Reflecting on the significance of this, the Director notes: *'The modelling research was integral to our final report and greatly influenced our conclusions. As well as being very widely covered in the media, the report was well received by the policy and business community. Following on from the report, a new productivity index has been established by CBI Scotland - which I know that the Fraser of Allander Institute are helping to develop – supported by 24 recommendations for government'* [S7]. This work also *'directly led to the David Hume Institute raising significant additional funds for future work'*, with GBP300,000 of funding being secured. The Director asserts that *'our association with the research track-record and reputation of the FAI was a significant factor in being able to secure these funds'* [S7].

Northern Ireland Executive

On the recommendation of the Scottish Government, in 2018 Strathclyde was tasked by the Northern Ireland Executive to build a bespoke sub-national CGE model that reflected the unique conditions of the Northern Irish economy. With ongoing support and training from the FAI team, this regional model has been used to understand different EU exit scenarios and guide appropriate policy responses to Brexit, including mitigating any challenges and taking advantage of any new opportunities. Confirming this, the Chief Economist within the Department for the Economy (DfE) states: *'The research of the Fraser of Allander Institute (FAI) has been critical to improving our ability within the NI Executive to better understand those challenges and opportunities. This included some of the first published analytical insight in the much debated topic of the Northern Ireland Protocol. Ultimately the work with FAI helped bring new understanding around EU Exit alongside helping us in DfE and the Northern Ireland Statistics and Research Agency (NISRA) develop new analytical capabilities that will be used to inform economic policy for decades'* [S8].

European Commission

Stretching its influence beyond the UK, elements of the FAI CGE model have been integrated into the European Commission's RHOMOLO Spatial Modelling Framework which supports EU policy makers to provide sector, region and time specific simulations on investment policies and structural reforms. As noted in the 2018 technical report, *'the RHOMOLO model has been used with DG REGIO for the impact assessment of Cohesion Policy and structural reforms, and with the European Investment Bank for impact assessment of EU investment support policies'* [S9 p.4]. Key Strathclyde contributions include enabling the separation of investment from saving decisions and the introduction of a fixed real wage assumption that allows it to operate as an extended I-O based demand driven model. These are acknowledged by the EC Scientific Officer for Regional Economic Modelling, who affirms that *'the research that has taken place at Strathclyde in developing methods and techniques for regional CGE modelling have been essential building blocks for the RHOMOLO CGE model and for other regional modelling frameworks'* and that without this *'it would have taken far longer to develop the sophisticated model that we have in place today, and which we use extensively in our policy analysis and policy evaluations'* [S10].

5. Sources to corroborate the impact

- S1 Factual statement from Chief Economist, Scottish Government, dated 25 August 2020.
- S2 Factual statement from Deputy Director, Head of Enterprise and Innovation, Scottish Government, March 2020.
- S3 Factual statement from Director of External Affairs, Scottish Government, dated December 2018
- S4 Factual statement from Convenor, Culture, Tourism, Europe and External Relations Committee, The Scottish Parliament, dated 19 October 2016
- S5 Factual statement from Director of Regional Economic Growth, Glasgow City Council, dated 29 September 2020.
- S6 Factual statement from Director Scottish Policy Foundation, dated 24 March 2020.
- S7 Factual statement from Director, The David Hume Institute, dated 20 September 2019.
- S8 Factual statement from Chief Economist, Northern Ireland Department for the Economy, dated 24 September 2020.
- S9 European Commission (2018) [RHOMOLO V3: A Spatial Modelling Framework](#)
- S10 Factual statement from Scientific Officer, European Commission Joint Research Centre, Regional Economic Modelling, dated 27 July 2020.