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Public Data Analytics: The New Essential Service

Francesco Mureddu
Director - The Lisbon Council
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Task 2 - Policy Modelling and Simulation

- **Five simulation models:** finance, energy, pollution and climate change.
  - What is the impact of monetary policies such as the large scale asset purchase?
  - What are the most cost-effective response strategies for combating air pollution?
  - How can we restructure the EU energy system to cope with climate change?

- **COVID-19 predictive models:** 27 predictive models from six countries (DE, ES, FR, IT, UK, US) aimed to provide insights to policy makers in copying with the COVID-19 outbreak.
  - How many people will be infected? How many people will die?
  - Are the mitigating actions effective? Is the mobility of population affected?
  - How many ICUs will be necessary?
  - How fast will the epidemic outbreak spread?

Simulation models – NAWM II

- **Rationale:** financial model aimed to provide an analysis of the impact of several non-standard measures (NSMs) that have been implemented by the European Central Bank with the objective to mitigate the impact of the financial crisis on the economy as well as to ensure the transmission of standard monetary policy.
- **Use in policy making**
  - The model allows to carry out economic projections contributing to the elaboration of the projection baseline for the largest euro area countries and to forecasting with judgment and model-based projection narratives.
  - Further, the model allows for risk analysis and policy analysis, the latter related to the impact study of monetary policy options as well of strategic issues related to Monetary-fiscal-financial policy mix in the euro area.
- **Challenges:** DSGE models need to take risk into account by incorporating individual, institutional, and regulatory responses to changing risks. Further, DSGE models need to incorporate the financial sector and its intricacies, and to departure from the assumption of optimizing agents following rational expectations

Simulation models - WEM

- **Rationale.** Large-scale simulation model designed to replicate how energy markets function and is the principal tool used to generate detailed sector-by-sector and region-by-region projections for the IEA's World Energy Outlook (WEO) scenarios.
- **Use in policy making.**
  - The annual WEM-based WEO report is used by all OECD member nations as well as many non-member countries and other entities to inform their energy and climate policies.
  - WEM helps to assess achievability of policy targets related to energy consumption and energy efficiency, as well as to alternate energy sources, including renewable energy
  - It can also be used to identify appropriate policy response options for making the energy sector more sustainable, combat climate change and reduce water and air pollution.
- **Challenges.** The flexibility of economic behaviour is effectively contained, and that the relations of the modelling system are not sufficiently responsive to shifts and shocks in technology, preferences, policies and prices. Critics also argue that the IEA's World Energy Outlook, which uses the WEM, is largely a product of historical trends and developments, combined with exogenous assumptions that lead to a bias in favour of fossil fuels.

COVID-19 Prediction Models

- **Estimating epidemic variables.** University of Oxford by Lourenço et al.: the researchers calibrated a susceptible-infected-recovered (SIR) model to data on cumulative deaths from the UK and Italy, building on the assumption that such deaths are well reported events that occur only in a vulnerable fraction of the population

- **Assessment of epidemic spread/mobility of population.** COVID-19 GLEAM by Vespignani et al.: Global Epidemic and Mobility Model (GLEAM), an individual-based, stochastic, and spatial epidemic model used to analyze the spatiotemporal spread and magnitude of the COVID-19 epidemic in the continental US

- **Assessing mitigation actions.** Report 13 of Imperial College: use of a semi-mechanistic Bayesian hierarchical model to attempt to infer the impact of mitigation interventions across 11 European countries.

- **Estimating healthcare/epidemic variables and assessing mitigation actions.** Institute for Health Metrics and Evaluation (IHME) forecasting team: statistical model developing a curve-fitting tool to fit a nonlinear mixed effects model. The forecasts show demand for hospital services, daily and cumulative deaths due to COVID-19, rates of infection and testing, and the impact of social distancing

COVID-19 Prediction Models - Report 13 of Imperial College

- **Type of model:** use of a semi-mechanistic Bayesian hierarchical model to attempt to infer the impact of mitigation interventions across 11 European countries.

- **Methodology:** changes in the reproductive number are an immediate response to these interventions being implemented rather than broader gradual changes in behaviour

- **Data used:** Real-time death data from the ECDC, as well as data on the nature and type of major non-pharmaceutical interventions

- **Predictions:** the intervention has averted 59,000 deaths up to 31 March across all 11 countries, that between 7 and 43 million individuals have been infected, and that in Italy and Spain, respectively 38,000 and 16,000 deaths have been avoided

Policy Take-Outs – Transparency and re-use

- **Timely collection and transparency of data.** Data to be collected and updated at regular and timely intervals, transparent procedures for the data collection, provide stakeholders with access to results and outputs used to develop the different scenarios, in order to ensure comparability.

- **Transparency and openness of assumptions and models.** Openness of assumptions and modelling structure improves the comparability of the analysis and projections produced and increases trust when informing the policy making activity.

- **Use and re-use of data and software modules.** Models should be built in modules, to be made available to researchers for re-use and recombination. This allows researchers and practitioners to download, re-adapt and re-use the modules for their analysis, therefore conceiving new applications.

Policy Take-Outs – Validation and Collaboration

- **Perform validation and sensitivity analysis exercises.** The results of many modeling exercises have been deeply influenced by the modeling and estimation techniques used. Need to apply different modelling and estimation techniques to the same set of data, as well as changing the values of the input and internal parameters of to determine the effect upon the model output.

- **Generate collaborative model simulations and scenarios.** Clearly the collaboration of several individuals in the simulation and scenario generation allows for policies and impact thereof to be better understood by non-specialists and even by citizens, ensuring a higher acceptance and take up.

- **Develop easy to use visualizations.** Policy makers should be able to independently visualize results of analysis, make sense of data and interact with them. This will help policy makers and citizens to understand the impact of containment policies: interactive visualization is instrumental in making evaluation of policy impact more effective.

Policy Take-Outs – Proper use of models

- **Consider carefully the sources of uncertainty in the model.** Uncertainty can be statistically related, related to parameters in the model that are difficult to estimate (e.g. the rate of transmission), concerning the data used (e.g. data on fatality rate might be not precisely measured), or of a more conceptual level (e.g. assuming a representative agent).

- **Tailor the model to specific questions you are trying to address.** SIR models use few data inputs and can be useful to assess the epidemic outbreak in the short term. Such models cannot be used to depict uncertainty, complexity and behavioural change. Strategic models encompass multiple scenarios assessing the impact of different interventions are able to capture some uncertainty underlying the epidemic outbreak and the behaviour of the population and are the foundation for policy making activity.

- **Use models properly.** Models are not a commodity that provide a number which the policy makers use to take decisions. There needs to be a full understanding of the subtleties involved, the levels of uncertainty, the risk factors. You need in-house data and model literacy embedded in the policy making process.