E-3 India: User Perspective

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The E3-India (Beta Version 3) model is reviewed here from the perspective of a prospective user. It is important to note that the model is still in its development stages. The developers hope to finalize the model in late January 2017. The review is based on written response to detailed query sent to the modelling team via email, follow up discussions, available documentation and personal experience in using the model to the extent possible in given timeframe.

The model provides a convenient, coherent and reliable tool for professionals and policy researchers to evaluate impacts of various 'what-if' scenarios of economy and energy related interventions at the state and national level. The shortcomings are primarily limited to those inherent in the model paradigm and data availability. As with any modeling effort in initial stages, increase in use over time and development of a vibrant user community will gradually help address data gaps, flag any unresolved or overlooked issues and thereby contribute to model development.

There is a strong need for a user friendly, yet rigorous and dynamic model at the state level to perform detailed economic and energy policy analysis in the Indian context. The E3-India model very timely addresses this need. Neither the reviewer nor the model developers are aware of other models that address the interstate dynamics in India.

1. Use cases and the users

Potential use cases are variedand mostly about asking and answering questions relevant to public policy choices and alternatives. According to the model developers, the traditional use cases involve questions of economic impacts of a given public-sector investment, policy or regulation. It can be used as a tool for analysis, debate, and deliberation by government, politicians, and regulators. It can also be used as a tool to educate, instruct, and help guide sound policy by civil society, business, and academia. The model can be useful to fiscal agencies intent on balancing budgets. It can help guide the actions of executives or legislative bodies attempting to understand the full impacts of concessions made to industry on the economy, and jobs.

The capabilities of the model is also well suited to inform government on policies related to trade, natural resources, competitiveness of an industry, and on the environment. One of the key focus areas of the model is to help understand the impacts of energy (and particularly power sector) policy on emissions, energy security, and the economy. Itincludes analysis of carbon taxes, cap and trade systems, energy excise taxes, power sector price subsidies, and feed-in-tariffs on a wide range of impacts including the environment and the economy.

The model can also be used to identify strategies for tweaking policy to mitigate or alter the design of the policy in ways that either accentuates the impact of the policy (e.g., cap and invest for a carbon tax) or to reduce the impact on vulnerable segments of the economy (low-income or rural populations).

The modelling of interstate dynamics is one of the unique value propositions of the model which has largely been overlooked in commercially available solutions in the Indian context. The state

government can use it to understand the full impact of proposed policies on various economic sectors and its competitive advantage at the national level.

The model can also be used by business, industry houses andcivil society to understand and influence the policy choices by government. The simplicity of the interface makes it a very useful teaching tool to help understand economic linkages and dynamics for students and policy makers alike.

2. Model

2.1. Framework

E3-India is a simulation model built using the coupled input-output econometric approach. It is based on globally accepted E3ME model (www.e3me.com) which has been in existence since the mid-1990's and itself builds on the UK MDM-E3 model that has existed since the 1970s. For those who are not comfortable with the CGE approach, it provides a much desiredalternative. It is a demand based post Keynesian, non-equilibrium model which does not assume perfectly competitive market (nor optimized use of capital and labor). Limitations of this approach include lack of micro-foundations, inadequate treatment of error processes and the Lucas critique to name a few.On the other hand, typical CGE model is heavily reliant on assumptions about optimizing behavior, which in turn rely on perfectly available information. In my opinion, the E3ME framework is comparatively more transparent, less rigid, versatile, and easy to use without sacrificing technical rigor.

2.2. Data, variables and parameters

Data used to calibrate the model are mostly from public sources and well documented. Model's exogenous variables primarily include population, natural resources (including coal, oil and natural gas, raw commodity price), current and capital spending of government, tax rates and allowances, long-term interest rates and data for countries outside India. Other model variables are endogenously determined and are categorised into two groups: behavioural and identity. Example of identity is GDP and its components (how they must add up) and behavioral bit is where they are econometrically estimated using system of simultaneous equations.

All model parameters are estimated using historical and publically available data and are neither borrowednor assumed. The model baseline for all states is currently calibrated to India projections from the World Energy Outlook (current policies scenario, 2014) from the IEA. However, the model can be readily recalibrated for a national or state level forecast.

2.3. Scenario analysis

The assumptions used to create base run are transparent and can be edited by the user. However, the real value of the model is to evaluate impact of real world policy scenarios in terms of the deviation in results from the baseline or alternative scenarios.Scenarios to mimic simple policy options can easily be defined using text based input to the browser based interface. As with any model, a poorly designed scenario can result in inconsistent or meaningless output. Tutorials are available to assist users in creating and evaluating these scenarios.Examples of scenarios that can be easily evaluated include changes in renewable shares; renewables policies like direct subsidies, carbon taxes, emission trading schemes, changes in international commodity prices or assumptions about activity levels in the rest of the world, changes in general taxation, etc. Complex scenarios

involving multiple parameters and other endogenous variables can be evaluated with little extra understanding of underlying model logic and some coding experience.

Given the underlying structure, it is not possible to directly trace the impact of policy intervention sequentially.However, the detailed disaggregation of the model may allow users to logically trace impacts through the model results. Since the model solves all equations simultaneously to get a converged solution for every year, it can be difficult to distinguish between direct, indirect and rebound effects. It's useful to understand the model linkages and have prior expectation before checking scenario results. It is recommendedthat users build up scenario inputs (rather than putting all policies in one run) so that the effect of individual policies can be identified.

2.4. Code and interface

The model is very light on computing resource needs, is coded in FORTRAN and can be easily installed on any personal computers running Windows. The installation is simple, quick, and does not have dependencies other than a modern web browser. The installation process takes couple of minutes and the first base run can be generated with just a few clicks.

The model interface is browser based, minimalistic and intuitive. Documentation, assumptions, model inputs, scenarios, results and visualization can all be accessed from the same place. The interface allows viewing the results and also comparing different scenarios from within the same browser. The results can be exported as CSV for further analysis and visualization, if need be.

2.5. Documentation

A good documentation is the keystone of any model. It not only improves usability but also ensures transparency and enhances credibility. The E3-India model is well documented with ready access from within the tool interface.It also provides ready access to key assumptions like projected values of exogenous variable which can easily be editedby the end user.

The accompanying manual promises to provide a more detailed documentation including description of the underlying theory and list of key assumptions. E3-India modelwill also share historical data used for model calibration with users to enhance the credibility and transparency of the model.

2.6. Model cost and updates

The model development is supported by the Regulatory Assistance Project. The modeling team is planning to propose a low annual subscription to cover maintenance costs and support. In addition, it intends to provide annual updates, create and support a vibrant community in India for training, model development and collaboration.

3. Current limitations and suggested features

Given that the model is still a work in progress, it needs to address some issues related to data and modelling of labour migration and interstate trade.The inter-state dynamics, which is the unique offering of this model, is currently limited to few states due to lack of data. Publically available data used to estimate model parameters often suffer from common issues like incompleteness, varying time-line and missing data. It will be nice to see the data sources documented along with the variable names.The model needs to be fed with quality and timely data. There needs to be a strong

connection between the model usage and the data that is maintained by state and national agencies.

Currently, the model runs are vetted through a small group of users. Once the model moves to production mode and there is an increase in user base and diversity of applications, many new issues may evolve.

The visualization features embedded in the interface is fast, interactive and aesthetically pleasing. Some additional features like ability to export graphics, compare more than one variable on the same graph and customization will be helpful. The interface comes with the functionality to easily export results that can be analyzed using other tools and thus, the embedded visualization capabilities should not be seen as a limiting factor.

Though, not the primary intent, the ability to manipulate the underlying model logic (e.g. switching on/off a set of equations) will help advanced users and researchers to debug, customize and model more complex policies than those envisioned by the developers early on in the product cycle. This will help to drastically increase the usefulness of the model.

The model is continuously being updated and it is hoped that over time, some of these gaps will be addressed by a vibrant user community.The subsequent phase of model development is very promising and much needed. In the next few years the promoters should ensure continuous engagement of the model development team with the user communityso that the true potential of the model is realized.

4. Closing remarks

The model delivers on most accounts as a policy analysis tool. It is simple, transparent, easy, fast and versatile to analyzemany real life policy interventions.

With understanding of the economy and little training on the model, most users can start generating and analyzing useful policy scenarios within 2-3 days. The complexity of the algorithm is neatly screened from the end user, though available for detailed study for more advanced users. There are more complex models to evaluate policy decisions but they have largely been within the academic or research domain. However, they typically lack development and maintenance cycles, are closely guarded and provide negligible access to practitioners. The effort by the modeling team on this front is really commendable in terms of bringing a complex model to the desktop of professionals and researchers alike.

The success of this model will strongly depend on continued collaborative work among model developers, funding agency, user groups and acceptance by policy makers.