**Topic 1: Dynamic Issues in Computable General Equilibrium models**

Description:

The lack of formal tests to validate computable general equilibrium models implies that seemingly good structure of a model may contain flaws that lead to unreasonable results. Your task will be to describe the key elements of intertemporal CGE models omitted in the relevant literature and provides guidance to policy modelers. For example, the models with public demand could behave badly if the government faces one-period budget constraints even though this model formulation is not overly restrictive *per se*. Furthermore, the order of sectors summation versus time summation is important in the multi-sectoral models. The models with sector-specific investments may lead to a uniform investment price even if it was not the modeler’s goal. In fact, it is difficult to find a computable general equilibrium model with differentiated sectoral price of investments that would behave properly.

Student task:

* to make a good literature review of badly designed CGE models,
* to understand the problems related to models dynamisation,
* to explain Ramsey model
* to describe the different dynamic possibilities
* to analise the results of the model with and without the identified problems

Teacher task:

* to help to describe dynamic possibilities (you will get a draft of my description)
* to help to identify dynamic problems
* to provide the results of simulations with bad and good model

Value added:

* policy makers will understand what does it mean “strange results” provided by experts

**Topic 2: The importance of capital-labor relationship in dynamic models**

Description:

Even a well-designed model will not converge to a steady-state if the data do not fulfill several requirements. While the benchmark investment, capital stock, depreciation ratio and the flow of capital services may reach the standard steady state assumptions, it may not be a sufficient condition to return to the steady state in scenarios. The benchmark capital-labor ratio plays crucial role here. Applying several computable general equilibrium models to the single database allow to explain and to solve the above issues.

Student task:

* to explain the problem of steady-state fail
* to find the literature, where model did not reach a steady-state
* to find theoretical explanation for K/L condition in steady-state
* to find the solution of the problem (one of the solution is to rescale K/L in database)
* to analyse results of the model with and without steady-state convergence

Teacher task:

* to provide the balanced input-output table
* to help with the theory
* to provide the results of simulations with/without steady-state

Value added:

* policy makers will understand that amount of capital should be supported by the appropriate amount of labor

**Topic 3: Detailed CGE modeling of energy-economy interactions in Poland**

Description:

Using CGE modeling we can find interactions between the markets. This process is done by accounting for complex set of linkages between energy sector and other parts of economy. Currently, there is no appropriate research tool in Poland that could accommodate the complex structure of different energy sources use, and incorporate wide linkages of the energy sector to assess economy-wide impacts of energy policy in longer horizon. By creating such a tool we fulfill an important scientific gap and allow for a proper verification of several quantifiable hypotheses related to the economic efficiency of different scenarios which have been brought on the table. Your task will be to understand how the model works and to implement some modifications.

Student task:

* to describe the model
* to implement detailed input-output database into the model
* to describe the data
* to make simple simulations
* to analyse the results

Teacher task:

* to provide detailed input-output database
* to provide the model
* to help with simulations

Value added:

* policy makers may get useful remarks related to their decisions
* you will contribute to the real scientific model

**Topic 4: Simulation of Polish environmental policy with CGE model**

Description:

In the coming decades energy sector in Poland will undergo substantial transition towards low carbon

usage, what will have a preponderant impact on the economy. Nowadays, primary energy production in Poland is based mainly on fossil fuels with electricity generation relying in 88% on hard coal and lignite. Meeting the target of zero energy economic growth and new energy efficiency targets set by the EU institutions will entail an abrupt transition towards low carbon usage. The choice of scenario will have a fundamental and multidimensional influence on the entire economy.

Student task:

* to prepare environmental data
* to integrate environmental data with input-output database
* to describe the model
* to make simple simulations
* to analyse the results

Teacher task:

* to provide the model
* to help with environmental data
* to prepare scenarios

Value added:

* policy makers will be happy to have a good quality tool to study consequences of environmental regulations

**Topic 5: The value added of international trade in CGE analysis**

Description:

The simulation can be done with closed or open economy. The purpose is to show the differences in the results. On the one hand, the simple model decrease the possibility of making error and it is more easy to analyze. On the other hand, some simplifications can considerably influence on conclusions. The idea is to verify for what public policy it is important to consider open versus closed economy model.

Student task:

* to implement international trade into the CGE model
* to add international trade into input-output database
* to describe the model
* to make simple simulations
* to show when it is important to complicate the model by implementation of international trade

Teacher task:

* to provide the model
* to help with simulations
* to explain different possibilities to design open economy model

Value added:

* policy makers will be happy to know when it is make sense to complicate the model

**Other topics:**

* **Stability of the Polish economy in two selected periods** (CGE modeling requires to choose the selected year as a benchmark equilibrium. That period should characterize a stability. The question is whether e.g. 2007 and/or 2010 can be used as a benchmark equilibrium? The selection of the above periods is explained by the availability of the input-output tables just for those periods).
* **Biased results in economic models** (Some models, like CGE or DSGE, are so complicated that works like a black box. In this situation, a modeler do not understand his model and the results can be biased. This means that value added of such models is quite low. The purpose of the paper is to explain selected biased results and to identify there sources)
* **Exogenous growth theory as a basis for dynamic CGE models** (There are at least two class of exogenous growth models: Ramsey and Solow. Dynamic CGE modeling is based on the Ramsey theory. Why other theories are not appropriate for this kind of modeling?)
* **Hybrid modeling** (There two broad class of models, no matter of topic - economic, engineering etc. Bottom-up models concentrate on individual variables (discrete technologies, detailed individual data), while top-down – on aggregated variables (total consumption, GDP, welfare, etc.). Top–down models usually include piecewise-smooth functions to describe marginal cost curves, while bottom–up models describe those curves with a step function. An advantage of the piecewise smooth cost curve is the possibility to define elasticity of substitution, while an advantage of the step curve is the possibility to determine technologies, but they ignore the interactions between markets, indirect costs, and social welfare. Hybrid models allow to specify for selected sectors smooth production function (top-down approach), while for others – a step function (bottom-up approach) through an activity analysis representation of discrete output generation options).
* **Nuclear and other non-operated energy technologies for Poland** (Poland has several times discussed the possibility to implement energy technology, but public protests implied that this technology was never implemented. Using CGE modeling, we can make a simulation of nuclear energy effects for the economy)
* **Nesting structure of functions** (Production or consumption function can be represented using nesting structure in order to represent different possibilities for elasticity of substitution. The proper design of this structure is important for simulation results).
* **How to represent government in economic models?** (Rational behavior assumes that producers maximize profit and consumers maximize utility. What about government? Government cannot maximize utility, rather it implement promises and try to equilibrate the budget. This means that government should be described by Leontief function. What about public deficit? CGE modeling assumes equilibration on markets and balancing budgets. However government not necessary balance public budget. Dynamic CGE models allow to choose when to balance the public budget – every year or at the end of analyzed period)
* **Emissions trading market design: theory versus practice** (Researchers designed the European Trading System (ETS) for carbon dioxide considering many aspects, both theoretical and practical. However, during legislation process, many elements of these design were modified by policy makers. The way how this market was finally designed violates aspects considered by researchers. As a result the market is not as much efficient as it could be and does not work in a proper way, i.e. does not send the appropriate signals to the participants).
* **How Poland was able to decrease the considerable amount of coal consumption during 20 years?** (Poland is responsible for 8% of EU greenhouse gases emission in 2019, making it the 4th biggest emitter in the region. This emission comes mainly (over 70%) from burning fossil fuels (this is 90% in case of CO2). The main reason is historical, as after WW2 it was decided that Polish energy security will be built on domestically available coal resources - electricity produced from coal was 97% in 2000. However, the coal consumption for electricity production was reduced to 70% in 2020. How the coal based economy was able to do it? What modifications were done by electricity plants? Does future similar modifications are still possible or we should build new plants based on other technologies?)
* **Tradable energy certificates.** Energy colorful certificates promotes low-emission technologies, stimulates the development of renewable energy sources, and improve energy efficiency. Electricity producers and energy trading companies, in such countries like Poland, obliged to purchase the percentage of various certificates. Each type has been assigned an appropriate color: white for energy efficiency certificates, green for certificates of origin for energy from a renewable source, blue for certificates of origin for agricultural biogas, brown for certificates of agricultural biogas in distribution network, purple for certificates of origin for cogeneration with methane, red for certificates of origin for cogeneration with heat, yellow for certificates of origin for cogeneration with gas. Getting the certificate is related to property rights which is the subject of trading on the Power Stock Exchange => an additional source of income for entities producing energy classified as environmentally friendly. There is no such possibility for trade for other companies that invest in low-emission technologies and energy efficiency. The goal of the thesis is to evaluate the current financial system of certificate trading and to propose its improvement.
* **Simulation of the effects of selected elements of the “Polski Ład” using a general equilibrium analysis.** According to the economic theory, when tax rates decreases, then prices decreases and demand goes up. Why producers may not decrease prices after decrease of tax rates? Since the government will have lower tax revenue it has to balance it with decreasing of some expenditures or increasing other taxes. Thus producers will afraid to decrease prices due to unstable future expectations.
* **Tax incidence on petrol market.** According to microeconomic theory, the tax incidence depends on the relative price elasticity of supply and demand. When demand function has a constant elasticity D(P) = aP-b, producer (except perfect competition) increases prices unproportionally dP/dt >1. This is a common case of oil and alcohol markets. Polish government implemented “Anti-Inflation Shield 2.0” by temporary decrease, among others, of VAT, excise, and sales taxes on petrol. Will it imply unproportional decrease of fuel prices? This policy is very bad for environment because transportation is one of significant sources of pollution emission.
* **Empirical research tailored to the client.** It happens that clients (either private companies or public institutes) order empirical analysis that will show results that client expect. The purpose of the thesis will to compare few types of models to show how the results can be adjusted to the clients' wishes by appropriately changing parameters or other assumptions. When the model structure is transparent and details are not hided such model adjustments is not a problem. The problem is that usually such details clients hide to prove their “proper” point of view.
* **Calibrated share form of functions**. A comparison of the traditional form of utility, production, etc. with a figure that normalizes all its endogenous variables to one. This means that traditional algebraic form of each function, e.g. Leontief, can be rearranged in such a way that benchmark values of such functions will be always 1 and all elements of such function will be 1. The advantage of this approach is ease of results interpretation of counterfactual values.
* **Sensitivity analysis of economic models with respect to functional forms**. The choice of functional form (CES, CD, Leontief etc.) for utility, demand, production etc. may have some influence on results. The flexibility of function helps to select such parameter values in order to replicate reality as close as possible. However, usually details of parameters for flexible functions are not available and modelers make some arbitral assumptions. The goal of the thesis is to compare functional forms and to analyze the sense of flexible forms when detailed values for such functions are not available.
* **Financial CGE modeling.** Such model assumes a financial agent tatt takes care of expected rate of return in allocation budget between capital and financial assets. The example financial module in CGE analysis: <https://jgea.org/ojs/index.php/jgea/article/view/152>
* **Next financial crisis.** Public debt considerably increases worldwide due to the Covid-19 pandemic. Countries like Japan and Greece exceeds 200% of government debt to GDP in 2020: <https://tradingeconomics.com/country-list/government-debt-to-gdp>. Despite the economic recovery in 2021, debt ratios did not improve. This is a risk of a debt crisis and financial crisis. The EU fiscal policy requires to take corrective actions when public debt exceeds 60% of GDP: <https://www.consilium.europa.eu/en/policies/european-semester/european-semester-key-rules-and-documents/>. This level was exceeded already in 2000, but the actions like quantitative easing (government bonds are purchased by central banks) helped due to stable economic growth and low (less than economic growth) interest rates (nominal and real). According to monetary theory, when interest rates (the price of money) are low, the economy grows and inflation increases. Inflation influence how likely people are to borrow money. Currently quantitative easing implies inflationary pressure due to unstable economic growth and problematic relationship to keep interest rates below economic growth. In practice, interest rates (short and long term) follow nominal GDP trend (not the other way around) and higher economic growth causes higher interest rates (not lower rates stimulates economic growth): <https://www.sciencedirect.com/science/article/pii/S0921800916307510>