International Trade Theory

Structural Estimation of AvW (not for the use of Spring 2021)

Due ——, 2021. Please provide your answers in a typed Word or Latex document in an email to me. Provide your GAMS codes in .gms files attached to the same email.

1. (*6 points*) Write a GAMS program to solve the U.S.- Canadian general equilibrium model specified in Balistreri and Hillberry (2007). Follow the procedures below:

In this lecture, we hope to show you how to use GAMS-F tool to facilitate the program. You may find more details in Ferris, Rutherford and Starkweather (1998). In short, GAMS-F is a tool which facilitates programmer's computation by reducing complexity and burdens of a standard GAMS program. This will become handy when you have many equations and variables to declare at the expense of increasing the model space. Copy and paste the 5 files (`gams-f.gms` `gams-f.pl` `gams-f.exe` `perl.dll` `cw3220mt.dll`) provided to you on the GAMS sub-directory in which the version you use is running. In the first two lines of the script, you must also write the statements `$sysinclude gams-f` and `$exit` (the second statement is required if using version prior to release 2.50a). For simplicity, assume border costs are symmetric. Use GAMS-F to define the trade cost as the following:

$$t_{ij} = d_{ij}^{\rho}\left[\exp\left(\frac{A}{1-\sigma}\right)\right]^{1-\delta_{ij}},$$

where d_{ij} is the distance between i and j observed from the data (attached), ρ is the elasticity of trade costs with respect to distance; consistent with Balistreri and Hillberry (2007), $A = (1-\sigma)\ln b$ are the border coefficients, where b equals one plus tariff equivalent of border costs. δ_{ij}'s are the dummy variables equaling zeros if shipments cross international border and equaling ones if the shipments are taken place domestically in locations $i, j \in S$ (i.e., δ_{ij} equals zero for state-province and province-state trade). Make sure to scale the distance data. First define the shortest distance pair = "short", then use the minimum value over controlling index (*smin*), and scale the distance by the factor of 1/"short". You also need to scale the GDP and trade flows data (for numeric stability) as shown in the lecture slides. In

the coding, you might want to define a cross-border variable $\Gamma = A/(1-\sigma)$. You also need to assign a subset (the econometric sample) that does not include: i) internal pairs (i,i); ii) missing or zero flow pairs; and iii) involve the rest of the US region. Moreover, the equals sign in GAMS-F is "==" (for relevant declared function only).

a) Use the *Least Squares* optimization objective function and GE constraints (1) - (5) discussed in the lecture slides. Note that (5) is a normalization constraint outside the general equilibrium *regime*, but it is still needed for identification (up to scale).

b) Fix the elasticity of trade cost with respect to distance ρ to be 0.32, what is the value of CES elasticity of substitution σ?

c) In international trade literature, it is widely accepted that σ is in the neighborhood of 5. As mentioned in the lecture, this parameter must be determined and specified by modelers in order to separately identify trade cost parameters (e.g., ρ) and trade responses to trade costs (i.e., σ). When we run an OLS regression of trade flows on distance and regional income, we would obtain a regression coefficient of $\rho(1-\sigma)$. From a structural point of view, with this data the model is underidentified. What is the value of ρ if we fix σ to be 5?

2. (*3 points*) In the lecture, we discussed *Poisson Pseudo-Maximum-Likelihood* (PPML) estimator which has become standard in trade literature. The PPML estimator allows pervasive zero bilateral trade flows to enter into the gravity estimation framework albeit with very small effective weights given by conditional mean. Re-estimate the model with PPML estimator in the objective function with σ equaling 5. What is the value of ρ? Use of PPML in structural estimation is a frontier work, and you will stay on top of this subject after this lecture. Useful readings: Santos Silva and Tenreyro (2006) and Gourieroux, Monfort and Trognon (1984). What might also be useful to you in the coding is the Applications To Poisson Models published by the latter authors.

3. (*3 points*) Verify, computationally, the ACR (Arkolakis, Costinot and Rodríguez-Clare (2012)) formula: $\widehat{U} = \widehat{\lambda}^{1/\theta}$, where $\widehat{\lambda} = \lambda_1/\lambda_0$ is the ratio of the domestic trade shares (counterfactuals over initial), $\widehat{U} = U_1/U_0$ is the ratio of utilities (counterfactuals over initial), and θ is elasticity of imports with respect to variable trade costs. Suppose that the trade costs of U.S. imports of Canadian goods (i.e., $t_{\text{"}CAN\text{"},\text{"}US\text{"}}$) is increased by 20% (with ρ=0.32).