

Chapter 3 Literature Survey on Multi-Region OLG/AGE Models

3.1 Motivation

As we attempt to build a multi region OLG/AGE model with forward-looking intertemporal framework, we are in search of existing OLG/AGE models whether they have equivalent features or functions as guiding light in our modeling. However, it seems that only a handful of multi region OLG/AGE models are available for this study. Since we consider every region in the model as a large region so that any change in the region would translate into an impact on time path of economic variables that would be further affecting the rest of the world. One apparent reason is that implementing a multi region OLG/AGE model derived from the collection of theoretical literatures faces enormous difficulties in computation with data.

There has been continuing study effort to opening up the OLG/AGE models of closed economy. At the early years of OLG modeling, the scope for international transactions, which requires at least two regions, has been studied by employing assumptions to make OLG/AGE model tractable. Modifying the model developed in their seminal book by Auerbach and Kotlikoff (1987), Auerbach *et al.* (1989) allowed an economy to open its border for international trade by taking factor price that is exogenously determined in the foreign market. In effect, this is a small open economy assumption used as a building block for later studies.

Similar extensions have been made on the model of Auerbach *et al.* (1989). For instance, Kenc and Sayan (2001) considered the channel between Turkey and EU, where the former is assumed as a small country whereas the latter as a large country. Although there exist more literatures on OLG/AGE modeling employing the small open economy assumption, we limit our attention to the model without such assumption.

3.2 Multi region OLG/AGE model without small country assumption

Börsch-Supan, Ludwig, and Winter (2006) developed a OLG/AGE model with realistic long-run demographic details for seven regions that are modeled symmetrically as large open economies. Perfect capital mobility is assumed in the international capital market so as to equalize the rate of return on investment across regions. Allowing the capital flows among regions, they quantitatively analyzed the impact of population aging and pension reform on international capital market. Their simulation showed that population aging resulted in substantial capital flows from the region mostly affected by population aging to the region affected least, and that this trend of capital flow reversed in later simulation period. They also found that as pension plans were pre-funding with higher degree, capital exports would be more likely to rise.

According to Börsch-Supan, Ludwig, and Winter (2006), there are several studies abstract from the small open economy assumption. Attanasio and Violante (2000) constructed and calibrated an OLG/AGE model with two regions, the North and Latin America, and investigated the effect of demographic change on macroeconomic variables and capital flows across regions as well as effects arising from pension reform. In their results, capital flowed from the poor region to the rich region. Brooks (2000) simulated a calibrated OLG/AGE model of eight regions in the world to evaluate the impact of historical and projected demographic changes on capital flow among the regions. In their analysis, as aging progressed in a region, a turning point emerged as deteriorating saving investment balance, thereby leading to capital inflow from other regions. Feroli (2003) used a similar calibrated OLG/AGE model with flexible number of regions of the G-7 member countries, and it has detailed demographic of five years as one period that differs from Brooks (2000)'s twenty years' specification. With the detailed demographic data, Feroli (2003) investigated the link between differences in demographic structure across regions and their effects on current account balance reflecting saving-investment imbalance. The model calibrated to the historical demographic differences and explained the long-term movement of capital flows. Similarly, Henriksen (2002) calibrated a OLG/AGE model of U.S. and Japan to their historical and projected demographic data of five-year periods to explain the current account imbalance observed in both countries. The model was able to account for the degree and persistence of the current account imbalance.

The models described above have treated regions as larger open economies,

and their calibrated models casted light on capital movements among regions by simulating with historical and projected data. Methodology and technique used in their studies provide useful information for OLG/AGE model building and implementing simulations. As pointed out by Börsch-Supan, Ludwig, and Winter (2006), however, their models do not have a pension system such as PAYG.

We are interested in potential repercussion arising from pension reform or introduction of pension system in developing countries onto the rest of the world in response to the looming aging issues. Therefore, our attention is now shifting toward OLG/AGE model with a pension system.

Domeij and Floden (2006) investigated current account balance by calibrating a OLG/AGE model of eighteen OECD countries with PAYG pension system. Although Domeij and Floden (2006) incorporate PAYG pension into their model, their research focus was to explain international capital flow by changes in demographic structure across regions. Their model demonstrated that demographic change can explain the changes in current account balance. INGENUE (INGENUE 2001) is a global OLG/AGE model developed at the CEPPII, Paris, to investigate a relationship between a pension reforms and capital flows. Continuously the INGENUE model has been modified for further improvement and the model is calibrated to the baseline scenario and to perform policy scenarios of pension reforms (Aglietta *et al.* 2005). There are two pension reform scenarios, fixing contribution rate and postponing legal retirement age, and one migratory scenario for investigating effect of increased labor mobility on pension system. The second pension reform scenario and the migratory scenario resulted in higher trade balance as compared to the baseline projection, whereas trade balance in the first pension reform scenarios was predicted to be lower than the baseline. Fehr, Jokisch, and kotlikoff (2003) developed a OLG/AGE model of three regions. Their model has a feature of “immigration, age-specific fertility, life span extension, life span uncertainty, bequests arising from incomplete annuitization, and intra-cohort heterogeneity (Fehr, Jokisch, and kotlikoff 2003).” They asked whether or not increased migration help developed economies suffering from looming fiscal burdens of pension and health care benefit. Even in the developed economies, preparing for the coming aging with payroll tax increase would result in capital shortage and lower real wages. Their simulation indicates that there are not significant mitigation effects from increased immigration.

Börsch-Supan, Ludwig, and Winter (2006) improve over these by introducing more detailed demographic projections, and they made distinction between population aging and population shrinkage. Life time is subject to uncertainty, labor productivity is age-specific. Also, the model incorporates endogenous labor supply as well as convex adjustment costs of investments. Sensitivity analysis implemented over the simulation results revealed that the specification of labor supply affected considerably the results while the adjustment cost did not.

Mérette and Georges (2010) introduced explicitly international trade by employing the Armington structure. Our research project has made improvement to add more flexibility to specifying the international trade settings by incorporating Krugman (1980) and Melitz (2003) on top of the Armington (1969), as documented in later Chapters. Also, for the aforementioned features except for immigration, stochastic life expectancy, and heterogeneity within cohort, our OLG/AGE model covers most of the features, and this comprehensiveness is one of the uniqueness and advantage over the existing models. As the search in literature is focused only on the field of multi region OLG/AGE models, the frontier of this are of research would not be too far to reach.