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Chapter 7

Conclusion and Discussion

In this dissertation we have focused on two aspects of dynamic macroeconomics: the role of demographics and demographic change as one of the main determinants of intergenerational redistribution, and the impact of public capital on economic growth.

7.1 Realistic demographics in overlapping generations models

In Part I of this dissertation, we developed an extended version of the Blanchard-Yaari-type overlapping generations (OLG) model. We incorporated a general description of the mortality process, overcoming one of the main drawbacks of the standard model: the perpetual youth assumption. In Chapter 2 we showed that incorporating a realistic demographic structure is quite feasible as long as we restrict our attention to a small open economy facing a constant world interest rate. One of the most attractive features of our extended model is that at the level of individual households, a realistic description of the mortality process reinstates the classic life-cycle saving insights of Modigliani and co-workers. The added complexity does not destroy the main strength of simple theoretical models, we can still analytically track the effect of various macroeconomic shocks on the main variables in the model, both on the individual as on the aggregate level.

The recently developed tractable OLG models with realistic demographics (like Kalemni-Ozcan et al. (2000) and Boucekkine et al. (2002)) have not yet been applied to welfare analysis of policy shocks and exogenous shocks, this in contrast to the perpetual youth models (see e.g. Heijdra and Meijdam (2002) and Bovenberg

(1993)). Using our standard model in Chapter 2, we find that there are significant differences in welfare effects of different shocks between the perpetual youth models and models with a realistic mortality process. First of all, transition is much faster in models with realistic demographics than in models with the perpetual youth assumption, because expected remaining lifetimes are much lower. Second, the perpetual youth model neglects the fact that old generations do not value future income gains or losses as high as new or unborn generations, because the conditional survival function is equal for all cohorts. Finally, we have demonstrated that the demographic details do not ‘wash out’ at the aggregate level. The impulse-response functions for the different shocks are quite different for the Blanchard and the Gompertz-Makeham models, especially the ones for per capita consumption and financial assets.

In Chapter 3 we used the extended OLG model to analyse the effects on the economic growth performance of a small open economy of demographic shocks of the type and magnitude that hit the Western world over the last decades. Following Lucas (1988), we assumed that schooling is the main mechanism that causes growth. Individuals spend their first years at school, which increases their productivity and earnings potential later in life. Our analysis shows that only for a unrealistically strong intergenerational knowledge spillover, policy changes and demographic shocks lead to a permanent higher (or lower) growth rate. Moreover, if the intergenerational spillover is unrealistically large, the link between longevity and economic growth is non-monotonic. A higher life expectancy at birth causes a lower long-run growth rate in most developed countries.

As a second application we extended the basic framework of Chapter 2 with a retirement decision as proposed by Sheshinski (1978) and a pension system that fits the stylised facts of Gruber and Wise (1999, 2004, 2005). A consumption and leisure loving individual chooses a retirement age that maximises his lifetime utility. With our simple model we analysed the effects of a baby bust and a longevity shock on a hypothetical economy. Both shocks lead to an ageing society and renders the pension system unsustainable. We showed that at a microeconomic level it is under most pension systems in the Western world optimal for people to retire at the age where retirement benefits are first available (the early eligibility age, EEA). Large policy reforms are necessary to make people work longer, without forcing them by increasing the EEA.

Although our models are far too simple for real world policy evaluation, they do provide useful insights. The main advantage of our models is that at least the

steady state effects are analytically tractable. Moreover, it is usually even possible to analytically distinguish between various phases in the transition process, making it easier to understand what is happening when and more importantly why.

Various models already exist for policy evaluation. These large computable general equilibrium models like the well-known Auerbach-Kotlikoff model (Auerbach and Kotlikoff (1987), see Altig et al. (2001) for an enhanced version of this model), IMF's MULTIMOD (Laxton et al., 1998) and specifically for the Netherlands, the IMAGE model (Broer, 1999) often include highly detailed institutions and are calibrated to fit the real world as closely as possible. Their high level of detail and the corresponding complexity is both a strength and a weakness of these models. The advantage is that these models can be used for real world scenarios evaluations and to determine the effect of various policy shocks on different agents. The disadvantage is that the high level of realism is bought at the cost of tractability; due to their inherent complexity, the interpretation of the observed effect is very difficult. A second drawback of these models is that they take a long time to solve and this makes them ill-equipped for sensitivity analysis and quick calculations. Analytically tractable overlapping generation models do not suffer from these drawbacks and if a realistic mortality process is incorporated, these models can take real intergenerational links into account that will provide valuable insights in the ongoing ageing process of the developed world. Furthermore, with relaxed assumptions, overlapping generation models will be better suited to analyse the historical long-run relationship between demographic change and economic growth.

The drawbacks of these large scale CGE models are exactly the strengths of our simple models. It is our opinion that the framework we develop in Chapter 2 and the extensions in Chapters 3 and 4 are a useful addition to the large scale CGE-models. Our models can be used to identify the main effects observed in the large models and to better understand how these models work.

7.1.1 Limitations and future extensions

All three models share two common limitations: they only apply to an open economy that faces an exogenous world interest rate and we need the existence of an actuarially fair insurance system. Unfortunately, it is far from trivial to drop these assumptions.

As we showed in the Chapter 2, a mortality process with a realistic probability of death results in a life-cycle profile of savings. If we combine this life-cycle savings profile with ageing, it is expected that ageing will result in a lower capital

supply (IMF, 2004; Poterba, 2001). If capital is not perfectly mobile or if the ageing problem is of such a scale that it becomes a global phenomenon, the assumption of an exogenous interest rate might be too strong. The introduction of a realistic mortality process in a *closed* economy is complicated by the fact that exact aggregation of the consumption function is impossible. Of course, the steady state can still be characterized analytically, it is the same as the steady state of the open economy with one extra restriction, namely that foreign assets should be zero. The transitional effects of various shocks are, however, much more difficult to compute due to the fact that equilibrium factor prices will generally be time-varying. In the near future we wish to investigate whether approximate aggregation of the key behavioural relationships is feasible for particular shock parametrizations. If that fails, numerical methods will be employed to characterize transitional dynamics.

The other limitation concerns the assumed availability of actuarially fair annuities that agents can use to insure themselves against dying indebted. Mitchell et al. (1999) document how unattractive private annuity contracts are in the United States, making the assumption of actuarial fair notes rather far-fetched, even in modern developed financial markets (see also Davidoff et al., 2005). Things become even worse if one realises that one objective of introducing realistic demographics is to explain the historical non-monotonic relation between demographic change, human capital accumulation and economic growth (Kalemni-Ozcan et al., 2000; Boucekkine et al., 2002; Fuster et al., 2005). Especially in a historical context, the assumption of actuarially fair annuities is unjustified. Kalemni-Ozcan and Weil (2002) present an overlapping generation model that they use to analyse the effect of mortality change on retirement without insurance possibilities. Unfortunately, to keep the model analytically tractable they have to assume that the mortality rate is constant (Blanchard's perpetual youth model) and that income and the interest rate is high enough to prevent the liquidity constraint to be binding. They fall back on simulation techniques to study a more complex version of their model, with a realistic mortality rate. The whole problem boils down to solving a dynamic optimization problem with constraints on a state variable; individuals are not allowed to die in debt. This class of models is inherently difficult to solve, but since there is no aggregate risk, only lifetime is stochastic, we expect that it is possible to solve the macroeconomic model.

In conclusion, we hope that the extended Blanchard-Yaari model we constructed will prove to be a useful addition to the toolbox of both theoretical economists and policy practitioners alike. At least in the context of a small open economy, there

is no justification whatsoever to use models based on a blatantly unrealistic description of demography. Had mortality not caught up with him, Benjamin Gompertz would probably support that conclusion!

7.2 Public capital and economic growth: an empirical analysis

In Part II of this dissertation we ignored intergenerational issues and focused entirely on public capital, one of the determinants of economic growth. The central issue in Chapter 5 and 6 was whether a robust long-run empirical relationship exists between public capital and economic performance.

Chapter 5 provides a review of the recent studies that examine the relationship between public capital and economic growth. Although not all studies find a growth-enhancing effect of public capital there is more consensus in the recent literature than in the older literature that public capital does spur economic growth. The impact is also much lower than found by Aschauer (1989), which is generally considered to be the starting point of this line of research.

Many studies report that there is heterogeneity: the effect of public investment differs across countries, regions, and sectors. This is perhaps not a surprising result. After all, the effects of new investment spending will depend on the quantity and quality of the capital stock in place. In general, the larger the stock and the better its quality, the lower will be the impact of additions to this stock. Some studies also suggest that the effect of public investment spending may also depend on institutional and policy factors. The network character of public capital, notably infrastructure, causes non-linearities. The effect of new capital will crucially depend on the extent to which investment spending aims at alleviating bottlenecks in the existing network.

Chapter 6 investigated whether it is possible to arrive at robust estimates of the long-run output elasticity of public capital using internationally comparable aggregate and industry data for a considerable number of developed countries. State of the art econometric techniques and economic modelling insights were used to correct for heterogeneity regarding time, country and industry. Unfortunately, we had to conclude that stable output elasticity estimates based are elusive. The estimated parameters vary wildly between equally plausible econometric specification and range between -2 and 2. The aggregate estimates tend to be more stable, but even those range between 0.04 and 1.13. While it is hard to discount cross-country

variation, the cross-specification variation we found suggests extreme sensitivity to conceptually innocuous specification choices. Overall, this suggests that production function estimates of the impact of infrastructure are not well-suited to be used for infrastructure policy recommendations.

The question arises why Chapter 5 concluded that ‘there is more consensus’ and Chapter 6 concluded that the production function estimates vary wildly? There are several possible reasons. First, most studies that use a production function approach in a panel setting estimate a single equation for each country and take the average for all countries. These studies tend to present only one specification and as we showed in Chapter 6, it is possible to arrive at any outcome. Those studies that use the cross-section variation in a panel setting usually do not present elasticity estimates, but focus on the question whether the current public capital stock is optimal.

7.2.1 Limitations and future research

There are a few problems that have not received much attention in the literature on public capital and economic growth. Three of these problems are institutional factors that play a role in the creation of public capital, the role of maintenance on public capital, and the lack of sound theoretical foundations in most empirical studies.

Part of the heterogeneity between countries and regions can be explained by the large differences in the quantity and quality of the public capital stock. Attempts at explaining existing differences in capital stocks are only in their infancy. A possible complicating factor is that certain questionable political practices may determine where and what is invested in public capital. According to Estache (2006, p. 5), ‘there is strong anecdotal evidence now that politics matter. Experiences in Asia, Eastern Europe or Latin America show that politicians will never give up the control of a sector that buys votes in democratic societies. Moreover, in societies in which corruption is rampant, they will not give up control of a sector involving large amounts of money and in which contract award processes often provide opportunities for unchecked transactions.’ These practices are not confined to developing countries, others (e.g. Cadot et al., 2002 and Kemmerling and Stephan, 2002) find also in industrialised countries evidence of pork barrel politics. Attempts that try to explain differences between countries must take these political factors into account.

As pointed out by Kalaitzidakis and Kalavitis (2005), in most theoretical stud-

ies public capital deterioration is considered as an exogenously given technical relationship, thereby neglecting a crucial choice concerning the implementation of public investment decisions, namely the choice between investing in 'new' public capital and extending the durability of the existing public capital stock via maintenance. There is a small, but very interesting line of literature on maintenance. In contrast to standard results derived by endogenous growth models with public infrastructure, the optimal tax burden that maximizes the long-run growth rate of the economy is now larger than the elasticity of infrastructure in the production function. The lack of studies that take maintenance into account can be explained by the fact that published data on maintenance are very scarce due to inherent problems in the measurement of the maintenance expenditures. Kalaitzidakis and Kalavitis (2005) use data from a Canadian survey which contains evidence on maintenance expenditures of both private firms and government organizations, to test the impact of total public capital expenditures and their components on growth. Their results indicate that the Canadian economy would benefit from a fall in total expenditures on both 'new' capital and maintenance, and that the aggregate share of maintenance in total expenditures should be lower over the period under consideration.

A striking result is that only a few of the enormous bulk of studies on the output effects of infrastructure base their estimates on solid theoretical models. A problem is that the theoretical papers that link public capital to economic growth, starting with the work of Uzawa (1974) usually neglect the channels through which infrastructure affects economic growth. They simply postulate an aggregate production function with public capital as an extra input. This neglects the usually complex links, after all, government roads as such do not produce anything. A major exception are the spatial economics models. In these models extra public capital, mostly infrastructure, reduces transportation costs, which boost productivity of the other production factors.

Finally, we must conclude that although there is more consensus on public capital having a positive impact on economic growth, the size of the effect is still not clear. Still, not all possible methods of research have been explored. What is certain is that aggregate level methods are probably too crude to provide policy makers with useful information.

