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ASSET MARKETS AND FINANCIAL FLOWS IN GENERAL EQUILIBRIUM MODELS

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Asset Markets and Financial Flows

in General Equilibrium Models

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Asset Markets and Financial Flows in General Equilibrium Models

Abstract

This paper discusses the importance of asset markets and financial flows in general equilibrium models. Asset markets and financial flows play an important role in the adjustment process to economic shocks and policy changes. It is argued that if asset markets are not integrated into economic models, the dynamic story of adjustment will be incomplete and the usefulness of modelling results for a variety of applications will be limited. This paper provides a general outline of the MSG and G-Cubed approaches focusing on the role of asset markets and financial flows. These models have been used extensively over the past two decades to analyse the impact of various economic shocks and policy adjustments globally. A range of studies where the models have provided interesting and important insights are summarised and the key role of asset markets and financial flows in the adjustment process is highlighted.

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1. Introduction

This paper discusses the importance of asset markets and financial flows in general equilibrium models. Asset markets and financial flows play an important role in the adjustment process to economic shocks and policy changes. If this role is not acknowledged and integrated into economic models, the dynamic story of adjustment will be incomplete and the usefulness of modelling results for a variety of applications will be limited. The MSG and G-Cubed models are dynamic inter-temporal general equilibrium models that combine the approaches of traditional Computable General Equilibrium (CGE) models[1] and macro econometric models[2][3]. The explicit treatment of asset markets and financial flows in the models allows the models to provide important insights into the adjustment process following economic shocks and policy changes[4]. This paper provides a general outline of the MSG and G-Cubed approaches focusing on the role of asset markets and financial flows. These models have been used extensively to analyse the impact of various economic shocks and policy adjustments. A range of studies where the models have provided interesting and important insights are summarised and the key role of asset markets and financial flows in the adjustment process is highlighted. The studies include the impact of the North American Free Trade Agreement (NAFTA), the impact of trade policy reform, the causes and consequences of the Asian Crisis, and the impact of alternative climate policy initiatives. In each of these studies, the G-Cubed and MSG models provided important insights that were difficult to explore in traditional CGE modelling analyses.

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[1] These are also referred to as Applied General Equilibrium (AGE) models. Hereafter we will only use the term CGE models. See de Melo (1988), Robinson (1989) and Shoven and Whalley (1984) for an overview of CGE models. An example of this approach include models by Dixon et al (1982),

[2] See Bryant et al (1988) for a summary of the major multi-country macroeconometric models and a list of references relating to each model.

[3] Attempts have been made to reconcile the two approaches. See for example Powell (1981) and more recently Parsell, Powell and Wilcoxen (1989). Also a number of attempts to link macroeconometric models and CGE models explicitly do exist. See Cooper and McLaren (1983) for one such attempt using Australian models.

[4] The treatment of dynamics varies considerably across CGE models. Some are very simple while others are integrated more completely into behavior. Examples of dynamic CGE models include Burniaux et al (1991), Goulder and Eichengreen (1989) and Jorgenson and Wilcoxen (1990).

2. The MSG and G-Cubed Models

The MSG and G-Cubed set of models are dynamic inter-temporal general equilibrium models that attempt to integrate the best features of traditional CGE models, real-business-cycle models, and Keynesian macroeconometric models.

The sectoral and country coverage of the models is flexible and there are a range of alternative specifications. The original MSG model was developed by Warwick McKibbin and Jeffrey Sachs during the 1980s is response to the poor performance of existing macroeconometric models in understanding oil price shocks and macroeconomic imbalances, and the theoretical attack provided by the Lucas Critique (Lucas (1972). This early work which was largely macroeconomics with rational expectations in several financial markets evolved into the MSG2 model, documented in McKibbin and Sachs (1991), which is a single-sector dynamic inter-temporal general equilibrium model. This model was the first applied SDGE model based on intertemporal models drawing on Blanchard and Fischer (1989) and later popularized by Obstfeld and Rogoff (1996) and Sargent (1997). The MSG3 model, which replaces the MSG2 model, is an aggregation of the G-Cubed model (outlined next) to 2 sectors of production (energy and non-energy) in each economy. From this point we will refer to all version of the MSG model as MSG models unless referring to a particular model.

The G-Cubed multi-country model was developed by Warwick McKibbin and Peter Wilcoxen (McKibbin and Wilcoxen, 1998). It is a multi-sectoral dynamic inter-temporal general equilibrium model that combines the approach taken in the MSG2 model with the approach taken in the disaggregated, econometrically estimated, inter-temporal general-equilibrium model of the US economy by Jorgenson and Wilcoxen (1990). The G-Cubed set of models includes the G-Cubed (environment) model, G-Cubed Asia Pacific model, which draws on the theoretical approach of the G-Cubed model but focuses on a country and sectoral disaggregation relevant for the Asia Pacific region (see McKibbin, 1998a), and the G-Cubed Agriculture model (see McKibbin and Wang (1998)), which was developed for the United States Department of Agriculture to analyse the impact of changes in global macroeconomic conditions on US agriculture.

Key aspects from the macroeconomic literature incorporated into the models include the role of money, the role of asset markets and the determination of asset prices, nominal rigidities, balance of payments and unemployment. These issues are crucial to our understanding of the nature of the transmission mechanism in financial and real markets and the dynamic adjustment path between equilibria.

CGE models are generally built for exploring the long run equilibrium outcomes of policy. Increasingly, however, they are being augmented with very simple dynamics and used for short run policy evaluation. This approach is often inadequate. The G-Cubed and MSG3 models attempt to balance the benefits of a detailed disaggregated approach to modelling with the need for an appropriate aggregate story.

The main features of the models are as follows:

(i) The models are based on explicit optimisation by the agents (consumers and firms) in each economy in a traditional neoclassical growth framework. These models differ from static CGE models in the assumption of inter-temporal optimisation by economic agents, subject to explicit inter-temporal budget constraints. In contrast to static CGE models therefore, time and dynamics are of fundamental importance in the G-Cubed and MSG3 models. This makes their core theoretical structures like those of real-business-cycle models.

(ii) The models take account of the various rigidities observed in macroeconomic data by allowing for deviations from fully optimizing behaviour in the short run due either to myopia or to restrictions on the ability of households and firms to borrow at the risk free bond rate on government debt. For both households and firms, deviations from inter-temporal optimising behaviour take the form of rules of thumb, which are consistent with an optimising agent that does not update predictions based on new information about future events. These rules of thumb are chosen to generate the same steady-state behaviour as optimising agents so that, in the long run, there is only a single inter-temporal optimising equilibrium of the model. In the short run, actual behaviour is assumed to be a weighted average of the optimising and the rule-of-thumb assumptions.

(iii) There is an explicit treatment of the holding of financial assets including money. Money has an explicit role in the models because it is a factor of production – households require money to purchase goods. Asset markets are comprised of money, bonds, equity, foreign exchange and housing. Each financial asset represents a claim over real resources. Financial assets are perfect substitutes both within economies and internationally. Within an economy the expected returns to each type of financial asset are arbitraged, taking into account the costs of adjusting physical capital and allowing for exogenous risk premia. Financial asset prices are therefore linked both within and between economies.

(iv) The MSG3 and G-Cubed models allow for short-run nominal wage rigidity (by different degrees in different countries) and therefore allow for significant periods of unemployment depending on the labour-market institutions in each country. This assumption, when taken together with the explicit role for money, is what gives the models their 'macroeconomic' characteristics.

(v) The models distinguish between the stickiness of physical capital within sectors and within countries and the flexibility of financial capital, which immediately flows to where expected returns are highest. Financial capital therefore flows quickly between countries and asset markets whereas physical capital is sector specific and capital specific and subject to adjustment costs in moving within or between countries. This important distinction leads to a critical difference between the *quantity* of physical capital that is available at any time to produce goods and services, and the intertemporal *valuation* of that capital as a result of decisions about the allocation of financial capital.

Both the MSG3 and G-Cubed models embody a wide range of assumptions about individual behaviour and empirical regularities in a general equilibrium framework.

The models contain rich dynamic behaviour, driven on the one hand by asset accumulation and, on the other hand, by wage adjustment to a neoclassical steady state.

Financial Markets are an important part of the interdependence between macroeconomics and individual behaviour and they perform a central role in the G-Cubed and MSG3 models. The G-Cubed and MSG3 modelling of financial markets allows information about future events to be projected into current asset prices. For example the price of

equity in the share market is the expected present discounted value of the future dividend stream from a representative firm in a given sector. This is valuable information for calculating household wealth as well for making investment decisions. The long term bond rate in the bond market is the geometric average of expected future short term interest rates. The value of foreign assets is the expected discounted present value of the future stream of trade surpluses. The value of government debt is determined by the expected future stream of fiscal surpluses. The financial markets in the models provide the valuation of a range of future real activities for consumption and investment decisions as well for valuing wealth.

3. Model Insights and the Role of Asset Markets

The MSG and G-Cubed models have been used extensively to examine the impact of economic shocks and policy initiatives (see McKibbin and Vines (2000) for an overview). In this section, four key studies, in which asset markets play a crucial role in the adjustment story, are summarised. In each case the important insights gained from the G-Cubed and MSG approaches are outlined and the limitations of alternative model specifications are highlighted. The summaries focus on the role of asset markets and financial flows in the adjustment process.

3.1 The North-American Free Trade Agreement

In a study for the United States congressional budget office report on the North American Free Trade Area the MSG2 model was used to assess the impact of the trade agreement between Canada, the United States and Mexico (see Congressional Budget Office (CBO) (1991), McKibbin (1994) and a summary in McKibbin and Vines (2000)). At the time in which the NAFTA was being evaluated, most (if not all) CGE studies suggested that NAFTA would lead to a flood of cheap goods into the United States economy and a loss of US jobs. The MSG2 results in the CBO study showed the opposite.

In the CBO study, the key aspect of the agreement was not actually the removal of tariffs in the USA on Mexican goods, but the impact on expected future productivity in Mexico and the reduction in the risk premium attached to the holding of Mexican assets. The model predicted that NAFTA would lead to a large flow of financial capital from the rest of the world into the Mexican economy in response to a rise in the expected return to capital and a reduction in the risk premium in the Mexican economy. The Mexican real exchange rate was predicted to appreciate, crowding out net exports and leading to a rise in the Mexican current account deficit.

Whilst most CGE studies at the time were predicting a worsening of the US bilateral trade deficit with Mexico because of a rise in labour intensive exports to the US, the MSG2 model predicted that the trade balance of Mexico would worsen as capital flowed into Mexico, the exchange rate appreciated and net exports fell. The short term impacts of NAFTA were consistent with the MSG2 model predictions. The medium to long run predictions from MSG2 were more consistent with the majority of CGE studies at the time. The additional insight from the MSG2 model was the short run adjustment process which was driven by capital flows. The model predicted a large impact from expected long-term productivity improvements, and that it showed how, through the operation of inter-temporal forces, this stimulated short term capital inflows into Mexico. In the short term, this completely dwarfed the static effect (ie changing the composition of trade) of the tariff changes between the United States and Mexico, which was the focus of the CGE studies. The scale of economies as well as the relativities within economies change in dynamic models. Financial markets contain important information about absolute and relative returns to current and future activities.

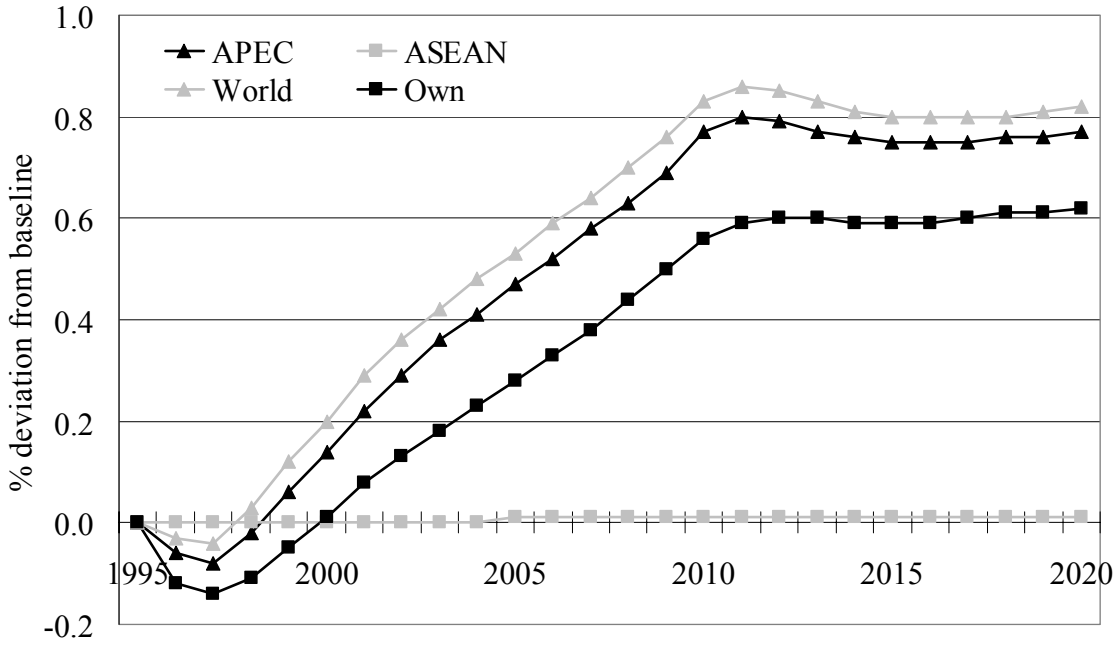
3.2 Trade Policy Reform

The Asia Pacific version of the G-Cubed model has been used to explore the impact on economies of trade liberalisation under alternative regional and multilateral arrangements. The key adjustment to the various trade policy changes is the instantaneous change in asset prices in liberalising economies. Changes in the returns to bonds and equities drive exchange rates and trade adjustment in the short run.

McKibbin (1998a) examined different regional groupings for trade liberalisation. Countries were assumed to reduce tariff rates from current levels in 1996 to zero by 2010 for developed countries and by 2020 for developing countries.

Figure 1 shows the impact on Australian Real GDP of liberalisation in alternative groupings.

Figure 1: Effects on Australian Real GDP of Alternative Regional Groupings for Trade Liberalisation



Source: McKibbin, W. (1998a)

Liberalisation within the regional groupings that include Australia (World, APEC and Own) results in short term losses as the tariff reductions are phased in, but significant medium to long term gains relative to the base scenario. There are significant additional benefits to joint liberalisation but the majority of medium to long term gains occur through own liberalisation. Liberalisation by other countries (ASEAN) results in only small GDP gains for Australia.

The adjustment path to phased liberalisation can therefore exhibit short run costs as resources begin to be reallocated before the trade reforms are implemented. Once the liberalization is announced, the return to capital in some sectors rise and capital flows in, appreciating the real exchange rate. This further dampens demand for exported goods as they temporarily become more expensive. Liberalisation by other countries at the same time can help to reduce these short run adjustment costs and real exchange rate changes. In the long run, own reforms give larger gains than foreign reforms and there is little benefit to a policy of free riding.

The key insight from the G-Cubed model is the short run adjustment process. It is important for policy makers to understand this adjustment process. The impact of a policy change may be perverse in the short run and if the adjustment process is poorly understood policy makers may become disaffected or may implement inappropriate policy responses. For example a worsening of the trade account is likely during a liberalization period. This is driven by capital inflows required to build future capacity in expanding sectors, appreciating the real exchange rate and worsening the trade balance, rather than representing a loss of underlying competitiveness. The reallocation of resources is driven by the signals in financial markets of where expected returns are highest.

3.3. The Asian Crisis

In McKibbin and Martin (1998), the G-Cubed (Asia Pacific) model was used to simulate the Asian Crisis. Data from the key crisis economies of Thailand, Korea, and Indonesia were used as inputs in the model simulations to see if the model could generate

the scales of adjustment in asset markets as well as the sharp declines in economic activity that actually occurred.

The study considered three key factors in explaining the qualitative and quantitative events that unfolded in the crisis economies: revisions to growth prospects, changes in risk perceptions, and policy responses in individual countries. The role of asset markets and financial flows was critical to the simulations. Expected growth revisions operated through changing current asset prices which had income effects and wealth effects that were important. The extent to which financial markets responded through inter-temporal arbitrage relations was crucial to the risk shocks. Finally, being able to model the anticipated policy responses, both through price-setting and through asset-market adjustments was crucial to an understanding of the outcomes.

McKibbin (1998b) focuses on the second of these factors: the impact on Asian countries of a jump in the perceived risk of investing in these economies. McKibbin argues that "a financial shock can quickly become a real shock because of the interdependence of the real and financial economies. Too often policymakers and modellers ignore this interdependence. The reaction of policymakers directly, and in the implications for risk of their responses are crucial to the evolution of the crisis." (p16)

Both McKibbin (1998b) and McKibbin and Martin (1998) conclude that the risk shock was crucial to understanding the Asian crisis. The results for a risk shock are similar to the results for a fall in expected productivity. The shock leads to capital outflow from crisis economies and a sharp real and nominal exchange-rate depreciation. This reduces the value of capital, which together with a significant revaluation of US$ denominated foreign debt, causes a sharp fall in wealth and a large collapse of private consumption expenditure. The fall in the return to capital and the large rise in real long-term interest rates lead to a fall in private investment.

Early in the debate over the Asian crisis, the results from the G-Cubed model were interesting and controversial because they were counter to popular commentary, both in Australia and in the United States. The model showed that although the international trade effects were negative for countries that export to Asia, the capital outflow from crisis economies outflow would push down world interest rates and

stimulate non-traded sectors of economies that were not also affected by changes in risk assessment. The model suggested that Australia would slow only slightly in the short run and the United States would actually experience stronger growth as a result of the capital reallocation. This is now conventional wisdom. Furthermore, for Australia in particular, the existence of markets outside Asia and changes in relative competitiveness meant that substitution was possible for Australian exports. Models with an aggregate world growth variable or a single exchange-rate variable would not be able to capture this international substitution effect, which was an important part of the story. Models with exogenous balance of payments could replicate the shock but it required an exogenous change in the trade balance and other factors that are exogenous to the model.

3.4. Climate Policy

The G-Cubed model was originally constructed to contribute to the current policy debate on environmental policy and international trade with a focus on global warming policies and it has been used extensively to study the impact of climate change policy.

In G-Cubed, the direct impact of a policy that increases the price of carbon is a rise in the price of energy and lower GDP in carbon intensive economies relative to non-carbon intensive economies.

In McKibbin, Ross, Shackleton and Wilcoxen (1999) international capital flows play an important role in the adjustment process to emissions policies. A rise in the price of carbon leads to a fall in the return on capital in carbon intensive economies and capital outflow from carbon intensive economies into large economies and less carbon intensive economies. Although developing countries are generally less carbon intensive, they cannot absorb a large amount of capital because of the adjustment costs in physical capital formation. There is therefore much less carbon leakage in the G-Cubed model than in trade model predictions because of the impact of capital flows and adjustment costs in developing countries.

The appeal of an international permit program is strongest if participating countries have very different marginal costs of abating carbon emissions. The analysis in

McKibbin et al. suggests that abatement costs are quite heterogeneous and international trading offers large potential benefits to parties with relatively high mitigation costs. The analysis also highlights that in an increasingly interconnected world in which international financial flows play a crucial role, the impact of greenhouse abatement policy cannot be determined without paying attention to the impact of these policies on the return to capital in different economies. To understand the full adjustment process to international greenhouse abatement policy it is essential to model international capital flows explicitly.

4. Conclusions

The G-Cubed and MSG models combine the approaches of traditional CGE models and macro econometric models and they provide some important lessons that have contributed to both streams of economic modelling. In particular, the explicit treatment of asset markets and financial flows in the models allows the models to provide important insights into the adjustment process following economic shocks and policy changes. Also the tight theoretical specification and disaggregation across sectors allowing macroeconomic consequences of relative price changes to emerge, illustrates that for some macroeconomic applications the traditional assumption of a single good in economies is inadequate. Understanding the interdependence between relative prices and macroeconomic adjustment is crucial to the implementation of appropriate policy responses.

Asset markets are an important part of the adjustment process in the face of real shocks – changes in trade policy, economic liberalisation, climate policy, changing risk perceptions and monetary and fiscal policies. An inter-temporal optimization framework gives asset markets a natural role in dynamic general equilibrium models. Money and asset markets play a critical role when combined with the assumption of nominal stickiness and other real world rigidities that form the basis of macroeconomics.

The examples in this paper demonstrate that a consideration of financial flows and asset markets improves our understanding of short run adjustment processes. They also demonstrate the importance of institutional structures and rigidities in the short run that

tend to be ignored in some general equilibrium models that model the short run as a sequence of long run solutions of a CGE models. As McKibbin and Vines (2000) argue, the interaction of short term real and nominal rigidities and volatile forward looking asset markets gives a better understanding of the global economy which modellers are trying to replicate.

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