Studying Socio-Economic Problems in the Mekong Delta, Vietnam: An Agent-based Modelling Approach

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To my parents, Nguyen Quan and Lan Phuong,
my sister, Khanh Huyen,
my wife, Ngoc Bich, and my son, Hung Son

Statement of Originality

I hereby certify that the work embodied in the thesis is my own work, conducted under normal supervision.

The thesis contains no material which has been accepted, or is being examined, for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository, subject to the provisions of the Copyright Act 1968.

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Acknowledgement of Authorship

I hereby certify that the work embodied in this thesis contains published papers/scholarly work of which I am a joint author. I have included as part of the thesis a written declaration endorsed in writing by my supervisor, attesting to my contributions to the joint publications/scholarly work.

Khanh Hung Nguyen

By signing below I confirm that Khanh Hung Nguyen made major contributions in conducting the literature review, designing and developing the models and writing all papers that are listed in Section 1.6.

Dr Raymond Chiong

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Abstract

The Mekong Delta (MKD), located in the far south of Vietnam, is known as the 'Rice Bowl of Vietnam'. The region accounts for half of the country's total rice production and 95% of its rice exports. Despite its increasing standard of living, the MKD has lagged behind the national average in terms of many socio-economic development indicators, such as employment, education, health care, and housing welfare. In this research, we address two pressing problems influencing the socio-economic progress of the region: (i) the failure of implementing the agricultural contract-farming scheme in the MKD rice supply chain, and (ii) the high out-migration rate from the MKD to the South East (SE) region.

We use agent-based modelling (ABM), which is a computational approach that focuses on a population of autonomous and interacting agents. ABM has the unique power of modelling individual decision making while also incorporating heterogeneity, social interaction/feedback and the dynamic impacts of different external factors. We present two agent-based models to tackle the above-mentioned socio-economic problems in the MKD region. Simulation results from the two agent-based models are then validated, providing further scenario-based insights into the related problems.

For the first problem, we investigate obstacles to the expansion of contract rice farming in the MKD region. We develop an agent-based contract-farming model and focus on two critical components of the contractual relationship: financial incentives and trust. The agent-based model is then used to predict emergent system-wide behaviour and compare different counterfactual scenarios of different policies and initiatives on maintaining contract rice farming. The results of this model showed that a fully equipped contractor who opportunistically exploited only a relatively small proportion of the contracted farmers in most instances could

outperform spot-market-based contractors in terms of achieved average profit. In addition, a committed contractor who offered lower purchasing prices than the typical rate could obtain better earnings per ton of rice and a higher profit per crop. However, in both of those cases, the contractors could not enlarge their contract-farming scheme, as either the farmers' trust towards them gradually decreased or their offers could not compete with those of a competitor or the spot market. Another important observation was that the contract-farming scheme is not a cost-effective method for buyers with limited rice-processing capacity, which is a common situation among the contractors in the MKD region. The model also identified the ranges of contracted purchasing prices for two rice types, in which both parties – the contractor and farmer – might find it beneficial to remain committed to contract rice farming.

For the second problem, the aim is to understand the dynamics of migrants' decision-making processes in the MKD region and explain why the MKD is the main migration-sending region in the country, with the highest out-migration rate and the highest deficit of net migration. We incorporate the Theory of Planned Behaviour into the agent-based model to break down migration intention into three related components: behavioural attitude, social network and perceived behaviour control. Different economic, social and environmental circumstances are considered to model the way an individual makes migration decisions. Outputs of the model are automatically calibrated via real province-level data using a genetic algorithm. This automated calibration yields some significant results, with most observed net- and out-migration data captured within the 95% confidence interval. Parameter exploration and sensitivity analysis are carried out to understand the impact of critical migration determinants. We further explore the migration behaviour of people in certain demographic groups and delineate the migration flows across cities and provinces from the MKD to the SE region.

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