

Chapter 2

Two Approaches to Modelling Trade

2.1 The Multilayer and Agent Based Model (ABM)

As mentioned in Chap. 1, our two case studies have some similarities as we will see, but they differ in scale. The SPICs case calls for an outward looking perspective and the scale is extensive; whereas Uganda is inward looking and demands a micro-scale of analysis. For the outward looking perspective of the South Pacific Islands we adopt network theory and a spatial interaction approach (Jackson 2008; Wilson 2008) through which we examine how trade is influenced by cumulative network interactions. The twofold interpretation of the cumulative network concept involves (1) representing the shipping network system; in this sense, elements are aggregated in categories whose combinations help to describe the complete network system; and (2) accounting for the vertical and horizontal interactions within the system. The inward looking perspective of Uganda uses agent based modelling (ABM) (Epstein 2006). ABMs are a class of model applied widely in agriculture economics (Happe et al. 2006; Berger 2001; Balmann 1997, 1999). The advantages of this methodology are that it allows us to employ data from different sources and different groups of heterogeneous agents who interact; exchange of information ensues and the adaptive behaviour responses to accommodate changes in the environment are taken into the model. Both of our selected modelling approaches, network theory and spatial interaction on the one hand, and agent based modelling on the other, can handle positive and negative feedback. Given that trade theory warns us of the importance of information asymmetry as an established factor that can hinder trade and limit growth, we also introduce a new concept based on information exchange. This new concept is operationalised through the multiplier attachment factor. In the next sections we set out the details of our two approaches.

2.2 The Multilayer Model

There are two objectives to be delivered by the Multilayer model:

1. **To understand the connectivity and economy of scale in logistics services.** We investigate dependencies and causalities among networks/determinants that inhibit trade facilitation in sea locked countries. This part of the analysis will accomplish the aforementioned objective by focussing on the connections of sea locked countries' supply chains to international long-distance trade, international short-distance trade, and short sea shipping activities. In the case of sea locked countries, one of the Islands' major problems is its isolated geographic condition. Towards this objective we analyse how these three major trade networks are connected and integrated, and study how to improve the trade capability and trade facilitation of the South Pacific Island Countries.
2. **To identify performance of the trade market.** SPICs are experiencing rapid population growth over the past decade (especially Solomon Islands and Papua New Guinea); nevertheless, transport services encounter different obstacles. Among the main hindrances are the high pricing structures for exports and imports, fragmentation of the different logistics services, and the low participation of the private sector in trade services and operations. We examine how the implementation of the optimization of the logistics system and the introduction of a new institutional system and trade policies (spatially-blind policies versus clustering and agglomeration of remote areas) can increase the diversification of export earnings.

In keeping with the two objectives, our study of trade in sea-locked countries is grounded on the concept that trade flows are made up of integrated layered networks. Our model has three categories of layers: physical, economic, and sociological. Due to the interactive nature of the layers, and in order to analyse their interrelationships and impacts on international and national trade, we construct the Multilayer model based on two distinct perspectives: firstly, horizontal layers are examined through the use of complex network theory (Barabasi and Albert 1999; Watts and Strogatz 1998; Erdős and Rényi 1959). Secondly, vertical integration is analysed by considering the dynamic spatial interaction approach (Wilson 1970, 2008). We are then able to investigate horizontal and vertical interdependency among layers, and the impact of shocks (natural and man-made), such as the introduction of a specific policy for the reduction of trade cost, maintenance of the infrastructure, and the provision of inter-island shipping services.

The **horizontal interrelations** within each layer define the architecture of each network; (for example, in the physical network layer we examine the links between seaports which are generated by shipping liner services), and we study these through the application of network theory. The **vertical interrelations** are established according to the spatial interactions between the nodes belonging to various networks (i.e. the port of Honiara, a node in the physical network layer, is

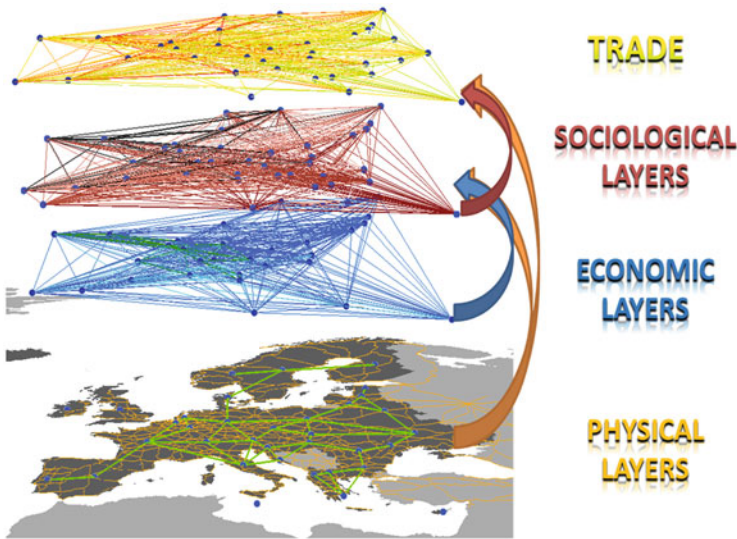


Fig. 2.1 Multilayer networks

vertically connected with the node representing the Solomon Islands in the economic network layer of trade agreements). This approach allows us to investigate the possible impacts/shocks transmitted across the considered layers.

In the Multilayer model trade flow depends on the physical layers (e.g., quality and endowment of infrastructure, geographic position), economic layers (e.g., GDP, trade agreements, common currency) and sociological layers (e.g., Customs procedures and migration movement). Figure 2.1 gives the illustrative example of the European zone. A similar framework is adapted for the SPICs trade.

Our study is structured under four main components, as depicted in Fig. 2.2:

- I. Data collection and analysis
- II. Horizontal Network analysis
- III. Vertical Interaction model
- IV. Optimization of shipping trade cost

The data collected in component I represents the input to the Multilayer model. Statistical data analysis are used as a descriptive tool in this component. The Multilayer model consists of components II, III and IV. In component II, horizontal network analysis is applied to examine the topological structure of the layers (i.e. the existence of hub-and-spoke network architecture). The existing network architectures are investigated in relation to Barabasi-Albert model, Small-World model, and Random Network models in order to evaluate which configuration best fits each existing network. In component III we analyse the vertical interlinking between the layers. And lastly in component IV, we optimize trade shipping costs by taking into consideration the results of the previous components.

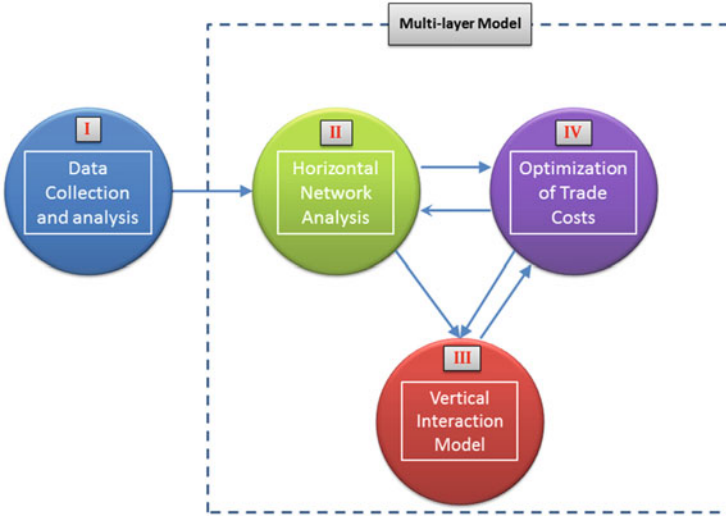


Fig. 2.2 Outline of the applied methodology

The Multilayer model is built through three main components corresponding to: horizontal network analysis (component II), the vertical interaction model (component III), and the optimization of the shipping trade costs (component IV). In component II, we consider both static and dynamic networks. Static networks do not evolve over time but rather they maintain a fixed architecture. In this type of network we test the effects of introducing specific policies by adding topological modifications to the networks and thereafter evaluating the vertical consequences generated on the trade layer of the Multilayer model. Conversely, dynamic networks evolve and change their topology over time and the nodes in this type of network follow various possible patterns, such as preferential attachment (Barabasi and Albert model), clustering and agglomeration (Small World model), and spatially-driven solutions (Erdős and Rényi class of models). The different dynamic models are used in order to study the topological configurations which best describe the existing networks applied to the SPICs. We are interested in exploring the effect of hubs and volume consolidation at different locations (nodes) in order to minimise trade costs and evaluate the impacts of hubs in different locations (inside and outside the SPICs). In component III we examine the vertical interactions between layers. Figure 2.3 visualises the vertical integration among layers; these are represented as functional relationships, where the upper layer level (trade) is the “dependent variable” and the next layer levels represent the set of associated “independent variables.” Any of these layers can in turn be considered as a “dependent variable” from its own set of “independent variables,” hence the term multilayering.

All of the layers are potentially interactive. For example, if we consider the trade layer, this layer interacts with the underlying physical layer where a change (disruption or improvement) in the physical layer may generate impacts on the trade costs.

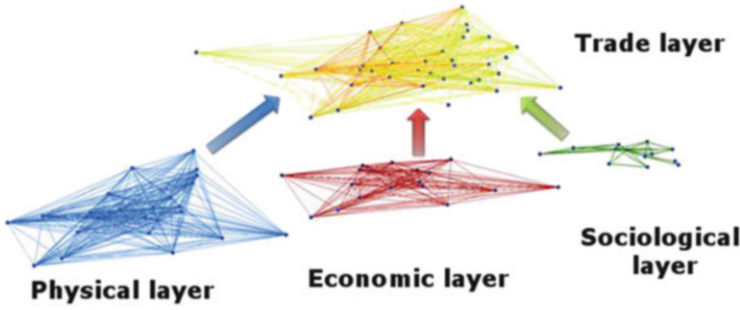


Fig. 2.3 Functional relationships between layers

The vertical interaction model is able to investigate dependencies and causalities among layers/determinants that may inhibit trade, and evaluate the transmission of effects across layers. We later calibrate the Vertical Interaction model by using the analytical specification of the parameters, as in Wilson (1970).

The rationale of the vertical interaction model is based on the entropy maximising theory (Wilson 1970). In the case of our study, we focus on aggregated trade flows rather than on the movement of individual goods. The entropy maximising theory assumes a stochastic formulation for trade problems in which the probability of a flow of trade pattern to occur is proportional to the number of ways in which goods can be arranged in aggregated flows to produce that pattern (Wilson 2000). The maximisation problem is subject to two constraints in order to restrict the number of assignments giving rise to a distribution. Thus, total origin and destination flows have to be equal to the sum of outward and inward flows of each spatial unit (i.e. regions, countries or intra-country units). In the case of trade, the constraints on trade flow T_{ij} between unit i and j —Exports (E) and Imports (I)—can be written as

$$\sum_j T_{ij} = E_i \quad (2.1)$$

$$\sum_i T_{ij} = I_j \quad (2.2)$$

We adapt the solution for the maximisation problem proposed by Wilson (1967, 2000) for the trade case as follows

$$T_{ij} = A_i B_j E_i I_j f(\beta, \text{cost}_{ij}) \quad (2.3)$$

where $f(\beta, \text{cost}_{ij})$ is a general measure of impedance between i to j , cost_{ij} is the shipping trade cost and β is a factor which considers the effect of trade costs on trade. A_i and B_j are balancing factors.

The multilayer network introduced in Fig. 2.1 (vertical connection between layers) will be developed by considering physical, economic and sociological layers.

The interactive nature of the model allows us to construct key performance indicators in order to measure accessibility and attractiveness among the SPICs. According to literature on spatial interaction models, balancing factors A_i and B_j can be interpreted as accessibility measures. Accessibility indicators assume the following form for the model in Eq. (2.3)

$$A_i = \frac{1}{\sum_j B_j} I_j f(\beta, \text{cost}_{ij}) \quad (2.4)$$

$$B_j = \frac{1}{\sum_i A_i} E_i f(\beta, \text{cost}_{ij}) \quad (2.5)$$

As these indicators are dependent and estimated in an interactive procedure, they incorporate the competition on supplied opportunities and the competition on demand. We use these measures to benchmark the effects of new policies in the system.

In component IV we optimize shipping trade costs subject to the conditions of the horizontal and vertical models (components II and III). The optimization of trade costs is central to the increase of trade volumes and economic growth in the SPICs. The optimization component of the multilayer method will be developed according to standard Origin-Destination models (Hillier and Lieberman 2005). We take into account that, as shown in the literature, trade costs are mainly influenced by transport costs (freight rates), consolidation processes to increase economies of scale, infrastructure quality, location, and vertical and horizontal organisation (Immaculada and Celestino 2005). For the case of the SPICs, the distance between ports is one of the major proxies to identify trade costs due to the impact of fuel charges on the transport cost (ADB 2007). Geographical distance is used to approximate the trade cost for the aggregated trade flow; and in the case of disaggregated goods, we need to adopt additional specifications based on available data. In relation to the trade flow cost optimization, we assume that differentiated products (i.e. products with a distinct identity and which the manufacturer has some control over pricing), have higher trade costs than homogeneous products due to the search cost buyer-supplier (Rauch 1999).

We can conclude this section by observing that the Multilayer model is the culmination of three interdependent components which add flexibility and robustness to the overall model. The framework allows us to evaluate policy impacts and link the effects of physical, economic and sociological variables to trade. Horizontal and vertical analysis of the networks and layers (topological architectures) enables us to test integration policies among SPICs as well as the effect of new agreements, joint-ventures and associations. The optimization of trade costs clarifies the interlinking between the topological architectures.

2.3 The Agent Based Model

Agriculture and agribusiness is seen as an opportunity to alleviate poverty and food security for the majority of Uganda's people, while also capitalising on the untapped potential of the agriculture sector inside the country (World Bank, *Growing Africa: Unlocking the Potential of Agribusiness* 2013). To pursue this prospect, among other factors, the agriculture sector will need to compensate for the lower competitiveness caused by the landlocked geography and an inadequate inland market network. An inland market network can be described as a nexus of goods production, flows, and points of consolidation and exchange. We can therefore comprehend an inland market network as a spatial structure with components and processes that move goods and products from origin to destination. The main actors operating in the inland market network of our case study are farmers, traders, wholesalers, and exporters.

According to Freund and Rocha (2010), in general in Africa, a 1-day increase in inland network trade delay reduces export values by about 17%. On the Uganda inland market network we can highlight three principal reasons for delay

1. Contracting, documentation, cross-border Customs. This is sometimes the longest delay and is a major barrier to private participation in trade;
2. Transit time. This represents the generalised transport cost;
3. Logistics chains and consolidation catchment areas. These delays are especially restrictive if they are associated with financial obstructions, and as such, there may be high rent costs for inventory, storage and security.

Enhancing trade facilitation is therefore a primary concern in Uganda. An improvement in the inland market network is likely to boost exports and generate broad economic effects in terms of regional and national competitiveness, reduced poverty, and increases in production and supply chain performance. By addressing inland market network inadequacies we will be able to leverage the agriculture sector's likelihood of attracting investment, and in so doing, stimulate economic growth (Bazinzi et al. 2013).

Our main objective is to study how to reduce trade costs, and in particular transaction costs, in order to achieve trade facilitation and improve connectivity and coordination among farmers in Uganda. Many African countries, including Uganda, have preferential access to international corridors destined for the US and the EU; we will therefore focus on the factors that mainly impede Uganda trade and increase farmers' transaction costs: the inland networks. Our study is structured under four specific steps, as follows

1. **Identify main operating agents and geographic linkages and integration within the inland market network.** Understanding of the market (production and trade) arises from our analyses of the inland market in its geographical context. In other words, knowing where farmers are located, the typology of production (e.g., large or small farms), and how consolidation centres and wholesale markets are distributed and linked.

2. **Understand behaviour of the different market agents.** The next step is to work out how the different components and actors relate and interface with each other. We analyse the functions of individual markets (production, consolidation and wholesale) and the movement of fresh product through the inland market network.
3. **Show direct and indirect interdependence between agents in relation to market performance.** After the spatial links of the inland market network have been determined, we assess market performance. Market performance provides insights into the extent of goods distribution and its implications. To clarify market performance and connectivity, we examine market integration and in particular analyse how prices are transmitted among different market agents.
4. **Evaluate resilience and adaptability to shocks or hazards.** The three aforementioned steps allow us to clarify current and expected future conditions so as to provide a spatial baseline for decision makers. The outcomes stemming from the previous analyses dictate the structure for the final step of our study: the creation of a platform for decision makers to elaborate specific policy directives (e.g., set price ceilings to avoid speculative behaviour, incentivise cooperative production to increase economies of scale) from which we test potential scenarios and demonstrate the possibility of mitigating exogenous shocks and risks.

With these four steps in mind, we present our methodological approach in the next section.

Given the structure of our analysis, we propose the application of agent based modelling (ABM) techniques for this part of the work. ABMs are a class of computational models and simulations based on a large number of acting and interacting agents. The outcome of a simulation is principally determined by the agents at the micro level who interact among themselves and within their own environments. Hence, ABM provides a way to study the behaviour of agents as a result of a set of different scenarios, and thereafter to test for possible policies.

One of the advantages of AB models is that they are robust and less demanding than econometric models in regard to availability of aggregate data; this makes them especially attractive for policy analysis in transition and in studies of developing countries. AB models also differ from other conventional simulation models grounded in mathematical programming because they can capture the interactions between actors explicitly (individual farms, for example), thereby allowing for the study of transaction and information costs. Second, these models can fully account for the spatial dimension: agricultural activities for instance, and hence the role of internal transport costs and the physical features of land. Consequently, the explanatory power of these models is in line with our research questions, since we aim to examine agent interactions in relation to the diffusion of market information, productivity performance and policy evaluation, and where space plays a decisive role.

In order to study inland trade flow estimations and subsequently logistics cost assessment, we tailor a spectrum of agents who represent the main actors in the

inland market network in the present study: (farmers, traders, wholesalers, exporters, governments, financial institutions, banks—plus other contractual arrangements that offer funds to farmers). Inclusion of the main actors in the supply chain network allows us to explore underlying dynamics. These diverse actors operate in the same context but have different goals, resources and available information. They also operate under different constraints; therefore, if the actors are exposed to identical shocks/incentives, given their differences and locations in various parts of the region, and their unique contexts, we expect them to respond differently from one another. In the next section we fully describe the agents who interact in the Uganda fresh product supply chain.

Actors selected for inclusion in the ABM simulation enter at the moment when agriculture goods (in our case fresh product) leave the farmers, up until these goods reach the international market, consequently mapping part of the supply chain. Actors supporting and/or affecting the value chain without being an actual part of it, such as government and financial institutions, are also included as agents. The agent-actors are listed in Table 2.1. Whereas in Fig. 2.4, the entire schema is shown, starting with farmers at the base of the chain, moving upwards to wholesalers, and finally to exporters. The majority of agents facilitate the flow between the two endpoints, farmers and exporters.

The population of farmer agents is assumed to produce within a certain time, and within a given statistical distribution of product volume. Also in the model there will be the possibility to select different types of product, and different lifetimes for each product, thus affecting its quality and selling price. In the model we distinguish between two groups: cooperative farmers and independent farmers. In the first group, the farmers are organised under cooperative agreements in order to increase the percentage of farmed land and they link directly with the traders, thus achieving low transaction costs. The second group is represented by the independent farmers who farm small quantities of land and link with different intermediary levels of traders in order to sell their product (See Fig. 2.4).

Their product is available for sale to interfacing agents, e.g., Farm-level traders and Market traders, with whom the farmers negotiate the prices. Next, the resulting volume distribution of the fresh product within the market trader population is

Table 2.1 Agents

Government
Financial institutions
Logistics Transport Service providers (LTSS)
Exporters
Processors
Large suppliers
Wholesalers
Market traders
Farm-level traders
Farmer cooperatives
Farmers

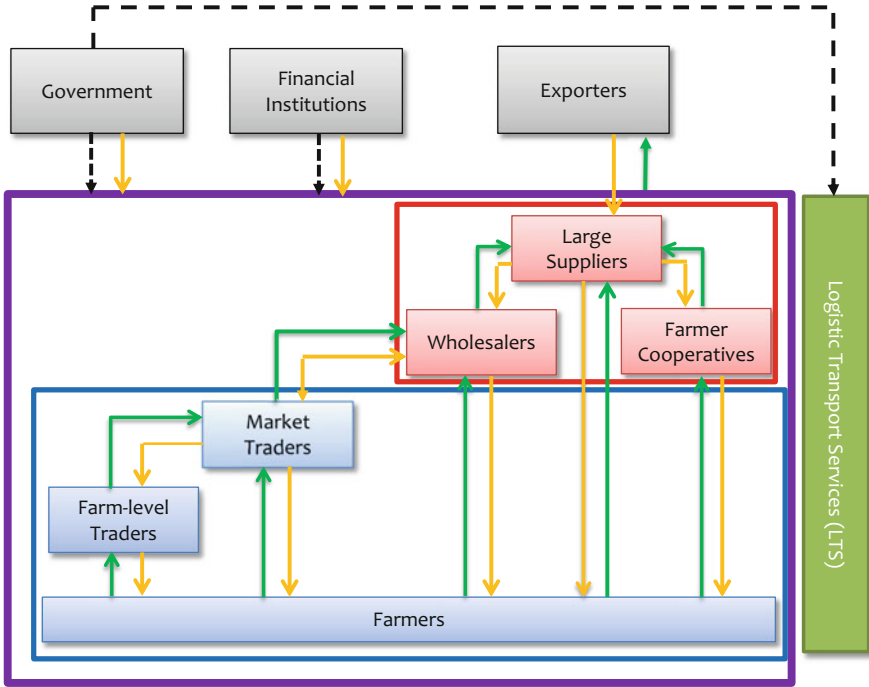


Fig. 2.4 Schema of a supply chain

shifted by the same negotiating process to other interfacing agents: wholesaler and large supplier agents, who in turn sell to exporter agents. The model assumes that interfacing agents conduct trade via a preferential attachment process. The flow of fresh product is depicted in Fig. 2.4, moving upwards from Farmers to Exporters (dark lines). The price of the product in the model is set by the exporter agents in a top-down fashion, following the same paths as shown in Fig. 2.4, but in the reverse direction (light lines).

Exporters have an acceptable price range within which they buy fresh product. The Exporter's accepted range of price is communicated via the negotiation process to the interfacing agents, who in turn adjust their price margins as the chain is traversed downwards to the farmer's price negotiations. The aim of the model is the optimization of the supply chain; we therefore assume constant demand and constant supply in the first instance. Different types of demand are involved: local demand, distribution within the country and international demand. Of course, international demand requires shipping through the airport, which in turn affects the supply chain.

Interaction between layers also takes place across the layers. Policies are implemented by the Government agent, while financial institutions may give loans to farmers and other agents. As shown in Fig. 2.4, we identify three macro layers of agents, which can be aggregated; represented from the top of the chain to the

bottom they are Main, Middle and Bottom, respectively. All the agents, with the exception of exporters, Government and financial institutions, belong to the Main set; wholesalers, large suppliers and farmer cooperatives belong to the Middle set, which identifies the interfacing agents cooperating or having agreements; and farmers, market traders and farm-level-traders belong to the Bottom set, which represents the single interfacing agents. Processors and Logistics Service Providers, who constitute the Logistics Transport Service (LTS) can be contacted by any of the actors. Warehouses are located at different places around the country in accordance with the density of farmers. We assume that farmers can stock a finite amount of product. At each stage from top to bottom a logistics service cost is introduced which reduces the price range between each layer. Thus, results have to be averaged in a Monte Carlo simulation.

A price is established from the top to the bottom, but when the price at the bottom is not above the production cost, the price is rejected and the negotiation process starts over again in a movement from top to bottom, with a biased new price proposal at the top. All the prices in the model at any stage depend on a supply-demand function. The wealth of the agents will be generated according to the distribution, location, and quality of fresh product at the start of the simulation.

Each agent in the supply chain can be described briefly.

Farmers and farmer cooperatives As producers, these are the essential agents. Farmers are divided in two groups: individual farmers who represent the small farmers, and farmer cooperatives operating under agreements and/or with large amounts of arable land. Farmer and farmer cooperatives have a production cost that is a direct function of the volume. Their price depends on the quality of the fresh product and this will be taken into account in the model.

Farm-level traders and market traders These agents act as aggregator of supply and as traders. These pay fast, and buy small amounts of fresh product in order to sell it again to the next layer for a higher price.

Large suppliers and wholesalers Large suppliers are in direct contact with exporters. Their role is to aggregate product from the supply chain for an agreed price. These agents pay with a delay.

Logistics Transport Service (LTS) The Logistics Transport Services (LTSs) move fresh product from place to place. Included in the model will be a function which gives an approximate time and cost of shipping. For the sake of simplicity, processors and logistics services are twinned and we consider them as a unique agent; they are able to interact with any other agent in the system and the timing and cost depend on the distance, for a higher price.

Financial institutions Financial institutions have the ability to provide loans to agents. Since any agent has a certain amount of funds, by applying to financial institutions, agents can skip steps in the supply chain in order to maximise the selling price of fresh product.

Government The government will implement policies. Possible policies include the implementation (or the reduction) of tariffs in some steps of the supply chain. Government interacts with financial institutions.

Exporters Exporters fix the demand and propose prices to the top actors in the supply chain. Their function is to adapt the price to the outcome of the negotiation process in the supply chain (top-to-bottom approach).

The interactions between the different agents and their behaviour are what matters most in our case study context. Starting from the government and financial institutions, policy implementations are top-down implemented: they can affect parameters and structural properties of the ABM during the simulations (by reflecting the impact of a reduction or increase of Customs tariffs). The Logistics Transport Service (LTS) agent introduces prices to ship tonnes of product between different points in the country, and thus its behaviour is only limited to establishing a price (although Government could affect this). Agents will have a position and an associated distance $D(i,j)$ between agent i and j . The LTS agent will be a function (price) $p_t(i,j,t,k)$, where i and j are the agents, t the tonnes to be moved and k the type of transport (boat, air, rail, and road). This approach, rather simplified, is different from other ABMs in the literature (Holmgren et al. 2012; Roorda et al. 2010). Changes in transport infrastructures, such as the construction of a new road, will also affect the function p_t . This function p_t can be affected by economic and policy initiatives and its details will be built on throughout the work.

Intermediate layers between demand and supply can be modelled to some extent by Walras markets (Gee 2004). Farm level traders act as Walras auctioneers between market traders and farmers (Gee 2004). By virtue of the model's construction, only a few farmers are in contact with market traders, and this is established through a probability distribution that is flexibly chosen, in that the Walras equilibrium is formed between market traders and farmers, where the price change is determined by the excess demand

$$\frac{dp}{dt} = ED \quad (2.6)$$

with ED being the excess demand. Such a model is along the lines of minimal agent based models for the origin of self-organisation in markets (Alfi et al. 2009). However, price information asymmetry takes place in the following sense. We assume that the farmers are connected through informal social networks. We model the spreading of information (i.e. the product price) as an epidemic spreading of information on this social network (Daley and Kendall 1965; Moreno et al. 2004). However, farmers tend to sell at the best price that they are aware of, to buyers whom they know, and for this reason price information is asymmetric. The informal social network is modelled as a biased Barabasi-Albert model, where connections are established on the basis of the distance $D(i,j)$ between two agents. The propagation of information is modelled in two ways in order to test the robustness of the

model (Daley and Kendall 1965; Moreno et al. 2004); first, by using a Daley-Kendall model (1965) and then as a Markov process (Moreno et al. 2004).¹

The model includes the exit/entry of agents in Eq. (2.6) and, market traders will also act as auctioneers between farmers and market traders. By following the diagram in Fig. 2.4 any intermediate agent may be considered as an auctioneer between two layers. Each layer has a market dependent price depending on the excess demand, as from Eq. (2.6). The effect of shocks on the infrastructure, and then on price and warehousing, is then evaluated accordingly.

The whole infrastructure is modelled, for simplicity, as a single agent. This macro-agent is providing a service, which in turn is subject to the Walrasian supply-demand law. The variation in the price of the service provided by the Logistics agent affects the market process directly (growth or decline). As several factors exogenous to the market under consideration might impact the price of the service, part of the model is able to account for such factors while keeping the overall model as simple as possible.

2.4 Multiplier Attachment

In order to take into account in both models the role of information and online communications, we introduce the concept of multiplier attachment. The Barabasi and Albert (1999) preferential attachment concept is grounded in the assumption that an agent will select another agent with whom to connect based on the number of connections. In other words, Agent A will connect with B rather than C, if B has more connections than C, and this will be the mechanism for building the network structure (shipping network and farmer social network). The implications of this process are that

- 1) Agent B gets more and more connected and thus increases its influence among agents and subsequently becomes a hub;
- 2) Agent A may acquire higher utility by connecting with a highly connected agent, since it can decrease its transaction costs (Schelling's assumption) and implement economies of scale and density;
- 3) At this point we are not certain whether we have obtained a solution with a higher level of competition in the market, i.e. if we have a Pareto efficient

¹If A is the adjacency matrix of the informal social network of farmers, the Markov matrix of the spreading of information on the social network is given by the row normalised matrix $A_{ij} = A_{ij} / \sum_{j=1}^N A_{ij}$. If information is withheld with a probability q , the Markov matrix is:

$$M_{ij} = qI_{ij} + (1 - q)A_{ij}$$

Layers above the Farmers are randomly connected with a few of the farmers. In order to find the demand of each, we connect higher layers to lower layers at a probabation price p_p vector.

allocation; we may instead be moving towards an oligopolistic structure of the trade market.

The concept that we propose here is a new type of attachment between agents, which we call *multiplier attachment*; it differs from the Barabasi and Albert preferential attachment. In our case, Agent A at time T_1 has specific knowledge (e.g., prices, trade flows, etc.). His or her information is partial and asymmetric in relation to the main principal (exporter, shipping companies). Agent A will connect with Agent B based on the expectation to acquire more knowledge than in his present knowledge state. We assume that the acquired information is still partial but is nevertheless additional (i.e. Agent B does not have complete information) and above all, the information is not corrupted (i.e. every connection diminishes the asymmetry and thus reduces the noise of cheap talk).

However, the acquired information occurs at intervals over time and it is this final assumption that matters most for policy implications. We can obtain a lagged measurement adjustment of the information to give us an idea of how government can intervene to reduce the lag period (implementation of cell phone networks, facilitation of trade agreement, etc.). The concept of multiplier attachment defined above is applied in the two case studies and with the two methodologies in order to verify its robustness and its capacity as an explicative factor for better understanding of trade growth. In both cases the concept of multiplier attachment is reinterpreted and tailored to the specification of the data and the given objectives.

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