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Governance structures in smallholder pig value chains in Uganda: constraints and opportunities for upgrading

RESEARCH ARTICLE

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Abstract

This paper analyses governance structures in Uganda's smallholder pig value chains by applying the New Institutional Economics framework. It utilises cross sectional and qualitative survey data from randomly selected pig value chain actors in 4 districts. A multinomial logit model is applied to assess the determinants of vertical integration among pig traders. The findings indicate that most relationships at the pig production node of the value chain are based on spot market governance structures supported by personal relationships and trust. Live pig traders are mostly vertically integrated. High integration levels of the pig traders are positively influenced by access to market information, value of investments in the value chain, and dedicated asset specificity in terms of backyard slaughter premises. Upgrading opportunities in the value chain in the form of value addition strategies, policy implementation and promotion of business models that link producer organisations to quality inputs and service suppliers through contractual arrangements are identified.

Keywords: smallholder pig value chains, governance structures, transaction cost economics, vertical integration, upgrading, Uganda
JEL code: D4, D23, L11, L14, Q13

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1. Introduction

Agri-food value chain systems are being transformed with a shift from traditional sales and purchase channels to more coordinated linkages and value chain governance systems in developing countries. This is driven by increased demand from consumers for food safety and better food quality specifications. Value chain governance refers to the relationships among the buyers, sellers, service providers and regulatory institutions that operate within or influence the range of activities required to bring a product or service from inception to its end use (Kaplinsky and Morris, 2001). Governance is about power and the ability of actors to exert control at any point in the chain by setting or enforcing product or process parameters under which others in the chain operate. The key parameters of focus as indicated in value chain governance literature (e.g. Dolan and Humphrey, 2000; Gereffi *et al.*, 2005) include; what is to be produced; including product design and specifications, how it is to be produced; in terms of the production processes including elements such as the technology to be used, quality control, labour standards and environmental standards, and how much and when it is to be produced; implying production scheduling and logistical arrangements.

Several prototypes of governance structures are distinguished in the literature. There is consensus that these structures exist along a spectrum (Gereffi *et al.*, 2005; Minot, 2011; Webber and Labaste, 2010). The spectrum has the spot market governance on one end and hierarchy or vertical integration on the other. Between the two governance poles are a variety of intermediary structures such as production and marketing contracts. Marketing contracts refer to pre-production agreements on the terms of sale for example quality, quantity and pricing, while production contracts refer to agreements that include pre-production assistance such as inputs, information and credit. Spot market governance involves transactions that require little or no formal cooperation between participants. It is characterised by many buyers and sellers leading to lack of repeated transactions, limited information sharing and significant flexibility and independence (Webber and Labaste, 2010). Market price provides powerful signals and is the principal coordinating mechanism. Commodities typically produced and traded in spot markets include staples.

The hierarchical forms are characterised by full integration whereby all value chain activities are brought together within one legal entity or ownership. Horizontal and vertical coordination are also internalised in such structures. In the framework of transaction cost economics (TCE), such forms offer greater protection for specific investments and provide relatively efficient mechanisms for responding to change where coordinated adaptation is necessary (Shelanski and Klein, 1995). Full integration is common in commodities that are economically produced at scale and those that have high operational standards (Minot, 2011). Vertical coordination exists between actors with different functions while horizontal coordination exists among the actors who have the same function in the value chain. When specialised investments in the form of assets such as equipment and human resources are needed to carry out transactions, and when product or input markets are thin, central coordination of investment decisions and combined ownership become desirable. The shift from spot market to hierarchy along the spectrum entails a trade-off between price incentives and adaptive properties of the market, and the safeguards and central coordinating properties of the firm.

Agri-food value chain governance is pivotal especially for small and medium enterprises (SMEs) for better integration and coordination of their activities in value chains and improved performance. The evolution and significance of value chain governance in promoting SME performance in agri-food chains has attracted considerable attention of agribusiness and policy analysts (e.g. Thorpe and Bennet, 2004; Trienekens and Willems, 2007). There are risks that as value chains develop and get more organised in order to meet the changing patterns in consumer demand, SMEs may be left out. An important challenge for the largest number of developing country SMEs is how to enter into these chains and become competitive. This is because they are often confronted with asymmetric power relationships that impact on the distribution of costs and benefits in the chain.

This study analyses existing governance structures in smallholder pig value chains in Uganda and identifies inclusive models that could enhance integration and competitiveness of SMEs. It further examines the

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institutional environment under which the value chain operates and highlights opportunities for upgrading. Piggery is increasingly becoming an important sector dominated by SMEs in the country, yet there is limited evidence as regards its structure and functioning. The smallholder pig value chain in Uganda is a major source of livelihood for more than 1.1 million households (Uganda Bureau of Statistics, 2009), and contributes to national food security.

The pigs are mainly kept in smallholder backyard systems, managed by women. Pigs are often preferred as they grow fast, produce 16-20 piglets per sow per annum, and are efficient transformers of various low value feed resources, mostly considered as 'waste', into high-value animal-source food, for sale or home consumption (Mutua *et al.*, 2010). These livestock, normally considered as 'living banks', can quickly be sold for cash to meet household financial needs, such as school fees and inputs for crop cultivation. Demand for pork in Uganda is increasing rapidly and the annual per capita pork consumption, at 3.4 kg, is now the highest in East Africa (FAOSTAT, 2015). Fuelled by the increasing demand, the number of pigs in Uganda has increased from 0.2 to 3.2 million between 1980 and 2008. With a projected annual growth rate of 8% over the coming decade, the number of pigs in the country will come close to eight million by 2020 (Uganda Bureau of Statistics, 2009). Given its strategic location, there are opportunities for Uganda to export pig and pig products to neighbouring countries such as the Democratic Republic of Congo (DRC), Rwanda, and South Sudan where the demand for pork is also growing.

2. Theoretical and analytical framework

The New Institutional Economics (NIE) framework, specifically TCE is applied to assess the rationale for governance structures and relations in the pig value chain. The basic premise of TCE is that transactions must be governed as well as designed and carried out, and that certain institutional arrangements affect governance better than others (Coase, 1998; Williamson, 1991). Transactions between firms are governed under conditions of bounded rationality and opportunism of the actors involved. Opportunism refers to unscrupulous behaviour of agents in an attempt to maximise their individual utility.

Bounded rationality refers to the limited rationality of humans due to lack of relevant information and limited capacities. Williamson (2000) employs the bounded rationality assumption in TCE to suggest that all complex contracts are unavoidably incomplete, which leads to significant contracting issues in the face of opportunism. He suggests that contract incompleteness arises from two distinct mental bounds: cognitive and verbal limitations. The cognitive limitations prevent actors from generating all possible contingencies to include in the contract; while verbal limitations attenuate the contract's content, because an idea cannot be included if it cannot be expressed in words. These limitations lead to incomplete contracts because actors can neither imagine all the possible contingencies that should go into the contract nor articulate them. In the presence of opportunism by agents, incomplete contracts lead to serious contractual difficulties, which can prevent exchanges from occurring. In smallholder farmer settings, limited capacities and lack of information lead to oral non-formal agreements based on trust between trading partners.

Under these two conditions, transactions are characterised by hazards, thus measures must be taken to mitigate the losses arising from high transaction costs. TCE offers a set of normative rules on how trading partners choose governance arrangements that mitigate all forms of contractual hazards found between the partners in order to minimise transaction costs (Masten, 1993). There are key transactions cost-related constraints in the smallholder pig value chain in Uganda as in other agri-food value chains. These include high transaction costs due to high transportation costs and poor physical infrastructure; poor information flows, resulting in information asymmetry in buyer-seller relationships; low value final markets; weak legal and quality assurance systems; high costs of production inputs, high search costs, especially due to scarcity of pigs during subsequent periods after African swine fever (ASF) disease outbreaks (Minten *et al.*, 2009).

The institutions of principal focus in NIE are the institutional environment, that is 'rules of the game' and the institutions of governance referred to as 'play of the game' (Williamson, 1999). The institutional environment

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refers to the formal rules, comprising policies, laws, regulations and property rights that create order in exchange (North, 1991). The institutions of governance refer to the use of governance structures such as spot market, hybrids or the hierarchical forms. Such structures consist of a collection of rules or institutions and constraints structuring the transactions between the various actors in the value chain. A fundamental notion of TCE is that market forces work to bring about an 'efficient sort' between transactions and governance structures, so that exchange relationships observed can be explained in terms of transaction costs. It also recognises that markets have difficulty dealing with some transactions because of asset specificity, bounded rationality, and opportunistic behaviour by the parties to the transaction. Williamson (1996, 1999) identifies key important properties of underlying transactions that influence governance structures. These include asset specificity, uncertainty about the future of the relationship, complexity of the transaction and frequency of transactions.

Asset specificity refers to the transferability of assets (physical and human) that support a given transaction (Williamson, 1999). Transaction costs are affected by the extent to which specialised investments have to be made to carry out transactions. These specialised investments cannot be redeployed to alternative use without loss of productive value (Shelanski and Klein, 1995). Assets that are specific to a particular production relationship can empower those who own them because unique assets reduce the ease with which the asset owner may be replaced, should the production relationship deteriorate (Masten, 1993). This increases the dependence of other value chain actors in maintaining this production relationship. However, specific assets can also disempower the owner because they reduce the ease with which the asset owner can abandon the production relationship. Under such circumstances the owner may therefore seek stronger governance structures for protection. Bounded rationality further limits the capability of markets and simple contracts to handle asset specificity since all contingencies cannot be foreseen and contracted for by the parties. Spot market transactions offer no protection to asset owners against opportunism when transaction-specific assets are involved. Contracts and hierarchy forms of governance structures offer some protection for transaction-specific assets by tying the buyer and seller together for a specified period. When asset specificity, bounded rationality, and opportunism make contracting problems severe, vertical integration is preferred to ensure that the value of transaction specific assets is internalized.

Uncertainties are unanticipated changes in the circumstances and behaviour surrounding a transaction. Aside from increasing information, contracting and ex post monitoring costs, uncertainty is the source of contractual disturbances to which costly adaptation may be required of two contracting parties (Williamson, 2008). Due to uncertainty, the exchange partners may find it difficult to write market contracts, leading to opportunism (Leiblein, 2003). As uncertainties increase, TCE hypothesizes that economic actors will respond by adopting coordination mechanisms and governance structures that offer increased control over unknowns. The probability of observing a more integrated governance structure depends positively on the amount or value of the transaction – specific assets involved in the transactions, the degree of uncertainty about the future of the relationship, the complexity of the transaction, and on the frequency of trade (Shelanski and Klein, 1995).

Observed governance structures in the smallholder pig value chain are analysed using cross sectional and qualitative focus group discussion data. Specifically a multinomial logit (MNL) model is employed to examine the determinants of vertical integration observed in the pig trading node of the value chain by considering their transaction characteristics. Different levels of integration are observed in the live pig trading node, with traders carrying out multiple functions including logistical functions such as transportation and value addition roles such as pig slaughter and pork retail under single ownership. Other studies such as Mtimet and Baker (2013) also observe vertical integration among pig traders in Uganda.

The traders are assumed to maximize their expected net returns from transactions, by selecting a given integration level that minimizes transaction costs. The expected net returns, $E(\pi)$ from a given level of integration i can be represented by a latent variable:

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$$E(\pi)_i^* = Z\gamma_i + \mu_i \tag{1}$$

Although the $E(\pi)_i$ for the trader is not known to the analyst, Z is a vector of transaction related attributes, including asset specificity, uncertainty, other externalities and value chain actor characteristics that are observed. The relevance of these attributes on the levels of integration of pig traders is tested. The stochastic components and parameter estimates are represented by μ and γ, respectively. The behavioural model for the analyst is that a trader *j,* compares the expected net returns from transactions associated with different levels of vertical integration, and chooses alternative *i* from a finite set of alternatives *I*, with probability $P(i)$ if the expected net return associated with *i* is greater than other alternatives. This is depicted in (2) as follows:

$$P(i|I_j) = E(\pi)_{ij} > E(\pi)_{kj} = P(\mu_{kj} - \mu_{ij}) < (Z_{ij} - Z_{kj}) \qquad \forall k \in I_j = 1,\ldots K;\ i \neq k \tag{2}$$

The stochastic term, μ is assumed to be independent and identically distributed with a type 1 extreme value distribution, resulting in a MNL model:

$$P(i|I_j) = \frac{\exp(Z_{ij}\mu_{ij})}{\sum_k \exp(Z_{kj}\mu_{kj})} \tag{3}$$

In the MNL, the vertical integration level for each trader is the dependent variable, and the transaction attributes and socio-demographic characteristics of the traders, the independent variables.

3. Data and description

The data employed in this study are from pig value chain actor surveys that were conducted in 2013-2014 in Masaka, Kamuli, Mukono and Kampala districts, representing high pig supply and demand areas. Random samples of 376 pig farmers, 101 pig traders, 36 veterinary drug stockists and 36 livestock feed traders were used. The samples were drawn from lists of each value chain actor category prepared by local council authorities from 14 sub-counties in the survey districts. Survey tools were developed to capture information on characteristics of the actors, in particular the types of assets held, purchase of inputs and intermediate inputs in terms of cost, origin, supplier types, transaction characteristics, value addition, and marketing of outputs in terms of prices received, geographic destinations, buyer types, as well as quality attributes. The survey tools were administered by qualified and trained enumerators using in-person questionnaire interviews in the dialects of the value chain actors. Qualitative focus group discussion data from 1,400 randomly selected pig farmers were also used to complement the producer level data. In this paper, the value chain data is used to describe the overall pig value chain governance structures, while the pig trader data is used to model determinants of integration among pig traders by using a MNL model.

The dependent variable considered in the MNL estimation is the level of integration of the live pig traders in the value chain. In this study, it is defined in terms of the number of value chain functions in which the trader is involved in the value chain. The traders involved in only one function are considered as low integrated while those involved in two to three functions as medium integrated. Traders involved in more than three functions are considered as highly integrated. Survey results indicate that 33% of the traders were highly integrated, while 35% and 32% were medium low integrated, respectively. The independent variables employed to explain determinants of integration levels among pig traders are based on the TCE literature (Shelanski and Klein, 1995; Trienekens, 2011; Williamson, 2000) and are presented in Table 1.

90% of the pig traders in the sample were men, with an average of 7 years of formal education, corresponding to primary level of education. The low integrated traders however, had an average of 5 years of education. In the sample, 50% of the traders had access to market information, of which 70% were vertically integrated compared to 30 and 40% of the low and medium integrated traders, respectively. Pig slaughter is carried out in unregulated backyard slaughter premises, that often lack appropriate waste disposal infrastructure and

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Table 1. Definition of variables used in the multinomial logit model.[1]

Variables	Definition	Overall sample (n=101)	Highly integrated (n=33)	Medium integrated (n=35)	Low integrated (n=33)
Age	Age in years	38.2 (9.3)	38.3 (10.1)	38.9 (10.4)	37.6 (7.2)
Education	No. of years of schooling	6.4 (3.3)	6.9 (3.1)	7.0 (3.2)	5.1 (3.3)
Gender	1=male; 0=female	0.91 (0.3)	0.97 (0.2)	0.91(0.3)	0.91 (0.3)
Experience	Years in pig business	9.6 (7.9)	10.0 (8.9)	8.5 (7.3)	10.3 (7.6)
Market information	Access to market information on pork retail (1=yes; 0=otherwise)	0.5 (0.5)	0.7 (0.5)	0.4 (0.5)	0.3 (0.5)
Trade association	Member of a trade association (1=yes; 0=otherwise)	0.2 (0.4)	0.2 (0.4)	0.2 (0.4)	0.2 (0.4)
Assets (log)	Value in Uganda shillings of assets used in piggery business (log transformed)	12.3 (1.5)	12.8 (1.7)	12.2 (1.4)	11.8 (1.3)
Backyard slaughter	Access to a slaughter premise (1=yes; 0=otherwise)	0.6 (0.5)	0.7 (0.5)	0.5 (0.5)	0.4 (0.5)
Market perception	Trader's pig market supply situation in last 5 years (1=increase; 0=otherwise)	0.7 (0.4)	0.6 (0.5)	0.8 (0.4)	0.7 (0.5)

[1] Standard deviation in parentheses.

adequate water supply. The backyard slaughter premises are usually adjacent to pork retail outlets. In most cases, the traders collectively use such slaughter premises, often owned or rented by one of them.

Most of the vertically integrated pig traders (70%) have access to such slaughter premises. The backyard slaughter premises for slaughtering pigs are less easily transferable for slaughtering other livestock species due to religious biases associated with pig consumption for religious groups such as Muslims and Seventh Day Adventists among others. The value of assets used in piggery is relatively similar across the 3 groups of traders in the sample.

4. Results and discussion

Description of the pig value chain

The pig value chain map is presented using GTZ's ValueLinks approach (Springer-Heinze, 2007). Most relationships in the pig value chain are based on 'arm's length' spot market governance structure (Figure 1).

■ *Pig production*

There are several smallholder farmers selling pigs for slaughter to several intermediary parties (traders and collectors) through uncoordinated spot-market transactions, based on oral agreements (Figure 1 and 2). This is usually supported by personal relationships and trust. The farmers sell on average 1-2 pigs at a time, twice a year to local traders or collectors working within larger traders' business networks.

The chain is long, with several intermediaries between the production and consumption nodes. There is limited availability of end market information on prices and preferred product attributes to producers. Asset specificity for individual pig farmers is generally low, given that the production assets associated with piggery can usually be deployed towards other livestock. There are generally no standards to adhere to and low barriers to entry. This system offers some advantages to the trading parties. Farmers are able to meet

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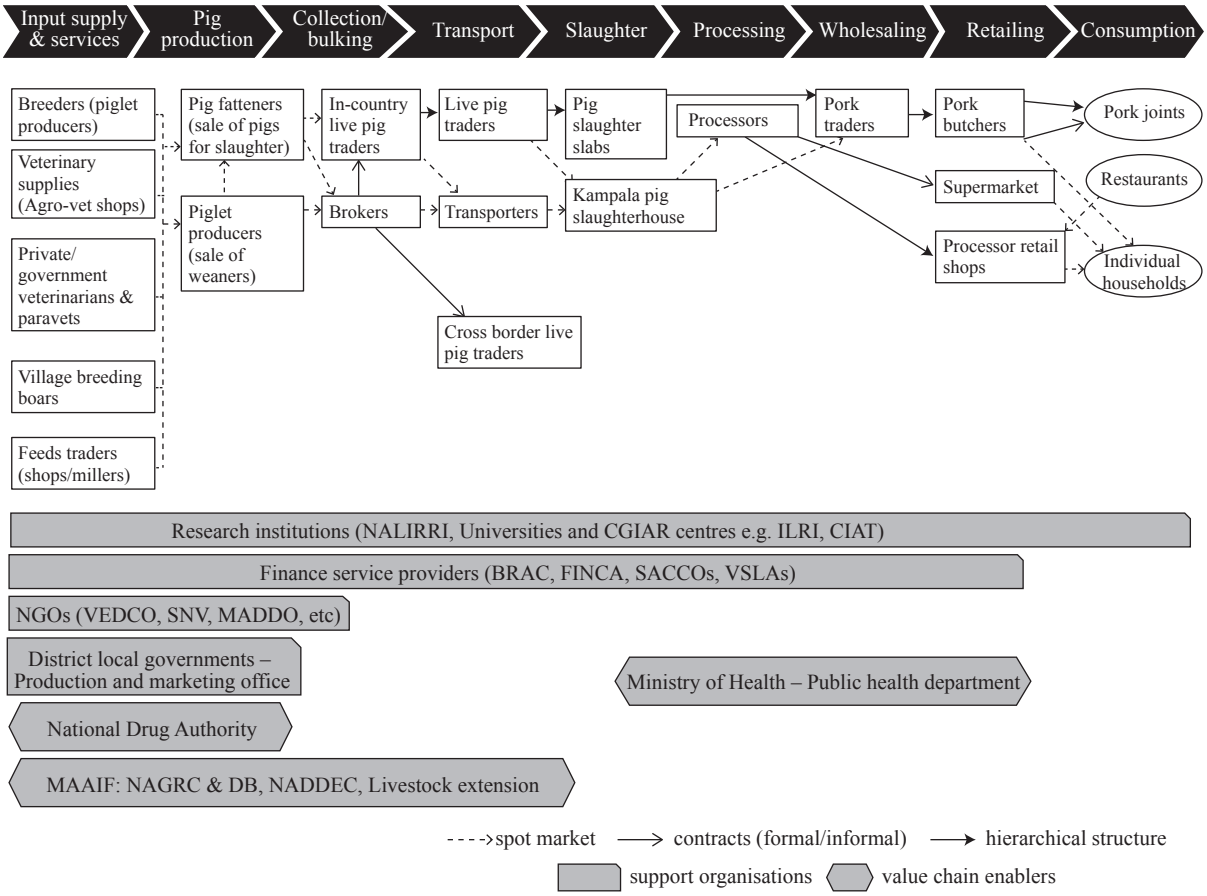

Figure 1. Pig value chain map.

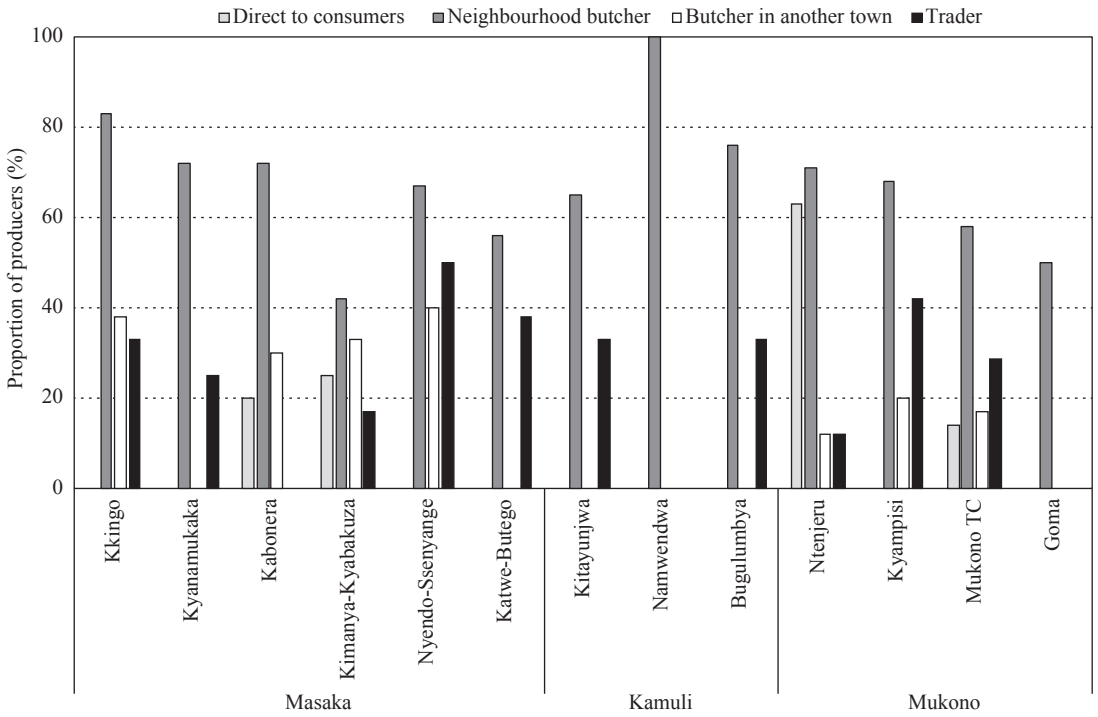

Figure 2. Pig sales outlets.

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cash needs through spontaneous transactions and both transacting parties are not burdened by the governance costs of complex coordination structures. However, the disadvantage with such a coordination mechanism is that the transactions are not transparent and transaction costs are borne by individual players. Farmers receive prices imposed by the traders, based on visual estimates given that pig weights are not monitored to inform the price determination process.

■ *Live pig trade*

Pig trading involves collection of pigs from individual pig farmers and bulking for sale to larger traders located in urban areas, neighbouring districts and to some extent neighbouring countries. The specificity of assets used in the live pig trade is low, thereby enabling the traders involved solely in live pig trade to easily switch from pig trading to other income generating activities during low pig sale seasons. The most important fixed investments owned by the pig traders interviewed include motorcycles for transporting pigs and mobile phones for obtaining market information and networking. The specificity of these assets is low insofar as they can be used for a range of trading activities. During low pig sales period, the traders switch from pig trading to transportation of people using the motorcycles.

Results show that most of the pig traders are vertically integrated, performing several functions in the value chain under single ownership. Compared to pig farmers who are largely concentrated at the production node, live pig traders are also involved in the retail nodes of the value chain, operating pork butcheries and pork joints while also carrying out pig slaughter functions (Table 2).

The multiplicity of functions by live pig traders was observed across the four survey districts (Figure 3). In these districts, the traders purchased pigs from producers and village brokers, provided transport services, slaughtered pigs and also retailed pork in pork joints and pork butcheries. Only 7-25% of the live pig traders were involved in sale of live pigs to other traders.

Informal contracting arrangements between the traders and village brokers, who source pigs from farmers was common. Pig traders wielded a lot of power in the value chain, as they collaborate through informal groupings and collude in setting both producer price of pigs and pork retail price, making them rather powerful actors in the chain. 21% of the traders in the sample were members of such groupings. Such platforms were also used by the traders to share information on pig product prices and other market conditions.

■ *Pig slaughter*

There is absence of designated slaughter facilities for pigs, in both rural and urban areas in the districts, except for Kampala. This gap is filled by traders who invest in backyard slaughter premises that are not regulated and without ante-mortem inspection of pigs. The resulting pork is largely not inspected and

Table 2. Traders engagement in other business activities along the value chain.

Value chain activities	Proportion (%) of producers (n=376)	Proportion (%) of live pig traders (n=101)
Butchery	1.1	95.1
Pork joint[1]	0.8	62.4
Live pig trading	0.5	100.0
Pig slaughter	0.5	60.4
Supply inputs (e.g. feeds)	0.8	0.0
Pig production	100.0	22.7

[1] Pork joints are common pork eateries in Uganda serving roasted or fried pork. Many people socialise and watch football matches in such joints.

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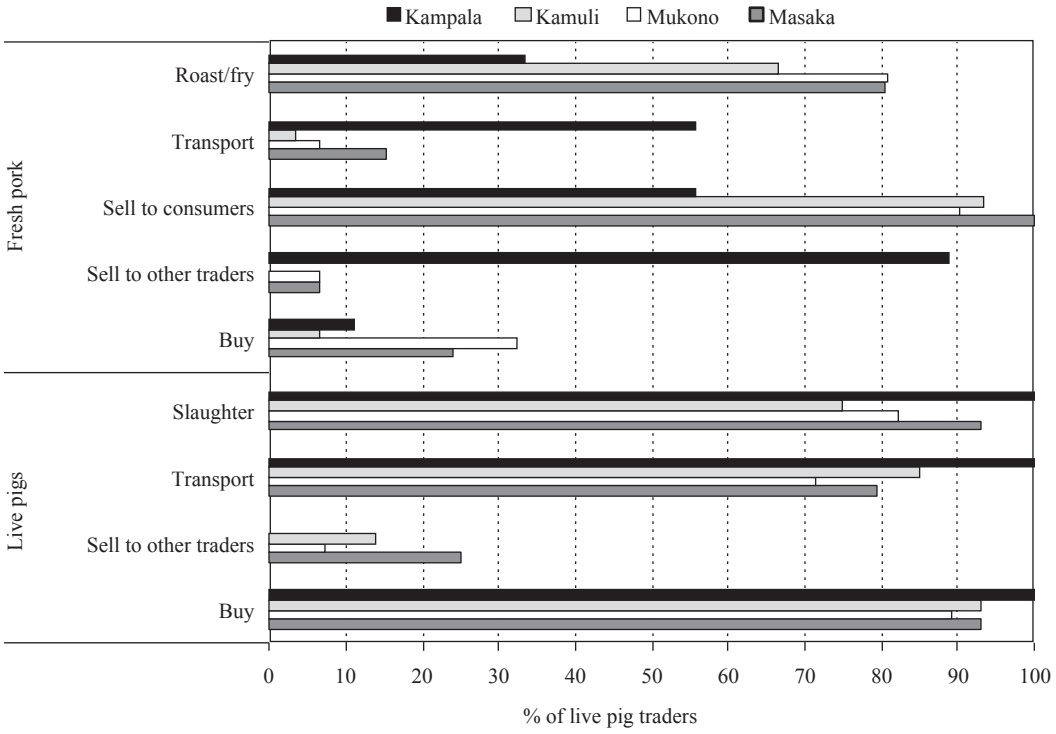

Figure 3. Functions of live pig traders, by district and product type.

mainly sold through local retail outlets such as butcheries and pork joints (Ouma *et al.*, 2015; Tatwangire, 2014), and there is no grading or standards of pork carcasses sold through such retail outlets. Furthermore, the hygiene of the backyard slaughter premises, and pork joints in addition to pork handling are often poor. The veterinary and public health departments in local governments have the responsibility of regulating such premises and enforcing standards to ensure that only quality and safe pork and other meat products are offered in the market. However, enforcement of such controls and standards in the value chain has been weak. The traders operating backyard slaughter premises tend to be vertically integrated in the value chain, sourcing for live pigs and also operating pork retail outlets within the proximity of slaughter facilities to minimise on transport cost for the carcasses. The slaughter premises are often adjacent to the retail outlets. Most of the live pig traders in the districts (more than 60%) are involved in backyard slaughter of pigs. As a consequence of significant pressure from religious groups, most of the backyard slaughter premises and pork joints are not visibly advertised (Worsley, 2013). There is only one officially recognised and regulated pig slaughterhouse located in the capital city in Kampala. Due to repeat transactions, informal and largely oral contractual relationships through a relational type of governance structure exist between the slaughterhouse and traders supplying pigs sourced from several districts for slaughter.

■ *Processing*

There are only two main pork processing firms in Uganda, mainly relying on the pig slaughterhouse in Kampala for supplies through formal contracts. Purchase of pigs from smallholder farmers by the firms is very seldom. The processors invest in processing and chilling equipment for their pork products. The pig slaughterhouse in Kampala is the main supplier of pork to these firms. The processors target high end consumers of their processed products. The high end consumers demand for high and consistent quality pork and pork products through the supermarket chains and retail outlets owned by the processors. The linkages between the pig slaughterhouse in Kampala and the pork processors on one hand and the processors and the supermarket chains on the other is formalised though written contracts.

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■ *Input supply*

The value chain map shows input suppliers comprising livestock feed traders, and suppliers of veterinary products and services. Their relationship with the chain operators especially pig farmers is mainly on spot market basis. A number of policies are in place to promote animal production and productivity but these are either poorly implemented or lack a legal framework for implementation. Such policies include the National Animal Feeds Policy (2005) to govern the processing and sale of compounded animal feeds with the goal of developing the animal feeds industry (Ministry of Agriculture, Animal Resources and Fisheries, 2005), and the National Drug Policy to ensure availability, of essential, efficacious and cost-effective drugs though the National Drug Authority (Ministry of Health, 2002).

The national feeds policy emphasizes the importance of the private sector in spearheading the supply of quality animal feeds. Nevertheless, constraints associated with poor quality feeds due to adulteration, and poor formulation, and inefficacious livestock drugs still abound. Uganda's Draft Feed Bill which is the legal framework for implementation of the policy has been formulated but not yet approved and enacted. The Feed Bill is vital in providing a legal framework to guide feed compounders and traders, and regulators in the feed sector.

Empirical results on determinants of vertical integration of pig traders in the value chain

The parameter estimates of the choice of vertical integration levels used by pig traders are presented in Table 3. The base group for comparison is traders that are low integrated. Marginal effects are used to interpret the determinants of pig trader choices of level of vertical integration.

The results show that the high integration level of pig traders is positively and significantly influenced by access to market information at the retail node, value of investments in the value chain, and dedicated asset specificity in terms of backyard slaughter premises. The marginal effect of market information variable is positive and statistically significant for high integration and negative for low integration, showing that if a live pig trader has access to market information, this increases the likelihood of being highly integrated. Market information can be exploited to reduce uncertainty. However, information tends to be more reliable for the retail node (downstream) and not the live pig trade node of the value chain (upstream) which is often characterised by supply uncertainties. This influences the traders to pursue higher integration levels in order to have increased control over supply uncertainties and protect value. Key sources of uncertainty in the pig value chain that may disrupt pig trade business include price fluctuation of pigs as a result of outbreaks of

Table 3. Multinomial logit estimates of determinants of vertical integration among pig traders.[1,2]

Variable	Low integrated		Medium integrated		High integrated	
	Marginal effects	z-value	Marginal effects	z-value	Marginal effects	z-value
Age	-0.001	-0.07	0.010	1.40	-0.009	-1.23
Education	-0.039	-2.07**	0.000	0.00	0.039	1.89*
Gender	-0.210	-0.75	0.250	1.97**	-0.039	-0.14
Experience	0.001	0.09	-0.017	-1.73*	0.016	1.80*
Market information	-0.281	-2.53***	-0.127	-1.15	0.408	3.62***
Trade association member	-0.033	-0.24	0.225	1.46	0.192	1.58
Log of assets	0.000	0.01	-0.129	-2.85***	0.129	2.51**
Backyard slaughter	-0.289	-2.42***	-0.147	-1.25	0.436	3.89***
Market perception	0.090	0.72	-0.044	-0.33	-0.046	-0.36

[1] Base group is low integrated traders.

[2] *, **, and *** denotes significant variables at 10, 5, and 1% levels, respectively.

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ASF disease. The infectious nature and high mortality rates associated with ASF, along with the absence of a vaccine and medical treatment has made the disease one of the most constraining factors (Dione *et al.*, 2015). During outbreaks of the disease, price offer by pig traders to farmers are quite low due to panic sales by the latter, despite the largely stable retail pork price to consumers. Subsequent periods after ASF outbreaks are characterised by low pig supplies due to scarcity, thereby raising search costs for live pig traders. Studies such as Hennessy (1996) show the important role of information asymmetry in agro-food industry vertical integration.

The positive and significant marginal effect of the asset variable for high integrated traders and negative effect for the medium integrated indicate that the traders who have a higher asset value in the value chain are more likely to be highly integrated and less likely to be medium integrated. This implies that traders with higher levels of investments in the value chain would prefer contractual relationships that provide sufficient security. This is even more so if such investments have higher levels of asset-specificity as described by Williamson (1979) and Joskow (1998). The backyard slaughter premises variable is an example of such an asset. Its marginal effect in the model is positive and significant for high integrated traders and negative for the low integrated traders, implying that traders operating slaughter premises are more likely to be highly integrated. The slaughter premises are located in close proximity to pork retail outlets such as butcheries and pork joints to minimise on transport related costs, thus representing some aspects of dedicated asset specificity. These findings are consistent with other studies on agri-food supply chains such as Trienekens and Willems (2007) that find governance structuring of South African grape supply chain towards chain coordination and vertical integration that lead to innovations that require investments in relationship-specific assets. A lot however still remains to be learnt regarding the role of asset specificity in vertical integration governance structures due to the dearth of empirical analysis as measurement issues remain a challenge. This concern is also raised by authors such as Joskow (2004). Marginal effects of socio-demographic variables such as education, experience and gender are not strongly significant in the model.

5. Conclusions

The pig sector in Uganda is generally underdeveloped although it has high potential for growth, given the rising demand for pork domestically and in neighbouring countries such as South Sudan, Rwanda and the DRC. The smallholder pig production node is dominated by spot market and informal relationships. The implication of this is that pig producers are generally price takers and lack a common voice. In order to improve the value chain position of farmers, their value capture and reduce transaction costs associated with individual spot market transactions for inputs and sale of pigs, business models along the lines suggested by Cadilhon and Kobusingye (2014) could be promoted. Such models necessitate horizontal integration of producers into collectives in order to improve their bargaining power for better terms of trade and reduced transaction costs associated with transportation due to economies of scale. The farmer collectives can then be linked to different business development service providers to improve access to quality inputs and services including market information, through contractual arrangements.

The results show minimal investments by private sector players for value addition and processing of pork and pig products, yet these are critical avenues for upgrading the value chain. The gap for processed pork products in the country is currently met through importation. Opportunities for such value addition exist but the cost of the investments including equipment, cold chain infrastructure that meets quality standards, and energy for processing tends to be high. This study reveals gaps in the pig slaughter node of the value chain, currently dominated by pig traders. Opportunities for investment in appropriate pig slaughter facilities exist, through private or public-private partnerships. Dedicated supply of pigs to such facilities can be in the form of contractual arrangements with pig farmer collectives.

Government has a role in supporting the development of the pig value chains by providing a favourable business environment to incentivise private sector investments in the value chain. An additional and critical role of government in upgrading the value chain is the establishment of functional systems for implementation

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of rules and regulation for quality input supply, pork quality assurance and standards as documented in other studies such as Lee *et al.* (2012).

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