Wageningen University and Research Centre
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MSc. THESIS

Economic impact of alternative contracts on Dutch broiler chain performance

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Preface

This research was conducted at the chair group Business Economics of Wageningen University, the Netherlands to fulfill the course requirement of Major Thesis (BEC-80433).

First, I would like to thank my supervisor Dr. Ir. Miranda Meuwissen for her guidance during the whole thesis period, who always gave me constructive and motivating comments. Furthermore, I would like to thank also my second supervisor Dr. Ir. Annet Velthuis for her support, especially in development of the simulation model.

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Konstantinos Karetsos

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Summary

Poultry meat is consumed in every region and in countries with very different levels of development (Magdelaine et al., 2008). The poultry meat is the second highest consumed meat after pork, in the world and in the EU (about 40% the pork and 30% the poultry meat). Broiler meat is almost the 90% of poultry meat in the Netherlands. Many companies and farms are involved in broiler production chain. Contractual arrangements are a very common form of governance in agri-food chains. The agricultural contracts are distinguished in production and marketing contracts. Usually, the Dutch broiler meat is produced on contract basis and the chain participants are independent companies.

The chain performance in Dutch broiler chain is perceived to be suboptimal and this has several effects on chain participants, because of the high degree of dependency between them. This study has three objectives, to identify the current structure of Dutch broiler contracts, study the impact of those contracts on chain performance and of alternative contract structures on chain performance. Moreover, it focuses on contracts among PS breeder farms, hatcheries, broiler farms and slaughterhouses.

From literature review derived that there is a lack of information for the current structure of contracts in Dutch broiler chain. A questionnaire was developed to fill up this gap and interviews were taken from experts in different fields. Additionally, a Monte Carlo simulation model is developed to give an insight of effects of current and alternative contract structure on performance of broiler chain. The results that derived from the analysis of the questionnaires are used as a basis for the development of the model. The model is applied for contracts between PS breeder farms and hatcheries, as well as for hatcheries and broiler farms. The outputs of model are expressed in terms of gross margin (GM) per year. Data are retrieved from literature and interviews and referred to year 2007. Two default scenarios were tested. Their difference is based on the criterion that is used on payment. The criterion is determined on contracts between PS breeder farms and hatcheries.

From questionnaires is derived the following results for the current structure of contracts. Marketing contracts (94%) dominate in broiler chain. The duration of contracts is mainly one year. Chain members are free to change partners as they are stable to contracts with their already partners. Differences in prices and quality are the main reasons to change partners. Egg weight (>50gr), fertility, hatchability, first week mortality and weight of broilers are the main quality criteria that are determined on contracts. The payment methods are almost the same for all chain participants, but the parameters that affect the price are not identical for all of them. Either hatchability or fertility is the criterion that is used on payment system for contracts among PS breeder farms and hatcheries. In contracts among hatcheries and broiler farms, the criterion that is used on payment system is first week mortality. For the sharing of information, it is remarkable that chain participants share a variety of information with chain members. The existence of a contract is not the main factor for the sharing of information among chain members, as there is share of information among chain participants that they do not have direct link in production process.

The simulation model is based on results that derived from questionnaire, regarding to current structure of contracts. Additionally, two alternative contract structures were

tested. For the current structure of contracts, two default scenarios were used and their difference is the criterion that is used on payment system of contracts among PS breeder farms and hatcheries: fertility (D-F) or hatchability (D-H). The gross margin of the chain is the sum of gross margins of chain members. The gross margin per chain member is the average.

Current structure of contracts

The difference that exists on chain's GM of default scenarios is relatively small. The expected GM of the chain is higher by 0.7% for D-H and the expected GM of PS breeder farm is higher by 0.2% for D-F. For both scenarios, the expected GM of a broiler farm remains constant.

A sensitivity analysis was done for the values of bonus-penalty system for the contracts between PS breeder farm and hatchery, of the limit for fertility, hatchability and FWM in the contract, as well as for the price of first day old chicks that are sold in free market.

Chain's GM is not sensitive in changes on the values of the parameters that were mentioned above.

The GM of hatchery is more sensitive in comparison to broiler farms, for changes in the limit of FWM in contracts.

Alternative contract: Distribution of losses among chain members.

In this contract structure, the losses that occurred from infertile and not hatched eggs, as well as from first week mortality (FWM) are distributed between chain members. Two alternative contracts were tested, which differ on the criterion that is used on contract payment among PS breeder farms and hatcheries. The criteria are fertility (A-F) and hatchability (A-H).The proportions are determined on the contracts.

- The expected GM of the chain, for A-F and A-H remains constant in comparison to D-F and D-H, respectively. The expected GM of PS breeder farm increased. The increase on GM of broiler farm is very small. Contrarily, hatchery's GM is reduced for all the proportions that have tested.

Alternative scenario: Distribution of chain's GM .

In this alternative contract structure, the GM of the chain is distributed to chain members in percentages. The percentage that receives each chain member is determined on the contracts.

The expected GM of the chain is smaller than in default scenarios, but the difference is small. GM of hatchery is presented an increase for all the proportions that were tested. The gross margin of PS breeder farm is increased in two out of four proportions that were tested. On the other hand, GM of broiler farm is reduced.

Finally, a suggestion for further research is to investigate the incentives from the structure of contracts that could lead to an improvement of the technical performance. This improvement has as a result to add profit in the chain.

Results from stochastic simulation model for current and alternative contract structures

	Gross Margin											
	PS farm €(x1000)	95th -5th [a] €(x1000)	RC[b] %	Hatchery €(x1000)	95th -5th €(x1000)	RC %	Broiler Farm €(x1000)	95th -5th €(x1000)	RC %	Chain €(x1000)	95th -5th €(x1000)	RC %
Loss Distribution (%)												
Fertility[c]												
D-F [d]	**156**	**2**	**0.0**	**1,327**	**626**	**0.0**	**122**	**1**	**0.0**	**16,769**	**642**	**0.0**
40:60:60:40 [e]	211	8	35.0	117	631	-91.2	123	1	0.9	16,765	625	0.0
50:50:50:50	202	7	29.2	328	634	-75.3	123	1	0.7	16,768	640	0.0
60:40:40:60	192	5	23.3	534	621	-59.8	123	1	0.5	16,768	628	0.0
Hatchability[c]												
D-H [d]	**156**	**2**	**0.0**	**1,323**	**568**	**0.0**	**122**	**0.1**	**0.0**	**16,887**	**603**	**0.0**
40:60:60:40	230	7	47.2	-266	749	-120.1	123	0.11	0.9	16,885	616	0.0
50:50:50:50	218	5	39.4	5	718	-99.6	123	0.9	0.7	16,886	609	0.0
60:40:40:60	205	4	31.5	276	696	-79.2	123	0.7	0.5	16,886	608	0.0
Distribution of GM (%)												
Fertility[c]												
D-F [d]	**156**	**2**	**0.0**	**1,363**	**626**	**0.0**	**122**	**1**	**0.0**	**16,769**	**642**	**0.0**
10:20:70[f]	83	3	-46.7	3,337	101	114.8	115	3	-6.1	16,687	505	-0.5
17:11:72	142	4	-9.3	1,836	55	34.7	118	4	-3.4	16,691	503	-0.5
25:50:25	209	6	33.3	8,345	254	512.2	41	1	-66.4	16,691	508	-0.5
33:33:33	278	8	77.8	5,563	169	308	55	2	-55.2	16,691	508	-0.5
Hatchability[c]												
D-H [d]	**156**	**2**	**0.0**	**1,323**	**568**	**0.0**	**122**	**0.1**	**0.0**	**16,887**	**603**	**0.0**
10:20:70[e]	83	3	-46.6	3,337	101	152.2	115	3	-6.1	16,687	505	-1.2
17:11:72	142	4	-9.1	1,836	55	38.8	118	4	-3.4	16,691	503	-1.2
25:50:25	209	6	33.6	8,345	254	530.7	41	1	-66.5	16,691	508	-1.2
33:33:33	278	8	78.1	5,563	169	320.4	55	1	-55.3	16,691	508	-1.2

[a] The range of expected GM per year, between the 5th and 95th percentile.
[b] The relative change of GM in comparison to current structure of contract.
[c] The criterion that is used in payment system.
[d] The bonus-penalty per egg is 0.1 eurocent and the limit of FWM is 1.5% in default scenario.
[e] The proportion for the distribution of losses among chain members. 40:60 are the percentages of losses for PS breeder farm and hatchery, respectively. 60:40 are the percentages of losses for hatchery and broiler farm, respectively.
[f] The 10:20:70 is proportion of distribution of chain's GM, where 10% for PS breeder farms, 20% for hatchery and 70% for broiler farm.

1. Introduction

1.1. Background information

Poultry meat is consumed in every region and in countries with very different levels of development (Magdelaine et al., 2008). The poultry meat is the second highest consumed in the world and in the EU after pork (about 40% the pork and 30% the poultry meat). The European Union holds the third position in broiler consumption, whereas the leader in the ranking is the US, as well as in production (USDA, 2006). The 90% of the Dutch poultry production was for broiler meat in 2005 (PVE, 2006). In 2006, 590 million broilers were produced for slaughter and the 19.2% of them was exported with a value of approximately 84 million Euros (PVE 2007). Few hatcheries and slaughterhouses are responsible for almost 50% of production in their sectors. The broiler sector in Netherlands had an increase in number of broilers and in production, although the number of broiler farmers decreased almost 50% from 1990 to 2005 (PVE, 2007). In contrast, the average size of the broiler farmers increased significantly during the last decades, resulting to a higher amount of exports of broiler meat, as well as meat products.

Different types of companies are involved in the production of broiler meat. The broiler meat chain consists of feed companies, breeding companies, breeding flock farms, parent stock breeder farms, breeding flock farms, hatcheries, broiler farms and slaughterhouses. A characteristic of broiler chain is that all chain participants are dependent. This high grade of dependency among them exists because of the crucial role that plays the quality of delivered products. An example for this is that in case of a possible health problem in the breeders might affect the optimal levels of egg production, the maximum hatchability and good quality chicks. These aspects are essential and they could affect profitability (Butcher et al., 2002). A low production of eggs and hatchability means a loss in income for the breeders. For the hatcheries this occurs with low hatchability plus high first week mortality. In addition, a bad quality of chicks and high mortality reduces the income of broiler farmers. An approach for the coordination of the broiler chain is the use of contracts.

Contractual arrangements are a very common form of governance in agri-food chains. The contracts governed an increasing share of agricultural production as Cook and Chaddad, (2000) referred (cited by Hendrikse, 2007). Agricultural contracts are arrangements under which farmers agree to deliver products of a specified quality and quantity to a contractor for a specified price or fee, in a specified time and can be classified in production and marketing contracts. Moreover, they are used to coordinate production and distribution of agricultural products and inputs in many sectors, as in the broiler production (Vukina & Leegomonchai, 2006).

Except the U.S broiler chain, which is dominated by production contracts (MacDonald, 2008), also the French poultry production (over 80%) in 1994 operated under contracts (Menard and Klein, 2004). Usually, the Dutch broiler meat is produced on contract basis and the chain participants are independent companies. The chain performance in Dutch broiler chain is suboptimal and this has several effects in all chain participants, because of the high degree of dependency between them, regarding to raw materials that use as inputs. The chain members focus in

achievement of their individual targets as the profit margins distributed in a way that increases criticism for some of them. As mentioned before, contracts are common governance method and through them made the exchanges of commodities between the chain participants. There is a lack of information about the structure and type of Dutch broiler contracts and their impact on the performance of broiler chain in Netherlands.

1.2. Objectives and research questions

In the context of that mentioned before and regarding to fact that Dutch broiler chain, might has suboptimal performance, while contracts are parts of the coordination mechanism of the chain, the objectives of this study are:

i) To identify the current structure of Dutch broiler contracts.

ii) To study the impact of those contracts on chain performance.

iii) To study the impact of alternative contract structures on chain performance.

This study will focus on contracts between PS breeder farms-hatcheries, hatcheries-broiler farms and broiler farms-slaughterhouses. These are the down-stream chain participants of broiler chain. The chain performance will be measured from cost perspective.

To achieve the aim of this study there is a need to answer the following questions.

1. What is the current structure of the Dutch broiler chain and what is the role of contracts?

2. What is the dilemma that the current contract structure is bringing in the chain? What are the losses and gains for the chain members and for the whole chain?

3. Which alternative contracts might be possible to implement and solve the problem?

4. What are the parameters to implement the alternative contracts?

1.3. Outline of the research

The chapter 2 presents the broiler production chain in NL and makes a comparison with U.S broiler chain. Chapter 3 covers a literature review on contract theory. This chapter is divided in two parts: the first part presents the contract theory in general and the second part presents the types of contracts as well as their use in broiler chain. In chapter 4 is described materials and methods that are used for fulfill of this research. In chapter 5 the results from interviews are presented. Moreover, chapter 6 is presented the results from simulation model. Finally, in chapter 7 is presented the discussion and the conclusions of this study as well as the recommendations for further research.

2. Dutch broiler chain configuration

The broiler chain is characterized by high complexity, while all members are dependent. A huge number of farms and companies involved. All of them influence the end -product of the chain, the broiler meat (chicken meat), in different grade.

During the first stage, grand parent stock breeder farms are supplied with grand parent animals by breeding farms. Grand parent animals are the stocks, which are selected and improved in breeding companies. From cross combinations of grand-parent animals, hens and cocks that have different genetic composition are bred, resulting to the parent animals. Several types of strain exist with different attributes.

Figure 1 shows the direct link of feed companies with the chain participants. The role of feed companies is important for the end-product, from the perspective of growth rate, quality and cost. Animal feed contributes in high percentage in total broiler cost (van Horne and Bondt, 2006). Animal feed companies have a direct influence on quality and safety of the end-product (van Asseldonk et al., 2006). The eggs that produced in grand parent stock farms are transported to hatcheries. From hatcheries, first day old chicks are transported to rearing farms and at the age of 18 weeks are transported to parent stock farms. The hens lay eggs until the age of 65 weeks.

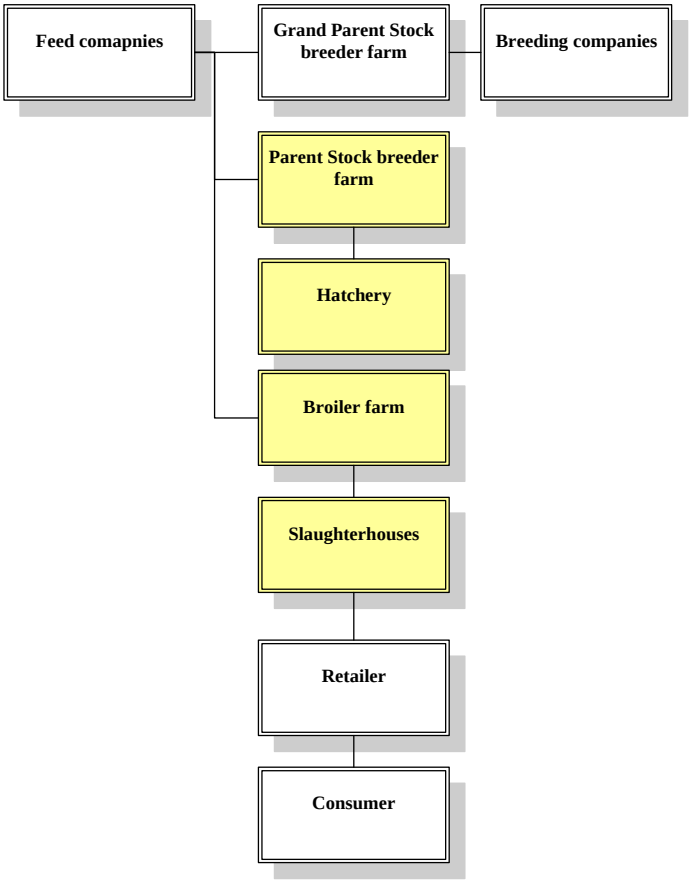


Figure 1. Broiler production chain

The eggs from parent stock farm are transported then to hatcheries, where the broiler farms get first day old chicks supplied. Broilers grow on average 50gr, per day. The production cycle until the full-growth is 6 weeks in broiler farms. The average weight of broilers was around 2.2 kg, live weight (KWIN, 2008). Broilers below this weight are sold as entire animal, whereas more weighty broilers are slaughtered in parts (Verreth, 2008). The broilers are transported to slaughterhouses and the meat is transported to downstream chain participants (retailers and consumers).

A characteristic of broiler chain is the 'all-in all-out' system. For instance, broilers are transported to slaughterhouses when they are achieved the desirable weight. After the transportation of all broilers, broiler farm is supplied with new first day old chicks, only when the farm is empty and clean.

Table 2.1. Data of broiler production in Dutch broiler chain

Chain stage	# Farms/ Companies/	Production end material (year basis)	Import (year)	Export (year)
Feed	170[a]	1,483 ton [a]		
Breeding[a]	5			
Parent animals	272[b]	863 mln eggs[b]	469 mln f.d ch.[b]	394 mln f.d ch.[b]
Hatcheries[b]	19	607 mln 1-day old chicks	415 mln f.d ch. [b]	130 mln f.d ch.[b]
Broilers	701[b]	912,000 ton[b]	108,000 ton[a]	103,000 ton[a]
Slaughterhouses	20[b]	674,900 ton[b]	79,900 ton[a]	7,600 ton[a]

[a] Statistic annual report PVE 2007 (2008)
[b] Statistic annual report PVE 2007 (2008): number includes hatched chicken and breed eggs

In the different stages of broiler chain, there is an import and export possibility. Table 2.1 gives an overview of characteristics of chain participants in the Netherlands. Many parent stock and broiler farms are involved in the chain and few hatcheries and slaughterhouses exist. Four out of thirteen hatcheries are covered 49% of demand for first day old chicks and five of twenty slaughterhouses are covered 52% of broiler production. Contracts are used as a tool of coordination mechanism in Dutch broiler chain. As it is presented in table 2.2, the gross margin per broiler varies from year to year and the difference from years 2006-2007 is almost 30%.

Table 2.2. Data regarding broilers revenues and costs[a]

Description	Value (2004)	Value (2005)	Value (2006)	Value (2007)
Revenue (€/broiler)	1.51	1.56	1.42	1.76
Costs (€/broiler)	1.34	1.20	1.22	1.45
Gross margin (€/broiler)	0.17	0.36	0.20	0.31
Cost of feed (€/100 kg)	25.2	21.2	22	27.7

[a]Data retrieved from: PVE(2007)

Wholesalers are supplied broiler meat in 60% as fresh product and in 40% as frozen (Verreth, 2008). Fresh broiler meat goes to supermarkets. The frozen meat is mostly used in further processing and in food service. Chicken meat can be sold packed (85%) or unpacked (15%), (Verreth, 2008). From the total sold chicken meat 5.62% is sold as whole chicken, 47.9% as breast meat, 20.5% as leg meat, and 26% as other parts of the chicken (PVE, 2006).

In the broiler meat sector several quality systems are applied; IKB Chicken, Actionplan 2000+, ISO 9002 (now named ISO 9001:2000), HACCP, GMP+, and

EurepGAP (now named GlobalGap) (Vaerreth, 2008). Moreover, industry initiatives for the animal feed industry exist; TrusQ and Safe Feed.

3. Contracts in agricultural production

3.1. Contracts overview

A fundamental observation about the economic world is that people can produce more if they cooperate, specializing in their productive activities and then transacting with one another to acquire the actual goods and services their desire (Milgrom and Roberts, 1992). The crucial point is that specialization requires coordination, which could be found in different forms. Methods of coordination can be classified according to the degree of control over other vertical stages. At one end of the spectrum is open market coordination, representing the least control and on the other end is the vertical integration (figure 2). Open market coordination refers to sales that are made after production has been completed. In contrast, vertical integration, representing the most control and refers to ownership and management of two or more successive stages of the marketing system by a single firm. Among the ends of spectrum, there are two intermediate forms of coordination. The contracting, that includes market-specification contracts and resource-providing contracts (Martinez, 1999).

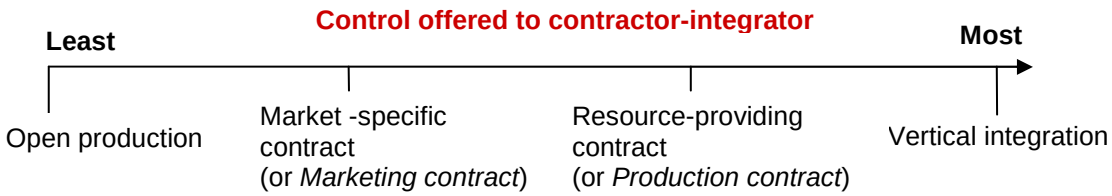


Figure 2: Methods of vertical coordination along the spectrum of control
Source: Adopted from Martinez, 2002

3.1.1. What are contracts?

A contract is a written or oral agreement that defines the terms, conditions of exchange, and reduces the information and asset asymmetries (Church and Ware, 2000; Hall and Langemeier, 1994). In addition, a contract is a governance structure and therefore also a transaction mechanism for conducting an exchange (Slangen and Loucks, 2008). Contracts can be distinguished into complete and incomplete.

3.1.2. Complete contracts

A complete contract could solve the coordination and motivation problems and it will never need to be revised or changed plus the fact that it is enforceable (Milgrom and Roberts, 199; Church and Ware, 2000). Moreover, it specifies exactly what each party has to do in every possible circumstance and as well as how the allocation of the gains of the trade has to be done (Milgrom and Roberts, 1992). This type of contract would provide no opportunities for renegotiation or hold-up, since it would not contain any

gaps or missing provisions. A contract would be complete if the transaction costs are zero.

3.1.3. Incomplete contracts

In reality, most contracts are incomplete and are revised and renegotiated all the time (Hart, 1995). There are the three factors that lead to incomplete contracts:

i) complexity and unpredictability of the world
ii) the difficulty of the parties to negotiate all the possibilities
iii) difficulties in writing plans down is such way that in the event of a dispute, an outside authority can figure out and decide what these plans mean and enforce them (Hart, 1995).

In case of incomplete contracts, incentives are aligned imperfectly and there is the possibility of being disadvantaged by self-interested and opportunistic behaviour (held up). Contracts are often incomplete, since the individuals are subject to unobservable outcomes or bounded rationality. Bounded rationality refers to the restricted ability that has an individual, to foresee all future possibilities and to formulate and solve complex problems (Milgrom and Roberts, 1992; Douma and Schreuder, 2002). According to Church and Ware (2000:74), the opportunistic behaviour, which appears in an incomplete contract, increases the following inefficiencies:

i. *Complex contracts*: The expectations of potential holdups will guide the firms to write more complex contracts.
ii. *Costs of renegotiation*: Incentives for holdup mean that a firm may has to renegotiate the terms of exchange.
iii. *Resource costs to effect and prevent Holdup*: A firm possibly will expend resources to obtain concessions and its trading partner possibly will expend resources to prevent being held up.
iv. *Unrealized surplus*: The failure to renegotiate and realize efficient adaptation will result in unrealized gains from trade.
v. *Ex ante investments*: Firms may incur extra investments and expenditures with purpose to avoid to being locked in a single supplier. In this way the firms tried to be more impendent from their single supplier and to increase their bargain power.
vi. *Underinvestment in specific assets*: A firm may reduces its investments in specific assets in order to alleviate, through this way the exposure to opportunistic behavior.

Under some conditions the problem of moral hazard occurs. Moral hazard refers to opportunistic behavior that someone has after entered in a contract, which can reduce his exposure to risk. This happens because actions that required from the contract terms are not observable.

3.1.4. Types of contracts

According to Slangen et al., (2008) the contracts can be distinguished in three types: classical, neoclassical and relational. These types can be characterized by five key elements, which in general are the following:

i. **Identity**: It is connected with identity and personal characteristics of the contracting parties.
ii. **Duration**: The duration of the relationship among the contracting parties.
iii. **How to deal with unexpected events**: It is focuses on how people are expected to deal with unexpected events and contingencies. It is crucial in cases of relation-specific investments.
iv. **The role of written information**: The role of the written documentation. There exist differences between the three types of contracts.
v. **Differences in opinions**: In case of conflict opinion, there are procedures that have to be followed.

Classical contract

i. Irrelevant are the identities and personal characteristics. Frequently, this type of contract involves discrete or one term transactions that characterized by a low degree of asset specificity, uncertainty, frequency and connectedness. Furthermore, the performances can be measured without difficulty and the goods or services that involved are rival and excludable.
ii. Additionally, the classical contract are suitable in relations such as 'market – relation' according to Ménard, 1996 (cited by Slangen et al, 2008:245). The determinant factor is the price, both contracting parties are not going through in specific investments and there is a very small need for contractual certainty, due to the nature of the good.
iii. The duration of the contract is specified and can be extremely short.
iv. *Contingencies and /or unexpected events and penalties for non-performance are specified*. Moreover, the classical contract has low degree of usefulness for relation –specific investments or in some case is ineffective and inefficient, because it can not be able to indicate all the probable future events.
v. In this type of contract, a verbal agreement can be overruled by the written documents. In case of a different opinion or of a disagreement between the contracting parties a court of law arbitrates.

Neoclassical contract

i. The identities of the contracting parties play an important role.
ii. Generally, the duration is fixed. Besides, it haves a longer duration than classical contract, with purpose to pursue a continuous relationship.
iii. It is accepted that not all contingencies can be specified in the contract as well as the unexpected events. The parties from the beginning are familiar with the fact that the agreement is incomplete, because are not capable to specify all rights and obligations in all future circumstances.
iv. For further negotiations, can be used as basis the written documentation.
v. In case differences in opinions or dispute exist, the arbitration procedure can be used.

Relational contract

i. The identities and personal characteristics of contracting parties are vital.
ii. The duration of this contract is very long or in some cases can be even unspecified.

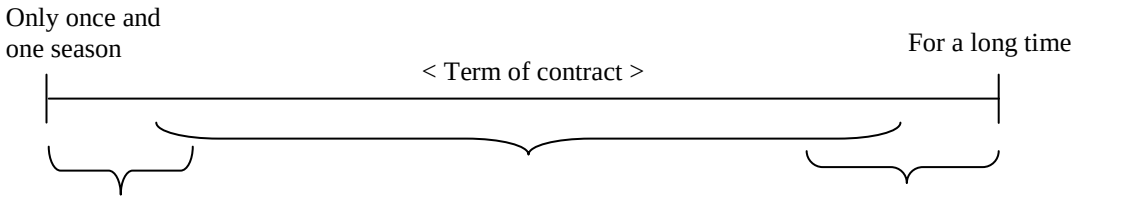
iii. Norms of behavior or shared codes of conduct specify the reaction to new developments, or inform responses to new developments as they spread out

iv. The official document of agreement is the written documentation or it can be used as a proof of what has been agreed. The relationship is often more important than the content of the contract.

v. When differences in opinions exists the values and norms of behavior or shared codes of conduct appear to be more important than written documentation. They overrule written documents in settling disputes. A characteristic of this contract type is the substitution of the legal system. The informal agreements such as verbal promises, letters of intent or gentleman's agreement are more used in comparison to formal documents.

3.1.5. Spectrum of contracts

There is a broad spectrum of different types of contracts. At the one end of the spectrum are the classical contracts, with the price being the most important coordination mechanism, while the identity of a partner is not relevant. The duration is short as well as asset specificity is small. Among the spectrum are the Neo-classical contracts. They can be characterized by longer duration and the identity of partner is important. The asset specificity is the cause for the limited role of prices as co-ordination mechanism. Moreover, complete self-enforcing safeguards are difficult to implement. On the other end are the relational contracts. In this type of contract, the relationship between the partners can be even more important than the content of the contract as also the identity and personal involvement. The duration is much longer in comparison to classical and a neo-classical contract, as well as the asset specificity is larger. For the relational contract, it is recognized that are gaps in the agreement, but reputation, commitment and trustworthiness can overcome these problems.



Classical contracts	Neo –classical contract	Relational contracts
-Term of contract is short	-Term of contract is longer	-Term of contract is very long or duration is even indeterminate
-The identity of parties does not matter	-The identity of parties matters	-The identity and personal characteristics of parties are crucial
-Price is most important co-ordination mechanism	-Price is less important as co-ordination mechanism	-Price is of minor importance or subordinated as co-ordination mechanism
-Asset specificity is small or relative small	-Asset specificity is larger	-Asset specificity is large
-Safeguards are of little importance	-Safeguards are important	-Safeguards are very important

Figure 3: The spectrum of contracts
Source: Slangen et al. (2008)

3.2. Agricultural contracts

The contracts consists an integral part of the production and marketing of livestock commodities such as broilers, eggs and milk. For the production or marketing of

agricultural products, contracts are the vehicle through food processors and marketers can respond to changes in consumer preferences. The growing of markets requires a uniform product supply and standardization in quality (Johnson et al., 1996).
The agricultural contracts can be classified in the production and marketing contacts (table 1).

3.2.1. Marketing contracts

A marketing contact is a verbal or written agreement between a farmer and a buyer that specifies quantity, quality, price and timing of the product to be delivered by the farmer. Most management decisions remains to the grower, who retains product ownership during the production process. The farmer assumes all the risks of production, but shares price risk with the contractor (Perry et al., 1997).

According to Johnson et al. (1996), the forms that a marketing contract can take, are:

i. Forward sales of an agricultural product, where the contract provides for later delivery and establishes a price before delivery
ii. A formula that considers grade and yield of product, used and determine the price after delivery
iii. Pre-harvest pooling arrangements, in which the amount of payment received is determined by the net pool receipts for the quantity sold

3.2.2. Production contracts

Production contracts involve a payment of fee to the farmer, for the management actions and other assets (labour, facilities and equipment) that provides. During the process, the contractor has the ownership of the product. The contract specifies in detail the production inputs supplied by the contractor, which could be a processor, a feed mill or another operation. As far as concerning the contractors' trend to have more influence on contract terms. Additional, contract determines the quality and quantity of each commodity. An advantage of production contracts is the sharing on production and marketing risks while financing is more readily available, because funds can be obtained directly from the contractor or indirectly from other lenders can guaranteed the repayment of a loan. In contrast, the choice of an inefficient producer includes high risk (Hall and Langemeier, 1994; Perry et al., 1997). Furthermore, production contracting are the most commonly found in broiler chain in US (Harwood et al., 1999) and a characteristic is that all agents contracting under formally identical contract provisions, covering only one flock or one batch of animals at time (Levy and Vukina, 2002).

As Hall and Langemeier (1994) refer, the production contracts can be distinguished in the three following types:

i. Market-specific production contract is a negotiation among a buyer and a seller and both of them operate in a different stage of the value chain.
ii. Production-management contract, usually transfers more risk and control crosswise of stages of the value chain in comparison to market- specific contract. They typically appear when decisions at the upstream directly affect a feature considered valuable to the downstream or vice versa.

iii. Resource-providing contract can be considered as production-management contract, in which the contractor retains the ownership of a key input, through the pass of one stage to another.

3.2.3. Compensation of contracts

The contract terms vary across contracts, which one of them is the type of compensation. There are different types of compensation for the farmers: the base payment, the incentive or performance payment and the disaster payment. The base payment is a fixed fee per unit. The modern broiler contracts have a similar payment structure based on "two-part piece rate tournaments" consisting of a fixed base payment per unit of output and a variable bonus/penalty payment based on the grower's relative performance (Tsoulouhas and Vukina, 2001). The incentive payment is a percentage of the difference between average settlement costs of all contractor flocks during a specific period and costs associated with the individual grower[1]. There are incentives and penalties according to the management of the flock, which provided by the contracts. The penalization for U.S growers occurs when the cost per unit is higher than average cost per unit for the pool of growers (Vukina and Foster, 1996). The methods that the contractors use to calculate the incentive payments differ. Moreover, explicitly uniform contracts (US broiler chain) do not necessarily guarantee that all agents are treated equally (Leegomonchai and Vukina, 2005).

Table 3.1. Comparison of Production and Marketing contract characteristics

	Types of agricultural contracts	
Contract members	*Production Contracts*	Marketing contracts
Contractor	• Arranges to have a specific quality and quantity of commodity produced	• Buys a known quantity and quality of the commodity for a negotiated price (or pricing arrangement)
	• Usually owns the commodity being produced	• Doesn't own the commodity until it's delivered
	• Makes most of the production decisions	• Has little influence over production decisions
Contractee[a]	• Provides a service and other fixed inputs (land, buildings, etc.) for a fee	• Has a buyer and a price (or pricing arrangement for commodities before they are harvested)
	• Supplies a small part of the total production inputs needed	• Supplies and finances all or most of the inputs needed to produce the commodity
	• Usually does not own the commodity	• Owns the commodity while it's being produced
	• Makes few, if any, of the production decisions	• Makes all or most production decisions
	• Bears few price or market uncertainties and limited production risks	• Assumes all risks of production but reduced price risk
	• Receives a fee for production that does not reflect the full market value of the commodity	• Receives largest share of total value of production

[a] The operator
Source: Johnson et al. (1996)

[1] The US broiler contracts are characterized by this type of incentive payment.

3.3. Reasons to enter into a contract

After a literature review of Johnson et al. (1996), it is supported that there are different reasons for the farmers and processors to enter into a contract. The farmers through the contracts expect to achieve *income stability*, because of the reduction of risks in comparison to traditional production and marketing channels. In addition, they improve their efficiency, through the fact that management decisions are transferred to contractors and then the farmers can benefit from managerial advices, technical support, technological advances and market knowledge. Additional, the farmers have *access to capital* through the production contracts that reduces in a high degree the need of farmers for production credit, since the contractors' supplies them with inputs.

The processors and others entities enter into a contract, for *controlling input supply*, because of the need to control the large flow of uniform products to different customers, with dissimilar processing facilities and equipment. The increasing control over the production process, gives to contractors the ability for better *response to consumer demands*, as well as flexibility to change the standards of product form to satisfy consumers preferences. Moreover, the processors and the businesses can *expand and diversify their operations* through contractual arrangements. All these reasons reflect efforts to bring a more uniform product to market (Hall and Langemeier, 1994).

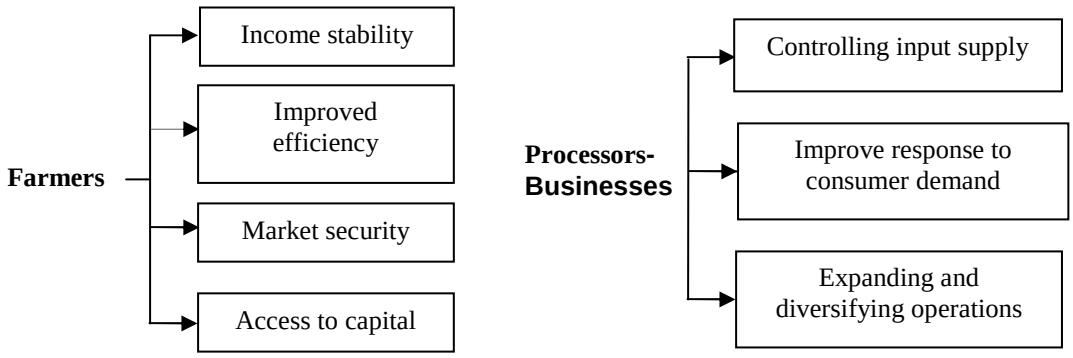


Figure 4: Reasons farmers and processing-businesses enter into a contract

3.3.1. Spot markets - contracts

The agricultural contracts are agreements that include transactions of agricultural products, between parties (producer, consumer, trader, retailer and all possible combinations). Many agricultural commodities, such as cattle, hogs, wine, grapes, corn and more, represent several industries, in which both contract and spot markets co-exist. This happens, in the sense that a quantity of the market output is procured through contracts, as some is procured through conventional spot exchange (Xia and Sexton, 2004).

The supply chains that based on spot markets are coordinated by accurate widely available market information. In addition, spot markets are governance structures that mainly use the price as coordination mechanism (Slangen, Loucks and Slangen, 2008:279). The pricing systems of spot markets can become ineffective to warn with

suitable signals, producers and customers. According to MacDonald et al.2004, the spot markets will be unsuccessful to respond in changes in consumer demand if price don't reflect the attributes of products that consumers prefer. The competition is a crucial element for the operation of the spot markets, but the greater than before number of agricultural markets are marked by limited completion.

3.3.2. Transaction costs and contracts

Transactions incur costs. Churh and Ware (1999), define Transaction Costs (TC) as the costs associated with negotiating, reaching, and enforcing agreements. The Transaction Cost Economics (TCE) makes an effort to clarify which governance structure has a comparative advantage in carrying out transactions. The element of analysis is transaction. For a specific transaction, the transaction costs can be low or high and this depends on (Slangen, Loucks and Slangen, 2008: Douma and Schreuder, 2002),

- The environment characteristics:
  i) Asset specificity ii) Uncertainty iii) Frequency of transaction
- The Human characteristics:
  i) Bounded rationality ii) Opportunistic behaviour

Asset specificity is the most essential characteristic of the environment according to Williamson (1987), (cited by Slangen et al, 2008) and it is important because of the situation "hold-up problem". There are five different types of asset specificity as Slangen et al. 2008, described:

- **Site specificity** refers to assets that have place-restrictions, and it reflects the distance and accessibility in terms of money
- **Dedicated Assets specificity** are those assets, invested after the request of a particular partner
- **Physical Asset** specificity involves assets which cannot change after they have been made
- **Human Asset specificity** are the assets invested on personnel and specific knowledge on specific areas and finally
- **Brand name capital specificity** which refers on the commitment of assets on a well-known brand name and the decrease of freedom on pursuing other opportunities

Uncertainty refers to events that are judged at high costs or that they cannot judge or it is too difficult to judge them (Slangen, Loucks and Slangen, 2008). Finally, the aspect of **frequency** is about how often the transactions take place. If frequency is low, the TC will be extremely high whereas if the frequency is high, the TC will be low.

According to MacDonald et al. (2004), in some spot markets the contracts can reduce transaction costs. Additionally, Frank and Henderson, 1992 support that vertical integration and contracts, may also generate efficiency gains, by reducing transaction costs (cited by Ménard and Klein, 2004). A factor that affects TC and can take several forms in agricultural contract is the asset specificity, which comes up when the asset is useful in low degree as well as less valuable for another use; different from this that it is designed, as also the reorganization is very expensive. For instance, a broiler

house has designed for growing broilers and this mean that has physical asset specificity as well as site specificity if it located in small distance from a slaughterhouse. This happens also for other livestock products, because the animals when they must be transported for a big distance create extra costs, which could be extra feed, Dead on Arrival animals and loss weight.

In spot markets, asset specificity has lower degree. The specific investments (asset specificity) that could reduce production costs and increase quality, in spot markets could leave farmers dependent on one or few buyers. Moreover, high investments from farmer's part and the existence of few buyers for his product, is possible to lead to hold-up problem from the part of buyers. On the other hand, a contract that has specific compensation scheme, which determinate many parameters for both parties can reduce, the probability for a hold-up problem.

3.4. Contracts in relation to broiler chains

The contracts governed an increasing share of agricultural production as Cook and Chaddad, 2000 referred (cited by Hendrikse, 2007). In many countries, the agricultural commodities are traded with contracts. Regarding to livestock sector, in US, broiler production is dominated by production contracts (MacDonald, 2008). In addition, the French poultry production (over 80%) in 1994 operated under contracts (Menard and Klein, 2004). In US pork industry, in 2001 the 72% of hogs were sold under marketing contracts (Menard and Klein, 2004). The Danish broiler production, until one point is coordinated through contracts (Bogetoft and Olesen, 2002). A conclusion is that different types of contracts (production or marketing) are used in different livestock chains and in different degree. In Table 2 it presents the existing literature according to use and role of contracts in broiler chains in several markets (especially for US broiler market). There is a lack of information regarding to type and characteristics of contracts in Dutch broiler chain.

Table 3.2. Literature review for contracts on broiler chains

Authors	Short description of research that refers in broiler contracts
Bogetoft, 2002	Ten rules of thumb in contract design: lessons from Danish agriculture. A small part of this research refers to contract broiler production
Goodhue, 2000	Broiler production contracts in US and the role of incentives, heterogeneity and common risk
Harwood et al,1999	Managing risk in farming. The role of production and marketing contracts in US broiler chain
Leegomonchai and Vukina, 2005	The broiler production in US and the discrimination on agent (growers) for the supply of variable quality inputs from processors
Johnson et al,1996	Farmer's use of production and marketing contracts. The production contracts in US broiler chain.
MacDonald et al,2004	The role of contracts in agricultural commodities and also in US broiler production
MacDonald, 2008	The economic organization of US broiler production
Perry et al, 1997	Contracting a business option also for broiler production
Tsoulouhas and Vukina, 2001	The welfare effects for broiler farmers are higher with the replacing of tournaments with schemes that compare performance with fixed standard
Vukina and Leegomonchai, 2006	The broiler contracts and the political economy of regulation on them.

4. Materials and methods

4.1. Introduction

This chapter describes the materials and methods were used to identify the current contract structure of Dutch broiler chain and assess the economic impact of current and alternative contracts in chain performance. The performance of each chain participants it is affected by many parameters and has effect on the performance of downstream members of broiler chain, as it is presented in section 1.1.

4.2. Interviews

From chapter 3 derives that there is a lack of information for the structure of contracts in Dutch broiler chain. A method to collect information is the interview. There are two options to apply this method. One option is to define a representative sample of chain members and interviewing them and the other is to interviewing experts in the field. Since the time is was restricted, the method of interviewing experts was chosen. Experts are considered as a panel of knowledgeable informants. Each respondent was expected to provide a great deal of information for his area. Five experts were interviewed. Each of them was covering a different part of the chain (breeding companies, rearing organizations, PS breeder farms, hatcheries, broiler farms)

For these interviews, a questionnaire was designed in order to extract valuable information from experts. The questionnaire was divided in six parts, where two of them were focused on general characteristics of contracts in the chain (Appendix I). The other four parts were focused on different stages of the broiler chain. In the questionnaire were used a combination of free-response questions, multiple-choice questions and ranking question according to their benefits (Cooper and Schindler, 2006). The information that derived from the interviews was analyzed.

4.3. Monte Carlo simulation

A Monte Carlo simulation model was developed to illustrate the economic impact of current and alternative contract structure on broiler chain. The results that derived from the analysis of the questionnaire were used as basis for the development of the model. For this study, the effects of uncertainty for several significant parameters of contracts (as derives from chapter 5) were important to take into account. The software for a Monte Carlo simulation is @Risk, an add-in via Excel.

For the model deterministic and stochastic variables were used. Stochastic variable is a variable that is defined in a collection with a chance definition, an uncertainty effect (Garlick, 2007) and is an important part of Monte Carlo simulation. The variable must be measurable and take into account the probability of certain values (distribution probability) and the relations among variables (correlation).The Monte Carlo simulation distinguishes the stochastic variables in different functional probability distributions. In this study was used the Pert distribution for the variables, fertility, hatchability and first week mortality. Pert distribution was used for the minimum, most likely and maximum values that derive from experts. For the values of stochastic

variables (fertility, hatchability and first week mortality), was used data that derived from interviews and literature.

In this study, there are two defaults scenarios. The criterion that was used on payment system, which was determined on contracts among PS breeder farms and hatcheries, differs. From table 5.8, derives that hatchability was most used as criterion for the payment. However, from a contact with three hatcheries is derived that two out of three are used fertility as criterion.

A sensitivity analysis was done for the following parameters and for both default scenarios:

- Value of bonus-penalty system for the contracts among PS breeder farm and hatchery
- Value of the limit for fertility and hatchability that is determined in the contract
- Value for the price of first day old chicks that are sold in free market
- Value for the limit for FWM that is determined in the contract among hatchery and broiler farm

4.4. Model description

4.4.1. Default scenario

The current structure of contracts is described in the default scenario and it is based on results that derived from interviews (chapter 5). The model focuses on PS breeder farms, hatcheries and broiler farms and it is consisted by 20, 1 and 102, respectively. The number of PS breeder farms and broiler farms is determined according to capacity of hatchery. Capacity of hatchery is estimated to 60 million eggs per year and is representative for the Dutch broiler chain (PVE, 2007). The outputs of model are expressed in terms of gross margin (GM) per year.

A) Default scenario for **fertility (C-F).**

The output variable of the stochastic model is the sum of Gross Margins in chain (GM_c).

$$GM_c = GM_{PS} + GM_H + GM_B \quad (1)$$

The Gross Margin for each chain member is derived from the following equations.

PS breeder farms

The output variable of stochastic model for PS breeder farm is Gross Margin (GM_{PS}):

$$GM_{PS} = R_{ps} - C_{ps} \quad (2)$$

where, R_{ps} are the total revenues of the parent stock farm and C_{ps} are the costs of goods sold. The gross margin per PS breeder farm is the average value that derives from 20 PS breeder farms of the model.

Revenues

The revenues of PS farms (R_{ps}) are:

$$R_{ps} = R_{be} \quad (3)$$

where, $R_{b.e}$ are the revenues from broilers.

$$R_{b.e} = N_{f.e} \cdot SP_{f.e} \quad (4a)$$

where, $N_{f.e}$ is the number of fertile eggs at 18th day and $SP_{f.e}$ is the selling price for the fertile broiler eggs .The $SP_{f.e}$ is connected with a bonus/penalty system. A correction exists for the egg price, according to fertility level that achieved F_a and to level of fertility that is determined in the contract.

$$SP_{f.e} = SP_{h.e} / F_a \quad (5)$$

where, $SP_{h.e}$ is the selling price for hatched eggs and F_a is the percentage of actual fertility.

$$\begin{aligned} R_{b.e} &= (SP_e - PP) \cdot N_{f.e}, \text{ if } F_a < F_{c.} \\ R_{b,e} &= (SP_e + BP) \cdot N_{f.e}, \text{ if } F_a > F_{c.} \\ R_{b,e} &= SP_e \cdot N_{f.e}, \text{ if } F_a = F_{c.} \end{aligned} \quad (6a)$$

Additionally, PP is the penalty and BP is the bonus price per egg as well as F_c is the percentage of fertility that is determined as the limit in the contract. It is assumed that PS breeder farm receives a bonus or penalty for all the amount of eggs that sells to hatchery.

$$N_{f.e} = N_{e.d} \cdot F_a \quad (7)$$

with, $N_{e.d}$, the number of eggs (hatched eggs) that is delivered to hatchery.

$$N_{e,d} = \{N_{h.e/hen} \cdot [N_{hens} \cdot (100\% - M_{hens})]\} \cdot N_{f.year} \quad (8)$$

where, $N_{h.e/hen}$ is the number of hatched eggs per hen, N_{hens} the number of hens per flock, M_{hens} the percentage of hen mortality for the period of 18-22 week and 22-60 week and $N_{f.year}$ is the number of flocks in a PS breeder farm per year. An assumption has been done that M_{hens} is the half of the actual in order to not overestimate or underestimate the number of live hens during the life cycle.

Cost of goods sold

The cost of goods sold (C_{PS}) for parent stock farm derives from the following equation:

$$C_{b.e} = N_{e.d} \cdot CP_e \quad (9)$$

where, CP_e is the cost price of broiler eggs and is excluded the fixed costs, such as labor, housing and other fixed costs. Moreover, CP_e includes the revenues from consumption eggs and hens that slaughtered at the end of round.

Hatchery

The output variable of the model for hatcheries is gross margin GM_H:

$$GM_H = R_H - C_H \quad (10)$$

where, R_H are the revenues and C_H the cost of goods sold for a hatchery.

Revenues

$R_H = \sum_{j=1}^{4} R_j$, where j are the different products sold, such as: (11)

j=1 is c.c= The first day old chicks that are sold via contracts
j=2 is f.c= The first day old chicks that are sold in free market
j=3 is i.e= The eggs that are sold to industry

The revenues for first day old chicks $R_{c.c}$, derive from equation 14:

$$R_{c.c} = TN_c \cdot SP_c \quad \text{, if } FWM \leq contract \quad (12)$$
$$R_{c.c} = (TN_c \cdot SP_c) - (N_{fwm,c} \cdot SP_c) \text{, if } FWM > contract$$

where, TN_c is the total number of first day old chicks and SP_c the selling price of first day old chicks. *FMW* is first week mortality; *contract* is the percentage of first week mortality that is determined in the contract per round. $N_{fwm,c}$ is the number of first day old chicks that is above the *contract* percentage and are paid by the hatchery.

$$TN_c = N_{b.e} \cdot H_a \quad (13a)$$

where, H_a is hatchability percentage. Hatchability percentage derives from the following equation:

$H_{a=}$ *# of saleable chicks / # eggs set up in incubator.* (14)
(For the default model is the average hatchability in NL and is constant)

$$N_{fwm.c} = (TN_c \cdot FWM) - (TN_c \cdot contract) \quad (15)$$

The revenues of eggs $R_{i.e}$ that are sold to industry are:

$$R_{i.e} = (N_{f.e} - TN_c) \cdot SP_{i.e} \quad (16a)$$

where, $SP_{i.e}$ is the selling price of industry eggs. As industry eggs, we refer to the amount of eggs that are infertile and not hatched after the set up in incubator. It is assumed that hatchery sell these eggs to industry and not pay a company to disposal these eggs.

The revenues of first day old chicks that are sold to broiler farms without contracts $R_{f.c}$ are:

$$R_{f.c} = (TN_c - MC) \cdot SP_{f.c} \text{ , if } TN_c > MC \quad (17)$$
$$R_{f.c} = 0 \text{ , otherwise}$$

where, *MC* is the maximum capacity of broiler farms and $SP_{f.c}$ is the selling price of chicks to free market.

$$MC = N_{rounds} \cdot N_{b.round} \quad (18)$$

where, N_{rounds} is the number of rounds per year for a broiler farm and $N_{b.round}$ the number of broilers per round.

Cost of goods sold

The cost of goods sold C_H, for hatchery is:

$$C_H = TN_c \cdot CP_c \quad (19)$$

where, CP_c is the cost price per first day old chick.

$$CP_c = C_{h.e} + OC \quad (20a)$$

where, $C_{h.e}$ are the costs for a hatched egg and *OC* are variable costs per first day old chick.

$$C_{h.e} = SP_{h.e} / H_a \quad (21)$$

where, $C_{h.e}$ are is the average cost price that is derived from the 20 PS breeder farms.

Broiler farms

The output variable for the model, for broiler farm is Gross Margin (GM_B):

$$GM_B = R_B - C_B \quad (22)$$

where, R_B are the revenues for broilers and C_B are the cost of goods sold for broilers. The GM_B is the average value of gross margin for the 102 broiler farms of the simulation model.

Revenues

$$R_B = \left[(N_{b.b} - N_{b.DOA}) \cdot SP_b\right] - (N_{b.r} \cdot SP_b) \quad (23)$$

where, $N_{b.b}$ is the total number of live broilers at broiler farm and $N_{b.DOA}$ is the number of broilers that are dead on arrival (DOA). SP_b is the selling price of broilers and $N_{b.r}$ is the number of broilers that are rejected by slaughterhouse.

$$N_{b.b} = (TN_c \cdot FWM) + (TN_c \cdot M_r), \text{ with constraint: } TN_c \leq MC \quad (24)$$

with, M_r is the percentage of mortality for broilers for the 5 or 6 rounds out of 6 or 7.

$$M_r = M - FWM \quad (25)$$

where, M is the total mortality of broilers at broiler farms.
The $N_{b.DOA}$ is the number of broilers DOA (Dead On Arrival) chicks:

$$N_{b.DOA} = N_{b.b} \cdot (K_{DOA} - K_{C.DOA}), \text{ if } K_{DOA} > K_{C.DOA} \quad (26)$$
$$N_{b.DOA} = 0 \quad \text{, otherwise}$$

where, K_{DOA} is the percentage of DOA that occurs during the transportation of broilers and $K_{C.DOA}$ is the percentage of DOA that id determined in contract.

$$N_{b.r} = N_{b.d} - (N_{b.d} \cdot K_{b.r}), \text{ if } K_{b.r} > 0.5\% \quad (27)$$
$$N_{b.r} = 0 \quad \text{, otherwise}$$

where, $N_{b.d}$ is the total number of live broilers that are delivered to slaughterhouse and $K_{b.r}$ is the percentage of rejected broilers.

$$N_{b.d} = N_{b.b} - N_{b.DOA} \quad (28)$$

The selling price of broilers SP_b derives from the following equation:

$$SP_b = SP_{b/kg} \cdot W_b \quad (29)$$

where, $SP_{b/kg}$ is the selling price of broiler per kg and derives from the value of one broiler divided to live weight of broiler (table with inputs). W_b is the average live weight per broiler.

The $SP_{b/kg}$ derives from the following equation:

$$SP_{b/g} = R_{b/kg} + BP_b, \text{ if } W_b > W_{h.c}$$
$$SP_{b/g} = R_{b/kg} - PP_b, \text{ if } W_b < W_{l.c} \quad (30)$$
$$SP_{b/g} = R_{b/kg} \quad \text{, if } W_{l.c} < W_b < W_{h.c}$$

where, $R_{b/kg}$ are the revenues of broiler per kg, BP_b is the bonus value, PP_b is the penalty value, $W_{h.c}$ is the higher value for the range of live weight, W_b is the average live weight per broiler and $W_{l.c}$ is the lower value of the range.

Cost of goods sold

The cost of goods sold for the broiler farms is:

$$C_B = N_{b.b} * CP_b \quad (31)$$

where, $N_{b.b}$ is the total number of live broilers at broiler farm and CP_b is the cost price per broiler.

$$CP_b = SP_c + OC_b \quad (32)$$

where, SP_c is the selling price of first day old chicks and OC_b is the other variable costs per broiler.

B) Default scenario for **hatchability (C-H).**

In this scenario the criterion that is used in payment system of contract, between PS breeder farm and hatchery, is hatchability. The differences with C-F are described in the following equations.

$$R_{b.e} = N_{e.d} \cdot SP_{h.e} \quad (4b)$$

$$\begin{aligned} R_{b.e} &= (SP_e - PP) \cdot N_{h.e}, \text{ if } H_a < H_{c.} \\ R_{b,e} &= (SP_e + BP) \cdot N_{h.e}, \text{ if } H_a > H_{c.} \\ R_{b,e} &= SP_e \cdot N_{h.e} \quad , \text{ if } H_a = H_{c.} \end{aligned} \quad (6b)$$

where, H_a and H_c are the percentages of actual and limit (that is determined in the contract) hatchability, respectively.

$$TN_c = N_{e.d} \cdot H_a \quad (13b)$$

$$R_{i.e} = (N_{e.d} - N_{h.e}) \cdot SP_{i.e} \quad (16b)$$

4.4.2. Alternative contracts

4.4.2.1. Distribution of losses for infertile/not hatched eggs and FWM

In this contracts structure, PS breeder farms, hatchery and broiler farms share the losses that occurred by the biological factors (fertility –hatchability and FWM). Each chain member bears the losses in a percentage that is determined in the contract. The payment methods of bonus-penalty and for FWM (equations 5, 14) are not used. The variables that are used remain the same. As in default scenarios, also in alternatives there are two criteria that are used in payment system between PS breeder farm and hatchery: fertility (A-F) and hatchability (A-H).

The differences of alternative scenarios with default scenarios are presented per chain member in the following equations,

PS breeder farms

a) The payment is based on number of fertile eggs (A-F).

$$R_{b.e} = (N_{f.e} + N_{f.e.l}) \cdot SP_e \quad (4c)$$

where, $N_{f.e.l}$ is the number of fertile eggs that are paid to PS breeder farms by hatcheries after the sharing of loss of infertile eggs.

$$N_{f.e.l} = (N_{e.d} - N_{f.e}) * K_{s.l} \quad (33)$$

where, $K_{s.l}$ is the percentage of loss that is for the hatchery and is determined in the contract. The 1- $K_{s.l}$ is the percentage of loss for PS breeder farm.

b) The payment is based on number of hatched eggs (A-H).

$$R_{b.e} = (N_{h.e} + N_{h.e.l}) \cdot SP_e \quad (4d)$$

where, $N_{h.e.l}$ is the number of hatched eggs that are paid to PS breeder farms by hatcheries after the sharing of loss of not hatched eggs.

$$N_{h.e.l} = (N_{e.d} - N_{h.e}) * K_{s.l} \quad (34)$$

Where, $K_{s.l}$ is the percentage of loss that is hatchery and is determined in the contract. The 1- $K_{s.l}$ is the percentage of loss for PS breeder farm.

Hatchery

Hatchery pays to PS breeder farms, the number of fertile or hatched eggs plus an amount for eggs that are infertile or not hatched, which is determined in the contract.

Hatchery's revenues derive from the following equation.

$$R_{c.c} = (TN_c \cdot SP_c) - (N_{f.w.m} \cdot SP_c) \quad (35)$$

where, $N_{f.w.m.}$ is the number of chicks that are paid as compensation to broiler farms for FWM.

$$N_{f.w.m} = [TN_c - (TN_c \cdot FWM)] \cdot K_{s.l.c} \quad (36)$$

where, $K_{s.l.c}$,is the percentage of loss that is for hatchery and is determined in the contract. The 1- $K_{s.l}$ is the percentage of loss for broiler farms.

$$C_H = TN_c \cdot CP_{c.c} \quad (19b)$$

where, CP_{cc} is the cost price per first day old chick and it is corrected for the additional cost that is derived by the amount of infertile and not hatched eggs.

$$CP_{c.c} = C_{h.e} + C_{c.c} + OC \quad (20b)$$

$$C_{c.c} = N_{f.e.l} / TN_c, \text{ for A-F} \quad (37)$$

$$C_{c.c} = N_{h.e.l} / TN_c, \text{ for A-H} \quad (38)$$

Broiler farms

Broiler farms share the losses for FWM with hatcheries, in a percentage that is determined in contracts.

$$R_B = \{[(N_{b.b} - N_{b.DOA}) \cdot SP_b] + (N_{f.w.m} \cdot SP_c)\} - (N_{b.r} \cdot SP_b) \quad (39)$$

4.4.2.2. Distribution of Chain's Gross Margin

This alternative scenario differs in the following points from default scenarios. There are not applied the bonus–penalty per egg (fertile or hatched) as well as the compensation mechanism for first day old chicks. The GM of the chain derives from the total number of broilers that are sold to slaughterhouses multiplied with gross

margin per broiler (at the end of production cycle in broiler farm). Each chain member receives a percentage of chain's GM. The proportion of distribution is determined on contracts.

The main assumptions are that $SP_{h.e}=CP_e$ and $SP_c=CP_c$.

The gross margin of PS breeder farms is:

$$GM_{PS} = (K_{ps} \cdot GM_c) / N_{ps} \quad (40)$$

where, K_{ps} is the percentage of the chain's GM that received by PS breeder farms, GM_c is the gross margin of the chain and N_{ps} is the number of PS breeder farms that are included in the model.

The gross margin of Hatchery is:

$$GM_H = K_H \cdot GM_c \quad (41)$$

where, K_H is the percentage of the chain's GM that received by the hatchery.

The gross margin of broiler farm is:

$$GM_B = (K_B \cdot GM_c) / N_B \quad (42)$$

where, K_B is the percentage of the chain's GM that received by broiler farm and N_B is the number of broiler farms in the model.

$$GM_C = (GM_{\mathbf{b}} \cdot N_{b.b}) + R_{f.c} + R_{i.e} \quad (43)$$

where, GM_b is the gross margin per broiler.

$$GM_b = SP_b - [(SP_{h.e} / H_a) + OC + OC_b] \quad (44)$$

4.5. Model variables

Variables are selected for each stage of the broiler production chain. The technical and economic variables (deterministic) which are used for the current and alternative structure of contracts are mentioned in table 4.1.

Table 4.1. Technical and economic variables (deterministic) which are used in broiler chain simulation model.

Stage	Variable	Variable description	Value	Unit	Source
PS breeder farm	N_{hens}	Number of hens per round	16897	hens	Assumption
	$N_{e.hen}$	Average number of eggs per hen per round	168	eggs	KWIN 2008
	$N_{e.hen}$	Average number of hatched eggs/hen	153	eggs	KWIN 2008
	$N_{f.year}$	Number of rounds per year	1.13	round	Assumption
	M_{hens}	Hens mortality (18-22 week)	1	%	KWIN 2008
	M_{hens}	Hens mortality (22-61)	10	%	KWIN 2008
	$SP_{h.e}$	Revenues per broiler egg	0.1958	€	NOP 2007
	$CP_{b.e}$	Cost price per broiler egg	0.1914	€	Van Horne, 2007
	BB	Bonus	0.001	€	Interviews
	BP	Penalty	0.001	€	Interviews
Hatchery	$SP_{i.e}$	Value o of egg for industry	0.005	€	Assumption
	OC	Variable costs per first day old chick	0.032	€	Van Horne, 2007
	SP_c	Revenues per first day old chick	0.30	€	Assumption
	$SP_{f.c}$	Value of chick for free market	0.28	€	Assumption
	H_c	Limit of hatchability in contract	80	%	Interviews
	F_c	Limit of fertility in contract	87	%	Interviews
Broiler farm	$Contract$	Limit of FWM in contracts	1.5	%	Interviews
	M	Mortality (6 weeks)	3.5	%	KWIN 2008
	W_b	Live weight of broiler	2.150	kg	KWIN 2008
	$N_{b/round}$	Number of broilers/round	80000	broiler	Personal communication, 2008
	N_{round}	Number of rounds	6	round	PVE 2008
	$SP_{b.kg}$	Value per kg of broiler	0.83	€	NOP 2007
	OC_b	Variable costs per broiler	1.222	€	Van Horne, 2007

The $N_{f.year}$ is calculated via 52 (weeks within a year) divided by 38 weeks the duration of a production round in PS breeder farm plus 8 weeks for cleaning and maintenance of farm.

As input in the model for hatchability is used 80%. According to Yassin et al., 2008, the average hatchability in Netherlands is 74%. From interviews and Economie van de Pluimveehoudrij, is derived that average hatchability is 80% and this value is chosen in order to be consistent with the other variables.

Table.4.2. Stochastic variables for the broiler chain simulation model.

Variable	Variable description	Unit	Source	Prob.Distr	Parameterization			
					Overall	min.	m.l.	max.
F_a	Fertility	%	Interviews	Pert	87	81	87	93
H_a	Hatchability	%	interviews, Economie van de Pluimveehoudri	Pert	80	73	80	86
FWM	FWM	%	Yassin et al.,2008	Pert	1.5	1	1.5	3

4.6. Assumptions research

In this study assumptions are made for the broiler simulation model.

- The number of eggs that produced is the same for all PS broiler farms. Additionally, the capacity of first day old chicks is identical for all broiler farms. Selection of eggs exists only in PS breeder farms and not in hatchery.
- The number of PS breeder farms and broiler farms is constant and both of them sell and buy their products only via contracts.
- The selling and cost prices per egg, firsts day old chick and broiler, are average prices and are identical for PS breeder farms ,hatchery and broiler farms, respectively.
- The slaughterhouses receive all the quantity of broilers from broiler farms.
- The variables of Dead On Arrival first day old chicks, broilers that rejected in slaughterhouses, are zero. The simulation model has the ability to take into account these parameters, but there is a need for more valid data for them.

5. Current structure of contracts

This section presents the results that derived from the interviews with experts of Dutch broiler chain. A questionnaire was used in these interviews (Appendix 1).The results of these interviews covered the lack of information for the current structure of contracts in broiler chain. The interviewers answered a questionnaire.

5.1. Contracts types among chain partner

In Dutch broiler chains many contracts exist, which are used for supplying and selling animals and products, such as hens, broilers, eggs and meat (table 1.1). Chain members use contracts to organize their production process and to be benefited by contracts attributes (Chapter 2.3). The PS breeder farms have contracts with feed companies and hatcheries. Broiler farms have contracts with feed companies, hatcheries and slaughterhouses. Additionally, slaughterhouses have contracts with feed companies and broiler farms. Slaughterhouses, as hatcheries do not have a direct link with feed companies, in the production cycle. An explanation for the existence of contracts among slaughterhouses and feed companies could be the fact that feed companies are associates or owners of the slaughterhouses. Finally, hatcheries have contracts with PS breeder farms and broiler farms. It was mentioned by one expert that hatcheries have contracts with feed companies, although there is no a direct link in the production cycle. Probably this is based on misunderstanding of contract meaning and refers to exchange of information (table 5.11).

Table 5.1. Number of experts that indicate existence of contracts among chain partners of Dutch broiler chain

	Number of experts indicating existence of contracts with			
Firm/Farm	PS Breeder farms	Hatcheries	Broiler farms	Slaughterhouses
Feed companies	4[a]	1	5	2
PS Breeder farms	-[b]	4	-	-
Hatcheries	4	-	5	-
Broiler farms	-	4	-	3
Slaughterhouses:	-	-	5	-

[a] Based on interviews with 5 experts of the Dutch broiler chain.
[b] Missing values.

Agricultural contracts can be distinguished in two types, marketing and production contracts with different attributes (chapter 2). The marketing contracts dominate the contractual arrangements, among chain partners with an average percentage of 94.0% (table 5.2).

Table 5.2. Average distribution of contract types per chain partner in Dutch broiler chain

	Distribution of contract types		
Firm/Farm	Production contracts	Marketing contracts	No contract
PS Breeder farms	12.0%[a]	87.0%	1.0%
Hatcheries	4.0%	96.0%	-[b]
Broiler farms	4.0%	94.0%	2.0%
Slaughterhouses	-	99.0%	1.0%

[a] Average percentages, exclude missing values.
[b] Missing values.

Production contracts are used in a small percentage (4.0%), except for PS breeder farms of which 12.0% use production contracts. A very small percentage of chain participants is without contract and sells their products at the spot market.

A contract characteristic is the duration, which is not the same for all contracts among chain participants. More specific, the duration of contracts among hatcheries and broiler farms is mainly one production cycle (table 5.3). One production cycle for hens of PS breeder farms is equal with almost one year. The duration of contracts between hatcheries and broiler farms, is mostly multiple cycles. The term multiple cycles is almost equal with one year and includes six or seven rounds of contracts.

Contract duration among broiler farms and slaughterhouses is mainly (90%) multiple cycles. The contracts are renewed repetitively, until there appears a cause, which leads parties to decide contract termination.

Table 5.3. Contract duration in the Dutch broiler chain

Duration of the contract	Percentage of contracts between		
	PS Breeder farms - Hatcheries	Hatcheries -Broiler farms	Broiler farms- Slaughterhouses
One year	-[a]	-	-
One production cycle	95.0%[b, c]	8.0%	10.0%
Multiple cycles[d]	5.0%	90.0%	90.0%
More years	-	2.0%	-

[a]. Missing values.
[b] One production cycle is also the same as to flock to flock.
[c] Average percentages, excluding missing values
[d]The multiple rounds (6-7) are equal with one year duration, in many cases (Appendix).

5.2. Chain participants' behaviour in relation to contracts

A part of the questionnaire is focused on the following characteristics of chain participants: level of freedom to change contract partner, level of stability to renew contracts with their current partners and causes for changing partner.

Most chain members are free to change partner, after the termination of their current contract. Only a small percentage of PS breeder farms and broiler farms have some obstacles, which reduce their freedom to choice. For these cases, experts mentioned the intercommunication of hatcheries and the exchange of information among hatcheries for PS breeder farms and broiler farms, as possible reason. Consequently, PS breeder farms and broiler farms hesitate to change partner. The major reasons for changing partner are the differences in prices and/or in quality (table 5.6).

Table 5.4. Average percentage farms that are fully, somewhat or not free to change partner.

	% of total farms			
	PS Breeder farms	Hatcheries	Broiler farms	Slaughterhouses
Fully Free	76.0%[a]	97.50%	82.0%	100%
Somewhat Free	20.0%	2.50%	17.0%	-[b]
Not free	4.0%	-	1.0%	-

[a] Average percentages, exclude missing values.
[b] Missing value.

Generally, chain members are characterized by high stability on renewing contracts, with their previous partners. However, the level of stability differs among chain members. For instance, PS breeder farms are more stable on renewing contracts with their current partners (rearing organizations and hatcheries) and less stable (16%) with feed companies (table 5.5). Hatcheries present lower level of stability in their contractual arrangements with broiler farms. Broilers farms are also less stable on renewing contracts, 20% and 17% with feed companies and hatcheries, respectively.

Table 5.5. Stability of chain members, to enter into contracts with previous or new partners.

	Contracts with new partners				
Renew contracts with	Feed companies	Rearing organizations	PS Breeder farms	Hatcheries	Broiler farms
PS Breeder farms	16.0%[a]	3.0%	-	7.5%	-
Hatcheries	-[b]	-	7.0%	-	20.0%
Broiler farms	20.0%	-	-	17.0%	-

[a] Average percentages, exclude missing values.
[b] Missing values.

The main causes for the lower level of stability (table 5.5) among chain participants can be summarized to differences in price and quality (table 5.6). For instance, in contracts among PS breeder farms and hatcheries, the causes are differences in price and quality, respectively. These causes affect the chain members in a different degree. PS breeder farms are more interested to increase egg price, as a way to increase their income. On the other hand, higher quality eggs can increase the profit of hatcheries. Quality level of eggs affects directly the technical performance of hatcheries and the last through the contract payment, the income of PS breeder farms. However, only for 32.5% of PS breeder farms, quality is a reason to change hatchery. For contracts between PS breeder farms and feed companies as main reasons are presented the differences in prices and quality.

Table 5.6.Reasons for chain members to change partner. Average percentages according to experts [a] (n=5).

	Contract partners			
Change partner because of differences in:	Feed companies	PS breeder farms	Hatcheries	Broiler farms
PS Breeder farms				
Price	54.0%	-	97.5%	-
Quality	32.5%	-	2.5%	-
Other	13.5%[b]	-		-
Hatcheries				
Price	-	7.0%	-	65.0%
Quality	-	90.0%	-	9.0%
Other	-	3.0%[b]	-	26.0%[c]
Broiler farms				
Price	93.0%	-	87.0%	97.0%
Quality	7.0%	-	13.0%	3.0%
Slaughterhouses				
Price	-	-	-	100%

[a] Average percentages, exclude missing values.
[b] Problems in business relationship.
[c] Change in integration.

A difference in price is the main reason to change partner, for almost all chain partners except PS breeder farms. For PS breeder farms, the main reason is the quality. For slaughterhouses, a different broiler price is the exclusive cause to end the contract with broiler farms (table 5.6).

5.3 The role of type of strain

The raw materials that are used in broiler chain, from the first stage of production chain, belong to a specific genotype (or strain). There exist many types of strains, which have different characteristics and performance. The differences in characteristics (embryo mortality, hatchability, First Week Mortality, Feed Conversion Rare, etc) have consequently dissimilar results that are related to the income of chain participants. For instance, type of strain affects the FWM that is an important performance measurement especially for broiler farms and less for hatcheries, through the payment system (table 5.8). So, in a high grade the selection of type strain is based on the characteristics that mentioned above.

The type of strain is mainly determined by broiler farms, followed by slaughterhouses and feed companies. The differences in the average ranking values among these three chain members are small. An interpretation of these small differences could be that these three chain participants are connected to contracts and all of them, contribute to the determination of type strain. Considering the existence of contracts among feed companies and slaughterhouses (table 5.1) and the fact that are powerful players of the chain, leads probably to the conclusion that their contribution to determination of type strain is higher.
Consumer demand as well as retailer demand has little effect on the determination of the type strain. Additionally, the PS breeder farms do not have any influence on the type strain.

Table 5.7. Determination of type of strain that used in Dutch broiler chain.
Ranking according to experts (n=5).

	Ranking of the expert from (1=highest, 6=lowest)					
	Breeding company	Rearing farms	PS Breeder farm	Hatchery	Broiler farm	Average rank
Broiler farmers	-[a]	1[b]	2	-	-	1.5
Slaughterhouses	2	3	1	2	1	1.8
Feed companies	1	4	3	1	2	2.2
Hatchery	-	2	-	-	4	3.0
Consumer demand/retailer	6	-	-	6	3	5.0
PS Breeder farms	-	-	-	-	-	-

[a] Missing value.
[b] Average values of ranking, exclude missing values.

5.4. Payment methods of contracts

5.4.1. Payment formulas and their characteristics

A main part of contracts is the payment method, which differs among chain partners (table 5.8). In majority, the payment method in contracts between PS breeder farms-hatcheries is based on hatchability (62.5%) and in a smaller percentage on fertility

(32.5%). The payment formula is contract price plus a correction with bonus/penalty that depends on level of hatchability or fertility achieved, compared with the percentage of hatchability or fertility that is determined in the contract.

The percentage of hatchability or fertility that is determined in the contract is not the same for all PS breeder farms that have contracts with the same hatchery. The causes for this vary and depend on:

- the market situation (supply and demand, surplus, quality, seasonality, etc)
- the average hatchability of the hatchery and percentage of production that is appropriated for exports
- the type of strain since it affects the % hatchability or fertility that is determined in contracts, because each type of strain can achieve different optimal results
- the negotiation skills of PS breeder farmers.

Hatcheries check past performance of PS breeder farms. This action, according to what experts indicated, can influence the price of eggs that is determined in contracts. The check of past performance of PS breeder farms depends on market situation. For instance, if demand for eggs is high, hatcheries do not check past performance and if exists a surplus in market, then they check it. Hatcheries check past performance of PS breeder farms, because with good quality eggs, they can achieve better technical results and this is interpreting in higher profit. Therefore, they are more flexible to offer higher bonus to PS breeder farms, since better quality eggs give to hatcheries higher profit, although the higher bonus that have to pay to PS breeder farms.

The payment method that is used in hatcheries-broiler farms contracts is a fixed price per old day chick minus the compensation for FMW as table 8 presents. Broiler farms receive a compensation for FMW, when it is above the value that is determined in contract. This value of FMW varies from 1% to 1.5% and it is not the same for all broiler farms. Hatcheries compensate the broiler farms for the percentage of FWM that is above the point that is determined in the contracts.

For the contracts among broiler farms and slaughterhouses, the payment method is based on live weight of broilers and has a correction with bonus or penalty for the price that broiler farms receive. The live weight that is determined in the contract has a range and the bonus or penalty is used when the weight takes values out of the range. Furthermore, there are penalties for some other characteristics, such as broken legs, not empty oesophagus and scabby lips.

These characteristics are determined by slaughterhouses and they are acceptable until the point of 0.5% of delivered production. Until 0.5% of delivered production, slaughterhouses bear the losses and above this point, broiler farms are responsible and bear the losses of the deviations. The payment formula in contracts among broiler farms and slaughterhouses remains the same for heavy and lightweight broilers, but the price for these two broiler categories, differs.

Table 5.8. Payment methods, frequency of payment and other characteristics regarding to price that are used in contracts among chain partners[a].

Variable	Contracts between chain members		
	PS breeder farms-Hatcheries	Hatcheries-Broiler farms	Broiler farms-Slaughterhouses
Percentage of contracts using payment methods based on Hatchability[b]	62.5% (min=78%,ml =80%)[d]	-	-
Fertility[c]	32.5% (min=86%,ml =87%)[e]	-	-
Fixed price	2.5%	100%[f]	-
Live weight	-	-	100%[g,h]
Is figure stated in contracting the same for all contracts?	No	No	-
Frequency of payment (% of payments)	2-4 weeks after delivery (100%)	After the end of round (72.0%)	Within 4 weeks after delivery (100%)
	-	2 -4 weeks after delivery (15.0%)	-
	-	At the 1st day (13.0%)	-
The price of the product delivered frequency of setting the price	Weekly (100%)	Weekly (33.0%) Period of multiple cycles (77.0%)	-
Is the price negotiable?	Yes	Yes	Yes
depending on following criteria	Market situation (100%)	Market situation (67.0%) Negotiation ability (33.0%)	Market situation (100%)

[a] Average percentages, exclude missing values.
[b] The number of saleable chicks divided by the number of eggs set up in incubator.
[c] The number of fertile eggs (candling at 18th day) divided by the number of eggs set up in incubator.
[d] Min is the minimum value and ml is the most likely value for of hatchability that is determined in the contract.
[e] Min is the minimum value and ml is the most likely value for fertility that is determined in the contract.
[f] Fixed price – compensation for first week mortality.
[g] There is not a price mechanism that determine different price for first and second quality broilers.
[h] The price is different for heavy and light weight broilers.

The payment methods that are used in the Dutch broiler chain are similar to those of the USA (section 2.2.3). A difference is that in Dutch broiler chains the compensation depends on individual results of each chain member and in the USA on the average results of the region.

5.4.2. Other characteristics of payment methods

The frequency of payment differs among chain partners. Hatcheries pay the PS breeder farms in 2-4 weeks after delivery of eggs (100%). However, only 15.0% of broiler farms pay hatcheries within 2-4 weeks after delivery. Majority of broiler farms (72.0%) fulfil their obligations after the end of each production round and only a small percentage pays at the day of delivery. Slaughterhouses execute the payment of broiler farms within 4 weeks after delivery of broilers.

The price of eggs always is settled weekly, whereas price of first day old chicks is settled weekly, only in 33.0% of cases. The common practice of setting the price of first day old chicks is a period of multiple rounds (77.0%) and is remained constant

for several periods. Additionally, the price of eggs, first day old chicks and broilers is always negotiable and the determination of price depends on the current market situation.

5.5. Parameters that determine quality characteristics of raw materials

Quality of eggs, first day old chicks and broilers is influenced by different factors as derives from Yasssin et al., (2008). All factors play a significant role in quality of animals or products and affect more stages of the chain. Some of these factors, although that can affect the income of chain members, are not included in contracts.

5.5.1. Quality of raw materials

The outcomes of each chain member are used as inputs from the others. An essential role in this chain plays the quality control of products. The egg weight is the most important criterion that is used as an indicator for quality of eggs in contracts. Besides egg weight, also egg texture, sanitation, size, % of ground eggs, % of second quality eggs, stamp and position not upside-down are also important, as mentioned by experts (table 5.9). With these criteria, PS breeder farms and hatcheries make the selection of eggs. Egg weight remains the main criterion for quality, for first and last delivery (23, 24- 55, 60 week respectively). The eggs are washed only if a wash agreement is part of contract.

Regarding to the quality of eggs, hatcheries almost never reject lower quality eggs from a PS Breeder farm (table 5.9). It is a very rare situation and only occurs in 1-2% of cases in total PS breeder farms. The eggs that are not appropriate for incubation are sold to the food industry.

Table 5.9. Criteria used in contracts in order to determine quality of raw materials. Ranking according to experts (n=5).

	Ranking according to expert from (1=highest, 6=lowest)				
Variables	Breeding companies	Rearing farms	PS Breeder farms	Hatchery	Broiler farm
Egg					
Egg weight > 50gr	1	1	1[a]	1	-[b]
Egg texture/sanitation	2	2	1[a]	3	-
%of ground eggs	3	6	1[a]	2	-
% of second quality eggs	3	3	1[a]	-	-
First day old chick					
First week mortality	1	-	-	1	1
Size, weight uniformity	2	-	-	2	-
Broiler[c]					
Live weight	1	-	1	1	-

[a] Are equally important.
[b] Missing value.
[c] Quality criteria are HACCP and IKB.

First week mortality is a significant measure for quality and is related with price of first day old chicks, that broiler farm has to pay to the hatchery (Yassin et al., 2008). Besides FMW, also the size and weight uniformity are significant indicators for good quality first day old chicks (table 5.9). The live weight, likewise the parameters or criteria that are determined in HACCP and IKB systems are used as quality criteria in

contracts among broiler farms and slaughterhouses. The last two systems settle on all hygiene controls.

5.5.2. Frequency of egg collection

The frequency of egg collection and the duration of storage in hatchery, until the eggs are set in the incubator, are not determined in contracts. Hatcheries collect the eggs from PS breeder farms and are responsible for the transportation. Mainly the eggs are collected twice a week (82.5%) and in smaller percentage (12.5%), three or more times a week (table 10). PS breeder farms store the eggs in rooms with climate control. The existence of climate control in the storage rooms is related (75%) with frequency of egg collection, however the climate control does not affect egg price. As derived from study of Yassin et al., (2008), hatchability decreased significantly when the duration of egg storage in hatcheries increased. Additionally, conditions and length of storage in PS breeder farms as well as in transportation and storage to hatchery have a great influence in hatchability and under some conditions reduce hatchability (Yassin et al., 2008). Although these factors have an effect on incomes of PS breeder farms and hatcheries and they are not included in the contracts.

Table 5.10. Hatcheries' frequency of egg collection and the role of climate control.

Variable	% of total farms/firms	
	Hatcheries from PS Breeder farms	PS Breeder farms
Frequency of egg collection		
Once a week	5.0%[a]	-[b]
Twice a week	82.5%	-
Three times and more /week	12.5%	-
Climate control during storage	-	100%
Related to frequency of egg collection		
Yes	-	75.0%
No	-	25.0%
Does it affect the price?		
Yes	-	-
No	-	100%

[a] Average percentages, exclude missing values.
[b] Missing value.

5.5.3. Transportation of raw materials

Hatcheries are responsible for the transportation of first day old chicks to broiler farms. The losses of first day old chicks due to Dead On Arrival (DOA), are measured through to FWM. The percentage of dead chicks per transport varies in extremely small range of 0.001-1%; hence, DOA percentage does not have impact on the price first day old chicks.

Slaughterhouses are responsible for transportation of broilers to their facilities. Regarding to DOA broilers, the compensation system among broiler farms and slaughterhouses differs than between hatcheries and broiler farms. Slaughterhouses are responsible until the point of <0.2% DOA broilers per transport and bear the losses. When the DOA of broilers is above 0.2% of total number delivered, then broiler farms bear the losses.

5.5.4. Uniformity of raw materials

Uniformity is an important indicator for the animals and products of broiler chain. Each product should be characterized by uniformity, which consists by different elements. For instance, the broiler eggs should have weight more than 50gr and the same size. Chain members are more interested in some elements that consists uniformity and these elements are used as quality criteria for the contracts (table 5.9). For hatcheries, uniformity for eggs is weight more than 50gr and for first day old chicks, the FWM. Uniformity for broiler farms is FMW and weight of broilers, as the last remain the main element of uniformity for slaughterhouses. The characteristics of quality scoring systems, such as HACCP and IKB are used to determine uniformity for slaughterhouses.

5.6. Sharing of information among chain participants

Part of the questionnaire is focused on the exchange of information among chain members. The results of each chain member depends on a grade to management actions that occurred by the upstream members of the chain. Chain members exchange information with their partners with purpose to avoid management actions, which reduce their technical results. In some cases, this exchange of information occurs because existing of contracts.

Table 5.11 presents the quantity and quality of information that chain members share. PS breeder farms share technical information, such number of total eggs, fertility, hatchability and mortality with feed companies. With hatcheries, they share technical information, technical performance and quality issues. As was mentioned by experts, informally they share information for differences in feed and PS hens' prices. Therefore, derives that PS breeder farms share a variety of information with their partners. However, the existence of a contract is not the cause for this.

Hatcheries share information with all chain members, although they have contracts only with PS breeder farms and broiler farms (table 5.1). Hatcheries share important information with feed companies, (technical results, performance, prices and hatchability) as well as with slaughterhouses, although hatcheries are linked directly with other chain members in broiler chain. As for PS breeder farms such as for hatcheries, contracts remain not to be a reason for exchange of information.

Broiler farms share information for diseases, feed, mortality and everything else that they judge as important with feed companies. With slaughterhouses, they share all information that is described in the VKI document. Broiler farms exchange information with hatcheries, only for FWM, since that is the criterion for the payment (5.4.1).

Slaughterhouses share information on quality characteristics with broiler farms, but share more information with feed companies, despite the fact that broiler farms are their suppliers. In contrast to PS breeder farms and hatcheries, for broiler farms and hatcheries the existence of a contract is the reason for the exchange of information.

Table 5.11. The information sharing among chain partners and the effect of contracts on this, in Dutch broiler chain.

Sharing information	Chain partners				
	Feed companies	PS breeder farms	Hatcheries	Broiler farms	Slaughterhouses
PS breeder farms[a]	• Technical information [b]		• Technical information, performance • Quality issues • Differences in feed and hens prices[c]		
Hatcheries[a]	• Technical results • Performance • Prices • Hatchability	• Hatchability • Quality issues		• Supply of farms with first day old chicks • Supply of farms with first day old chicks and feed of parent stock farms	• Supply farm • Feed on parents stock farm
Broiler farms[d]	• All kind of information[e]		• Only for 1st week mortality		• Everything that is included in VKI document
Slaughterhouses[d]	• Quality characteristics • Tecnical characteristics			• Quality characteristics only	

[a]. The existence of contract is not the reason for this sharing of information.
[b] Technical information such as: number of total eggs, % fertility, % hatchability ,% mortality
[c] These information are sharing informally
[d] The existence of a contract is the reason for this sharing of information.
[e] About diseases, feed, mortality etc

5.7. Informal agreements

Except the agreements that are made in contracts, there are informal agreements among chain partners during the period of their collaboration. For instance, hatcheries inform PS breeder farms, for the type of strain that they prefer and from which feed companies could be supplied. Furthermore, in contracts of broiler farms and slaughterhouses, is determined a range for broilers weight. For example, the weight of broilers should be between in the range of 2.1-2.2 kg, but in case that the actual weight differs a lot from this that is determined in contract, then the price per kg is adjusted according to market rules.

Experts indicated the following reasons as responsible for the reduction of chain performance:

- Chain members transfer the problem to the next chain member and are more interested in their own profit maximization.
- A hatchery never being supplied with the optimal amount of eggs, in relation to market demand, therefore is a loss or surplus.
- Production is organized by few key players and not regarding to market demand.
- Chain members have big freedom in all principles. There is a lack of rules in the chain.

5.8. Ideal contract

According to what is mentioned above by experts, none of the current contracts can be characterized as ideal for the broiler chain. An ideal contract could be based on following statements, as mentioned by experts, with purpose to improve chain performance.

- An ideal contract should be very tight and due to this, it will increase broiler chain performance.
- Good relationships as collaboration must exist among chain members in parallel with simple contracts.
- It should be able to adjust the amount of eggs and first day old chicks, to needs per week.
- A suggestion is the use production contracts. These contracts can use the payment method of certain amount of Euros per m^2 and a bonus-penalty method for several factors, such as fertility or hatchability or FWM.

5.9. Summary results from interviews

From the above, we can conclude that marketing contracts (94%) dominate the Dutch broiler chain. The duration of contracts is mainly one year. Chain members are free to change partners as they are stable to contracts with their already partners. For the cases that chain participants change partners, the main causes are differences in prices and quality. The type of strain looks that is determined by an upstream and a downstream member of the chain, feed companies and slaughterhouses respectively (section 5.3). Relatively to criteria, which are determined in contracts to check quality of raw materials, can be summarized to egg weight (>50gr), first week mortality and weight of broilers, for the eggs, first day old chicks and broilers respectively. For the contracts among chain members, the most important variables are hatchability, first week mortality and live weight. The payment methods are almost the same for all chain participants, but the parameters that affect the price are not identical for all of them. For the sharing of information, it is remarkable that chain participants share a variety of information with chain members, which occurs with or without existence of a contract.

6. Results of the model

6.1. Current contract structure

This chapter presents the results of the analysis from the stochastic model for the current and alternative contract structures in Dutch broiler chain. In this study, the gross margin (GM) per year is shown for the range of 95th -5th percentile and for the mean. The range between the 5th and 95th percentile and the mean are interpreted as the range of the different values for the GM and the most likely value, respectively. GM of the chain and of chain participants individually, is estimated for the default and two alternatives scenarios.

6.2. Default scenarios- Sensitivity analysis

Sensitivity analysis was conducted in order to find out the effects on the GM of the chain GM and chain members, as well as of the main parameters that are determined and were affected on by contracts. The parameters are eurocents per egg of bonus-penalty system, the value of limit in contract (for fertility, hatchability and FWM) and price of first day old chicks that are sold in free market. The default scenarios that are based on criterion of fertility and hatchability are mentioned as D-F and D-H, respectively. The values that are used in current contracts are 0.1 eurocent per egg, for bonus-penalty system and 1.5% for limit of first week mortality (FWM).

Bonus-penalty (ct per egg)

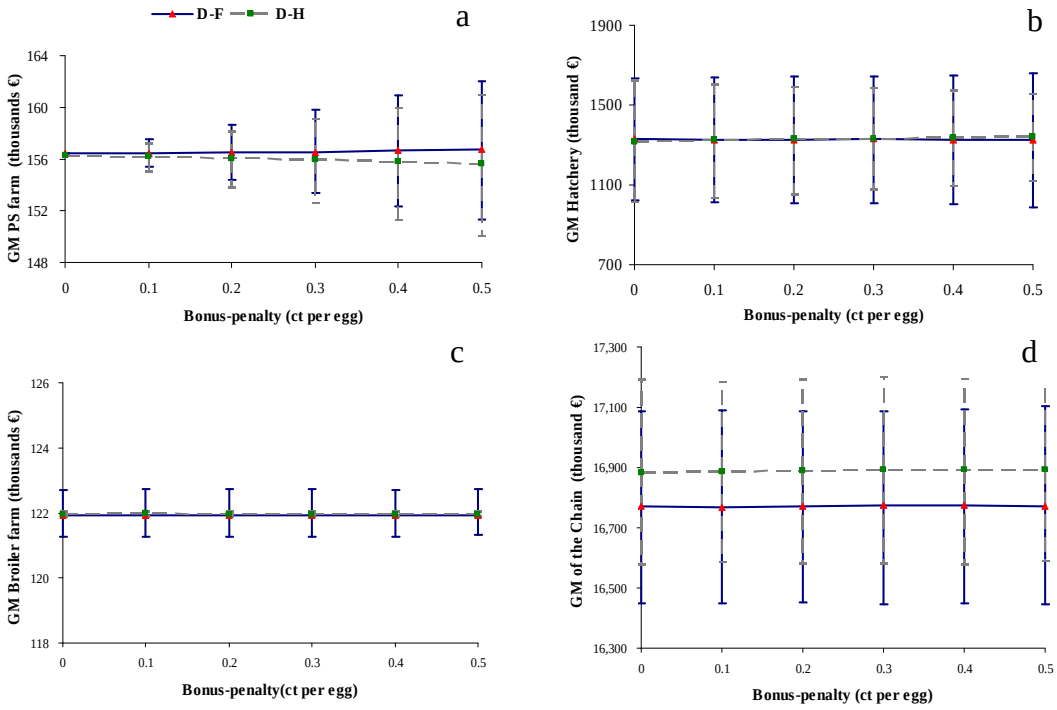


Figure 5. Effects of bonus-penalty system on default scenarios that are based on criterion of fertility (C-F) and hatchability (C-H). (a) PS breeder farm (b) Hatchery (c) Broiler farm (d) Chain.

Comparing the expected GM for D-F and D-H that are presented in table 6.1, derives that GM of PS breeder farm and hatchery is higher for D-F, but the difference is only 0.2%. In addition, chain's GM is 0.7% higher for D-H. However, the difference is relatively small, since they have almost the same range for GM among the 5th and 95th percentile. For both scenarios, the expected GM of a broiler farm remains constant.

Table 6.1. GM of chain and chain members, for different values of bonus-penalty system, for both default scenarios.

	Gross margin											
	PS farm	95th -5th [a]	RC[b]	Hatchery	95th -5th	RC	Broiler Farm	95th -5th	RC	Chain	95th -5th	RC
ct per egg												
€	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%
Fertility [c]												
0	156	0	0.0	1,329	613	0.2	121	1.4	0.0	16,770	634	0.0
0.1(D-F)[d]	**156**	**2**	**0.0**	**1,327**	**626**	**0.0**	**121**	**1.4**	**0.0**	**16,769**	**642**	**0.0**
0.2	157	4	0.0	1,328	634	0.0	121	1.4	0.0	16,771	634	0.0
0.3	157	6	0.0	1,330	632	0.2	121	1.4	0.0	16,773	640	0.0
0.4	157	9	0.1	1,328	649	0.1	121	1.4	0.0	16,773	642	0.0
0.5	157	11	0.2	1,325	672	-0.2	121	1.4	0.0	16,772	655	0.0
Hatchability[c]												
0	156	0	0.1	1,318	614	-0.4	122	0.14	0.0	16,884	614	0.0
0.1 (D-H)[d]	**156**	**2**	**0.0**	**1,323**	**568**	**0.0**	**122**	**0.14**	**0.0**	**16,887**	**603**	**0.0**
0.2	156	4	-0.1	1,329	536	0.4	122	0.14	0.0	16,890	608	0.0
0.3	156	7	-0.1	1,333	510	0.8	122	0.14	0.0	16,893	619	0.0
0.4	156	9	-0.2	1,337	477	1.0	122	0.14	0.0	16,893	618	0.0
0.5	156	11	-0.3	1,339	438	1.2	122	0.14	0.0	16,893	610	0.0

[a] The range of expected GM between the 5th and 95th percentile.
[b] The relative change of GM in comparison to current structure of contract.
[c] The criterion that is used on payment system.
[d] The bonus-penalty per egg is 0.1 eurocent and the limit of FWM is 1.5% in default scenario.

When the amount of eurocents per egg increased, the expected GM of PS breeder farm increases for D-F, whereas decreases for D-H. GM of hatchery is more sensitive to changes in values of bonus-penalty system, for D-H. Additionally, the range of expected GM between the 5th and 95th percentile, is lower in comparison to D-F. An interpretation for this is that for a higher bonus-penalty the GM of hatchery for D-H is more stable.

The expected gross margins of PS breeder farm, broiler farm and of the chain are not sensitive in changes on values of bonus-penalty system.

Limit for fertility and hatchability in contract

The expected GM of PS breeder farm and hatchery are presented to be sensitive in changes on values of limit for fertility or hatchability. More specific, for D-F, an increase on limit of hatchability has as a result the reduction of PS breeder farm's GM by 0.5% and the increase of hatchery's GM by 1.5%. The range of hatchery's GM is smaller in D-H, and this interpreted to more stable value for GM (table 6.2). In both scenarios, the GM of the chain and broiler farm's GM remains almost constant. The relative changes are the equal for both scenarios.

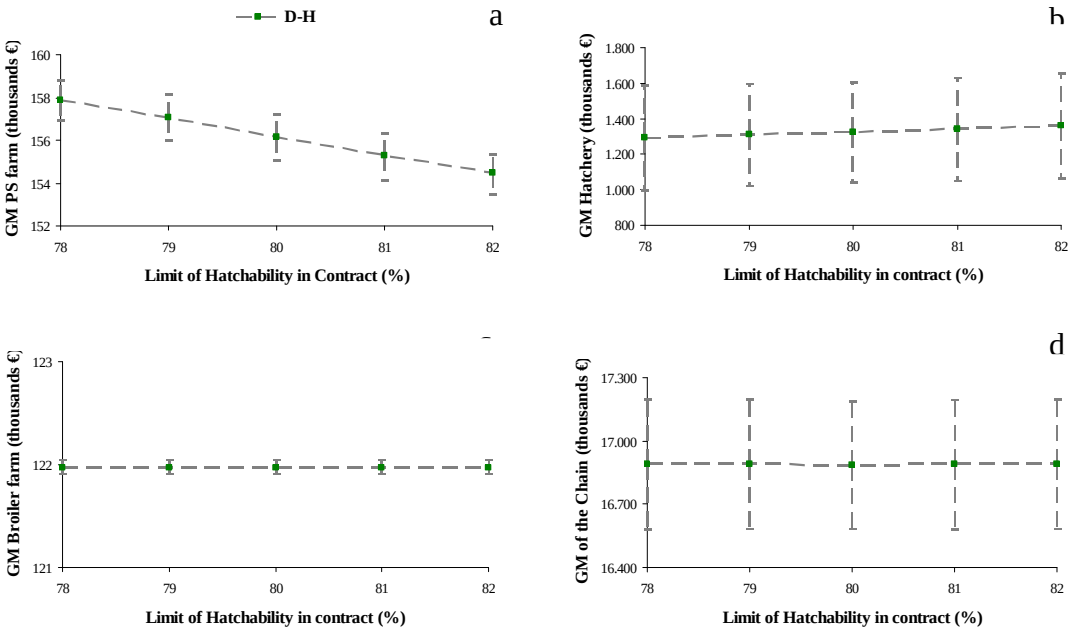


Figure 6. Effect of limit of hatchability on GM of chain members and of the chain. (a)PS breeder farm (b) Hatchery (c) Broiler farm (d) Chain

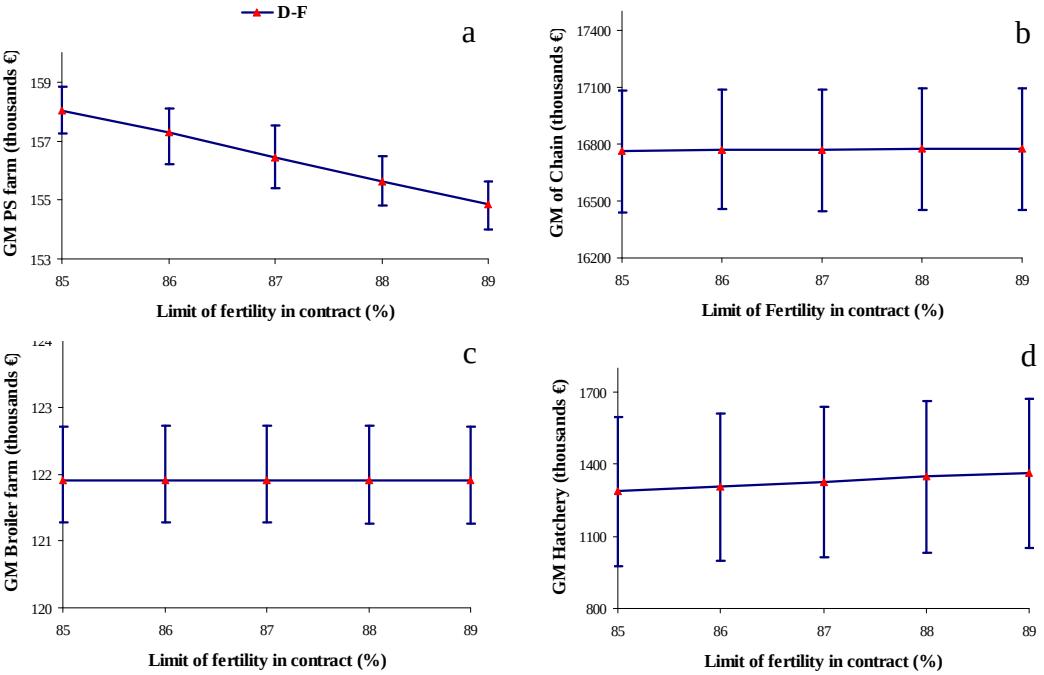


Figure 7. Effect of limit of fertility on GM of chain members and of the chain. (a)PS breeder farm (b) Hatchery (c) Broiler farm (d) Chain

Table 6.2. GM per chain member for different values of limit for fertility or hatchability that is determined in the contract.

Limit in Contract (%)	Gross Margin											
	PS farm	95th -5th [a]	RC[b]	Hatchery	95th -5th	RC	Broiler Farm	95th -5th	RC	Chain	95th -5th	RC
	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%
Fertility [c]												
85	158	2	1.0	1,288	622	-2.9	122	1	0.0	16,760	638	-0.1
86	157	2	0.5	1,309	611	-1.3	122	1	0.0	16,768	626	0.0
87(D-F)[d]	**156**	**2**	**0.0**	**1,327**	**626**	**0.0**	**122**	**1**	**0.0**	**16,769**	**642**	**0.0**
88	156	2	-0.5	1,348	629	1.6	122	1	0.0	16,773	64	0.0
89	155	2	-1.0	1,363	620	2.7	122	1	0.0	16,772	638	0.0
Hatchability[c]												
78	158	2	1.1	1,292	590	-2.4	122	0.1	0.0	16,890	620	0.0
79	157	2	0.6	1,310	575	-1.0	122	0.1	0.0	16,892	612	0.0
80(D-H)[d]	**156**	**2**	**0.0**	**1,323**	**568**	**0.0**	**122**	**0.1**	**0.0**	**16,887**	**603**	**0.0**
81	155	2	-0.6	1,344	580	1.5	122	0.1	0.0	16,890	614	0.0
82	154	2	-1.1	1,360	590	2.8	122	0.1	0.0	16,890	616	0.0

[a] The range of GM between the 5th and 95th percentile.
[b] The relative change of GM in comparison to current structure of contract.
[c] The criterion that is used in payment system.
[d] The bonus-penalty per egg is 0.1 eurocent and the limit of FWM is 1.5% in default scenario.

Value of first day old chicks

The results from table 6.3 show that an increase on price of first day old chicks, which are sold to free market, has an effect of hatchery's GM. In both scenarios, GM increased almost equally and the effect on chain's GM is small. Additionally, GM of PS breeder farm and broiler farm remains constant (table 6.3).

Table 6.3. GM per chain member for different values of price for chicks that are sold in free market by hatchery.

Price per chick €	Gross Margin											
	PS farm	95th -5th [a]	RC[b]	Hatchery	95th -5th	RC	Broiler Farm	95th -5th	RC	Chain	95th -5th	RC
	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%
Fertility [c]												
0.27	156	2	0.0	1,321	611	-0.5	122	1	0.0	16,763	635	0.0
0.28(D-F)[d]	**156**	**2**	**0.0**	**1,327**	**626**	**0.0**	**122**	**1**	**0.0**	**16,769**	**642**	**0.0**
0.29	156	2	0.0	1,337	628	0.8	122	1	0.0	16,780	646	0.1
0.30	156	2	0.0	1,340	646	1.0	122	1	0.0	16,782	661	0.1
0.31	156	2	0.0	1,349	654	1.7	122	1	0.0	16,791	672	0.1
0.32	156	2	0.0	1,354	667	2.0	122	1	0.0	16,796	680	0.2
Hatchability[c]			2									
0.27	156	2	0.0	1,317	560	-0.5	122	0.1	0.0	16,881	595	0.0
0.28(D-H)[d]	**156**	**2**	**0.0**	**1,323**	**568**	**0.0**	**122**	**0.1**	**0.0**	**16,887**	**603**	**0.0**
0.29	156	2	0.0	1,331	576	0.6	122	0.1	0.0	16,895	614	0.0
0.30	156	2	0.0	1,338	596	1.1	122	0.1	0.0	16,902	633	0.1
0.31	156	2	0.0	1,346	610	1.7	122	0.1	0.0	16,910	647	0.1
0.32	156	2	0.0	1,352	630	2.2	122	0.1	0.0	16,916	667	0.2

[a] The range of GM between the 5th and 95th percentile.
[b] The relative change of GM in comparison to current structure of contract.
[c] The criterion that is used in payment system.
[d] The bonus-penalty per egg is 0.1 eurocent and the limit of FWM is 1.5% in default scenario.

Limit of FWM

Results from figure 4, show that the expected gross margins of hatchery and broiler farm are sensitive in changes on values of limit for FWM. More specific, a 1% decrease on limit for FWM has as a result an 0.1% increase on GM of broiler farm. Contrary, GM of hatchery decreases (0.7%). When, the limit for FWM is 1.5%, hatchery has a 2.2% reduction on GM and broiler farm a 0.3% increase. The trend of increase and decrease for GM remains the same for both default scenarios (table 6.4).

GM of PS breeder farm is higher in C-F, but the difference with C-H is relatively small. Additionally, GM of chain and broiler farm remains almost constant (figure 8).

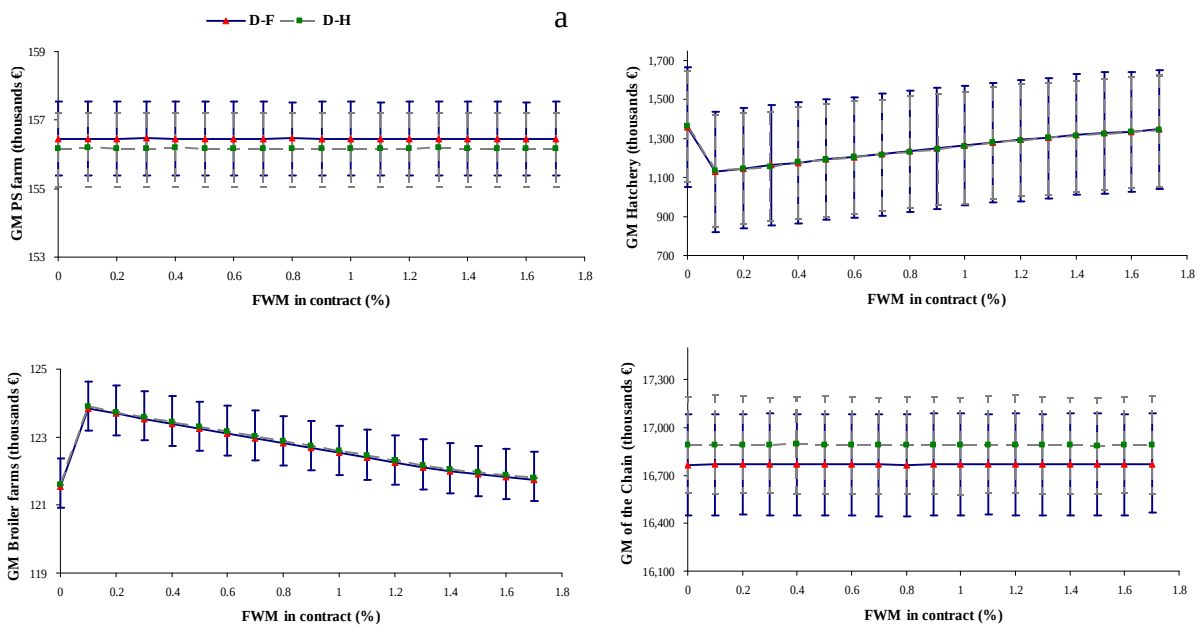


Figure 7. Effect of limit of FWM on GM of chain members and of the chain. (a)PS breeder farm (b) Hatchery (c) Broiler farm (d) Chain.

The absence of compensation mechanism has as a result, higher values for the expected GMs of hatchery and broiler farm, at both default scenarios. Furthermore, GM of broiler farm takes the lowest value, at both scenarios. The GMs of D-H is higher than D-F, for hatchery and broiler farm, but the difference is not small.

Table 6.4. GM per chain member for different values of limit for FWM that is determined on contract.

Limit in Contract (%)	Gross Margin											
	PS farm	95th -5th [a]	RC[b]	Hatchery	95th -5th	RC	Broiler Farm	95th -5th	RC	Chain	95th -5th	RC
	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%
Fertility [c]												
0	156	2	0.0	1,359	614	2.3	122	1	-0.3	16,766	633	0.0
0.1	156	2	0.0	1,132	620	-14.8	124	1	1.6	16,768	635	0.0
0.2	156	2	0.0	1,146	616	-13.7	124	1	1.5	16,768	629	0.0
0.3	156	2	0.0	1,164	622	-12.4	124	1	1.3	16,771	636	0.0
0.4	156	2	0.0	1,176	621	-11.5	123	1	1.2	16,769	634	0.0
0.5	156	2	0.0	1,193	616	-10.2	123	1	1.1	16,770	633	0.0
0.6	156	2	0.0	1,205	617	-9.3	123	1	1.0	16,767	638	0.0
0.7	156	2	0.0	1,221	630	-8.1	123	1	0.9	16,769	639	0.0
0.8	156	2	0.0	1,234	625	-7.1	123	1	0.7	16,767	642	0.0
0.9	156	2	0.0	1,252	627	-5.8	123	1	0.6	16,771	642	0.0
1	156	2	0.0	1,264	615	-4.9	123	1	0.5	16,768	637	0.0
1.1	156	2	0.0	1,279	615	-3.7	122	1	0.4	16,770	630	0.0
1.2	156	2	0.0	1,292	625	-2.8	122	1	0.3	16,768	639	0.0
1.3	156	2	0.0	1,304	617	-1.8	122	1	0.2	16,768	635	0.0
1.4	156	2	0.0	1,319	620	-0.7	122	1	0.1	16,771	639	0.0
1.5(D-F)[d]	**156**	**2**	**0.0**	**1,328**	**629**	**0.0**	**122**	**1**	**0.0**	**16,771**	**630**	**0.0**
1.6	156	2	0.0	1,336	613	0.5	122	1	-0.1	16,769	631	0.0
1.7	156	2	0.0	1,346	612	1.4	122	1	-0.1	16,773	624	0.0

[a] The range of GM between the 5th and 95th percentile.
[b] The relative change of GM in comparison to current structure of contract.
[c] The criterion that is used in payment system.
[d] The bonus-penalty per egg is 0.1 eurocent and the limit of FWM is 1.5% in default scenario.

Table 6.5.GM per chain member for different values of limit for FWM that is determined on contract.

Limit in Contract (%)	Gross Margin											
	PS farm	95th -5th [a]	RC[b]	Hatchery	95th -5th	RC	Broiler Farm	95th -5th	RC	Chain	95th -5th	RC
	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%
Hatchability [c]												
0	156	2	0.0	1,362	568	3.0	121	1	-0.3	16,891	607	0.0
0.1	156	2	0.0	1,134	577	-14.3	124	181	1.6	16,894	616	0.0
0.2	156	2	0.0	1,147	576	-13.3	124	182	1.5	16,892	610	0.0
0.3	156	2	0.0	1,158	560	-12.5	124	180	1.3	16,888	595	0.0
0.4	156	2	0.0	1,178,	573	-10.9	123	182	1.2	16,894	609	0.0
0.5	156	2	0.0	1,191	583	-10.0	123	182	1.1	16,892	617	0.0
0.6	156	2	0.0	1,203	578	-9.1	123	179	1.0	16,889	612	0.0
0.7	156	2	0.0	1,216	567	-8.1	123	185	0.9	16,888	602	0.0
0.8	156	2	0.0	1,231	571	-6.9	123	181	0.7	16,888	606	0.0
0.9	156	2	0.0	1,247	576	-5.8	123	181	0.6	16,889	613	0.0
1	156	2	0.0	1,261	577	-4.7	123	184	0.5	16,889	612	0.0
1.1	156	2	0.0	1,279	571	-3.4	122	181	0.4	16,892	610	0.0
1.2	156	2	0.0	1,291	576	-2.4	122	175	0.3	16,890	615	0.0
1.3	156	2	0.0	1,305	571	-1.3	122	169	0.2	16,892	608	0.0
1.4	156	2	0.0	1,314	569	-0.7	122	158	0.1	16,888	606	0.0
1.5(D-H)[d]	**156**	**2**	**0.0**	**1,323**	**568**	**0.0**	**122**	**144**	**0.0**	**16,887**	**603**	**0.0**
1.6	156	2	0.0	1,336	569	0.9	122	130	-0.1	16,891	605	0.0
1.7	156	2	0.0	1,341	5745	1.4	122	112	-0.1	16,890	612	0.0

[a] The range of GM between the 5th and 95th percentile.
[b] The relative change of GM in comparison to current structure of contract.
[c] The criterion that is used in payment system.
[d] The bonus-penalty per egg is 0.1 eurocent and the limit of FWM is 1.5% in default scenario.

6.3. Alternative contracts

6.3.1. Distribution of losses among chain members

In this alternative contract, the losses that occurred by infertile eggs, not hatched eggs and FWM are distributed among chain members, in proportions. The proportion is determined on the contract. The variables that are used in this scenario are the same as in default scenarios (tables 4.1 and 4.2). The bonus penalty per egg and the compensation mechanism for first day old chicks are not applied. The alternative contracts are distinguished to A-F and A-H, when the criterion for share of losses is fertility and hatchability, respectively. The structure of the model is described in details, in section 4.4.2.1.

Results show that the expected GM of the chain is increased for A-H, in comparison to A-F. The increase is 0.7% and it is relatively small. The expected GM of the chain for A-F and A-H are equal to D-F and D-H, respectively. Concerning to PS breeder farm and broiler farm, the expected GM is increased. The expected GM of PS breeder farm is higher for A-H. For instance, in proportion 40:60:60:40, the increase is 8.8%. Hatchery's GM is reduced at both alternative contracts. The reduction is higher on alternative contract A-H.

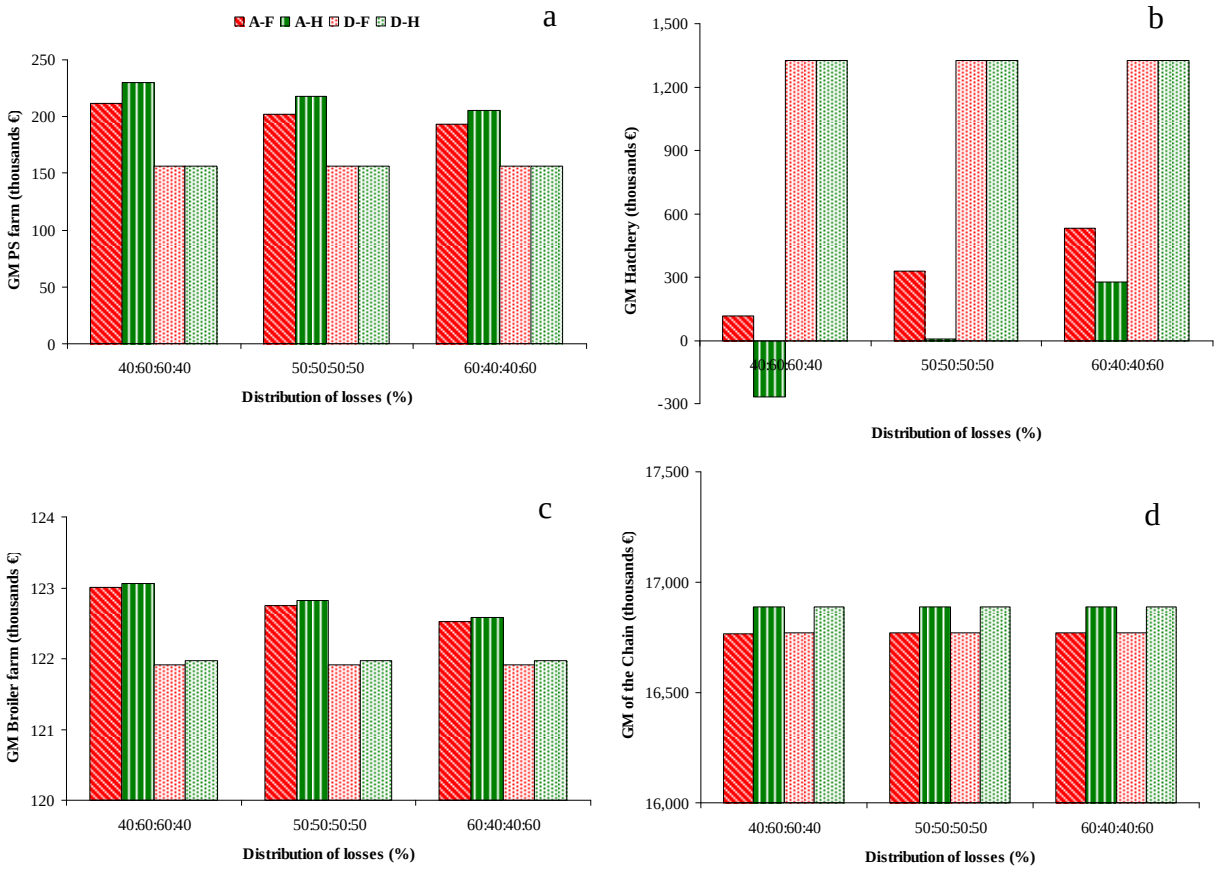


Figure 9. Effects of alternative contract structure, on GM of chain members and chain. The alternative contract is based on distribution of losses for infertile eggs, not hatched eggs and FWM. (a) PS breeder farm (b) Hatchery (c) Broiler farm (d) Chain

Table 6.6. GM per chain member, for the alternative contract of distribution of losses for infertile eggs, not hatched eggs and FWM, among chain members.

	Gross Margin															
Loss Distribution %	PS farm €(x1000)	95th -5th [a] €(x1000)	RC [b] (D-F) %	RC [c] (D-F= 0) %	Hatchery €(x1000)	95th -5th €(x1000)	RC (D-F) %	RC (D-F= 0) %	Broiler Farm €(x1000)	95th -5th €(x1000)	RC (D-F) %	RC (D-F= 0) %	Chain €(x1000)	95th -5th €(x1000)	RC (D-F) %	RC (D-F= 0) %
Fertility [d]																
D-F(=0) [e]	156	0	- [f]	0.0	1,363	619	-	0.0	122	1	-	0.0	16,769	639	-	0.0
D-F [g]	**156**	**2**	**0.0**	**0.0**	**1,327**	**626**	**0.0**	**-2.7**	**122**	**1**	**0.0**	**0.3**	**16,769**	**642**	**0.0**	**0.0**
A-F [h]																
40:60:60:40 [k]	211	8	35.0	35.1	117	631	-91.2	-91.4	123	1	0.9	1.2	16,765	625	0.0	0.0
50:50:50:50	202	7	29.2	29.2	328	634	-75.3	-75.9	123	1	0.7	1.0	16,768	640	0.0	0.0
60:40:40:60	192	5	23.3	23.4	534	621	-59.8	-60.8	123	1	0.5	0.8	16,768	628	0.0	0.0
Hatchability [d]																
D-H (=0) [e]	156	0	-	0.0	1,357	618	-	0.0	122	0	-	0.0	16,888	618	-	0.0
D-H [f]	**156**	**2**	**0.0**	**-0.1**	**1,323**	**568**	**0.0**	**-2.5**	**122**	**0.1**	**0.0**	**0.3**	**16,887**	**603**	**0.0**	**0.0**
A-H [g]																
40:60:60:40	230	7	47.2	47.1	-266	749	-120.1	-119.6	123	0.11	0.9	1.2	16,885	616	0.0	0.0
50:50:50:50	218	5	39.4	39.3	5	718	-99.6	-99.6	123	0.9	0.7	1.0	16,886	609	0.0	0.0
60:40:40:60	205	4	31.5	31.4	276	696	-79.2	-79.7	123	0.7	0.5	0.8	16,886	608	0.0	0.0

[a] The range of expected GM per year, between the 5th and 95th percentile.

[b] The relative change of GM in comparison to current structure of contract.

[c] The relative change of expected GM in comparison to case that are not applied the bonus-penalty per egg and the compensation for first week mortality.

[d] The criterion that is used in payment system.

[e] The expected GM in case that not applied the bonus-penalty per egg and the compensation for first week mortality.

[f] Missing value.

[g] The expected GM for the default scenario, where the values for bonus-penalty per egg and the limit for FWM are 0.1 eurocent and 1.5% ,respectively.

[h] The expected GM for the alternative scenario.

[k] The proportion for the distribution of losses among chain members. 40:60 are the percentages of losses for PS breeder farm and hatchery, respectively. 60:40 are the percentages of losses for hatchery and broiler farm, respectively.

The difference on hatchery's GM between the two alternative scenarios occurred from the criterion that is used for the payment of losses. When, the criterion is fertility, the number of eggs that are considering as losses for hatchery is smaller than in the case that the criterion is hatchability.

6.3.2. Distribution of chain's GM

In this alternative contract, the GM of the chain is distributed to chain members in different proportions. These proportions are determined on the contracts. A characteristic of this contract is that the selling price of egg and first day old chick is equal with cost price. The main idea of this contract structure is to distribute the GM that derives after the end of production cycle in broiler farm and the selling of broilers to slaughterhouses. A further analysis of the contract structure is presented in section 4.4.2.2.

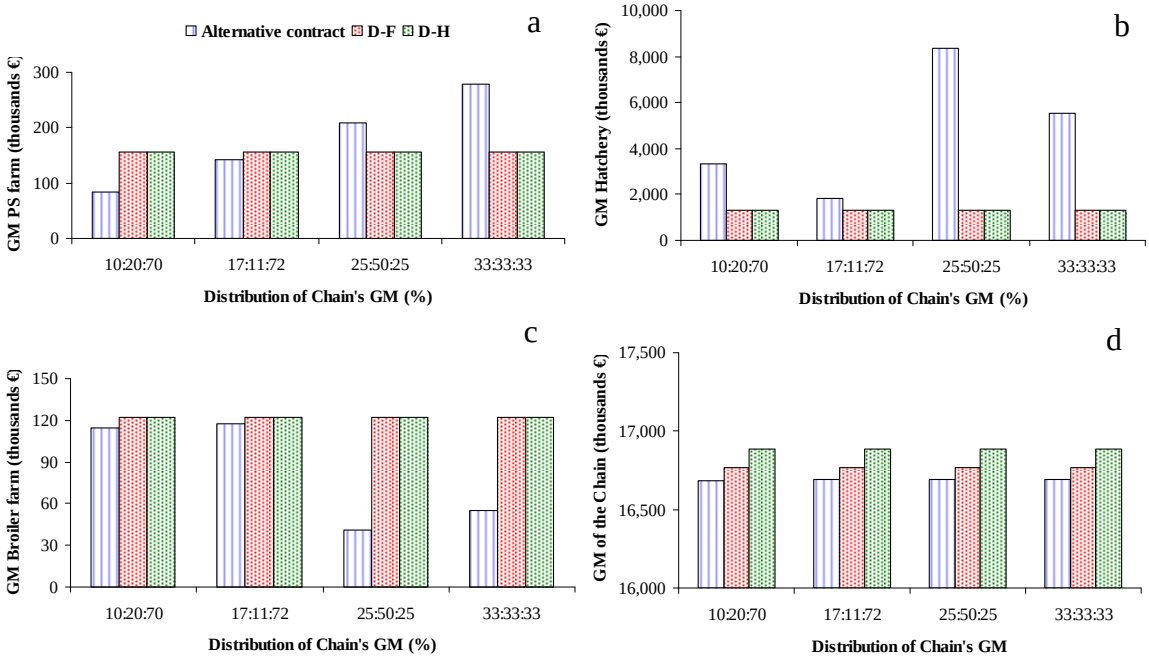


Figure 10. Effects of alternative contract structure, on GM of chain members and chain. The alternative contract is based on distribution of chain's GM to chain members in proportions that are determined in contract. (a) PS breeder farm (b) Hatchery (c) Broiler farm (d) Chain

Results show an increase on expected GM of PS breeder farms, when the percentage of chain's GM, which is distributed to them, is above 20%. The expected GM of hatchery is increased. The increase is higher in comparison to D-H. This could be explained by the fact that D-H is 0.7% higher comparing to D-F (table 6.7). Concerning to broiler farm, the expected GM is reduced for all the proportions that were tested (figure 10).

The small difference on expected GM of the chain compare to default scenarios is occurred from the assumption that the selling prices per egg and first day old chick are equal with cost prices. From equation 21 derives that the cost price per egg for hatchery differs for alternative contract and current contracts.

Table 6.7.GM of the chain and per chain participant for the alternative contract: Distribution of chain's GM.

	Gross Margin											
	PS farm	95th -5th [a]	RC[b]	Hatchery	95th -5th	RC	Broiler Farm	95th -5th	RC	Chain	95th -5th	RC
	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%	€(x1000)	€(x1000)	%
Fertility[c]												
D-F [d]	156	2	0.0	1,363	626	0.0	122	1	0.0	16,769	642	0.0
10:20:70[e]	83	3	-46.7	3,337	101	114.8	115	3	-6.1	16,687	505	-0.5
17:11:72	142	4	-9.3	1,836	55	34.7	118	4	-3.4	16,691	503	-0.5
25:50:25	209	6	33.3	8,345	254	512.2	41	1	-66.4	16,691	508	-0.5
33:33:33	278	8	77.8	5,563	169	308	55	2	-55.2	16,691	508	-0.5
Hatchability[c]												
D-H [d]	156	2	0.0	1,323	568	0.0	122	0.1	0.0	16,887	603	0.0
10:20:70	83	3	-46.6	3,337	101	152.2	115	3	-6.1	16,687	505	-1.2
17:11:72	142	4	-9.1	1,836	55	38.8	118	4	-3.4	16,691	503	-1.2
25:50:25	209	6	33.6	8,345	254	530.7	41	1	-66.5	16,691	508	-1.2
33:33:33	278	8	78.1	5,563	169	320.4	55	1	-55.3	16,691	508	-1.2

[a] The range of expected GM per year, between the 5th and 95th percentile.
[b] The relative change of GM in comparison to current structure of contract.
[c] The criterion that is used in payment system.
[d] The bonus-penalty per egg is 0.1 eurocent and the limit of FWM is 1.5% in default scenario.
[e] The 10:20:70 is proportion of distribution of chain's GM, where 10% for PS breeder farms, 20% for hatchery and 70% for broiler farm.

7. Conclusions and discussion

7.1. Main conclusions

This study identified the current structure of contracts, estimated the impact of current contracts and alternative contracts in chain performance. This section refers to main conclusions of this study. Additionally, there are presented a discussion for the limitations of the model and suggestions for further research.

- *Objective a) Identify the current structure of Dutch broiler contracts.*

From literature review, is derived a lack of information for the current structure of contracts in Dutch broiler chain. For this purpose, a questionnaire was developed to gather information for the contract structure of following chain members: PS breeder farms, hatcheries, broiler farm and slaughterhouses.

The main conclusions for the current structure of contracts are:

- Marketing contracts dominate the contractual arrangements among chain members, with an average percentage of 94%. The duration of contracts is mainly one year.

- Chain members are free to change partners, but also they are stable to contracts with their already partners. The main reasons to change partner are the differences on prices and quality.

- Egg weight (>50gr), fertility, hatchability, first week mortality and weight of broilers are the main quality criteria that are determined on contracts.

- Fertility, hatchability and FWM are used as criteria for the payment mechanisms in contracts. The payment mechanisms are mainly the same for all partners. On the contrary, the limits for fertility, hatchability and FWM, which are determined on contracts, are not identical for all chain partners.

- For the sharing of information, it is remarkable that chain participants share a variety of information with chain members. The existence of a contract is not the main factor for the sharing of information among chain members, as there is share of information among chain participants that they do not have a direct link in the production process.

- *Objective b) Study the impact of current contract structure on chain performance*

In this study, a stochastic model was designed and developed to estimate the performance of the current structure of contracts. The outputs of the model are expressed in terms of gross margin (GM) per year. The model examines the structure of contracts among PS breeder farm and hatchery, as well as hatchery and broiler farm. The contracts between broiler farms and slaughterhouses are not considered. Reason is the lack of information for the structure of contracts among broiler farms and slaughterhouses, although experts were interviewed.

The model is based on economic and technical variables of the broiler chain. Data derives from literature and interviews. A description of model and inputs are presented in section 4. All the variables that are used are for the year, 2007.

An analysis was done for two default scenarios. They differ on the criterion that is used for the payment mechanism on contracts between PS breeder farm and hatchery. In one case the criterion is fertility (D-F) and in the other hatchability (D-H).

- The expected GM of the chain is 0.7% increased for D-H, in comparison to D-F. This difference is relatively small. Concerning to chain members, expected GM of PS breeder farm is higher in D-F, but the difference from D-H is only 0.2%. GM of broiler farm remains constant in both scenarios.

Important factors affecting the GMs of chain and chain members.

- The expected GM of chain is not sensitive in changes on the amount of eurocents per egg for bonus-penalty system, on limits of contracts for fertility or hatchability and FWM, as well as for price of first day old chicks that are sold in free market.

- The expected gross margin of hatchery is more sensitive on changes of limits for fertility, hatchability and FWM in contracts, in comparison to GM of PS breeder farm and broiler farm.

o *Objective c) Study the impact of alternative contract structures on chain performance.*

The payment method that is based on bonus-penalty system and the compensation mechanism for FWM were changed. Two alternative contract structures were examined.

Alternative contract: Distribution of losses among chain members

In this alternative contract structure, the losses from infertile eggs, not hatched eggs and FWM are distributed in proportions, to chain members. The proportions are determined on the contracts. The variables in the model were remained the same and only the payment schemes were changed. As in default scenarios, there are two alternative scenarios, which differ in the criterion (fertility: A-F, hatchability A-H) that is used for the payment system in contracts between PS breeder farm and hatchery.

- The expected GM at both alternative contracts is not presented any change in comparison to default scenarios. The GM of PS breeder farm is increased significantly. The increase is higher for A-H. The increase of broiler's farm GM is less, around 1%. On the contrary, hatchery's expected GM is reduced, specially in A-H, when the losses are 60% for hatchery, the GM is taken negative values.

Alternative contract: Distribution of chain's GM

In this alternative contract structure, the GM of the chain derives from the number of broilers that are sold to slaughterhouses multiplied by the gross margin per broiler. In addition, selling prices per egg and first day old chicks are equal to cost prices. Chain's GM is distributed to chain members in proportions. The proportions are determined on the contracts.

The expected GM of the chain is smaller than in default scenarios. The difference is relatively small, since the reduction is 0.5% and 1.2% in comparison to D-F and D-H, respectively. GM of hatchery is presented an increase for all the proportions that were tested. The gross margin of PS breeder farm is increased in two out of four proportions that were tested. On the other hand, GM of broiler farm is reduced.

7.2. Discussion

This study has limitations like every academic study. This section presents an overview of these limitations and their effects on the outcome of this study.

From literature review, is derived that there is a lack of information for the current structure of contracts in Dutch broiler chain. A questionnaire was developed in order to gather information for the current contract structure. Interviews were taken from five experts. The number of experts is limited, although they were chosen and represented different stages of broiler chain. Additionally, the questionnaire was divided in six parts, four of them were referred to one chain member and the experts were answering parts of their suppliers or customers. Due to this, verification was done in their answers. The information that were gathered from interviews, gives a good start for the contract structure in broiler chain.

In broiler chain, many companies and farms are involved. This study examines only the contractual arrangements among PS breeder farms, hatcheries and broiler farms. These chain partners were chosen, because they represent an important part of production process. They mainly produce the outcome of the broiler production role, with out this mean that the role of the rest chain members is not important.

In the model, it is assumed that all PS breeder farms produce the same amount of eggs and all broiler farms have the same capacity of broilers. This simplifies the reality and assumed that each farm is treaded equally by hatchery. The selling prices of eggs and first day old chicks are identical for all PS breeder farms and broiler farms. In practice these variables are depended on market demand and on negotiation skills of chain partners.

The alternatives contract structures that were tested are not lead to an increase on chain performance. This is logical, since the gross margin per broiler is constant and it is redistributed to chain members according to contract structures.

All these limitation has as a result an over or under estimation of the expected gross margin for the chain and chain members.

7.3 Suggestions for further research

A suggestion for further research is to collect data for more parameters that are determined on contracts and have effects on chain performance as well as to take into account the correlations of this parameters. Additional, the GM can be measured as gross margin per flock or per delivery.

Moreover, the Monte Carlo simulation model could be developed more and include more stages of the broiler production chain.

Finally, further studies are needed to investigate the relationship between contract structure and technical performance. To examine the incentives of contract structures to improve technical performance, as this is the way to add profits in the chain.

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Appendix

Identify the current types of contracts on Dutch broiler chain

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This questionnaire has as an aim to gather data for the current type and structure of broiler contracts. The research focuses only on the contracts between the breeder farms-hatcheries, hatcheries-broiler farms, broiler farms-slaughterhouses.

Part 1 **General Questions**

1. With whom do chain participants have contracts? Mark 1 or more option.

Chain participants	**Breeder farms**	**Hatcheries**	**Broiler farms**	**Slaughterhouses**
Feed companies				
Grand parent stock farms				
Breeder farms				
Hatcheries				
Broiler farms				
Slaughterhouses				
Other				

2. Are the contracts in Netherlands production[2] or marketing[3] contracts? Please indicate the percentages.

	Production contracts (%)	Marketing contracts (%)	No contract (%)
Breeder farms:			
Hatcheries:			
Broiler farms:			
Slaughterhouses:			

[2] *Production contracts* involve a payment of fee to the farmer, for the management actions and other assets (labor, facilities and equipment) that he/she provides. During the process the contractor has the ownership of the product (hens, eggs or chicks). The contract specifies in detail the production inputs supplied by the contractor, which could be a processor, a feed mill or another operation.

[3] *A marketing contact* is a verbal or written agreement between a farmer and a buyer that specifies quantity, quality, price and timing of the product to be delivered by the farmer. Most management decisions remain to the farmer, who retains product ownership during the production process. The farmer assumes all risks of production, but shares price risk with the contractor

3. Is each chain participant Fully free, Somewhat free or Not free to enter into a contract with other partners? Please indicate the percentages.

% of total farms/firms

	Fully Free	Somewhat Free	Not free
Breeder farms:			
Hatcheries:			
Broiler farms:			
Slaughterhouses:			

4. With respect to the previous question, if answer was Not free, which are the difficulties / obstacles to change partner?

- Breeder farm: _____
- Hatcheries: _____
- Broiler farmers: _____
- Slaughterhouses: _____

5. Who determines the type of strains[4] that are used by the chain participants? Please rank them, with 1 be the highest

	Ranking
a) Feed companies	
b) Slaughterhouses	
c) Consumer demand / retailer	
d) Other	

6. In relation to previous question, what are the criteria?

Criteria: _____

Part 2 Breeder farms

Breeder farms-Hatcheries relation

1. The contract duration is:

Breeder farmer-Hatchery:
(Other[5])

	%
• One year:	
• One production cycle (round)	
• Multiple rounds = …….	
• Other: ….....	

[4] *Specific genotypes*
[5] *Long term contracts , contracts to continue in effect until terminated*

2. The breeder farms renew the contract/s with:
Please indicate the percentages.

Breeder farms	With previous partner (%)	Enter into a contract with a new partner (%)
Feed companies:		
Grandparent stock farms:		
Hatcheries:		

3. Percentage of breeder farms that enter into a new contract, because of:
Please indicate the percentages.

Breeder farms	% of total farms/firms		
	Differences in prices	Differences in quality	Other
Feed companies:			
Grand parent stock farms:			
Hatcheries:			

4. How often the breeder farms deliver the hatcheries:
Please indicate the percentage.

a) Once a week		%
b) Twice a week		%
c) Three times a week		%
d) Other…….		%

5. a) Is the frequency of delivery related to the climate control during the storage at breeder farms?

Yes No

Climate control during storage	% of total Breeder farms
Yes	
No	

b) Does this affect the price and how?

_____

6. According to which criteria do the breeder farms check the quality of the eggs that supply the hatchery? Please rank them, with 1 be the highest.

Ranking

	First delivery	Last delivery
a. Egg weight >50gr		
b. Egg texture, Sanitation		
c. Size		
d. % of ground eggs		
e. % of second quality eggs		
f. Other…….		
g. A combination of……		

7. What are the percentages of Hatchability and Fertility that are determinated in the contracts: Please indicate the percentages.

	Minimum %	Most likely %	Maximum %
Hatchability A[6]			
Hatchability B[7]/"Fertility"			

8. The hatcheries pay the breeder farms according to: Please indicate the percentages.
(% of hatchery-breeder farm relations that used as payment system in the contracts)

	%
• Hatchability A[5]	
• Hatchability B[6]/"Fertility"	
• 1day old chick price	
• Stable price	
• Other……	
• A combination of…..	

The payment formula is:……

9. a) Is the % of Hatchability that is determined in the contract, the same for all the breeder farmers?

Yes No

b) If the answer is No, what are the reasons?

a) Past performance b) Other……

10. a) Is the % of Fertility determined in the contract the same for all the breeder farmers?

Yes No

b) If No, what are the reasons?

a) Past performance b) Other……

11. The price of eggs is set:

a) Weekly b) Monthly c) Fixed d) Other……

[6] *The number of hatching eggs divided by the total number of eggs delivered from the breeder farm*
[7] *The number the number of eggs candling at 18th day divided by the total number of eggs delivered*

12. The breeder farmers received a bonus [8]/penalty based on:
Please indicate the percentages

a)	The average performance of the other breeder farmers	%
		%
b)	Predetermined value in the contract on Hatchability	%
c)	Predetermined value in the contract on Fertility	%
d)	Quality standards	%
e)	Other…….	%
f)	A combination of.....	

13. Do breeder farms share information:

- a) With feed companies? Yes No
  If yes, what information they share?

  b) Is the reason the existence of a contract?

- a) With hatcheries? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

- a) With broiler farms? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

- a) With slaughterhouses? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

14. Is the selling price of eggs negotiable?

[8] *Bonus: example 0.0001 euro/egg above the average*

Part 3 **Hatcheries**

Hatcheries-Breeder farms relation

1. The contract duration is:

		%
Hatchery- Breeder farm:	• One year:	
	• One production cycle (round)	
	• Multiple rounds = …….	
	• Other: ….....	

		%
Hatchery- Broiler farm: (Other, Flock to flock)	• One year:	
	• One production cycle (round)	
	• Multiple rounds = …….	
	• Other: ….....	

2. The hatcheries renew the contract/s with: Please indicate the percentages

Hatcheries	With previous partner (%)	Enter into a contract with a new partner (%)
Breeder farms:		
Broiler farms:		
Slaughterhouses:		

3. What is the percentage of hatcheries that enter into a new contract, because of: Please indicate the percentages

Hatcheries	% of total farms/firms		
	Differences in prices	Differences in quality	Other
Breeder farms:			
Broiler farms:			
Other			

4. How many times per week does the hatchery receive eggs from the breeder farms? Please indicate the percentages.

a)	Once per week	%
b)	Twice per week	%
c)	> than twice per week	%

5. a) How many days after the delivery of the eggs, must the hatchery put them in the incubator?

a) In 1 day b) In 3 days c) Other…….

b) Does this affect the price /egg that the breeder farms receive?

Yes No

c) If yes, in which way does it affect the price?

_____

7. How many days after the delivery of the eggs, does the hatchery pay the breeder farm?

   a) 1st day b) after candling c) other……

8. Based on which criteria do the hatcheries check the quality of the eggs that they receive from the breeder farm? Please rank them, with 1 be the highest.

		Ranking
a)	Weight >50gr	
b)	Size (not to small)	
c)	Egg texture, sanitation	
d)	Hatchability A[5]	
e)	Hatchability B[6]/"Fertility"	
f)	Other……..	

9. The hatcheries pay the breeder farms according to: Please indicate the percentages.
   (% of hatchery-breeder farm relations that used as payment system in the contracts)

a) Hatchability A[5]		%
b) Hatchability B[6] [6]/"Fertility"		%
c) 1day old chick price		%
d) Stable price		%
e) Other…….		%
f) A combination of……..		%

   The payment formula is:……

10. a) Is the % of Hatchability determined in the contract the same for all breeder farmers?

    Yes No

    b) If No, what are the reasons?

    a) Past performance b) Other…….

11. a) Is the % of Fertility determined in the contract the same for all the breeder farmers?

    Yes No

    b) If No, what are the reasons?

    a) Past performance b) Other…….

12. a) Does the hatchery checks the past performance of a breeder farm before determining the price/egg?

    Yes No

    b) If Yes, in which way does this affect the breeder farm?

[5] *The number of hatching eggs divided by the total number of eggs delivered from the breeder farm*
[6] *The number of hatching eggs divided by the number of eggs candling at 18th day*

13. a) In which case do hatcheries reject the eggs from a breeder farm?

a) >1 % bad quality eggs b) Other……..

b) How often does it happen?

% of cases/total breeder farms

Hatcheries-Broiler farms relation

14. What elements consists the uniformity hatcheries?

_____

15. The payment for the 1st day-old chicks that hatcheries supply broiler farms is based on: Please indicate the percentages.

	% of contracts that based on these criteria
• 1st week mortality	
• 6 week mortality	
• Size of chicks	
• Weight of chicks	
• Fixed price	
• Uniformity	
• Other……..	
• A combination of …….	

16. a) Is the price fixed for all the broiler farmers?

Yes No

b) If not, does it depend on other variables?

a) Past performance b) other……

17. a) In how many cases are there dead chicks on arrival?
Please indicate the percentages.

% of transports =	

% of dead chicks/transport

Minimum %	Most likely %	Maximum %

b) With respect to the previous question, who bears these losses?

_____

18. The price of the day-old chicks is set:

a) Weekly b) Monthly c) Other……

19. The selling price of day-old chicks is negotiable?

_____

20. Do hatcheries share information:

- a) With feed compan Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

- a) With breeder farms? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

- a) With broiler farms? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

- a) With slaughterhouses? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

Part 4 **Broiler farms**

Broiler farms-Hatcheries relation

1. The contract duration is:

		%
Broiler farmer-Hatchery:	• One year: • One production cycle (round) • Multiple rounds = ……. • Other: ….....	

Broiler farmer-Slaughterhouse:

	%
• One year:	
• One production cycle (round)	
• Multiple rounds = …….	
• Other: ….....	

2. The broiler farms renew the contract/s with:
   Please indicate the percentages.

Broiler farms	With previous partner (%)	Enter into a contract with a new partner (%)
Feed companies:		
Hatcheries:		
Slaughterhouses:		

3. The percentage of broiler farms that starting with a new contract partner, because of:
   Please indicate the percentages.

Broiler farms	% of total farms/firms		
	Differences in prices	Differences in quality	Other
Feed companies:			
Hatcheries:			
Slaughterhouse:			

4. How many days after the delivery of the day old chick, does the broiler farm pay the hatchery?

   a) 1st day b) after 1st week c) other……

5. According to what criteria do broiler farms checks the quality of 1st day-old chicks?
   Please indicate the percentages.

• Size	%	
• Weight	%	
• 1st week mortality	%	
• Uniformity (flock)	%	
• Other…….	%	

6. a) In how many cases are there dead chicks on arrival?

% of transports =	
% of dead chicks/transport	

   b) With respect to the previous question, who bears these losses?

   _____

7. What elements consists the uniformity for broiler farms?

8. a) The broiler farms pay the hatcheries according to:
Please indicate the percentages.

•	1st week mortality	%
•	6 weeks mortality	%
•	The uniformity	%
•	Fixed price per chick	%
•	Performance of the previous flock	%
•	Other…….	%
•	A combination of …….	%

b) Are there penalties in payment for the hatcheries?

Yes No

c) If yes, in which criteria they based on?

_____

Broiler farm-slaughterhouse relation

9. Who is responsible and takes the risk of preslaughter mortality during the transportation from the broiler farm to slaughterhouse? Please indicate the percentages.

	% of the cases
The slaughterhouse:	
The broiler farm:	
Other	

10. The payment of chicks delivered to the slaughterhouse is based on:
Please rank them, with 1 be the highest.

	Ranking
a) Quality standards (HACCP, IKB etc)	
b) Live weight	
c) Slaughter weight	
d) Size	
e) Feed Conversion Rate	
f) Uniformity	
g) Quantity (more quantity, higher price)	
h) Other	

The payment formula is:……

11. Is there a price mechanism that determine different price for 1st quality and 2nd quality broilers?

_____

12. What is on average the % of 1st quality and 2nd quality broilers in Netherlands?

	Minimum %	Most likely %	Maximum %
1st quality broiler			
2nd quality broiler			

13. Do broiler farms share information:

- a) With feed companies? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

- a) With breeder farms? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

- a) With hatcheries? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

- a) With slaughterhouses? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

14. Is the selling price of broilers negotiable?

Part 5 **Slaughterhouses**

Slaughterhouse-Broiler farm relation

1. The contract duration is:

		%
Slaughtehouse-Broiler farmer	• One year: • One production cycle (round) • Multiple rounds = ……. • Other: ….....	

2. The slaughterhouses renew the contract/s with:
Please indicate the percentages.

Slaughterhouses	With previous partner (%)	Enter into a contract with a new partner (%)
Broiler farms:		

3. Percentage of slaughterhouses that enter into a new contract, because of:
Please indicate the percentages.

Slaughterhouses	% of total farms/firms		
	Differences in prices	Differences in quality	Other
Broiler farms:			

4. Who is responsible for the transportation of broilers to slaughterhouses?

a) Broiler farmer b) Slaughterhouse c) Other…….

5. a) Who is paying the losses due to preslaughter mortality?

a) Broiler farm b) Slaughterhouse

b) What is the percentage of pre slaughter mortality in Netherlands?

Minimum %	Most likely %	Maximum %

6. How many days after the delivery of the broilers does the slaughterhouse pay the broiler farms?

a) 1st day b) after 1st week c) Other…….

7. What elements consists the uniformity for the slaughterhouses?

_____

8. What are the quality standards for the slaughterhouses?

a) HACCP b) IKB c) Other…….

9. Which criteria determine the prices of the broilers?
Please rank them, with 1 be the highest.

	Ranking,
• The age of the broiler	
• Live weight	
• Slaughter weight	
• Uniformity	
• Quality standards (HACCP)	
• Quantity	
• The strain	
• Past performance	
• Other ……	

10. The payment of broilers to broiler farms form the slaughterhouses based on:
Please indictae the percentages.

	Heavy weight broilers %	Light weight broilers %
a) The type of strain		
b) Basic price per kg (live)		
c) Basic price per kg (slaughter)		
c) Basic price per broiler		
d) Different payment per category of weight [9]		
e) Uniformity		
f) Special cost compensation[10]		
g) Quality bonus [11]		
h) Other……..…		
i) A combination of……..		

The payment formula is:……

[9] *example: 2 € for (2.100-2.200gr)*
[10] *GMO –free feed, special breeding brands*
[11] *Salmonella and Campylobacter free etc*

11. The price of broilers is set:

a) Weekly b) Monthly c) Per delivery d) Other……..

12. Does a contract lead to a better price comparing to free market for broiler farm?

_____

13. Do slaughterhouses share information?

- a) With broiler farms? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

- a) With hatcheries? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

- a) With breeder farms? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

- a) With feed companies? Yes No
  If yes, what information do they share?

  b) Is the reason the existence of a contract?

14. Is the price of broilers negotiable?

Part 6

- Are there any informal agreements among chain participants?

- Which are the Top3 failures of the broiler chains in Netherlands?

- What would be the ideal contract for you?