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PRODUCTION CONTRACT PERFORMANCE IN TOMATO PROCESSING INDUSTRY: ANALYSIS OF ALGERIAN CASE

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Abstract:

This paper analyses empirically the processing tomato market and contracting practice in Algeria. We use extensive data on production outcomes for processing tomato growers (including 3758 coordinated grower-processor contracts) to examine the performance of grower-processor contracts. The aim of this study is to characterize the empirical relevance and regularities in tomato processor-grower provision contract. Results indicate that technology differences and regional specificity affect significantly the contract performance (fulfillment) of tomato processor-grower contract. Some policy implications are derived from this study in order to highlight the main considerations to be taken into account by the involved regulatory office.
Keywords: *Vertical contract, Performance, Coordination, Tomato sector, Algeria.*
JEL Classification: *D02, D22, Q12, Q13*

1. Introduction

Vertical relationships in tomato industry have an important role in the food supply chain. More specifically, contracting and other forms of vertical coordination are important parts of the supply chains for many agricultural products (Goodhue *et al*., 2010). The changes that today characterize the agro-industrial sector in developing countries arise from adjustments that have accumulated over time, thereby creating a new productive and organizational reality. This reality is mainly expressed thought the development of complex relationships among the agents that operate in the various segments of the supply chains (Monteiro *et al*., 2012).

The grower-processor contract on tomato production is a recent practice in Algeria. The production of processing tomatoes since 2005 was generally governed by a written contract between few processors and individual growers. It seemed that processors were not able to enforce the contracts in order to meet the available production capacity or to satisfy the domestic demand in the absence of incentive schemes for growers.

In the last year (2015), an important institution intervene in the tomato market by mediating exchange between growers and processors. The National Inter-Professional Office for Vegetables and Meat (Ministry of Agriculture) is a public entity that arbitrates contract terms about the vertical relationships in tomato supply chain. This regulatory office has imposed some incentive schemes for growers to contract their production. Thus, the contracts offered

by processors are take-it-or-leave-it contracts from the perspective of an individual grower, meaning that contract terms are exogenous. The question is to examine production contract performance in the presence of a public intervention and to highlight the empirical regularities in the tomato grower-processor contracts.

Advances in theoretical studies of contracts have significantly improved our understanding of the role played by information constraints in shaping various kinds of market and non-market institutions (Hueth and Ligon, 2002). The most common regularity in contract performance is the fulfillment of contractual terms. Because of the biological relationships governing tomato quality and production process, it is expected to have interactions, but their nature will be influenced by growers' profit-maximizing behavior, which in turn is affected by the incentives offered in contracts (Goodhue *et al*., 2010).

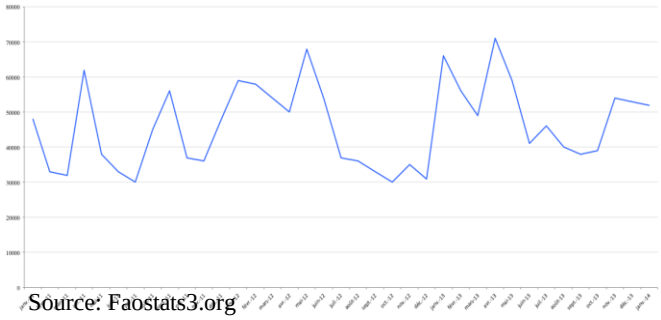
There are relatively few studies on the performance of tomato contracting around the word. We can find principally Hueth & Ligon (2002) in California (USA), Dileep *et al*., (2002) and Rangi & Sidhu (2000) in India, Tatlidil & Akturk (2004) and Gunes (2006, 2007) in Turkey; Zhu & Wang (2007) and Guo & Jolly (2008) in China. Accordingly, this paper is motivated by the absence of studies on tomato production contract in Algeria, and by the inquiry to highlight the major features and problems in regulating tomato processor-grower contracts through an empirical analysis in our context.

The paper is organized as follows. Section 2 presents an overview of tomatoes contracting in Algeria. Section 3 provides the empirical results and discussions. Section 4 concludes.

2. Tomatoes Contracting in Algeria

The grower-processor contractual arrangement of tomato production is a recent practice in Algeria. Before 2005, tomato processors (canneries) were compelled to deal with importation companies in order to provide industrial concentrate tomatoes. But since 2005, the government programs for agricultural development aimed to encourage the private initiatives in many agricultural outputs, such as industrial tomatoes. Until last year (2015), the production contract for processing tomatoes was established between a private farmer (a tomato grower) and a private firm (tomato processor). Many serious problems raised in such case in our context. The main problem was in the market structure from the side of processors. There were a few number of tomato processors (two processors, one from the public sector and another from the private sector), and those two firms couldn't in any case to satisfy the domestic demand. This problem was overcome by the promotion of industrial tomato production through the easy access for individual private initiatives. We have now exactly 20 tomato processors (cannery) across the country. From the other side of the market structure, another very serious problem was taken place. Tomato growers have no incentives to contract with processors for two reasons: the absence of private enforcement mechanisms and the price fluctuation of tomato market. The Figure 1 shows the monthly fluctuation of tomato price in Algeria based o the FAO statistics.

As shown in this figure, the tomato market price presents instability during the year (2011-2014). Through these fluctuations, growers could find the market price more advantageous if the predetermined price in the contract does not present any incentives to fulfil the provision contract. This situation was subsisted by the two actors in the tomato sector in Algeria for 10 years (2005-2014). The ministry of agriculture has established in 2010 a regulatory office and it was operationalized in 2014. This regulatory institution, "National Inter-Professional Office for Vegetables and Meat", was charged to regulate such problems in vegetables and meat in agrifood chain value. By his intervention in the vertical relationships between tomato processor and growers, this institution has arrived to coordinate vertically the industrial tomato sector through an explicit written contract at a predetermined price with premium incentive scheme.



Source: Faostats3.org

Figure 1. Monthly Fluctuation of Tomato Price in Algeria (Jan. 2001 – Fab. 2014)

All contracts generally specify tonnage and acreage to be devoted to producing tomatoes under that contract. The contractual specification of acreage and the clauses of the contract regarding the grower's obligations provide the processor with a legal claim on all tomatoes harvested from those fields until the grower's delivery commitment is satisfied.

The tomato growers present seemingly technology differences. Principally, differences in harvest technology, in irrigation technology and in specialization gains. Processing tomatoes are harvested using two methods: a mechanical harvester and manual harvester, it is irrigated by a drip irrigation system or by surface irrigation system. Some growers gain from specialization in tomato season or prefer to diversify their farm output.

Actually, there is a total of 3 758 coordinated grower-processor contracts for tomato production in Algeria. After the examination of the extensive data, this first experience of coordination in the tomato sector revealed a number of serious problems. The possible origin of these problems is the information asymmetry in grower-processor contracts.

3. Empirical Results and Discussions

3.1. Data

Contracts between tomato processors and growers in Algeria (last farming campaign 2015) were studied. Our study uses an extensive data on production contracts outcomes for processing tomato growers mediated by the National Inter-Professional Office for Vegetables and Meat (Ministry of Agriculture). It includes a total of 3758 contractual arrangements for tomato provision. The study of the contracts allowed as the identification of the main variables such as: The area contracted (in hectares), the quantity contracted (in tons), the quantity effectively delivered (in tons), and three technical aspects about the inputs specification in contracts, such as: the harvesting technique, the irrigation system, and whether the tomato grower is specialized or not.

3.2. Analysis of Algeria Processing Tomato Markets

The Table 1 summarizes the flows of contracted tomato production (delivered and received) in three kinds of region: our data show that there are regions having processors and growers (Region I), regions including only processors (Region II), and regions with only growers (Region III). The total contracted tomato production in Algeria for the last campaign is 6 564 418.65 tons. The Table 1 shows the distribution of this total production between the three kinds of regions.

The Region I shows a production surplus of 1 498 489.08 tons, and the Region III have only the production of 260 471.03 tons without reception (no tomato processors). By adding these two surpluses, we obtain the total reception of region II (with only processors) of 1 758 960.11 tons. It seems that the tomato production flows are balanced between regions.

Table 1. Contracted Tomato Production: Processors and Growers

Processor/Grower Regions	Tomato Quantity Received in Regions	Tomato Quantity Produced in Regions
Region I	4 805 458.54	6 303 947.62
Region II	1 758 960.11	0
Region III	0	260 471.03

Table 3 (in Appendix) shows in details contracted tomato production (delivered and received) by processors. The first column represents the district (wilaya) name: it seems that there are 13 districts concerned in contracting tomato production. The second column represents the processor (cannery) name. We have a total of 20 processors across the country localized in 8 districts. The third column represents the total quantity of received tomato production by cannery. The fourth column represents the market share in term of total received tomato production. The rest of the table corresponds to the data summarized above in Table 1.

The market share of tomato processors shows significant results. We can establish two measures for market structure of tomato provision. The first is the Herfindahl-Hirschman index[i]. From our data, this index is equal to 1 445, indicating a moderately concentrated market. The second measure is the four-firm concentration ratio[ii]. In our case, this ratio is equal to 57%. This indicates that the industry is an oligopoly (with medium concentration). The four largest firms in the Algerian tomato industry are respectively: (1) The CAB (Cannery of Amor Benamor) with a share of 33,16% in Annaba, (2) The Nlle Ere with a share of 8,58% in Setif, (3) The cannery Amour with a share of 7,84% in Blida, (4) The cannery of Latina with a share of 7,42% in Mila. It should be noted that the three last largest ones are localized in Region II.

The total contracted area for tomato production in Algeria is 19 408,56 hectares. It includes 39 growers having more than 20 hectares, and 128 growers owning an area less than 2 hectares. In order to show the whole distribution of the cultivated area across the country, Figure 2 shows the relative frequencies of the distribution[iii] of the tomatoes cultivated area in Algeria among 3 758 growers.

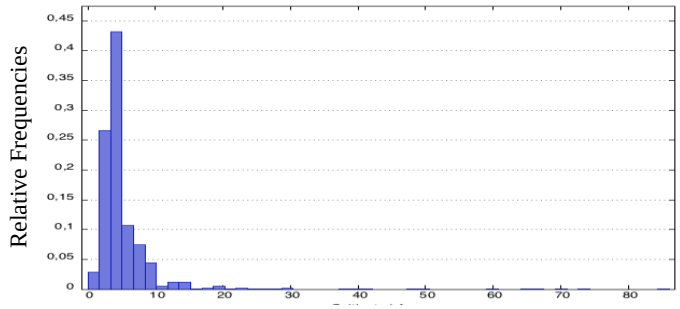


Figure 2.Relative Frequencies of the Distribution of Tomatoes Cultivated Area in Algeria

It seems from the Figure 2 that the portion that has the higher frequencies is roughly from 2 to 6 hectares, where the interval 3,5 to 5 hectares has the highest frequency (43,1%). This indicates that the optimal farm size is approximately 4 hectares.

3.3. Determinants of Contract Performance in Tomato Industry

In the first experience in coordinating vertical relationships in tomato industry, our main observed phenomenon is the fulfillment of contractual terms. The extensive data used here allowed us to obtain a very useful indicator of contract performance by growers. It is a measure of the rate of deviation (*DEV*) between quantity effectively delivered and quantity contracted. This variable could be expressed as follows:

$$DEV = Q_c - Q_d \quad [1]$$

where Q_c represents the quantity in grower-processor contract, and Q_d quantity effectively delivered by growers. The values of *DEV* are expected to be around about 100%. But used extensive data shows that the interval is between 0% and 600% with an average[iv] of 48,3%. In order to show the distribution of this variable among tomato processor-grower contracts, the Figure 3 represents the estimated frequency[v] plot of the deviation rate.

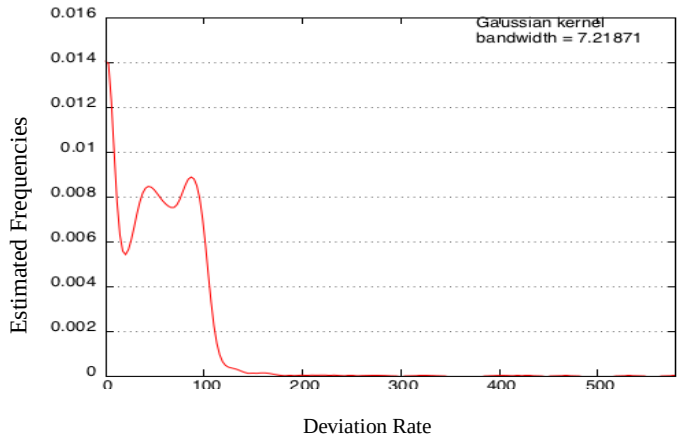


Figure 3. Estimated Frequency of the Deviation Rate for Tomato Contract in Algeria

It seems that there is a portion of contracts presenting a full respect also the average is displayed in the adjacent maximum of the kernel function. It is worthy to mention that the portion of non-fulfilled contracts presents a higher frequency. On the other side, we have some contracts present very large values, which could be represented as anomalies.
Now, we put this variable in relation with another important one. The grower yield seems to affect his behavior. The farm yield (*FY*) is computed as follows:

$$FY = Q_d / S \quad [2]$$

where *S* represents the farm area in contract. In order to display the relationship between the deviation rate and the farm yield, Figure 4 represents a plot of these two variables, where the deviation rate in the vertical axis and the farm yield in the horizontal axis.

It seems that there is a positive relationship between the deviation rate and the farm yield. It is noteworthy to mention the coexistence of two tendencies in this relationship (marked by dashed lines). This indicates that the technology differences matter in contractual behavior of the tomato growers.

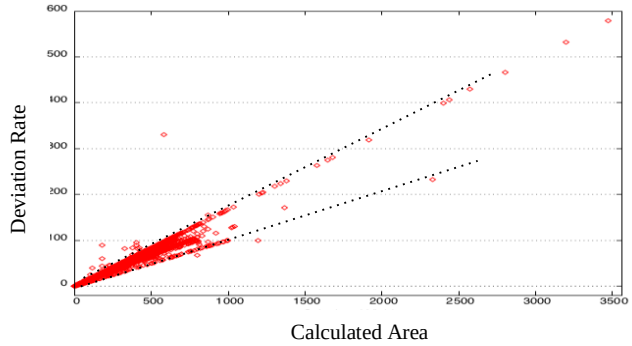


Figure 4. Plot of The Deviation Rate as Function of Farm Yield

In order to illustrate the effect of technology differences on the contractual behavior of the tomato grower, we proceed now an econometric modeling. Two model specifications have been designed. Model 1 uses a qualitative-binary dependent variable to capture the occurrence of contract fulfillment. Consequently, we use the Logit model specification with sample selection[vi] in order to determine the factors influencing growers' contractual performance. Contract fulfillment (performance) was defined when the production effectively delivered was more or less than 25% of the contracted quantity. This limit was set considering an average based upon the expected losses of production due to technical conditions. The Logit model can be written as follows:

$$P(D = 1 \mid X) = \Gamma(\alpha X) = [\, e^{\alpha X} / (1 + e^{\alpha X}) \,] \qquad [3]$$

where X is a vector of explanatory variables, α is a vector of coefficient parameters and $\Gamma(.)$ represents the logistic cumulative distribution function. The variable D takes the value of 1 if *DEV* is between 75% and 125%, and takes the value of 0 if *DEV* is between 0 and 75%[vii].

Model 2 defined a limited dependent variable as the percentage of tomato production delivered with relation to the total stipulated in the contract (D'), thereby generating a censored variable allowing for the use of a Tobit model. The Tobit model can be written as follows:

$$E(D' \mid X) = D' \quad if \quad 0 < DEV < 100 \qquad \begin{cases} 1 & if \quad DEV = 100 \\ 0 & if \quad DEV = 0 \end{cases} \qquad [4]$$

This model is appropriate since the dependent variable is a measure that takes values between 0 and 1 inclusive, as a special case of censored regression models[viii], and employ the maximum likelihood estimation technique in order to produce consistent estimates of the parameters of the Tobit model, under appropriate assumptions, such as homoscedasticity and normality of the error terms[ix].

The explanatory variables in our two models are: The irrigation system (*IRS*) captured by a binary variable. It takes the value of 1 if grower uses drip irrigation system and takes the value 0 if he uses a surface irrigation system. The tomato harvest technique (*HARV*) captured by a binary variable. It takes the value of 1 if the grower uses mechanical harvester (a reaper) and takes the value 0 if he uses manual harvesting. For the specialization of tomato growers, we use a binary variable (*SPEC*) taking the value of 1 if the grower is specialized in tomato culture and takes the value 0 if his farm is diversified simultaneously with tomato production contracting. The regional location of growers is captured by a design variable.

Table 4 (in Appendix) shows descriptive statistics of the extensive data used in this study (with 3 758 observations). The table includes the dependent variables, the contractual terms, and the explanatory variables of the econometric modeling. It shows a mean of 0.521 for the binary variable D indicating that 52.1% of growers fulfill their contracts (with less or more than 25%). The censored variable D' presents a mean of 0.482 which means that 48,2% is the average of deviation rate for a typical grower. Concerning the contractual terms in tomato provision, it seems that the average of the cultivated area (*S*) is 5.16 hectares (values between 0.6-85 hectares), the average of the contracted quantity (Q_c) is 3 589.3 tons (with high standard deviation), where the effectively delivered quantity (Q_d) has an average of 1 746.8 tons (lower standard deviation compared to Q_c). It was easy to calculate the contracted yield. It has the value of 6.84 tons/Ha, where the calculated yield from Q_d is equal to the half, 3.27 tons/Ha (with lower standard deviation).

Table 2. Regression Estimation Results of Contract Performance for Tomato Processing Industry in Algeria

Explanatory variables	**Dependent variables**			
	D		**D'**	
Technical Constraints				
IRS	0.022 (0.179)		0.004 (0.204)	
HARV	0.751 (1.911)	*	0.635 (2.518)	**
SPEC	0.041 (0.336)		0.005 (0.026)	
Growers' Region				
RELIZANE	1.497 (6.960)	***	0.141 (0.484)	
CHLEF	2.195 (6.813)	***	0.406 (9.784)	***
AINDEFLA	0.727 (2.244)	**	0.312 (4.935)	***
TIPAZA	0.873 (2.011)	**	0.744 (9.362)	***
SKIKDA	1.441 (10.89)	***	0.387 (16.76)	***
GUELMA	0.314 (2.199)	**	0.658 (24.84)	***
ANNABA	1.060 (6.917)	***	0.309 (11.12)	***
ELTARF	1.050 (7.001)	***	0.395 (14.73)	***
OUMBOUAGHI	1.075 (2.232)	**	0.768 (4.094)	***
SOUKAHRAS	1.382 (1.919)	*	0.245 (1.960)	*
R2 adjusted	0.257		0.934	
R2 McFadden	0.255		/	
Log-Likelihood	−2000.61		−2395.15	
Likelihood ratio test: $\chi(12)$	154.65 [0.0000]		78.39 [0.0000]	

From the side of the technical constraints of tomato growers, we have 50.8% of growers used drip irrigation system, 47.3% used the mechanical harvester, and 44.4% were specialized in tomato during the contract season. The growers' regional location of is shown by the different percentages, where *Skikda* (has 46.6% of growers) has the highest frequency of growers. These percentages reflect, on one hand, the agricultural vocation for tomato farming, and on the other hand, the regional specificity for the social and climatic differences for the tomato production. Estimation results and measures to assess the goodness of fit for both model 1 and model 2 are reported in Table 2.

Before the modeling procedures, the multicollinearity was checked using variance inflation factor for the twelve variables. The calculated VIF values are all less than 10 (the cut-off point), which indicated that multicollinearity is not a serious problem. The Adjusted R-squared coefficient is acceptably high for both models and show higher significance level for the McFadden R-squared (for Logit), and the Log-likelihood ratio test.

In both models, the use of drip irrigation system and the specialization dummies doesn't have statistical significant effects on the respect of contractual terms. In contrast, the most significant result is the effect of dummy HARV. It seems that the use of mechanical harvester in tomato production has a statistically positive significant effect on the fulfillment of contractual terms (an estimated coefficient of 0.751 with z-statistics of 1.911 for the Logit model, and a marginal effect of 0.635 with z-statistics of 2.518 for the Tobit model).

In order to illustrate graphically the effect of the use of mechanical harvester on deviation rate from contract, we use the residual plot. Figure 5 shows the graphic of the residual of deviation rate variable in the model.

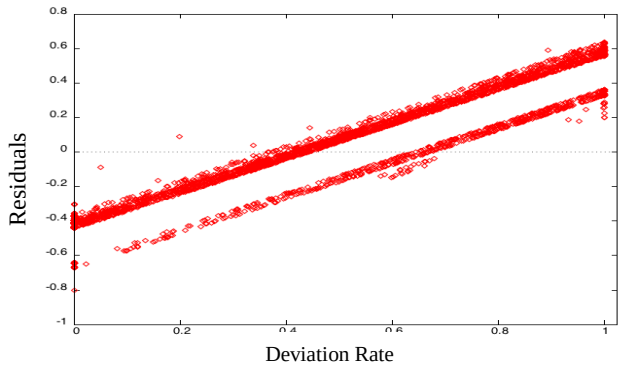


Figure 5. Plot of Residuals of Deviation Rate Variable

From this figure, the technological differences appear distinctively in two tendencies as expected from Figure 4. This distinction is due to the used technology, more specifically the use of mechanical harvester. The remaining dummies reflecting the regional location seem to have all significant positive effects. This indicates that the regional specificity plays an important role in tomato production contract performance.

3.4. Policy Implications of the Study

As first experience of tomato contracting in Algeria, the tomato market should require more attention by the government by regulating more efficiently the vertical relationships in agrifood supply chain. The market structure of tomato industry in Algeria should be studied more intensively in order to arbitrate the balance between domestic potentials in terms of production and demand. The regulated vertical contracts of tomato grower-processor studied here present some weaknesses in terms of performance and enforcement. The most important result from this study is that contract fulfillment (performance) is significantly affected by the

technology differences. The role of public contract enforcement mechanisms in improving tomato grower-processor contract fulfillment rate depends on introducing some input specifications in contract design. The involved regulatory office should consider the technology differences between tomato growers and their regional specificity in order to reduce the likelihood of contract default by tomato growers. The implication is that the use of some technology (specially harvest technology) should be specified in the contract.

Another result should be highlighted regarding the absolute non-fulfillment of contractual terms and the over-fulfillment in terms of the unexpected huge quantity delivered. The absolute non-fulfillment of contractual terms came from the weakness of enforcement mechanisms and the opportunism of growers as profit maximizing agents. This is due to the price fluctuation in tomato market. More elaborated incentive schemes should be considered in terms of price premium and renegotiation. On the other hand, the problem of over-fulfillment in terms of the unexpected quantity (up to 600%) could be explained by two reasons: (1) the intermediation problem, where large growers having a developed transport logistics intervene between smallholders and the processors, or (2) the information asymmetries, where the growers contract with many processors and deliver to one. The policy implication here stipulates that the involved regulatory office should interfere to enforce efficiently the tomato grower-processor contracts by considering transport logistics services in involved regions and reducing the effects of information asymmetries in contracts.

4. Conclusion

Our aim has been to characterize the empirical relevance and regularities in tomato contract provision across processor-grower contracts by using an extensive data. The study of the quantitative analysis of production contract performance in the Algerian tomato processing industry allows us to conclude that: (1) The likelihood of contract fulfillment is greater when mechanical harvesting is used at the farm level, where it is found that technology differences affect the delivery share (deviation from contracted quantity). (2) The geographical location of growers does matter in the performance of tomato production contract.

The role of public contract enforcement mechanisms in improving tomato grower-processor contract fulfillment depends on introducing some input specifications in contract design and that should be seriously considered by the regulatory public office. It can be suggested that to increase tomato production and develop the tomato processing industry, the government as well as other private integrators can take initiatives to spread an effective and well organized vertical contract system in Algeria.

Some shortcomings remain with our research. In this study, we only have had access to information about contract default by tomato growers. Also, our study is limited to identifying factors that influence tomato growers' decisions to fulfill contracts. In fact, there are many other factors such as the structure of the market, level of competition and logistic facilities that will affect the tomato growers' contract performance. These factors should be taken into account in future empirical research.

Acknowledgments

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APPENDIX

Table 3. Details on Contracted Tomato Production: Processors and Grower

Tomato Processor Region	Processor (Cannery) Name	Received Tomato Production	Reception Share of Processors	Production Received in Region	Tomato Production in Regions	Deficit or Surplus in Region
Region I						
Annaba	*BONOISE*	2 094 846	0,32	75 344 549	66 090 112	-9 254 437
	SICS	30 180 190	4,60			
	SIPA	15 721 418	2,39			
	SOUMAA	27 348 095	4,17			
Chlef	*TELLOISE*	11 634 374	1,77	11 634 374	20 993 370	9 358 996
EL Tarf	*CARAJUS*	15 489 039	2,36	94 973 270	108 474 040	13 500 770
	BOUTHELJA	4 508 520	0,69			
	ELBOUSTAN	20 295 280	3,09			
	GRA	885 161	0,13			
	AURES	26 669 900	4,06			
	SACA	27 125 370	4,13			
Guelma	*CRIEDESUD*	17 470 140	2,66	261 906 041	192 959 247	-68 946 794
	LABIDI	26 789 431	4,08			
	CAB	217 646 470	33,16			
Skikda	*IZDIHAR*	36 687 620	5,59	36 687 620	241 877 993	205 190 373
TOTAL		**480 545 854**			**630 394 762**	**149 848 908**
Region II						
Bilda	*AQUASIM*	8 325 871	1,27	70 869 971		-70 869 971
	AMOUR	51 455 640	7,84			
	SICAM	11 088 460	1,69			
Mila	*LATINA*	48 714 600	7,42	48 714 600		-48 714 600
Setif	*NLLE ERE*	56 311 440	8,58	56 311 440		-56 311 440
TOTAL		**175 896 011**	**100,00**			**-175 896 011**
Region III						
Ain defla	/	/	/	/	15 967 566	
Bouaghi	/	/	/	/	1 385 840	
Relizane	/	/	/	/	119 336	
Soukahras	/	/	/	/	735 860	
Tipaza	/	/	/	/	7 838 501	
TOTAL					**26 047 103**	

Table 4. Descriptive Statistics of Extensive Data on Tomatoes Contracting in Algeria

Variables	Mean	Min.	Max.	S.D.
Dependent variables				
D	0.521	0	1	0.406
D'	0.482	0	1	0.351
Contractuels terms				
S	5.164	0.60	85	4.464
Qc	3 589.3	300	76 500	3 741
Qd	1 746.8	0	68 978	2 775
FY	3.27	0	34.76	2.77
Technical Constraints				
IRS	0.508	0	1	0.421
HARV	0.473	0	1	0.499
SPEC	0.444	0	1	0.447
Grower's district				
RELIZANE	0.005	0	1	0.023
CHLEF	0.034	0	1	0.181
AINDEFLA	0.013	0	1	0.115
TIPAZA	0.007	0	1	0.087
SKIKDA	0.466	0	1	0.498
GUELMA	0.179	0	1	0.384
ANNABA	0.134	0	1	0.341
ELTREF	0.160	0	1	0.367
OUMBOUAGHI	0.013	0	1	0.036
SOUKAHRAS	0.015	0	1	0.039

[i] The Herfindahl-Hirschman index (HHI) is a commonly accepted measure of market concentration. It is calculated by squaring the market share of each firm competing in a market, and then summing the resulting numbers, and can range from close to zero to 10,000.

[ii] The four-firm concentration ratio consists of the market share of the four largest firms in an industry, expressed as a percentage, is a commonly used concentration ratio.

[iii] The number of bins equal to 50

[iv] Values of zero mean that the contract not at all respected, values between 0 and 100%, indicate that the contract is relatively respected but with insufficient quantity, values of 100% mean that the contract is fully respected, values slightly more than 100% indicate that the contract is relatively respected but with more unexpected quantity, and values far from 100% (up to 600%) mean that there is a large unexpected quantity is delivered (over-fulfilment).

[v] Using a Gaussian Kernel with unitary bandwidth factor. The formula used to compute the estimated density at each reference point, *x*, is

$$f(x) = \frac{1}{nh}\sum k(\frac{x - x_t}{h})$$

where *n* denotes the number of data points, *h* is a bandwidth parameter, and *k(.)* is the kernel function.

[vi] As described by Greene (2003) and Gujarati (2000).

[vii] The values from 125 up to 600% are excluded from the sample (i.e., there are 52 observations will be excluded).

[viii] The values up to 100% are excluded from the sample (i.e., there are 162 observations will be excluded).

[ix] According to Wooldridge (2010) and Greene (2003), the estimated coefficients identify the marginal effect of the explanatory variables on the deviation rate.