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GRAIN IMPORTS RISK HEDGING IN MOROCCO

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Abstract

Hedging price risk has become an increasingly popular activity around the world. This paper is devoted to analyze the main determinants that help Moroccan cereal importers use hedging instruments. Based on an application of Heckman model (1979), our empirical approach aims at determining the behavior of import companies face to price risk. The results show that firm size is a key determining factor in hedging decisions. More precisely, our findings suggest that the turnover of the company is positively related to the purchase of hedging contracts. The same relation is noted between risk aversion, risk premium, risk perception and adopted import pattern (self or grouped), on one hand, and using futures contracts, on the other hand. Surprisingly, variables such as total import volume, risk management structure or selling patterns are either not highly significant or not significant at all. These results based for the first time in Morocco, at our knowledge, open the door to further investigations that aim at better understand the underpinnings of Moroccan cereal importers behavior face to price risk at the world market.

Keywords: *Grain imports, futures markets, hedging, risk management, Morocco.*
Jel Codes: *C34, D22, F14, G23, G40, Q02.*

1. Introduction

Financial risk management is of great interest for companies looking to better manage their activity and ensure better financial stability. Variables of interest include currency risk, interest rate, commodity prices and equity prices. In 2009, the International Swap Dealers Association indicated that 94% of the 500 largest American companies (Fortune 500) use derivatives to manage the exchange rate (93.6% of them), the interest rate (88.3%) or the price of commodities (50.9%).

Several studies (Benkhediri, 2006; Bodnar *et al.*, 1998; Clark and Judge, 2017; Donohoe, 2015) have been carried out with the aim of studying individual decisions about risk and characterizing the factors that influence use of hedging instruments by importers. However, to our knowledge, no academic research has been undertaken in the case of Moroccan cereal

imports. Nevertheless, Jouamaa *et al.* (2020) report that the use of hedging instruments remains limited in Morocco since less than 26% of import companies do so.

This paper analyzes the behavior of Moroccan cereal importers facing the price risks. Using an econometric model, we aim to determine the factors that influence the decision of importers regarding the use of hedging instruments. The first section provides an overview of the investigations that have been carried out risk management, focusing on the main determinants underlying decision of importers. Then, the methodological approach is reported in the second section. The third section reports empirical research results.

2. Literature Review

According to Modigliani and Miller (1958), both the financing structure and the risk management policy do not affect the value of the firm[1]. However, these findings based on the absence of tax, transaction costs, information asymmetry and conflicts of interest are considered unrealistic.

The theory of the hedging behavior of value-maximizing corporation introduced by Stulz (1984) and Smith and Stulz (1985) relaxes the perfect market assumptions of Modigliani and Miller (1958). Their assumptions implicitly assume that managers act in the interests of shareholders, but they ignore conflicts of interest that may exist between stakeholders and the mode of decision-making within the company. Agency theory (Jensen and Meckling, 1976) and the incentive-signaling approach (Ross, 1977) are based on information asymmetry and on conflicts of interest, which may exist between the main partners of the company.

In financial theory, several empirical studies have been carried out to determine the key variables that underlie the use of the hedging instruments. Indeed, these risk determinants can be grouped into three main categories. The first category includes the determinants that maximize the value[2] of the firm, namely investment capacity, financing factors, tax burden and debt level. The second includes those related to the risk aversion and the assumption of maximizing the usefulness of managers. The third category concerns various hypotheses such as the size of the company, sector activity regulation, governance instruments and shareholder categories. Following are the main recent conclusions reported on the hedging determinants along with the adopted methodology.

As for the first category, some researchers have considered the firm's value as a determining factor in the use of derivatives. Indeed, Carter *et al.* (2002) and Nain (2004) show that hedging financial risks increases the value of the company. From a study based on a sample of 28 airlines, Carter *et al.* (2002) showed that jet fuel hedging increases the firm value. Giraldo-Prieto (2017) points out that the use of financial derivatives generates a positive value of almost 6.4% for companies. However, Allayannis and Weston (2001), Guay and Kothari (2003) and Brown *et al.* (2006) find no significant correlation between shareholders benefit and the use of derivatives, while Korkeamäki *et al.* (2016) find a weakly significant relationship between the value of companies and the price risk hedging.

On the other hand, the incidence of bankruptcy costs due to financial distress is cited by several authors as a determining factor in risk management for non-financial businesses. Benkhediri (2006), Geczy *et al.* (1997), Tufano (1996) and Visvanathan (1998) find a positive correlation between financial difficulties, debt ratio and hedging. Aretz *et al.* (2007) and Clark and Judge (2017) also find that the costs of financial distress are key determinants of the demand for currency risk hedging instruments. However, Nance *et al.* (1993) and Mian (1996) do not corroborate this result.

Moreover, Dionne and Garand (2003), Mian (1996) and Nance *et al.* (1993) confirm that correlation between firm's tax function and hedging is positive. In addition, Nance *et al.* (1993) show, through logistic regression modeling, that it is the investment tax credits that push companies to hedge against risk. Mian (1996) underlines that incidence of export tax

provisions is associated with a higher hedging likelihood. Dionne and Garand (2003) indicate that a higher convex tax function is positively correlated with the hedging strategy. Donohoe (2015) showed that firms using derivatives have tax rates that are approximately 3.3% lower than those of non-users. Other authors (Geczy *et al.*, 1997; Tufano, 1996) find that tax loss forwarding does not encourage companies to hedge.

Turning to the second category, Bartram *et al.* (2009) found, from a sample of 7,319 of non-financial firms in 50 countries, that the level of liquidity and the risk aversion rate are the most determining factors in the use of derivatives. Also, Aretz *et al.* (2007) showed that risk hedging provides a response to the risk aversion of managers and makes it possible to reduce the volatility of cash flows by eliminating or reducing unsystematic risk. Conlon *et al.* (2016) claimed that the optimal futures hedge ratio decreases for lower risk aversion because it is associated with higher levels of speculation. They added that hedgers with high risk aversion and short horizon significantly reduce the risk of the hedge portfolio but have inferior utility than those with low risk aversion.

Finally, for the third category, many authors find that there is a positive correlation between the size of the firm and the use of derivatives. Indeed, based on a large sample of American non-financial companies, Bodnar *et al.* (1998) reported that 83% of large companies and 12% of small firms use derivatives. Berkman *et al.* (1997) showed that, out of 79 New Zealand companies, all large firms use these products compared to only 36% of small firms. Similar results were obtained by Mallin *et al.* (1997) showing that all large companies use these instruments against only 29% of small firms in the United Kingdom. Nguyen and Faff (2003) and Yilmaz and Kurun (2007) corroborate such findings according to which the large companies will be more encouraged to use derivatives. Rais (2012) analyzed a sample of more than 400 French non-financial companies and concluded that size is a determining factor in managing financial risk.

Furthermore, the activity of the company is also considered as a determining factor. Bodnar *et al.* (1998) showed that the use of derivatives is higher in primary product firms (68%) and manufacturers (48%) than in service sector firms (42%). Loderer and Pichler (2000) claim that manufacturers do not quantify their currency risk exposure but they protect themselves before and after exchange rates reach worrying levels. Rais (2012) reports that 65.8% of listed companies implement a price risk hedging strategy against only 19.7% of unlisted companies.

The degree of diversification is also cited by some authors (Muller and Verschoor, 2005; Rais, 2012). A company which operates in an import-export context or which has a diversification of foreign operations would have more recourse to the futures for hedging than those operating locally. They also note that it is the largest companies that hedge risks and that these generally operate in an unregulated sector. Once the decision to hedge is taken, the hedging operation will depend on the tax incidence, the costs of financial distress and the firm's investment and financing plans.

The ownership structure has also been cited in the literature. Benkhediri (2006) finds that the ownership structure of the company is one of the significant determinants of the decision to use derivatives by a sample of 320 French non-financial companies. The results of Butt *et al.* (2018) show that the concentration of ownership has a negative impact on the use of derivatives. Indeed, concentrated owners (major shareholders, family businesses) and associated businesses are less likely to use derivatives for hedging purposes. On the other hand, managers are more encouraged to use derivatives to increase the value of their shares.

Continuing the list, Baranauskas *et al.* (2003) investigated the management of exchange risk in Lithuanian companies and found that the wider use of derivatives was hampered by relatively high costs, lack of managerial knowledge, mistrust of banks and complicated accounting procedures. On their part, Chaudhry *et al.* (2014) affirm that the foreign purchases variable to cover the procurement of goods, commodities and services is determining hedging decision for a 75 non-financial companies sample listed in Pakistan stock exchange.

Finally, Rais (2012) introduced the organization function of risk management, which depends on several variables including the presence of a risk management service, the size and attachment of the service, the training level of risk manager and the presence or absence of risk management information system. Using a Tobit model, he found that the organization of the risk management function is decisive for the intensity of hedging.

This paper aims at contributing to the determination of the factors, which influence the hedging decisions of Moroccan cereal import companies. It takes into account the above literature review but also other variables resulting from our interviews with the managers of cereal importing companies as well. As follows, we present the methodological approach adopted and subsequently analyze the obtained results.

3. Methodology

The adopted approach to analyze import hedging instruments includes two investigative tools, namely: field surveys of grain importing companies and econometric models. The first tool provides primary data of companies' risk management practices, while the second analyzes the determinants of used future contracts to manage their price risks. The variables we want to explain are the choice or not to use hedging instruments by the importer and, if so, the volume of hedged contracts on the futures market.

3.1. Theoretical Background

The econometric models treated in the literature to characterize the behavior of companies facing financial risk are notably Logit, Multinomial Logit, Probit or Tobit models. Our sample is characterized by censored data with situations in which the dependent variable is only observed for positive values. Thus, the necessary condition for studying the factors that influence hedged quantities on the futures markets is that the company concerned chooses to hedge.

The model developed by Heckman (1979) is the underpinning theoretical model that we used to explain the volume of contracts purchased by grain importers to hedge against price risk. This model consists in identifying the sources of differentiation existing between two populations, i.e. companies whose value of the dependent variable (volume of contracts) is strictly greater than 0 and individuals whose value is equal to 0. In the first step of this procedure, we will estimate, using a Probit model, the effects of the different variables of the model on the dependent variable (selection equation) and estimate the inverse of Mills ratio, which is used in the second step as a regressor by making adjustment to the standard error and t-value.

The inverse Mills ratio λ_i is a bias correction term that controls for the effect of observable and unobservable determinants of a firm's decision to hedge. This ratio (λ_i) is defined as the ratio of the standard normal density, φ, divided by the standard normal cumulative distribution function, ϕ[3].

$$\lambda_i = \varphi(W_i\hat{\alpha}) \Big/ \phi(W_i\hat{\alpha}) \quad (1)$$

At the second stage level, we will run a linear regression regarding only those who buy hedging contracts.

Thus, the selection equation and the substantial equation can be formulated as follows:

- Selection equation: Purchase hedging instruments, observed only if company i purchases a contract,

$$z_i = \omega_i\gamma + \mu_i \quad (2)$$

- Substantial equation: Volume of hedging contracts, observed only if $z_i > 0$,

$$y_i = x_i\beta + \varepsilon_i \quad (3)$$

Where ω_i and x_i are the observable explanatory variables; μ_i and ε_i are error terms with a normal distribution;

The dichotomous variable z (Purchase or not hedging instruments) determines whether or not y (volume of hedging contracts) is observed, y being only observed if z = 1. Then, the value expected from y is modeled provided that it is observed[4].

3.2 Empirical Approach

The choice of explanatory variables was largely shaped by reviewed literature but also driven from our discussion with professionals and our own knowledge of cereal import sector. Thus, the explanatory variables of hedging contracts fall into three categories. The first category is related to the level of importers' risk aversion which encompasses risk aversion, risk perception and risk premium. The second category stands for the size of the company and the volume of its transactions such as turnover, import quantity, integration degree and diversification degree of the company (quantities of cereals sold locally compared to those imported). The third and last category comes to the activity and the structure of the company, namely the nature of the imported products (Soft wheat, Durum wheat, Barley and Corn), mode of sales[5] (valuated at local or foreign currency), import mode[6] (Self import or grouping with other importers), transportation and logistics activities, ownership structure (family or not) and the company's risk management structure (service risk management, management of the service, size of the service and presence of a risk management information system).

It should be noted that certain variables, which reflect the financial characteristics of companies (See for instance Benkhediri, 2006; Constantin, 2016; Dionne and Garand, 2003 and Rais, 2012), were not included in our model because we did not have clear and/or reliable answers from managers through our interviews. These variables include particularly the operators' debt ratio (financial debts to equity), financial expense ratio (financial charges on profits before taxes and interest) and the level of cash flow.

Turning to the econometric analysis, our approach was carried out through two steps. First, univariate analysis in simple Logit is performed between the dependent variable and each selected explanatory variable in order to estimate the level of association between the two variables. The second step keeps only the explanatory variables which are strongly linked to the dependent variable.

To collect data, a field survey work has been performed with cereal importers using a questionnaire. Out of an exhaustive list of 49 identified cereal importers who carried out at least one cereal import operation during 2017 and 2018, 38 importers (78% of the total) accepted to cooperate.

Prior to the econometric model implementation, the level of risk aversion of importers was determined through three approaches. The first approach which is the certainty equivalent method determines the risk premium that the importer would be willing to cede to avoid price risk. The second approach makes it possible to classify individuals based on the lottery choices proposed by Barsky *et al.* (1997). The third and final approach is used to characterize the individual perception of risk using the Likert scale[7].

To determine the **risk premium** that the importer would be ready to give up, our method consists in setting up an adapted experiment of the urn games of Luttmer and Samwick (2018). We asked the subjects to choose, in a significant price volatility context, between two possibilities of purchasing wheat at prices P_A and P_B for a fixed term which is December 2018. We offer an option contract which guarantees them a certain purchase price[8] of P_B = 220 € and an uncertain price of 180 € per ton. If the respondent refuses P_B, we repeat the same question

with $P_{B(i)} < P_{B(i-1)}$ with differences between $P_{B(i)}$ and $P_{B(i-1)}$ becoming smaller until the subject accepts the contract guaranteeing $P_{B(i)}$. The price average between $P_{B(i)}$ for which the respondent accepts the contract and $P_{B(i-1)}$ for which the subject refuses the contract is the certainty equivalent. The subtraction of $P_{B(i)}$ accepted by the respondent from the uncertain price P_A is called the risk premium and indicates the amount of the premium that the respondent is willing to pay to avoid the risk.

The classification of respondents according to their **risk aversion** levels was based on the lottery choices proposed by Barsky et al. (1997). This method involves putting individuals in various situations between which they must make choices by bringing into play their current income. The first choice consists in proposing to the subject to keep his current income (activity A) or to opt for a lottery which allows him either to double his income with a probability of 50% or to reduce it by a third with a probability of 50% (activity B). If the subject accepts activity A, he is offered a second choice which consists of keeping the current income (activity A) or opting for a lottery which allows him either to double his income with a probability of 50% or to reduce it by a fifth with a 50% probability (activity D). On the other hand, if the individual accepts activity B proposed as part of the first choice, he is offered a third choice which consists in keeping the current income (activity A) or else opting for a lottery which allows him either to double his income with a 50% probability or to half reduce with a 50% probability (activity C).

This way, we classified subjects according to their risk aversion. The first group includes those who have the most risk aversion since they prefer activity A rather than the other three. The second group which brings together those who prefer activity A rather than activity B and activity D rather than activity A. The third group concerns subjects less risky than those of group 2 who opt for activity B rather than activity A but activity A rather than activity C. Finally, the last group includes the individuals who show the least risk aversion by opting for activity C rather than activity A.

For the risk perception variable, our approach is designed to assess the level of individual perception of the risk caused by the import operation through several sources of risk. We asked the subjects to express their attitude towards financial risk by placing themselves on a Likert scale in 5 points ranging from "Strongly disagree" to "completely agree". We asked six questions; four of them relate to the overall import operation while two relate only to imported wheat.

The items mainly relate to price volatility, decision-making risk, risk of the duration and hedging horizon, risk of dates and import taxes and State intervention and global context. These items have been pre-tested with four operators to detect those who are ambiguous or not well-formulated in order to make the necessary changes to the first proposal. Then, they were examined to verify the fidelity and the one-dimensionality of the scale and to eliminate the ambiguous or weakly (or not) correlated items. This step allowed us to eliminate the two first items among the six already proposed (price volatility and decision-making risk).

The choice of these items was based on the conclusions of Nivoix (2005) and on the specifics of cereal imports in Morocco. Then, the score is calculated and standardized for each subject to generate a single risk perception variable $\boldsymbol{x'}$ following Lusk and Coble (2005) as follows:

$$x' = \frac{(x-\mu)}{\sigma} \quad (4)$$

With x : score of all items

μ : Sample's mean

σ **:** Standard deviation

Finally, to evaluate **the risk management structure** in the company, we have constructed, as Rais (2012) suggests, a synthetic variable which groups together four variables, namely the presence of a risk management service, management of the service (general manager or other),

size of the service (number of staff working in the service) and presence of a risk management information system (models developed for risk management). Then, the risk management structure variable was calculated for each operator using the following formula:

$$y = \frac{(x-\bar{x})}{max-min} \quad (5)$$

With x : Variable of risk management structure

$\bar{x}$: Variable average

max and min : Maximum and minimum of the variable x.

4. Results

From the conclusions of Jouamaa *et al.* (2020), we have deduced that the use of hedging instruments to manage price risk is still low because only 26% of cereal importers do so. In addition, 76% of importers use the futures market to manage exchange rate risk, 26% to manage commodity risk and only 11% for risks linked to interest rates and stocks. Thus, we began our analysis on price risk hedging operations by seeking the operators' opinion about futures contracts. We then asked the respondents if they were convinced about the hedging function provided by the futures markets.

As shown in Table 1, almost 66% of professionals believe that existing hedging instruments protect them against price risk, while 34% of them do not share the same opinion. When asked if they were convinced that the futures markets are able to meet the expected objectives in the current context and under current legislation, only 8% were very convinced while 26% were moderately convinced. Thus, only 34% of them expressed some confidence in the functions of the futures market, while 45% were very little convinced and 21% were not at all. We also deducted that the lack of confidence in futures markets can be explained by the high cost of hedging instruments, the lack of information, the low level of risk exposure and the invisibility in relation to tax rates.

Table 1. Futures Market Utilization and Efficiency of Proposed Instruments

	Frequency (%)	**Number of importers**
A. hedging reasons		**38**
• Exchange rate risk	76	29
• Price risk	26	10
• Others: (Interest rate, shares ...)	11	4
B. Reasons for not using futures contracts		**28**
• Cost greater than benefits	64	18
• Lack of information	7	2
• Low risk exposure	14	4
• Other	14	4
C. Effectiveness of hedging instruments		**38**
• Effective	66	25
• ineffective	34	13
D. Futures market functions		**38**
• Very convinced	8	3
• Moderately convinced	26	10
• Less convinced	45	17
• Unconvinced	21	8

4.1. Importers Risk Aversion

Applying the methodological approach, we determined the level of risk aversion through three different approaches. The first approach is the certainty equivalent which aims to evaluate the risk premium that importers are willing to pay to avoid (at least partially) price risks. Table 2 and Figure 1 summarize the obtained results.

Table 2. Certainty Equivalent and Subject Risk Premium (€ / ton)

	Mean	Standard deviation
▪ Certainty equivalent	186,10	2,38
▪ Risk premium	4,70	2,36

The average risk premium calculated for our sample is 4.70 €/ton. More precisely, 39% of the subjects are ready to pay a premium of less than 2.5 €/ton to avoid price risk and 79% of the respondents are willing to pay a premium of less than € 5/ton. However, only 8% of respondents can bear a risk premium greater than 7.5 €/ton. These figures confirm the fact that the level of the risk premium negatively influences options that are certain.

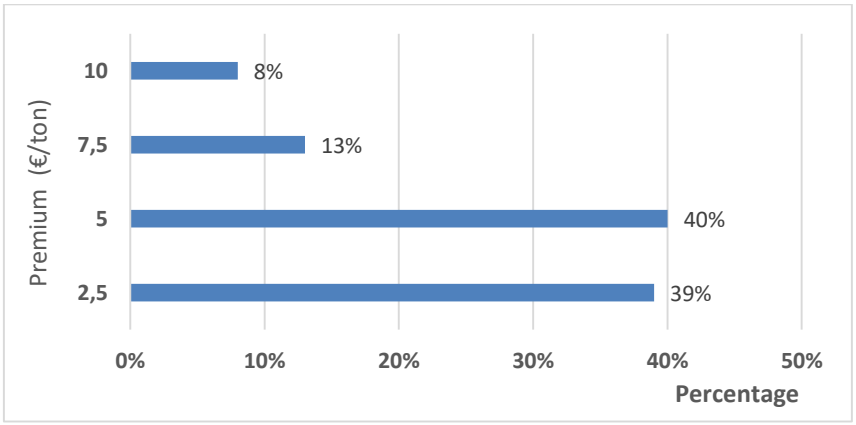

Figure 1. Distribution of the Risk Premium by Responses (%)

The second approach to characterize the level of risk aversion of operators is based on the choices of lottery games. The results shown in Table 3 clearly depict that most cereal importers (around 82%) are highly risk-averse while the rest are risk-tolerant.

Table 3. Importers Risk Aversion

Groups of individuals according to the choice of activity[9]	Risk preferences	Proportion (%)
Group 1: Preference for activity A rather than B, C and D	Very risk averse	31.58
Group 2: Preference for activity A rather than B and D rather than A.	Risk averse	39.47
Group 3: Preference for activity B rather than A and A rather than C.	Less risk averse	10.52
Group 4: Preference for activity A against B and D rather than A.	Risk-tolerant	18.42

4.2. Econometric Analysis Outcomes

The variables used in our model are summarized in Table 4.

Table 4. Description of Econometric Variables

Variable	Description of the variable	Average	Standard deviation
Vol_couv	Contracts hedged (Average share)	0.27	0.37
Mod_couv	Risk management	-	-
Risk_aver	Attitude towards risk	2.84	1.08
Risk_perc	Individual risk perception	8.58	5.29
Risk_prim	Risk premium	4.70	2.36
CA	Turnover in billions of dirhams	0.76	0.84
Qte	Total cereal imports in tons	154,395.13	234,390.30
Qte_bt	Common wheat (CW) imports in tons	68,613.82	90,250.96
Qte_mais	Maize imports in tons	55,006.29	174,607.17
Qte_bd	Durum wheat imports in tons	21,317.19	40,062.65
Qte_org	Barley imports in tons	10,018.82	24,423.89
Int	Importer's level of integration	-	-
Prd	Nature of imported cereals	-	-
Com	Selling methods in the local market (Foreign currency or local currency)	-	-
Imp	Import mode (Self or grouped)	-	-
Str	Risk management structure	2.26	0.41
Log	Transport and logistics (km from the sea port)	46.45	78.84
Div	Degree of diversification	0.50	1.31
Prop	Company ownership structure	-	-

Table 5. Univariate Analysis of Risk Management and Explanatory Variables

Explanatory variables	Coefficient	z-statistic	Probability
1. Risk_aver	-2.08	-3.05	0.0023***
2. Risk_perc	0.14	1.74	0.0815*
3. Risk_prim	0.84	2.93	0.0034**
4. CA	11.07	2.48	0.0131**
5. Qte	0.0001	1.70	0.0892*
6. Qte_bt	0.0001	1.65	0.0996*
7. Qte_maïs	2.89 e^{-05}	1.35	0.1771
8. Qte_bd	6.29 e^{-05}	1.81	0.0703*
9. Qte_org	4.19 e^{-05}	2.36	0.0180**
10. Int	2.38	2.13	0.0334**
11. Prd	0.58	2.23	0.0256**
12. Com	-0.42	-1.28	0.1978
13. Imp	4.10	3.48	0.0005***
14. Str	-2.75	-2.42	0.0157**
15. Log	-0.002	-0.56	0.5746
16. Div	-2.60	-1.40	0.1620
17. Prop	-2.75	-3.03	0.0024***

Notes: ***p<0.01 ; **p<0.05 ; *p<0.10

The univariate analysis allowed us to keep only the explanatory variables that are strongly linked to the dependent variable (Mod_couv). These results show that ‘’Imported quantity of maize (Qty_ maize)’’, ‘’Transport and logistics (log)’’, and ‘’the level of diversification of activities (div)’’ are not significant variable (Table 5).

From these results, we carry out a new verification and model estimate by removing non-significant variables successively. We note that the variables related to the quantity imported, the nature of the products, the mode of sales and ownership are not significant. In addition, no significant relationship is found between the level of integration, the risk management structure, the logistics and the level of diversification of activities, on the one hand, and the use of hedging instruments, on the other hand.

Using Gretl software, estimate results of our model using the Maximum likelihood method (MLM) and the Two-step procedure are presented in Tables 6 and 7.

Table 6. MLM Heckman Model Results

Heck_MLM: ML Heckit, using observations 1-38 Dependent variable: Vol_couv Selection variable: Mod_Couv				
Variables	**Coefficient**	**Std error**	**z-statistic**	**Probability**
Const	1.2864	0.0839	15.33	0.0000***
Risk_aver	−0.2061	0.0221	−9.339	0.0000***
Risk_prim	−0.0336	0.0064	−5.234	0.0000***
Risk_perc	−0.0063	0.0028	−2.244	0.0248**
Imp	0.1385	0.0292	4.734	0.0000***
Lambda	−0.0649	0.0111	−5.860	0.0000***
Selection equation				
Const	−2.8862	0.9174	−3.146	0.0000***
CA	4.9241	2.1117	2.332	0.0197**
Dependent variable mean 0.6833 ; Dependent variable standard deviation 0.2540 Sigma 0.06503 ; Rho −0.9982 ; Likelihood log 13.4093 Total observations: 38 ; Censored observations: 23 (60.5%)				

Notes: ***p<0.01 ; **p<0.05

Table 7. Two-step Heckman Model Estimate

Heck_2step : Two-step Heckit, using observations 1-38 Dependent variable: Vol_couv Selection variable: Mod_Couv				
Variables	**Coefficient**	**Erreur Std.**	**z-statistic**	**Probability**
Const	1.1442	0.1573	7.271	0.0000***
Risk_aver	−0.1960	0.0419	−4.679	0.0000***
Risk_prim	−0.0273	0.0087	−3.146	0.0017***
Risk_perc	−0.0058	0.0030	−1.935	0.0530*
Imp	0.2178	0.0626	3.474	0.0005***
Lambda	−0.0118	0.0454	−0.260	0.7952
Selection equation				
Const	−3.57192	1.21302	−2.945	0.0032***
CA	6.63383	2.61634	2.536	0.0112**
Dependent variable mean 0.6833 ; Dependent variable standard deviation 0.2540 Sigma 0.06487 ; Rho −0.1817 Total observations: 38 ; Censored observations: 23 (60.5%)				

Notes: ***p<0.01 ; **p<0.05 ; *p<0.10

We recall that the dependent variable is the hedged import volume. Reading these results, we see that the obtained values through both estimate methods are similar and that the variables removed from the model are the same. The signs of the coefficients also remain identical. However, the Lambda estimate which corresponds to the inverse of the Mills ratio is significant for the Maximum likelihood method. For the Two-step estimate, the inverse of the Mills ratio is not significant with the z-statistic value of -0.26 (Table 8). This means that the selection bias is not very large. In addition, the correlation between the error terms $\rho = -0{,}18$ here is close to 0 which indicates that the selection bias is minor.

We also find that the signs of the coefficients are conform to our economic expectations. All of our variables estimated for ''Risk aversion'' are highly significant and have a negative effect (β1=-0.2, β1=-0.03, β3=-0.01). This means that any increase of any of these variables will decrease the probability of hedging implementation by importers. Conversely, the variables "Import mode" and "Turn over" depict a positive effect. This result is understandable given that the grouped import mode leads to sharing between importers who adopt better risk management tools. In addition, the size of the company is one of the most determining factor that underpins the use of hedging instruments. Once the company's turnover increases, the importer tends to hedge more. Small firms do not take advantage of the benefits of futures contracts to manage their exposure to price risk.

Back to non-significant variables, our results show that total cereal imports, the level of integration and transport and logistics variables are not determining factors, contrary to what certain importers believe. In addition, we do not find any significant relationship between the risk management structure, the level of diversification and the sales methods, on the one hand, and the use of hedging instruments on the other hand. This can be explained by several reasons. First, Moroccan companies of cereal imports are generally family-owned and characterized by the absence of rigorous management, sometimes preferring liquidity over profit in the long term. Secondly, certain factors such as the level of integration and transport and logistics activities may be more decisive in the import operation than that of hedging against price risk. Finally, risk-averse behavior of importers (around 82%), need of mobilizing significant financial resources (option premiums, margin calls), recurrent lack of visibility at the global market, tariff levies and demurrage fees have a direct impact on the cost price of imported cereals. All these reasons put importers in a situation of uncertainty related to the selling price in the local market and, consequently, hinder the implementation of a better hedging strategy.

5. Conclusion

Using an empirical model developed by Heckman (1979), this paper analyzes the behavior of Moroccan grain importers facing price risk at the international market. It provides appropriate responses about determinants that influence the use of hedging instruments against the risk of imported commodity prices.

Based on survey data from 78% of importing companies, the obtained results corroborate reported empirical works that underline the effects of firm size and level of risk aversion on the use of hedging instruments. We also have shown the significance of import mode (self or grouped) as a new variable that we have introduced in this research in addition to those of literature.

Our findings suggest that there is a significant relationship between the use of derivatives and the turnover of the company which indicates that large companies are more likely to use hedging instruments. However, this variable does not influence the number of contracts on the futures market, which depends mainly on the importer's level of risk aversion and the import mode. This means that the number of futures contracts increases if the risk aversion of the company decreases and if the company imports without grouping with other companies.

Furthermore, our results show that total grain imports volume and selling methods do not have a significant effect on the importers' behavior with regard to price risk. Additionally, no significant relationship is noted between integration level, risk management structure, logistics and diversification of activities, on one hand, and the use of hedging instruments, on the other hand. These findings could be the result of the managers' decisions and how companies are organized internally. Indeed, the presence of other risk management strategies may justify the limited use of futures contracts. Thus, some companies, which sell large quantities of cereals, prefer to use premium contracts that allow them to manage price risk independently according to their own market analysis. In addition, it seems that companies that do not hedge consider the exchange rate and demurrage fees as the main risks that must be controlled.

Finally, for some companies, the main issue is mainly related to the supply and sale of the processed output (flour) rather than being directly concerned with the operation of grain import hedging. This is at least a reasonable purpose for integrated industrial companies (flour mills or feed mills) and importers who run processing units.

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[1] See below the meaning of the "value of the firm".

[2] The methodology that has been used in literature to measure firm value includes factors such as size, leverage and profitability (Allayannis and Weston, 2001). However, firm value as measured by Mian (1996) is book value of total assets minus book value of common equity plus market value of equity.

[3] For more details, see Puhani (2000).

[4] For the inverse of the Mills ratio to be statistically significant, both estimation steps must be independent. For more details, see Heckman (1979) and Sigelman and Zeng, (1999).

[5] We have taken the sales mode as an explanatory variable for the fact that it allows the distinction between companies which invoice part of their turnover in foreign currency and therefore, they will not be exposed to exchange risk unlike companies which invoice all of their turnover in local currency (Moroccan Dirham).

[6] We have classified the companies into three different groups according to the import mode which depends on the technical and financial capacity of each importer. For more details see Jouamaa *et al.* (2020).

[7] Likert scales are a common ratings format for surveys in which the participants rank preferences or degree of agreement on a predetermined scale from high to low using three or seven levels. See Bertram (2017) for more details.

[8] We assume that this option contract is reliable, guaranteed by the government and that no one can change or modify it.

[9] According to Barsky *et al.* (1997)