Export implicit financial performance measurement: the case of French wine companies

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Abstract

Noting the difficulties in measuring export performance (especially financial performance) of companies, we develop a new measurement approach grounded on modern portfolio theory. This approach allows deducing the margin ratio, the risk and the correlation with domestic activities of export activities knowing export intensities, domestic and global financial performance of exporting companies. Using a sample of French companies in the wine industry on the period 2001-2005, these implicit financial export performance characteristics are estimated. Main results are the following: export activities permit to obtain a better global margin-risk relationship essentially due to diversification gains because export financial performance seems to be inferior to the domestic one for a great majority of companies.

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1. Introduction

Indeed in spite of its having been in existence for thousand of years, the wine industry has been exposed for some years to the combined effects of globalisation and of exacerbated international competition. Anderson (2004) has pointed out the main characteristics of the globalisation of the wine industry:
- a tendency for supplies to converge : which spells growing quality from new world countries owing to the dissemination of know-how and technologies,
- a tendency for demand to converge in a context of falling consumption per head in the old world producing countries coupled with an increase of varying magnitude in importing countries and the new world countries, while low quality wine consumption falls across the board,
- a process of internationalisation whereby exports grow much faster than production,
- consolidation and multinationalisation of companies: national and international mergers while the strategies of large international groups lead to the emergence of a world oligopoly (Coelho, 2005) which disrupts the competition environment via strategies of differentiation, policies of massive promotion, and optimisation worldwide of the productivity and logistic chain.

For the French wine industry, this process of globalisation coming as it does in a context of oversupply that has become structural, offers both threats and opportunities. The major

opportunity stems from the growth in foreign markets which offers an alternative to a stagnating, not to say declining, home market. Among other things, threats are due to an extended competition on all market segments, notably that of quality wines which have developed a competitive advantage by implementing efficient commercial policies, as well as competitive costs also related to the size of firms and lighter regulations in New World countries. It is quite clear that their share of world trade has been growing steadily.

From the macroeconomic point of view, wine and spirits is the first exporting sector of the French food sector and one of the most important French exporting sector with 9 billions of euros in 2007 [1].

Taking into account the strategic importance of export in the wine industry at the company and country level it seems to us relevant to investigate the financial performance of companies in this particular industry.

Studies on export performance determinants are numerous testifying the importance of the issue in the literature (for different overviews, see Madsen (1987), Aaby and Slater (1989), Gemünden (1991), Chetty and Hamilton (1993), Zou and Stan (1998) and Leonidou *et al.* (2002)). However, despite considerable research, the evidence on the factors affecting export performance is largely fragmented and often contradictory (Aaby and Slater 1989; Cavusgil and Zou 1994; Zou and Stan 1998). One important explanation is the lack of agreement on how to conceptualize and make operational a measure of export performance.

Concerning the conceptual problem, performance is a multidimensional concept, with no single criterion being adequate. A problem that results in a variety of measures emphasizing different performance dimensions (Diamantopoulos, 1998). In the literature there is a number of ways how to dimensionalize export performance. One can make the distinction between financial, strategic and perceptual outcomes (Zou *et al.* (1998)), economic, non-economic (market related, product related) and generic measures (degree of satisfaction, perceived export success …), (Katsikeas *et al.* (2000)) or into sales-related, profit related and growth-related measures (Shoham (1996)) to quote some of the more classical typologies. These different measurement schemes make it difficult to compare findings in different studies. One solution is the construction of scales based on the set of different variables (Bijmolt and Zwart (1994)).The aggregation of various performance measures into a single measure of export performance partially overcomes the difficulty of performance measure (Katsikeas *et al.* (2000), Lages and Lages (2004)).

The issue is also complicated by the recognition that operationalization of performance measures seems often driven by the definition itself, most likely because of issues related to data availability (Boulding and Staelin, (1995)). It is difficult to access to archival data because companies do not report the financial details of their export activities. Specification and assessment of costs and benefit associated with export activities are also problematic because such costs are inherently related to how a company views these activities (Leonidou *et al.* 2002). Thus both objective and subjective export performance data are dependent of companies' view of their exporting activities.

The importance of the various performance dimensions (effectiveness, efficiency, adaptability) varies across stakeholder groups. Efficiency which is concerned with the outcome of business activities relative to the inputs employed to implement them is an essential dimension for investors and also for managers (Walker and Ruckert, 1987 [2]).

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[1] DGDDI (French customs).
[2] For the authors the two other dimensions are effectiveness and adaptability.

Financial performance measures aim to measure value creation for shareholders or investors (shareholder and debt holders). In the export performance literature, financial performance measures used are profit-related measures. Sousa (2004) built a review of empirical literature published between 1998 and 2004 about export performance measures. He gathered about 50 different export performance indicators and found that the most frequently used ones were "*export intensity (export-to-total sales ratio), export sales growth, export profitability, export market shares, satisfaction with overall export performance, and perceived export success" (p 8)*. He makes the distinction between objective (quantitative and calculated using financial data and cost analysis) or subjective (attitudes, perceptions: qualitative measures using scales) profit-related measures. A small number of studies use objective measures (export profitability, (2 studies), export profit margin, (3 studies), and export profit margin growth (1 study)). These measures are open to criticism in that, due to lack of data, they may not be known with any degree of certainty (Smiee and Anckar, 1998). When managers are unwilling or unable to provide objective financial data (Katsikeas *et al.* (1996), Yang *et al.* (1992)), subjective measures of profitability (perceived values of the variables) can be the solution but they are also subject to several sources of bias. Company officials are under no obligation to disclose information on exports and are often reluctant to disclose information on a single segment of their business. The majority of exporters are SME (that is the case in the French wine industry) lacking of appropriate export accounting mechanisms. However, Bilkey (1982) reported that "*management's perceptions of the relative profitability of exporting are somewhat "rubbery" but not necessarily erroneous yardstick for evaluating export marketing practices"*. We can find a confirmation of these results in the strategic literature where there is evidence of the reliability of subjective self-reported performance measures and of significant correlation between subjective and objective measures (Dess and Robinson (1984), Pearce *et al.* (1987), Venkatraman and Ramanujam (1986, 1987), Dawes (1999)).

Profit-related measures used in export performance determinants literature describe only one dimension of financial performance: the expected gain due to export activities. Two other important dimensions are missing: the risk of export activities and their contribution to diversification gains (the contribution of export activities to the overall risk of the company). Those two last dimension are sometimes taken into account in theoretical studies (Stahrl and Khoury (1986)) but are not used in empirical ones. Assuming that company's managers are rational, and following the portfolio theory (Markowitz, (1952, 1959) they must choose their various activities so as to maximize the return to risk relationship of the overall company. Following this approach, companies undertake export activities only if they contribute to ameliorate the return to risk ratio of the company. This objective can be achieved in two ways: the return to risk ratio of export activities is higher than domestic ones and/or export activities offer a diversification gain (their low correlation with domestic activities justify their introduction in the company's portfolio of activities). The more export activities are interesting (following these criteria), the more the company has to invest in them.

To measure the three dimensions of financial performance (profit, risk and diversification) of exports it will be necessary to know return and risk generated by export activities and the correlation with the domestic ones. Unfortunately these data are hardly available to researchers and often to companies' managers specifically in small and medium sized companies. To overcome this difficulty we propose a strategy directly inspirited by a methodology commonly used in finance. The objective of the method is to deduce the value of some parameters of interest by applying a quite generally accepted model to available data. A famous example of this strategy is the so-called implicit volatility (Latane and Rendleman, 1976) where the volatility of future asset returns is estimated by using market data and

inverting the famous Black and Scholes (1973) formula. In our case, we want to infer from data available in companies financial statements, the return, risk and correlation of export activities using a simple model of portfolio theory.

In short the present study contributes to the financial export performance measures in two ways. First, it proposes a more complete set of measures of financial export performance and second, a way to overcome the lack of data availability to make operational these measures. Finally it illustrates the approach on a sample of companies in the French wine industry.

The article is set out as follows. In the second section the portfolio model applied to companies activities (domestic and export) is constructed and some adaptations are made to obtain a testable form. The third section describes the sample selection method, data and estimation procedures of the various parameters. Fourth section is devoted to results presentation and analysis. The fifth section offers conclusion.

2. Theoretical framework

We present a simple expected utility maximization model of optimal proportions of domestic and export activities.

To know the success of export (particulary in SMEs), an important issue is how pleased the owner-manager is with the internationalization project. The management anticipation of the performance of export seems to us one of the main drivers of export decision. But contrary to the methodology presented above we will not use data on management anticipation or satisfaction but we try to infer these variables from the actual decision taken. The more the company exports the more management is supposed to be satisfied with export (cf. the disconfirmation of expectation proposed by Shoham (2000)). More specifically, in our approach proportion of domestic and export activities are supposed to be the result of expected utility optimization behaviour. Companies seek the combination of domestic and export activities so as to maximize expected utility of profit:

$$E[u(\pi)] = E[u(\tilde{m}_D S_D + \tilde{m}_X S_X)] \qquad [1]$$

with

π : profit,
$\tilde{m}_D$: random margin of domestic activities (in % of sales),
$\tilde{m}_X$: random margin of export activities (in % of sales),
S_D : domestic sales,
S_X : export sales,
U(.) : utility function,
E(.) : denotes expectation.

This approach supposes that total sales are given at this step meaning that companies have the opportunity to sell their products on the domestic market and in various foreign countries. We suppose that the choice of these foreign countries have been made at a preceding step and depends of various internal and external factors that will not be studied here. In short the

opportunity set (the various export markets accessible to the company) is supposed given. We are only interested in the consequences of the foreign countries markets choice made by the company on the margin and the risk of export activities. In other words the domestic and foreign activities represent a given universe and we concentrate on the optimal combination of these given activities. Accordingly, the sales constraint is the following: $S_D + S_X = S$ (S means total sales) and dividing equation by S constraint becomes: $s_D + s_X = 1$.

Moreover export and domestic margin are supposed to be constant whatever the level of sale or the market share of the company on the domestic and exports markets. But we can imagine that some French wine companies export to avoid a lower domestic margin due, for instance, to a saturated domestic market. Constant margin suppose perfect competition which is probably not the case on markets where differentiation and quality play an important role. Our choice is dictated by the fact that the sensibility of margins to the volume of sales is not available.

To solve the previous program, [1], it is common in empirical studies to use an approximation formula which incorporates agent risk aversion. Assuming a normal distribution, equation [1] becomes ([3]):

$$E[u(\tilde{m}_G)] = E[(\tilde{m}_D s_D + \tilde{m}_X (1 - s_D))] - \frac{\lambda}{2} V[(\tilde{m}_D s_D + \tilde{m}_X (1 - s_D))] \qquad [2]$$

with

$\tilde{m}_G$: global margin ratio of the company,

λ : coefficient of risk aversion, $\lambda > 0$,

V(.) : variance.

It is possible to show by direct calculation that equation [2] is exact for an exponential utility function ($U(w) = -e^{-\lambda w}$) ([4]). This function is characterized by a constant absolute risk aversion (CARA) and increasing relative risk aversion. For other utility functions equation [2] gives only an approximation.

By using simple properties of expectation and variance operator in equation [2] one can obtain:

$$E[u(\tilde{m}_G)] = (\overline{m}_D s_D + \overline{m}_X (1 - s_D))$$
$$- \frac{\lambda}{2}[V(\tilde{m}_D)s_D{}^2 + V(\tilde{m}_X)(1 - s_D)^2 + 2s_D(1 - s_D)Cov(\tilde{m}_D, \tilde{m}_X)] \qquad [3]$$

$\overline{m}_D = E(\tilde{m}_D)$
$\overline{m}_X = E(\tilde{m}_X)$
Cov(.,.) : covariance.

First order condition of expected utility maximization is:

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[3] This objective function is a direct adaptation to our specific framework of a currently used utility function simplification in finance. The passage from [1] to [2] goes back to Pratt (1964).
[4] Various other utility functions, such as the logarithmic, quadratic, linear, and power, to cite the more common, exist in the literature.

$$\frac{dE[u(\tilde{m}_G)]}{ds_D} = (\overline{m}_D - \overline{m}_X)$$

$$-\frac{\lambda}{2}[V(\tilde{m}_D)2s_D - V(\tilde{m}_X)2(1-s_D) + (2-4s_D)Cov(\tilde{m}_D, \tilde{m}_X)] = 0$$

By isolating s_D in the preceding equation it comes:

$$s_D{}^* = \frac{\overline{m}_D - \overline{m}_X + \lambda[V(\tilde{m}_X) - Cov(\tilde{m}_D, \tilde{m}_X)]}{\lambda[V(\tilde{m}_D) + V(\tilde{m}_X) - 2Cov(\tilde{m}_D, \tilde{m}_X)]} \qquad [4]$$

The importance of domestic activities depends on:
- The deviation between expected domestic and export margins, the more export activities are profitable in comparison to domestic ones the greater export intensity is,
- The domestic and export risk, export intensity is a positive function of domestic risk ([5]),
- Correlation between the two activities (emphasis on the diversification function of export),
- The coefficient of risk aversion.

From the previous theoretical model we can get three equations:
- The optimal combination of activities, (equation [4]),
- Expected margin decomposition for an exporting company:

$$\overline{m}_D s_D^* + \overline{m}_X (1 - s_D^*) = \overline{m}_G \qquad [5]$$

$$\overline{m}_G = E(m_G)$$

- Risk decomposition for an exporting company:

$$V(\tilde{m}_D)s_D^{*\,2} + V(\tilde{m}_X)(1 - s_D^*)^2 + 2s_D^*(1 - s_D^*)Cov(\tilde{m}_D, \tilde{m}_X) = V(\tilde{m}_G) \qquad [6]$$

The solution of the system formed by the two equations [4] and [6] is (see appendix 1):

$$V(\tilde{m}_X) = \frac{V(\tilde{m}_G)(1 - 2s_D^*) + s_D^{*\,2}V(\tilde{m}_D) - 2As_D^*(1 - s_D^*)}{(1 - s_D^*)^2}$$

$$Cov(\tilde{m}_D, \tilde{m}_X) = \frac{V(\tilde{m}_G) - s_D^*V(\tilde{m}_D) + A(1 - s_D^*)}{(1 - s_D^*)} \qquad [7]$$

$$A = \frac{\overline{m}_D - \overline{m}_X}{\lambda}$$

We get a system of only 3 equations for 9 unknowns. So we must deduce the value of 6 unknowns from financial data. From empirical data, we can obtain quite easily the expected

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[5] The sign of the derivative of export intensity on export risk is not determinate.

global margin $(\overline{m}_G)$ and the variance of global margin $(V(\tilde{m}_G))$ of exporting companies. The choice by a company of a specific risk reward relationship will enable us to induce it's coefficient of risk aversion, λ. We suppose that the actual combination of activities is equal to the optimal one, so $(1\text{-}s_D^*)$ is set equal to the observed export intensity. To obtain the expected margin and margin standard deviation of domestic activities, we suppose that the opportunity set for domestic activities of exporting companies is similar to the one of purely domestic one. Hence $\overline{m}_D$ and $V(\tilde{m}_D)$ are deduced from the mean and variance of margin ratio of purely domestic companies. The solution of the system of equations [4], [5], [6] gives us the value of the three remaining variables: expected export margin, export margin standard deviation, and correlation between export margin and domestic margin. The procedure is detailed in 3.2.

3. Sample selection, data and estimation procedure

3.1. Sample selection and data

To empirically test the relevance of the approach outlined above we use the survey called "Enquête Entreprises Aval de la Filière Vin[6] – 2006" (EEAFV-2006) which is about the determinants of the performance in French wine companies. It was carried out by Supagro, the Superior School of Agronomy in Montpellier (South of France, in the Languedoc Roussillon wine region). It provides data about the strategies and strategic choices chosen by companies and the elements impacting their financial, strategic, trade performance.

Data were collected through two different and complementary ways: a questionnaire was sent to the companies of the industry. The questionnaire was pre-tested on a dozen companies before it was used by researchers meeting firm managers like in a poll. Only companies with a turnover superior to three million euros were taken into account. Data were completed with financial statements from 1996 to 2005 available on Diane-SCRL ([7]) database.

The analysed unit is the company and more particularly companies owning a managerial autonomy: subsidiaries or firms controlled by a group are excluded. All French producing regions are gathered in this study, concerned companies. The final sample gathers 214 companies.

The questionnaire was divided into eight thematic parts (description of the company and human resources, firm relationship with suppliers, firm products, selling and relationships with downstream companies, governance, strategy, financial elements, and innovation) which gave indications about the firm resources and strategy and even some details about external determinants of export behaviour.

Variables are defined as the following:

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[6] English translation: Survey about companies in the wine Industry – 2006.
[7] This database is constructed by Bureau van Dijk (www.bvdep.com). It contains financial data on French listed and non listed companies, the European and World counterparts are Amadeus and Orbis.

- Export intensity: mean on the period 2001-2005 of the annual ratios $\frac{Export\ turnover}{Total\ turnover}$.

  The data was first extracted from Diane database, when data were not available in Diane, declarative data of the questionnaire were used.
- Expected margin ratio: mean on the period 2001-2005 of the annual ratios $\frac{EBITDA}{Total\ turnover}$ (EBITDA, Earnings Before Interest Taxes Depreciation and Amortization) extracted from Diane.
- Variance of margin ratios: variance on the 2001-2005 period of the annual margin ratios.

The sample was divided in 2 groups:
- Companies with only domestic activities: in fact to obtain a large enough sub-sample we select companies with mean export intensity on the period 2001-2005 inferior to 5 %.
- Export companies: only companies with mean export intensity on the period 2001-2005 superior to 15 % are chosen.

Table 1 describes the main characteristics of the two sub-samples and gives the probability of significant differences between companies included in each of them.

Table 1. Comparison of domestic and export companies of the sample			
	Domestic companies	Export companies	Signification Probability (d)
Sample size (number of companies)	46	90	
% export			
- Sample mean		0.4363	
- Standard deviation (a)		0.2154	
- Minimum		0.1518	
- Maximum		0.9295	
Global turnover (mean 01-05)			
- Sample mean	9 814	45 109	0.000
- Standard deviation (a)	8 850	54 302	
- Minimum	2 610	3 256	
- Maximum	45 469	308 366	
Global margin mean			
- Sample mean	5.92 %	7.84 %	0.2596
- Standard deviation (a)	4.68 %	10.92%	
- Minimum	-0.74 %	-14.92 %	
- Maximum	17.37 %	69.43 %	
Global margin standard deviation			
- Sample mean	1.80 %	2.42 %	0.1962
- Standard deviation (b)	2.12 %	2.87 %	
- Minimum	0.12 %	0.046 %	
- Maximum	9.93 %	15.72 %	
Margin to Risk Ratio (MRR) (c)			
- Sample mean	5.28	6.83	0.3963
- Standard deviation (a)	4.89	11.82	
- Minimum	-1.34	-0.98	
- Maximum	18.07	87.19	
(a) Cross-sectional standard deviation. (b) For each company the time series standard deviation of margin is calculated then the cross sectional standard deviation of all standard deviations is computed. (c) The margin to risk ratio is defined as: $MRR = \dfrac{\overline{m}}{\sigma(\tilde{m})}$ (d) Test of mean equality between the two samples with different variances.			

We can see from table 1 that:
- Export companies are significantly larger than domestic ones. The fact that small companies do not export could be explained not only by their anticipation of poor financial performance of exports but also by the lack of capabilities to export.
- The mean and standard deviation of margin ratios of export companies are higher than domestic ones but deviations between expected margin and risk are not significant.
- The financial performance ratio (MRR) is also higher but not significant for export companies.

So export activities generate higher margin expectation and risk but without generating significantly higher global financial performance.

3.2.   Procedure for estimating financial export performance

We develop an estimation procedure of the 3 dimensions of export financial performance (expectation and variance of margin ratios and correlation between domestic and export margin ratios) including the following steps:
1) Estimation of the coefficient of risk aversion
2) Estimation of the expected domestic margin and risk of domestic activities for exporting companies
3) Determination of the dimensions of exports financial performance (expected margin, risk and correlation with domestic activities)

3.2.1. Estimation of the coefficient of risk aversion

In order to compute financial performance of export it is necessary to obtain the value of the coefficient of risk aversion. It seems to us inappropriate to give a unique value for this coefficient to all companies by using estimates given in literature because these estimates do not concern companies but essentially individual investors and are widely dispersed (see Giamouridis (2005) for a recent review). On the other side we do not get enough data to make sophisticated estimation of these coefficients as proposed by Walls and Dyer (1996) in the context of the oil industry. This method supposes the capability to compute the certainty equivalent of risky prospect. In the oil industry exploratory budget are known and can be interpreted as the certainty equivalent of the risky prospection activity. Such data as a certainty equivalent of risky activities are not available in the context of the French wine industry. Moreover such a sophisticated estimation will be out of the scope of this paper because our objective is not to obtain precise value of risk aversion coefficient but to have the possibility to compare the degree of risk aversion of companies in the sample. Here again we develop a methodology directly inspired by portfolio theory simplifying the Walls and Dyer approach.

Following portfolio theory the position of investors on the risk return efficient frontier depends on their degree of risk aversion (cf. graph 1). We suppose that the observed global return to risk relationship of each company reveals their relative risk aversion coefficient. Knowing the opportunity set, a company is more risk adverse if it choose a lower global standard deviation[8]. In the graphic 1, company 2 chooses a lower level of risk than company 1, we can infer that it is more risk adverse than company 1.

The actual return to risk ratio of a company depends also on its managerial skill and various other specific characteristics and business environment. To reduce the impact of these factors on the estimation of risk aversion coefficient we conduct, using the sample of exporting companies, an Ordinary Least Square, (OLS), of margin ratios on standard deviation of these ratios[9]:

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[8] See below equation [11] and its comments for a more in depth analysis.
[9] Note that in portfolio theory the relation between risk and return on the efficient frontier can be quadratic or linear if a risk free asset exist or if a "zero covariance portfolio" can be constructed (see Merton (1972) or Huang and Litzenberger (1988) chapter 3 for a pedagogical presentation). We choose a linear relationship to simplify computation but we acknowledge that a quadratic one is probably more appropriate in the context of absence of a risk free rate. Note that in this paper we do not try to compute efficient frontier but only to find an empirical

$$m_{Gi}^e = \alpha_G + \beta_G \sigma_{Gi} \qquad\qquad [8]$$

m_{Gi}^e can be interpreted as the expected global margin ratio of company, i, having a global given risk σ_{Gi}. The deviation between the actual margin ratio $\overline{m}_{Gi}$ of a company and m_{Gi}^e is a measure of performance of company i [10]. On graph 1 we can see that company 1 has a better performance that a company on the line with the same risk level. That is just the contrary for company 2.

Supposing that each company chooses a point on the risk return line by combining the riskiest and the risk free activity so as to maximize a negative exponential utility function [11], the following program has to be solved for company, i:

$$E(u(\tilde{m}_i)) = E(\tilde{m}_i) - \frac{\lambda_i}{2} V(\tilde{m}_i) \qquad\qquad [9]$$

Using equation [8], equation [9] becomes: $E(u(\tilde{m}_i)) = \alpha_G + \beta_G \sigma_{Gi} - \frac{\lambda_i}{2} \sigma_{Gi}^2$ $\qquad$ [10]

The first order condition for the expected utility maximization [10] is:

$$\frac{dE(u(\tilde{m}_i))}{d\sigma_{Gi}} = \beta_G - \lambda_i \sigma_{Gi} = 0 \Leftrightarrow \lambda_i = \frac{\beta_G}{\sigma_{Gi}} \qquad\qquad [11]$$

In the context of a linear relationship between risk and return, the coefficient of risk aversion has a very simple interpretation. A company has a low risk aversion if it chooses an high global risk level (σ_{Gi}) even when risk is not well rewarded (β_G is low). In this context, the coefficient of risk aversion depends on the opportunity set (the same global line [8]). Hence the method can be used here only because we compare risk aversion of companies facing the same opportunity set.

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relation between margin and risk. We choose not to compute the efficient frontier because our objective is not to find for a given investor the best portfolio of exporting companies but to deduce from the risk level chosen by a company its level of risk aversion relatively to other companies in the same sector.

[10] This measure has the same philosophy as the one proposed by Jensen (1968). We compare the actual performance of the company with companies with similar risk. Note that in the Jensen approach, risk is measure by beta; here the risk is measured with sigma.

[11] Walls and Dyer (1996) used the same utility function to elicit risk aversion of oil companies.
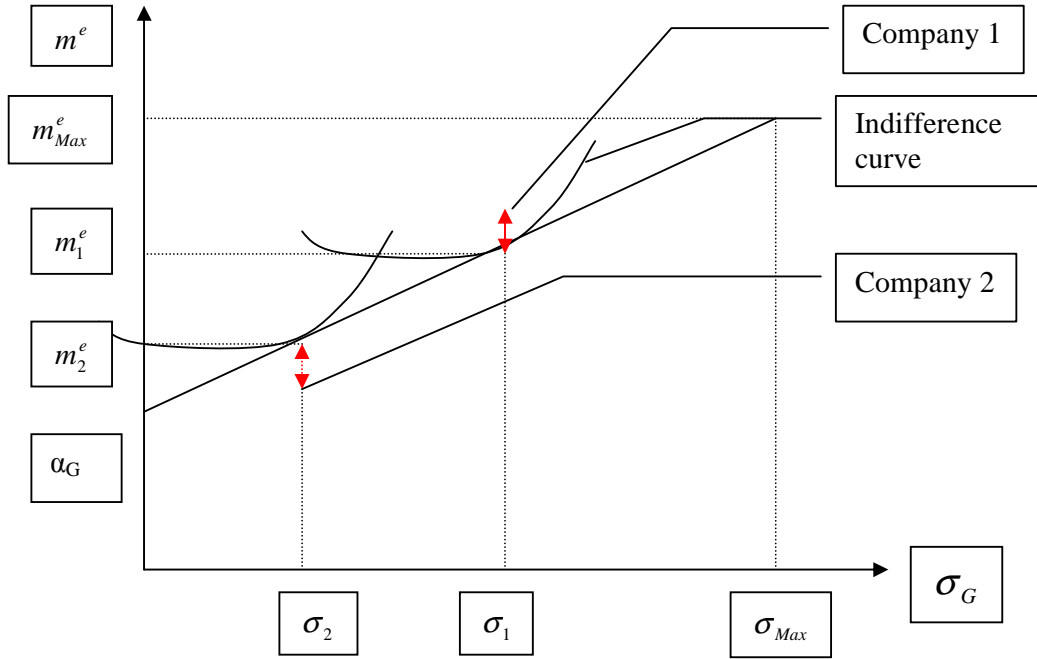
Graph 1. Choice of the risk - return relationship

3.2.2. Estimation of the expected domestic margin and risk of domestic activities for exporting companies

Using now the sample of domestic companies the same procedure is applied to obtain the implicit domestic expected margin and margin risk.

First, by OLS the opportunity set (relationship between their expected margin and margin standard deviation) of purely domestic companies is obtained:

$$m_{Di}^e = \alpha_D + \beta_D \sigma_{Di} \qquad [12]$$

m_{Di}^e, σ_{Di}: expected domestic margin and standard deviation of domestic margin of purely domestic companies.

As already stated, we suppose that exporting companies have the same opportunities that domestic ones concerning their domestic activities meaning that they face the domestic line as far as their domestic activities are concerned.

So our objective is to calculate the position on the domestic line that an exporting company would have chosen if it was purely domestic. As we have already calculated the coefficient of relative risk aversion for exporting companies (equation [11]), the expression of expected utility is now:

$$E\left(u\left(\tilde{m}_{Di}\right)\right) = \alpha_D + \beta_D \sigma_{Di} - \frac{\beta_G}{2\sigma_{Gi}} \sigma_{Di}^2 \qquad [13]$$

The optimal level of risk chosen on the domestic line is given by the first order condition of equation [13]:

$$\frac{dE(u(\tilde{m}_{Di}))}{d\sigma_{Di}} = \beta_D - \frac{\beta_G}{\sigma_{Gi}}\sigma_{Di} = 0 \Leftrightarrow \sigma_{Di} = \frac{\beta_D}{\beta_G}\sigma_{Gi} \qquad [14]$$

By observing equation [14] one can see that if companies face situation where risk is less rewarded ($\beta_D < \beta_G$) they invest in less risky activities.

The expression of the expected domestic margin of exporting companies (m_{Di}^e) can be deduced using the classical properties of expectation and equations [12] and [14]:

$$m_{Di}^e = \alpha_D + \frac{\beta_D^2}{\beta_G}\sigma_{Gi} = m_{Di}^e = \alpha_D + \beta_D\left(\frac{\beta_D}{\beta_G}\right)\sigma_{Gi} \qquad [15]$$

It is clear from equations [15] that the implicit domestic expected margin of exporting companies is given by the domestic market line where the risk of purely domestic companies is replaced by the risk level that exporting companies would have chosen if they were purely domestic.

3.2.3. Determination of the dimensions of exports financial performance

It is know possible to estimate the implicit expected margin on export activities, the implicit export margin risk and the implicit covariance between export and domestic margin by replacing the variables in equations [5] and [7] by their expressions given by equations [8], [11], [12], [14].

Estimations of implicit expected margin of export $(\hat{m}_{Xi}^e)$, risk $(\hat{V}(m_{Xi}^e))$ and covariance between export and domestic activities $\left(\hat{Cov}(m_{Xi}^e, m_{Di}^e)\right)$ are given by[12]:

$$\hat{m}_{Xi}^e = \frac{(\alpha_G - \alpha_D s_{Di})\beta_G + \sigma_{Gi}(\beta_G^2 - \beta_D^2 s_{Di})}{\beta_G(1 - s_{Di})} \qquad [16]$$

$$\hat{V}(m_{Xi}^e) = \frac{\beta_G^2\sigma_G^2 + s_{Di}\beta_D^2\sigma_G^2(s_{Di} - 2) - 2s_{Di}\sigma_G\beta_G(\alpha_D - \alpha_G)}{\beta_G^2(1 - s_{Di})^2} \qquad [17]$$

$$\hat{Cov}(m_{Xi}^e, m_{Di}^e) = \frac{(1 - s_{Di})\beta_D^2\sigma_G^2 + \sigma_G\beta_G(\alpha_D - \alpha_G)}{(1 - s_{Di})\beta_G^2} \qquad [18]$$

By comparing equations [16], [17], [18] and [5], [7] one can see we have replaced the optimal proportion of domestic activities by the observed one.

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[12] Demonstration in appendix 2.

In appendix 3 we demonstrate that unfortunately the method above does not insure that the implicit coefficient of correlation between domestic and export margin will be in the interval [-1, 1]. That is the case for company with a very low standard deviation of global margin.
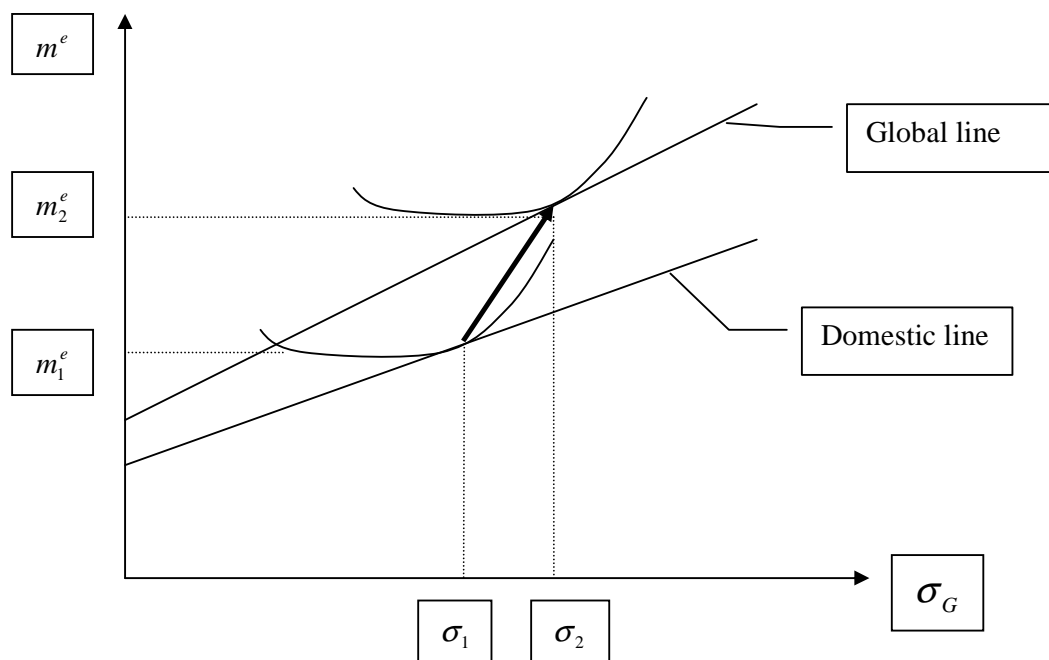
Graph 2. From domestic to global position of a company

The method presented above relies heavily on the assumption that the domestic line of exporting company is identical to the domestic line of purely domestic companies. So it seems to us interesting to investigate consequences of the impact of variation of domestic line characteristics (intercept and slope) on the characteristics of implicit export performance. Calculations in appendix 4 show that if the line of domestic activities of exporting companies is above the line of purely domestic companies (exporting companies are more efficient on their domestic activities than purely domestic ones):
- implicit expected margin of export will be overestimated,
- implicit export margin standard deviation will be overestimated,
- covariance between domestic and export margin will be underestimated.

It is of course the reverse if the line of domestic activities of exporting companies is below the line of purely domestic companies.

Note that the impacts of estimation errors on margin expectation and risk are on the same direction hence they partially compensate in the MRR which is a ratio of the two.

(b) Empirical results

To obtain the implicit characteristics of export we use a two step procedure:
-   first we estimate the global and domestic lines (equations [8] and [12]),
-   second we calculate implicit characteristics of export using equations [16], [17], [18].

4.1.   Estimation of the global and domestic lines

Using the sample of domestic companies, the OLS coefficients are computed:

$$m_D^e = \underset{(0.000)}{0.047} + \underset{(0.039)}{0.674}\,\sigma_D \quad AdjR^2 = 0.073 \qquad\qquad [19]$$

Using the sample of exporting companies, we obtain the following relationship between global margin and global risk:

$$m_G^e = \underset{(0.001)}{0.04915} + \underset{(0.002)}{1.2086}\,\sigma_G \quad AdjR^2 = 0.091 \qquad\qquad [20]$$

From the comparison of these two straight lines (see graphic 2) we can deduce that:
-   Export permit to obtain a better relation between risk and return because the global line [20] is above the domestic line [19] whatever the level of risk. The global line dominates the domestic one. Following portfolio theory, every company in the French wine industry have a commercial interest to export because it can obtain a better margin for the same level of risk. Note that this result does not permit to conclude to a financial interest to export [13] because the margin ratio does not take into account the investment necessary to export. If investments necessary to undertake export activities are similar to those of domestic activities we can say that export activities are more profitable than domestic one. But if export activities necessitate higher investments, it could be the case that commercial gains are offsets by those supplementary investments leading to a lower profitability of export activities.
-   Export offers a better remuneration of risk because the slope of the line is steeper for exporting companies than for domestic ones (1.2086 against 0.674). From this analysis, one can deduce than, *ceteris paribus*, less risk adverse exporting companies obtain a higher deviation between global and domestic margin for a same level of risk.

From 3.2.2. the position of company, i, on the domestic line is known. The standard deviation of global margin is calculated from the data. Using equation [14] the expected domestic margin is calculated. Following the theoretical framework of section 2, explanation of the movement from the position on the domestic line to the position on the global line is export activities (cf. graph 2). The characteristics of export explaining the passage from position 1 to position 2 are solution of the system of equations [5] to [7].

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[13] To be more rigorous, in financial analysis, the ratio of results obtained by the studied activities on the turn over of these activities is a financial measure of commercial performances. Financial performances are measured by the ratio of results divided by investment necessary to implement the studied activities. Using classical chain rules of ratio we get: $\dfrac{\text{Result}}{\text{Turn over}} = \dfrac{\text{result}}{\text{turn over}}\,\dfrac{\text{turn over}}{\text{Assets}}$. An higher margin ratio of exports activities, $\dfrac{\text{result}}{\text{turn over}}$, can be more than compensated by a lower $\dfrac{\text{turn over}}{\text{Assets}}$ of these activities.

4.1.   Global sample results

From equations [5] to [7] we compute for each export company the implicit mean and standard deviation of export margin, the coefficient of correlation between export and domestic activities and the margin to risk ratio. Summary statistics of results are given in table 2.

Table 2. Exports characteristics and implicit financial performance				
	Sample mean	Sample cross-sectional standard deviation	min	max
Implicit margin mean of export	11.33 %	7.48 %	5.60 %	55.88 %
Implicit margin standard deviation of export (risk)	5.65 %	6.69 %	0.40 %	45.76 %
Implicit coefficient of correlation	-0.086	0.4816	-2.73	0.45
MRR export	2.97	1.82	1.22	13.98

Comments on table 2:
- From comparison of table 1 and 2 we can see that implicit mean and standard deviation of export activities are higher to those of purely domestic companies. This result is simply a consequence of the positive impact of exports on the mean and standard deviation of the overall margin we observed in our comment of table 1.
- The sample mean of implicit coefficient of correlation between domestic and export activities is slightly negative indicating that exports aims to play an important role in diversifying companies' risk. Implicit coefficients of correlation are not necessarily between -1 and 1[14]. It is the case here for 5 coefficients over 90 that are below -1 (it is the reason why we observe a -2.73 in the "min" column of table 2. For those companies the global risk is very low and in particular below the level permitting to obtain coefficient above -1 defined in appendix 3.
- The sample mean of implicit export financial performance ratio (MRR) is below the one of domestic companies (2.97 against 5.28 (see table 1)). The higher margin of export activities is more than compensated by the higher risk they generate.

In short, export activities in the French wine industry seem to be better justified by the diversification gains they offer than by their intrinsic performance.

To explore if the implicit performance measure is redundant with existing performance measures, we calculate the coefficients of correlation of the expected implicit margin and the margin to risk ratio of export with three classical measures of export performance: export intensity, export growth rate and export intensity growth rate calculated for the 2001-2005 period (table 3). All coefficients of correlation are very low meaning that traditional performance measures are not good proxies of financial performance of exports. Even if export intensity is a determining variable of the model, the correlation with margin to risk ratio is very low and even negative with the implicit margin. The correlation between the

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[14] See appendix 3 for a demonstration.

variation of export or export intensity and the margin to risk ratio is negative during the period and slightly positive for implicit margin.

Table 3. Correlation between performance measures			
Coefficient of correlation	Export intensity	Export growth rate	Export intensity growth rate
Implicit margin	-0.131	0.088	0.093
Margin to risk ratio	0.075	-0.084	-0.086

Sample standard deviations of the variables are large probably because companies in the sample are in very different situations (different regions of production, types of wine - effervescent or not – different wine qualities …). It is the reason why we implement the cluster analysis described in the following paragraph.

4.2.   Clusters analysis

We conduct a hierarchical ascendant analysis using Ward criterion based on the three dimensions of export financial performance (return, risk and diversification). Then we calculate the statistical characteristics of the other variables for each class.

Table 4. Cluster analysis					
Clusters	1	2	3	4	5
N (number of companies)	30	11	45	2	2
Sample mean of global margin	5.06 %	14.67 %	7.79 %	29.67 %	-8.49 %
Sample standard deviation of global margin	0.78 %	4.28 %	2.13 %	14.65 %	11.22 %
MRR global	12.75	3.34	4.30	1.84	-0.63
Global turnover	60 906	19 983	43 561	15 558	10 745
% Export	47.05 %	37.53 %	43.27 %	30.11 %	47.29 %
Sample mean of implicit export margin	6.88 %	16.80 %	10.38 %	51.53 %	29.15 %
Sample standard deviation of export margin	1.66 %	10.60 %	4.81 %	41.78 %	21.02 %
Correlation	-0.40	0.12	0.05	0.17	0.26
MRR export	4.76	1.60	2.26	1.23	1.39

Half of the companies in the sample (cluster 3, N = 45) have implicit performance of export below the global mean (MRR equals to 2.26 inferior to 2.97). That can be explained by the fact that the margin ratio of export is quite high but risk is even higher. Implicit diversification gains are substantial (coefficient of correlation closed 0) but not sufficient to obtain a good global performance. Global performances of companies in this cluster are inferior to those of domestic companies (MRR = 4.30 against 5.28). Companies of cluster 1 (N = 30) obtain a very good global performance that seems to be due more too very important diversification gains (negative correlation between domestic and export margin) than pure export performance (although they obtain the best implicit export performance of the five cluster these performance is inferior to domestic performance of purely domestic companies in table 1). Companies of the three other clusters are relatively small companies with higher global

and export risk. They obtain contrasted global and export performance. Companies of cluster 4 (N = 2) obtain better global and export margin than companies of cluster 2 (N =11) by taking much more risk. Companies in cluster 5 (N = 2) are risky with a negative global margin but their expected export margin is positive.

Similar export intensity can be associated with very different financial export performances.

5. Conclusion

Noting the difficulties in measuring export performance of companies the paper is a first attempt to develop an approach grounded on modern portfolio theory. This approach allows deducing the margin ratio, the risk and the correlation with domestic activities of export activities knowing export intensities, domestic and global financial performance of companies. It can offer a complementary point of view to the traditional purely subjective approaches based on Likert scales.

Using a sample of French companies in the wine industry these implicit export performance characteristics are estimated. The estimation procedure necessitates determining the coefficient of risk aversion of the company. Moreover it relies heavily on the hypothesis of an identical opportunity set for purely domestic companies and exporting companies for their domestic activities.

Main results of the empirical study are the following: exports activities help to obtain a better (but not significant) global margin-risk relationship essentially due to diversification gains because export financial performance seems to be inferior to the domestic ones for a great majority of companies. This result leads us to question the rationality of export behaviour by French wine companies. Are companies' financial performances of exports justifying their high export intensity ratio? How such ratios could be explained? A simple explanation could be the decay of wine consumption in the French domestic market. All companies could not be successful or even survive if they have remained purely domestic.

The paper is only a preliminary investigation of the idea to use portfolio theory to measure export performance. The theoretical part could be improve by using more sophisticated portfolio theory tools (more realistic utility functions, better procedure to estimate risk aversion, non linear relationship between risk and margin). As already stated, the quality of implicit export performance measures estimation depends on the quality of the estimation of the financial performance of their domestic activities. For these last estimations to be reliable the sample of domestic companies should reflect the financial characteristics of domestic activities of exporting companies. In our case, domestic companies are in the same sector and the same country of exporting ones but their size is smaller. We should also check if other control variables (product quality and demand, wine sector and region, production in bulk or bottle…) are similar. As in most studies based on paired samples the quality of results depends heavily on the quality of the comparison sample. Finally results more significant (for instance for the margin to risk relationship) could be obtain using a larger sample of wine companies.

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System of equations [4] and [6] is written in normal form:

$$\begin{cases} \left(1-s_D^*\right)^2 V(\tilde{m}_X) + 2s_D^*\left(1-s_D^*\right)Cov(\tilde{m}_D,\tilde{m}_X) = V(\tilde{m}_G) - s_D^{*\,2} V(\tilde{m}_D) \\ \left(s_D^*-1\right)V(\tilde{m}_X) + \left(1-2s_D^*\right)Cov(\tilde{m}_D,\tilde{m}_X) = A - s_D^* V(\tilde{m}_D) \end{cases}$$

The resolution by the Cramer method is:

$$D = \begin{vmatrix} \left(1-s_D^*\right)^2 & 2s_D^*\left(1-s_D^*\right) \\ -\left(1-s_D^*\right) & \left(1-2s_D^*\right) \end{vmatrix} = \left(1-s_D^*\right)^2$$

$$D_{V(\tilde{m}_X)} = \begin{vmatrix} V(\tilde{m}) - s_D^{*\,2} V(\tilde{m}_D) & 2s_D^*\left(1-s_D^*\right) \\ A - s_D^* V(\tilde{m}_D) & \left(1-2s_D^*\right) \end{vmatrix} = V(\tilde{m}_G)\left(1-2s_D^*\right) + s_D^{*\,2} V(\tilde{m}_D) - 2As_D^*\left(1-s_D^*\right)$$

$$D_{cov(\tilde{m}_D,\tilde{m}_X)} = \begin{vmatrix} \left(1-s_D^*\right)^2 & V(\tilde{m}) - s_D^{*\,2} V(\tilde{m}_D) \\ \left(s_D^*-1\right) & A - s_D^* V(\tilde{m}_D) \end{vmatrix} = V(\tilde{m}_G)\left(1-s_D^*\right) - s_D^*\left(1-s_D^*\right)V(\tilde{m}_D) + A\left(1-s_D^*\right)^2$$

The solution of the system is:

$$V(\tilde{m}_X) = \frac{V(\tilde{m}_G)\left(1-2s_D^*\right) + s_D^{*\,2} V(\tilde{m}_D) - 2As_D^*\left(1-s_D^*\right)}{\left(1-s_D^*\right)^2}$$

$$Cov(\tilde{m}_D,\tilde{m}_X) = \frac{V(\tilde{m}_G) - s_D^* V(\tilde{m}_D) + A\left(1-s_D^*\right)}{\left(1-s_D^*\right)}$$

$$A = \frac{\overline{m}_D - \overline{m}_X}{\lambda}$$

APPENDIX 2 Expressions of the implicit export margin, the implicit margin risk and the implicit covariance between domestic and export margin

$$\hat{m}_{Xi}^e = \frac{\alpha_G - \alpha_D s_{Di} + \beta_G \sigma_{Gi} - \left(\beta_D^2 \sigma_{Gi} / \beta_G\right)s_{Di}}{\left(1 - s_{Di}\right)}$$

$$= \frac{\left(\alpha_G - \alpha_D s_{Di}\right)\beta_G + \sigma_{Gi}\left(\beta_G^2 - \beta_D^2 s_{Di}\right)}{\beta_G\left(1 - s_{Di}\right)}$$

$$A_i = \frac{\left(\beta_D^2 \sigma_{Gi} / \beta_G\right) + \alpha_D - \alpha_G - \beta_G \sigma_{Gi}}{\left(\beta_G / \sigma_{Gi}\right)\left(1 - s_{Di}\right)} = \frac{\sigma_{Gi}^2 \left(\beta_D^2 - \beta_G^2\right) + \beta_G \sigma_{Gi}\left(\alpha_D - \alpha_G\right)}{\beta_G^2 \left(1 - s_{Di}\right)}$$

$$\hat{V}\left(m_{Xi}^e\right) = \frac{\beta_G^2 \sigma_{Gi}^2 \left(1 - 2s_{Di}\right) + s_{Di}^2 \beta_D^2 \sigma_{Gi}^2 - 2s_{Di}\beta_D^2 \sigma_{Gi}^2 + 2s_{Di}\beta_G^2 \sigma_{Gi}^2 - 2s_{Di}\sigma_{Gi}\beta_G\left(\alpha_D - \alpha_G\right)}{\beta_G^2 \left(1 - s_{Di}\right)^2}$$

$$= \frac{\beta_G^2 \sigma_{Gi}^2 + s_{Di}\beta_D^2 \sigma_{Gi}^2 \left(s_{Di} - 2\right) - 2s_{Di}\sigma_{Gi}\beta_G\left(\alpha_D - \alpha_G\right)}{\beta_G^2 \left(1 - s_{Di}\right)^2}$$

$$\hat{Cov}\left(m_{Xi}^e, m_{Di}^e\right) = \frac{\beta_G^2 \sigma_{Gi}^2 + s_{Di}\beta_D^2 \sigma_{Gi}^2 + \sigma_{Gi}^2 \left(\beta_D^2 - \beta_G^2\right) + \sigma_{Gi}\beta_G\left(\alpha_D - \alpha_G\right)}{\left(1 - s_{Di}\right)\beta_G^2}$$

$$= \frac{\left(1 - s_{Di}\right)\beta_D^2 \sigma_{Gi}^2 + \sigma_{Gi}\beta_G\left(\alpha_D - \alpha_G\right)}{\left(1 - s_{Di}\right)\beta_G^2}$$

APPENDIX 3 Analysis of the correlation coefficient

$$\hat{Cor}\left(m^e_{Xi},m^e_{Di}\right)^2 = \frac{\left[(1-s_{Di})^2\beta_D^4\sigma_{Gi}^4 + \beta_G^2\sigma_{Gi}^2(\alpha_D-\alpha_G)^2 + 2(1-s_{Di})\beta_D^2\beta_G\sigma_{Gi}^3(\alpha_D-\alpha_G)\right](1-s_{Di})^2\beta_G^4}{\left[\sigma_{Gi}^2\beta_G^2 + s_{Di}\beta_D^2\sigma_{Gi}^4(s_{Di}-2) - 2s_{Di}\sigma_{Gi}\beta_G(\alpha_D-\alpha_G)\right](1-s_{Di})^2\beta_G^4\beta_D^2\sigma_{Gi}^2}$$

$$\hat{Cor}\left(m^e_{Xi},m^e_{Di}\right)^2 = \frac{(1-s_{Di})^2\beta_D^4\sigma_{Gi}^4 + \beta_G^2\sigma_{Gi}^2(\alpha_D-\alpha_G)^2 + 2(1-s_{Di})\beta_D^2\beta_G\sigma_{Gi}^3(\alpha_D-\alpha_G)}{\left[\sigma_{Gi}^4\beta_G^2\beta_D^2 + s_{Di}\beta_D^4\sigma_{Gi}^4(s_{Di}-2) - 2s_D\sigma_{Gi}^3\beta_G\beta_D^2(\alpha_D-\alpha_G)\right]}$$

$\hat{Cor}\left(m^e_{Xi},m^e_{Di}\right)^2 \le 1$ implies that

$$\beta_D^4\sigma_{Gi}^4 - 2s_{Di}\beta_D^4\sigma_{Gi}^4 + s_{Di}^2\beta_D^4\sigma_{Gi}^4 + \beta_G^2\sigma_{Gi}^2(\alpha_D-\alpha_G)^2 + 2\beta_D^2\beta_G\sigma_{Gi}^3(\alpha_D-\alpha_G) - 2s_{Di}\beta_D^2\beta_G\sigma_{Gi}^3(\alpha_D-\alpha_G)$$
$$\le \sigma_{Gi}^4\beta_D^2\beta_G^2 + \sigma_{Gi}^4 s_{Di}^2\beta_D^4 - 2\sigma_{Gi}^4\beta_D^4 s_{Di} - 2s_{Di}\sigma_{Gi}^3\beta_D^2\beta_G(\alpha_D-\alpha_G)$$

$$\beta_D^4\sigma_{Gi}^4 + \beta_G^2\sigma_{Gi}^2(\alpha_D-\alpha_G)^2 + 2\beta_D^2\sigma_{Gi}^3\beta_G(\alpha_D-\alpha_G) - \beta_D^2\beta_G^2\sigma_{Gi}^4 \le 0$$
$$\beta_D^2\sigma_{Gi}^4(\beta_D^2-\beta_G^2) + \beta_G\sigma_{Gi}^2\left[\beta_G(\alpha_D-\alpha_G)^2 + 2\beta_D^2\sigma_{Gi}(\alpha_D-\alpha_G)\right] \le 0$$

If we are in the reasonable case where $\beta_D^2 \le \beta_G^2$ (exporting companies obtain a better reward for risk than purely domestic ones) the first term of the equation above is negative.
The second term is negative if $\beta_G(\alpha_D-\alpha_G)^2 + 2\beta_D^2\sigma_{Gi}(\alpha_D-\alpha_G) \le 0$ or if

$$\sigma_{Gi} \ge \frac{\beta_G(\alpha_G-\alpha_D)}{2\beta_D^2}$$

In the reasonable case where $\alpha_G \ge \alpha_D$ the right hand side of the inequality is positive. So to be sure to obtain coefficient of correlation in the interval [-1, 1] the global risk must not be too small.

APPENDIX 4 Analysis of the consequences of error in the coefficients of the domestic line of exporting companies

A4.1. Derivatives of the implicit expected export margin

$$\frac{dm_X^e}{d\alpha_D} = \frac{-s_D}{1-s_D} \le 0$$

Implicit export margin decreases when the intercept of the domestic line increases.

$$\left|\frac{-s_D}{1-s_D}\right|'_{s_D} = \frac{-1}{(1-s_D)^2} < 0$$

The impact of error decreases when export intensity increases.

$$\frac{dm_X^e}{d\beta_D} = \frac{-2s_D\sigma_G\beta_D}{(1-s_D)\beta_G} \le 0$$

Implicit export margin decreases when the slope of the domestic line increases.

$$\left|\frac{-2s_D\sigma_G\beta_D}{(1-s_D)\beta_G}\right|'_{s_D} = \frac{-2\sigma_G\beta_D}{\beta_G(1-s_D)^2} < 0$$

The impact of error decreases when global risk or export intensity increases.

A4.2. Derivatives of the implicit variance of export margin

$$\frac{dV(m_X^e)}{d\alpha_D} = \frac{-2s_D\sigma_G}{(1-s_D)^2\beta_G} \le 0$$

Implicit variance of export margin decreases when the intercept of the domestic line increases.

$$\left|\frac{-2s_D\sigma_G}{(1-s_D)^2\beta_G}\right|'_{s_D} = \frac{-2\sigma_G}{\beta_G(1-s_D)^2} < 0$$

The impact of error decreases when global risk or export intensity increases.

$$\frac{dV(m_X^e)}{d\beta_D} = \frac{2s_D\beta_D\sigma_G^2(s_D-2)}{(1-s_D)^2\beta_G^2} \le 0$$

Implicit variance of export margin decreases when the slope of the domestic line increases.

$$\left| \frac{2s_D \beta_D \sigma_G^2 (s_D - 2)}{(1 - s_D)^2 \beta_G^2} \right|'_{s_D} = \frac{-4\sigma_G^2 \beta_D}{\beta_G^2 (1 - s_D)^3} < 0$$

The impact of error decreases when global risk or export intensity increases.

A4.3. Derivatives of the implicit covariance

$$\frac{dCov(m_D^e, m_X^e)}{d\alpha_D} = \frac{\sigma_G}{(1 - s_D)\beta_G} > 0$$

Implicit covariance increases when the intercept of the domestic line increases.

$$\left| \frac{\sigma_G}{(1 - s_D)\beta_G} \right|'_{s_D} = \frac{\beta_G}{\beta_G^2 (1 - s_D)^2} > 0$$

The impact of error increases when global risk or export intensity increases.

$$\frac{dCov(m_D^e, m_X^e)}{d\beta_D} = \frac{2\beta_D \sigma_G^2 (1 - s_D)}{(1 - s_D)^2 \beta_G^2} > 0$$

Implicit variance of export margin increases when the slope of the domestic line increases.

$$\left| \frac{2\beta_D \sigma_G^2 (1 - s_D)}{(1 - s_D)^2 \beta_G^2} \right|'_{s_D} = \frac{2\sigma_G^2 \beta_D}{\beta_G^2 (1 - s_D)^2} > 0$$

The impact of error increases when global risk or export intensity increases.