The role of previous export behaviour on current firm exports: evaluating both participation and export volumes

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The role of previous export behaviour on current firm exports: Evaluating both participation and export volumes

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Abstract:

As a result of the rapid growth of microeconometric studies of exporting firms, we know that firms which entered a foreign market the previous year are more likely to export the current year. This fact is traditionally interpreted as a consequence of country-specific sunk export costs. These costs are for instance the knowledge of foreign markets, the search for new distribution networks, or the compliance with border crossing standards specific to a given market. The specificity of the destination market appears to be of huge importance for the firms.

The questions addressed by this study are: Is persistence a key feature of the firm's export behaviour (decision and volume) and does it vary across export markets? A multivariate dynamic panel model of French agribusiness firms' exports to two aggregate markets (EU and Rest of the World) is specified. As a consequence, the degree of structural state dependence can be estimated for each export market. Previous export experience in both markets is shown to impact both the decision to export and the level of exports in each market.

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Key words: dynamic tobit model, French agri-food firms, persistence in exports, destination markets

1 Introduction

Hysteresis or persistence in export behaviour has often been highlighted in international economics. Firms which entered an international market in a given year are more likely to be an exporter the year after. This fact is traditionally interpreted as a consequence of sunk export costs at entry to the international market. These costs are for instance the knowledge of foreign markets, the search for new distribution networks or the compliance with border crossing standards specific to a given market. The specificity of the link between the firm and the destination market appears to be of huge importance. A given firm will incur lower entry costs when initiating exports to a market with the same language or where importing standards are not far from its domestic market's ones; on the contrary the costs incurred will be higher if the export market has fundamentally different practices and procedures, imposing highly specific quality standards for instance.

Papers in this field propose to test for the existence of sunk-cost hysteresis by analysing entry and exit patterns in plant-level panel data. Roberts and Tybout (1997) develop and estimate a dynamic discrete-choice model of the plant's current exporting status in Colombia. They show that prior export market experience significantly affects the current decision to export. They also highlight unobserved permanent firm effects as an important determinant of persistence in exports. Özler et al. (2009) also work on the export decisions of firms accounting for their past history using a Turkish dataset. They adopt the approach proposed by Wooldridge (2005) to control for initial conditions. Only a few studies address how the export decision may differ across different export markets. Blanes-Cristobal et al. (2008), also working on the export decision, show that previous experience in the EU market (considered as a whole) has a positive impact on the probability of exporting to the OECD and to the EU, but is less relevant for exports to the rest of the world.

Das et al. (2007) consider both the decision to export and the value exported in a dynamic model. They show that entry costs on international markets (whatever the destination market) are substantial.

Does persistence vary across destination markets from the French agri-food firms' point of view? Are there several types of markets regarding this persistence? What is the origin of the persistence: state variable dependence, or unobserved heterogeneity? Is the behaviour in each market independent of the behaviour on the other market or is there a link?

This paper proposes to take into account both the complete behaviour of exporters (export decision and volume traded) and the destination markets (through the identification of several groups). We work on a balanced panel of continuously operating firms in France in the agri-food sector from 1997 to 2005. The econometric specification leads to a multivariate dynamic panel model of French agribusiness firms' exports to two aggregate markets (EU and Rest of the World). The model accounts for both zero level and positively skewed exports by adopting the Cragg (1971) logarithmic Tobit model. In this study, we compare two destinations: intra-EU destinations (EU) versus the rest of the world (ROW) destinations. Unobserved firm-level heterogeneity is accounted for by introducing random effects which may be correlated across export markets. We use the approach proposed by Wooldridge (2005) to control for initial conditions.

The remainder of the paper is structured as follows: section 2 presents empirical facts and the intuition of persistence regarding both export status and value traded. Section 3 presents the econometric specification. Section 4 shows results. Here the role of initial conditions is specifically shown, as well as the role of the behaviour the previous year on the current behaviour on both markets. We also highlight the existence of a threshold of exported value the previous year for each market. When firms exported above this threshold value the previous year, their probability of exporting and their exported value both increase the current year.

2 Empirical facts: persistence in the status of export and in the volume exported according to the final destination

2.1 Data

In this paper, we use data concerning individual French agri-food firms for the years 1996 to 2005 from two main sources:

- The French National Institute of Statistics (INSEE) provides annual data collected in a survey which is compulsory for all firms located in France with more than 20 employees or with total sales over 5 million €. This survey (Enquête annuelle d'entreprises-EAE) collects a wide range of variables including the main activity of the firm (NACE code), total sales, the number of employees, investment, location and some accounting data. First we build our dataset as a balanced panel with firms continuously operating (i.e. in the EAE database) for the whole period. The balanced panel is initially composed of 1518 firms.

- The register of French Customs, which identifies the destination of exports per product (at the 8-digit level of the combined nomenclature) by value and quantity for each exporting firm. Each firm is identified by its identification number (SIREN code). This dataset comes from the register of French Customs which identifies all the French exporters whatever their size and the destination of their exports per product (at the 8-digit level of the combined nomenclature) by value and quantity. Agri-food products were selected according to the French classification of products (CPF3)[3].

As in the EAE database, firms are identified by their identification number (SIREN code) which enables us to merge the two datasets.

Consequently we know for each firm from our balanced panel the status regarding export; and for firms which export, we know the volumes and values exported according to the destination market.

The 1518 firms can be described regarding their export status:

[3]Agri-food products correspond to 9 groups (151: meat products, 152: sea food products, 153: processed F&V, 154: oil & fats products, 155: dairy products, 156: processed cereals; 157: animal prepared feeds, 158: other foodstuffs, 159: beverage). These groups of products correspond to the sectors of the NACE nomenclature. The concordance between the combined nomenclature and the CPF3 is obtained from INSEE.

For the whole period:		Export to the EU market			Total
		Never export	Export at least once	Export 10 years	
Export to the ROW market	Never export	475 *31%*	230 *15%*	144 *9%*	849 *56%*
	Export at least once	33 *2%*	186 *12%*	195 *13%*	414 *27%*
	Export 10 years	4 *0.2%*	26 *2%*	225 *15%*	255 *17%*
Total		512 *34%*	442 *29%*	564 *37%*	1518 *100%*

Table 1: Export status of the firms in the balanced panel according to the final destination (source: customs data-EAE from 1996 to 2005)

We chose to distinguish between two destinations: the EU or the rest of the world. This distinction represents a trade-off between geographic proximity and meaningful levels of involvement in the respective markets.

Considering the whole panel, we see that only 31% of French firms never export. This could be seen as a low rate of non exporting firms. At the step, one should keep in mind that our panel is built using the EAE survey, which deals with firms with more than 20 employees. In other words, small firms (mostly non exporting ones) are not considered here.

Regarding the destination, we can see that French firms mainly export to the EU (29+37=66 %). Among them, 24% (9+15) export only to the EU. Some firms export to the rest of the world (27+17=44%). Only few firms export only to the rest of the world. (2+0.2=2.2%). 42% of the sample export to both destinations.

2.2 Empirical facts and persistence

In line with prevailing notions regarding export patterns, we look at some empirical facts concerning persistence in export behaviour. Two components of export behaviour can be dealt with: the export status, and the value exported.

First, regarding the status of exporter linked with the destination of export, table 2 confirms the persistence as described in previous studies. Among non exporters in *t-1*, 93% are still non exporters the current year. This shows a high persistence in non-exporter status. Concerning

exporting firms, we can see that a firm exporting to a given set of destinations (European Union, Rest of the world, or both in our example) tends to export to the same set of destination the year after. For instance, out of 3828 transitions for firms exporting only to the EU in year *t-1*, 84% (3215) of subsequent transitions represent exports only to the EU in year *t* and only 0.7% represent exports only to the ROW market.

The non-export status is the most persistent one. For firms exporting only to the ROW market, the persistence is the lowest (63%).

Year t-1 status		Year t status	Average 1996-2005
No export	Total 5919 (100%)	No export	5513 (93.1 %)
		Export only to the ROW	60 (1.01 %)
		Export only to the EU	304 (5.14 %)
		Export to both	42 (0.71 %)
Export only to the ROW	Total 397 (100%)	No export	52 (13.1 %)
		Export only to the ROW	250 (63%)
		Export only to the EU	32 (8 %)
		Export to both	63 (15.9 %)
Export only to the EU	Total 3828 (100%)	No export	298 (7.8%)
		Export only to the ROW	27 (0.7 %)
		Export only to the EU	3215 (84%)
		Export to both	288 (7.5%)
Export to both	Total 3518 (100%)	No export	48 (1.4%)
		Export only to the ROW	53 (1.5 %)
		Export only to the EU	246 (7 %)
		Export to both	3171 (90%)

% out of 13662 observations (1518*9 transitions)

Table 2 Average transition (numbers of firms and rates) of French agri-food firm status according to the export market (EU/ROW) on the whole period 1996-2005-source: EAE, customs data set

To go further in details, Table 3 describes the transitions (in frequency and rate) from 1996 to 1997, from 2000 to 2001 and from 2004 to 2005. The persistence is still high showing variation in the transition rates. For instance the transition in exporting only to the ROW was 51% from 1996 to 1997; this rate reaches 70% from 2000 to 2001 or from 2004 to 2005.

Beside the high persistence in choice of destination, a non negligible transition appears in the period 1996-1997: 22% of firms exporting only to the ROW in 1996 become non exporters in 1997. This means that there exists an significant exit rate and that it should be dealt with.

Export status of French agri-food firms												
Initial status	Transition from 1996 to 1997				Transition from 2000 to 2001				Transition from 2004 to 2005			
	No export	Export only to the ROW	Export only to the EU	Export to both	No export	Export only to the ROW	Export only to the EU	Export to both	No export	Export only to the ROW	Export only to the EU	Export to both
No export	612 *91%*	5 *0.7%*	48 *7.1%*	7 *1%*	612 *93%*	6 *0.9%*	35 *5.3%*	5 *0.8%*	633 *95.6%*	6 *0.9%*	22 *3.3%*	1 *0.2%*
Export only to the ROW	12 *[illegible]*	28 *51.8%*	4 *7.4%*	10 *18.5%*	4 *9.8%*	29 *70.7%*	0 *0%*	8 *19.5%*	4 *9.8%*	29 *70.7%*	3 *7.3%*	5 *12.2%*
Export only to the EU	29 *6.7%*	0 *0%*	368 *85.2%*	35 *8.1%*	33 *7.7%*	7 *1.6%*	345 *80.2%*	45 *10.5%*	24 *5.8%*	3 *0.7%*	353 *85.1%*	35 *8.4%*
Export to both	5 *1.4%*	4 *1%*	18 *5%*	333 *92.5%*	7 *1.8%*	11 *2.8%*	23 *5.9%*	348 *86.5%*	3 *0.7%*	9 *2.25%*	23 *5.8%*	365 *91.3%*

Table 3: Transition (numbers of firms and rates) in export status of French agri-food firm according to the destination market (EU/ROW)- source: EAE, customs data 1996-2005

Second, we can look at the persistence in value exported according to the destination. We have split exporters in 4 categories according to their export value. Average transition rates on the whole period are shown in table 4. The quartiles the exporters belong to are defined according to the value exported to a destination. According to the destination, the bounds of the quartiles change. For the EU market, the four categories of value exported are: less than 495 thousand Euros; between 495 and 1724 thousand Euros; between 1724 and 6906 thousand Euros, and more than 6906 thousand Euros. For the ROW market, the bounds are lower and are: less than 262; between 262 and 883; between 883 and 3643 and more than 3643 thousand euros. The table confirms the high persistence rate in the quartile of value exported by the firm. A firm belonging to one quartile a given year still belongs to this quartile the year after. The persistence rate varies between 63% (for the first quartile of exporters exporting only to the ROW with the confirmation of a non negligible transition to non export with 22.4%) and 93% for the fourth quartile of exporters exporting to the EU.

Year t-1	Year t	EU market Period 1996-2005	ROW market Period 1996-2005
No export	No export	5875 (93%)	9330 (95.7%)
	First quartile of exporters	270 (4.3%)??	242 (2.5%)
	Second quartile of exporters	97 (1.5%)	101 (1%)
	Third quartile of exporters	53 (0.8%)??	50 (0.5%)
	Fourth quartile of exporters	21 (0.3%)??	24 (0.3%)
	Total	**6316 (100%)**	**9747 (100%)**
First quartile of value exported	No export	283 (15.1%)	221 (22.4%)
	First quartile of exporters	1342 (71.8%)	627 (63.5%)
	Second quartile of exporters	230 (12.3%)	127 (12.9%)
	Third quartile of exporters	13 (0.7%)	12 (1.2%)
	Fourth quartile of exporters	1 (0.05%)	0 (0%)
	Total	**1869 (100%)**	**987 (100%)**
Second quartile of value exported	No export	79 (4.3%)	85 (8.6%)
	First quartile of exporters	175 (9.5%)	87 (8.8%)
	Second quartile of exporters	1352 (73.36%)	673 (68%)
	Third quartile of exporters	230 (12.48%)	141 (14.2%)
	Fourth quartile of exporters	7 (0.38 %)	4 (0.4%)
	Total	**1843 (100%)**	**990 (100%)**
Third quartile of value exported	No export	48 (2.6%)	51 (5.3%)
	First quartile of exporters	20 (1.1%)	5 (0.5%)
	Second quartile of exporters	160 (8.8%)	82 (8.5%)
	Third quartile of exporters	1454 (80.1%)	733 (75.7%)
	Fourth quartile of exporters	133 (7.3%)	97 (10%
	Total	**1815 (100%)**	**968 (100%)**
Fourth quartile of value exported	No export	16 (0.9%)	21 (2.2%)
	First quartile of exporters	1 (0.05%)	1 (0.1%)
	Second quartile of exporters	6 (0.3%)	1 (0.1%)
	Third quartile of exporters	98 (5.4%)	71 (7.3%)
	Fourth quartile of exporters	1698 (93.3%)	876 (90%)
	Total	**1819 (100%)**	**970 (100%)**

Table 4: Average transition (numbers of firms and rates) for French agri-food firm according to the value of exports to the EU and Rest of the World markets on the whole period- source: EAE, customs data 1996-2005

Tables 5a and 5b offer a more detailed insight on each market. As for the EU market (table 5a), the persistence is high looking at the diagonal of the transition matrix. The rate is especially high for two categories: non-exporter and the fourth quartile of value exported. We can also see a non negligible exit rate for exporters which belonged to the first quartile in 1996 with 12.1%, in 2000 with 18% or in 2004 with 14.4%.

Previous year	Quartile of value exported to the EU														
	Transition from 1996 to 1997					Transition from 2000 to 2001					Transition from 2004 to 2005				
	No exp	1st quart	2nd quart	3rd quart	4th quart	No exp	1st quart	2nd quart	3rd quart	4th quart	No exp	1st quart	2nd quart	3rd quart	4th quart
No export	657	36	20	12	1	645	34	11	4	4	672	24	4	3	0
	90.5%	*5%*	*2.7%*	*1.7%*	*0.1%*	*92.4%*	*4.8%*	*1.6%*	*0.6%*	*0.6%*	*95.6%*	*3.4%*	*0.6%*	*0.4%*	*0%*
First quartile	24	145	29	0	0	37	140	25	3	0	29	157	14	2	0
	12.1%	*73.2%*	*14.7%*	*0%*	*0%*	*18%*	*68.3%*	*12.2%*	*1.5%*	*0%*	*14.4%*	*77.7%*	*6.9%*	*1%*	*0%*
Second quartile	9	19	143	27	0	8	27	145	24	0	7	20	155	22	1
	4.6%	*9.6%*	*72.2%*	*13.6%*	*0%*	*3.9%*	*13.2%*	*71%*	*11.8%*	*0%*	*3.4%*	*9.8%*	*75.6%*	*10.7%*	*0.5%*
Third quartile	4	4	15	160	15	7	2	24	161	12	2	1	27	161	13
	2%	*2.%*	*7.6%*	*81%*	*7.6%*	*3.4%*	*1%*	*11.7%*	*78%*	*5.8%*	*1%*	*0.5%*	*13.2%*	*78.9%*	*6.4%*
Fourth quartile	1	0	0	7	190	2	1	0	13	189	1	0	1	14	188
	0.5%	*0%*	*0%*	*3.5%*	*96%*	*1%*	*0.5%*	*0%*	*6.3%*	*92.2%*	*0.5%*	*0%*	*0.5%*	*6.9%*	*92.2%*

Table 5a: Transition rates in the volume of exports of French agri-food firm to the EU market -source: EAE, French custom data 1996-2005

As for export to the ROW (table 5b), the results are nearly the same. The diagonal of the transition matrix achieves a high rate showing persistence in a given category of value exported. The two highest transition rates are for non-exporters and the fourth quartile of value exported. We still observe a non negligible exit rate for firms belonging to the first quartile of exporter the year before.

Previous year	Quartile of value exported to the ROW														
	Transition from 1996 to 1997					Transition from 2000 to 2001					Transition from 2004 to 2005				
	No exp	1st quart	2nd quart	3rd quart	4th quart	No exp	1st quart	2nd quart	3rd quart	4th quart	No exp	1st quart	2nd quart	3rd quart	4th quart
No export	1057	27	9	7	4	1042	31	5	5	0	1032	28	10	6	1
	95.7%	*2.5%*	*0.8%*	*0.6%*	*0.4%*	*96.2%*	*2.9%*	*0.5%*	*0.5%*	*0%*	*95.8%*	*2.6%*	*0.9%*	*0.6%*	*0.1%*
First quartile	24	69	10	0	0	28	69	10	1	0	18	73	17	2	0
	23.3%	*67%*	*9.7%*	*0%*	*0%*	*26%*	*63.9%*	*9.3%*	*0.7%*	*0%*	*16.4%*	*66.4%*	*15.4%*	*1.8%*	*0%*
Second quartile	6	9	71	18	0	7	7	82	13	0	9	10	81	11	0
	5.8%	*8.7%*	*68%*	*17.3%*	*0%*	*6.4%*	*6.4%*	*75.2%*	*11.9%*	*0%*	*8.1%*	*9%*	*73%*	*9.9%*	*0%*
Third quartile	5	1	15	72	10	8	0	11	82	8	3	1	6	88	12
	4.8%	*1%*	*14.6%*	*70%*	*9.7%*	*7.3%*	*0%*	*10.1%*	*75.2%*	*7.3%*	*2.7%*	*0.9%*	*5.4%*	*80%*	*10.9%*
Fourth quartile	4	0	0	8	92	3	0	0	6	100	3	0	0	5	102
	3.8%	*0%*	*0%*	*7.7%*	*88%*	*2.7%*	*0%*	*0%*	*5.5%*	*91.7%*	*2.7%*	*0%*	*0%*	*4.5%*	*93%*

Table 5b: Transition rates in the volume of exports of French agri-food firm to the ROW market -source: French custom data 1996-2005

We see that the size of the export the current year appears to be linked to the size of export the year before. It is worth noting that among exporters belonging to the first quartile of exporters the previous year, 15% are likely to exit from the EU market, and 22 % from the ROW market. This exit rate is not negligible and shows a higher variability in transition for the first quartile of exporters. This empirical fact was expected. The idea of small values leading to short duration in relationships is analysed in Besedeš (2008). He shows, using a hazard model approach on US import data at the product level, that only starting large purchases from one country could gain distinct advantage in duration. In our point of view this result can be extended at the firm level: thus exporting small values to a country a given year leads more likely to exit the year after. This result is all the more expected when the destination is unfamiliar (as the ROW for French exporters).

3 From theory to econometrics:

3.1 Theoretical framework

In this paper we use the same theoretical model as in Roberts and Tybout (1997) or Campa (2004). We propose two extensions for these models. First we take into account the final destination of the export. According to the export market, the role of previous experience (in terms of presence or absence from an export market) will be revealed. Second, the previous experience considered is not only the status of the firm regarding export to a specific market, but it also includes the value traded towards this foreign market. The interactive impact of exporting to a market the previous year on the current decision to export and volume traded to the other market will be accounted for.

In this model, we assume that the decision to export in the current year is linked to the export history of the firm: the previous status but also the previous export supply, distinguishing between the final destinations. We introduce y_{ijt} which represents the observed exports of firm i (i=1, 2, ... N), to export market j (j=1, 2, ...J), in year t (t=1, 2, ..., T). This variable can be zero or have positive values of exports. I_{ijt} is an indicator variable that takes the value of 1 if firm *i* exports to *j* at time *t*, 0 otherwise

Let us introduce a function *l* representing the links established during the previous year (a result of networks or past negotiation on the market the year before) which are known by the firm in the current year. This function is increasing in the value traded. The more the firm traded with a country, the more the links established in the country. These links are

hypothesized to impact positively the export revenue the current year: the more the firm exported in a specific network the year before, the more it will export this year.

In every period *t* the firm chooses whether to serve the market *j* so as to maximise the present discounted value of its profits from exporting to *j*:

$$(1) \qquad V_{it}\left(\Omega_{it}\right) = \underset{I_{ijt}, y_{ijt}}{Max}\ E_t\left[\sum_{k=t}^{\infty} \partial^{j-t} R_{ijk}(I_{ijk}, y_{ijk}) / \Omega_{it}\right]$$

where Ω_{it} is the information set available at time *t*; ∂ is the one-period discount factor and R_{ijt} are the expected net revenues from exporting by firm *i* to country *j* in period *t*. Whenever the firm chooses to export, it will also choose its optimal export level y_{ijt} (y_{ijt} = 0 otherwise).

Suppose that there exist overall fixed costs to become an exporter (F_0) and fixed country-specific costs to enter market j (F_{ij}) or to exit (G_{ij})

Then the revenues from exporting y_{ijt} at time *t*, $R_{ijt}(y_{ijt})$ are:

$$(2)\ R_{ijt}\left(y_{ijt}\right) = I_{ijt}\left[\pi_{ijt}\left(y_{ijt}\right) - \left[F_0(1 - \underset{j' \neq j}{Max} I_{ij't-1}) + F_{ij}\left(1 - I_{ijt-1}\right)\right] + I_{ijt-1} * l\left(y_{ijt-1}\right)\right] - G_{ij} I_{ijt-1}(1 - I_{ijt})$$

A firm *i* for which I_{ijt-1} is 0 does not export to market *j* during time *t-1* and can be either a non exporter to any market, or a non exporter to market *j* but an exporter to market(s) *j'*. In this latter case the firm possesses a potential knowledge of export status and may have reduced fixed costs to enter one additional market compared with a non-exporting firm. Function *l* may play a determinant role according to the market specificities. The more a firm exported through a specific network the previous year (i.e. impact caught through $l\left(y_{ijt-1}\right)$), the more the exports in the current year. π_{ijt} is the gross profit (i.e. not adjusted for sunk costs) from exporting.

Using Bellman's equation to solve equation 1, we know that y_{ijt} must be such that it satisfies:

$$(3) \qquad V_{ijt}\left(\Omega_{it}\right) = \underset{I_{ijt}, y_{ijt}}{\text{Max}}\left[R_{ijt}\left(I_{ijt}, y_{ijt}\right) + \partial E_t\left[V_{ijt+1}\left(\Omega_{ijt+1}\right) / y_{ijt}\right]\right]$$

This program defines a participating condition based on the present profit $\pi_{ijt}\left(y_{ijt}\right)$ and the expected discounted value $V_{ijt+1}\left(\Omega_{ijt+1}\right)$ according to the decision to export to country *j* or not ($I_{ijt} = 1$ or $I_{ijt} = 0$).

$$\pi_{ijt}\left(y_{ijt}\right)+\partial\left[E\left[V_{ijt+1}\left(\Omega_{ijt+1}\right)/I_{ijt}=1\right]-E\left[V_{ijt+1}\left(\Omega_{ijt+1}\right)/I_{ijt}=0\right]\right]\geq$$
$$F_0(1-\sum_{j\neq j'}I_{ijt-1})+F_{ij}-(F_{ij}+G_{ij})I_{ijt-1}+l(y_{ijt-1})*I_{ijt-1} \quad (4)$$

The export supply is the value that maximises the present discounted value of its profits from exporting to *j*.

The value exported to country *j* will depend on the network knowledge, partly based on the past history of the export to this country (through $l(y_{ijt-1})$) and on the performance of the firm.

Hence both past status on market *j* and the volume traded on this market are important. The function above-called *l* is a way to capture the "penetration" of the firm in market *j*. The intuition is that the more a firm exports to market *j*, the more established its connexion with market *j*, hence the easier will be the export of the firm to this country (in decision and value). To account for this information previous studies have adopted the notion of access by taking into account previous export status. This is somewhat restrictive. The introduction of the function *l* in the model aims at allocating a weight (specific to the destination market) to the volume traded in *t-1* instead of just considering the decision to export in *t-1*.

The volume traded in the current year depends in part on the past export history of the firm, if any. State variables of the firm (as the productivity of the firm) should also play a determinant role.

We will not provide a structural form of the participation equation and volume traded. We will work on a reduced form model, which will be estimated hereafter.

3.2 Econometric specification

Again we let Y_{ijt} represent the observed exports of firm *i* (*i*=1, 2, ... N), to export market *j* (*j*=1, 2, ...J), in year *t* (*t*=1, 2, ..., T).

Hence we observe the following y_{ijt}:

Y_{ijt}=0 if firm *i* does not export to country *j* in time *t*

$Y_{ijt}=y_{ijt}$ the value of export of firm *i* toward country *j* in time *t*

We assume that the expected gross profits, defined by the value traded once the decision to export to the market occurs, depend on firm characteristics, macro conditions and past exports.

The history of the firm in the previous year is expected to have an impact on the decision to export, the volume traded, and the destination chosen in the current year. The export of a French agri-food firm to a given market is impacted by the history of the firm with regard to this market. But our aim is also to introduce a potential link between the history of export in one market and the current decision to trade on the other market.

To fully account for the lagged observed value, we do not introduce the lagged variable directly but we introduce function *g()*. This function is a vector function defined as follows:

$g(y_{ijt-1}) = \{\mathbf{1}[y_{ijt-1} \neq 0] \,;\, \mathbf{1}[y_{ijt-1} \neq 0] \; logy_{ijt-1}\}$

In this frame, the function *g(.)* allows the lagged value of the observed response to appear. The specification chosen (as in Woodridge 2005) allows the effect of lagged y_{ijt} to be different depending on whether the previous response was a corner solution (i.e. a zero) or strictly positive. This allowance is in line with the theoretical model.

As a specification of our model, we propose:

(5) $$P\left(y_{ijt} = 0 / \omega_{ij}\right) = 1 - \Phi\left(\alpha_j + \left(X_{ijt}\beta_j + g\left(y_{ijt-1}\right)\rho_j + Z_{ij}\gamma_j + \omega_{ij}\right)/\theta_j\right)$$

(6) $$f\left(y_{ijt} / y_{ijt} > 0, \omega_{ij}\right) = (2\pi)^{-\frac{1}{2}}\left(\sigma_j y_{ijt}\right)^{-1} \exp\left(-\left(\log y_{ijt} - X_{ijt}\beta_j - g\left(y_{ijt-1}\right)\rho_j - Z_{ij}\gamma_j - \omega_{ij}\right)^2 / 2\sigma_j^2\right)$$
$$\times\Phi\left(\alpha_j + \left(X_{ijt}\beta_j + g\left(y_{ijt-1}\right)\rho_j + Z_{ij}\gamma_j + \omega_{ij}\right)/\theta_j\right)$$

X_{ijt} are observable variables of the firm varying over time and the vector Z_{ij} contains all initial conditions and all values of the variables that vary with time (following Wooldridge 2005). Here ω_{ij} is a random variable from a *J* variate normal distribution $\omega \sim N(0, \Sigma)$. If the off-diagonal elements of Σ are non-zero, then the random effects are correlated across export markets. ρ is a vector describing the impact of the lagged variables: the lagged export status and the lagged exported value. These two variables may not impact the current export status or the current value exported in the same way. Hence ρ has two components and its knowledge will give us both the impact of the previous export status and the impact of the previous exported value on the current export behaviour of the firm on a given market.

The likelihood function for the i^{th} firm under the multivariate random effects tobit specification may be written

(7) $L_i=\int_{R^J}(\prod_t^T\prod_j^J P(y_{ijt}=0|\omega_j)^{d_{ijt}}f(y_{ijt}|\omega_j)^{1-d_{ijt}})\ (2\pi)^{-J/2}|\Sigma|^{-1/2}\exp(-1/2\omega'\Sigma^{-1}\omega)d\omega$

where $d_{ijt}=1$ if $y_{ijt}=0$.

To operationalize this model, we propose two simplifications. First, to reduce the number of parameters estimated, we replace the vector of all time varying explanatory variables in Z_{ij}, with the means of these variables, i.e. with $\overline{X}_{ij}=T^{-1}\sum_{t=1}^T X_{ijt}$. These variables include investment, capital, employees and wages of the firm. These variables are available for the whole period.

Second, rather than estimate Σ directly, we consider its Cholesky decompostion $H'H=\Sigma$ and replace the random effect ω_{ij} with the quantity $H_j\omega_i$ where H_j denotes the j^{th} row of H and ω_i is a vector of the J random effects that enter the i^{th} firm's export equations. This yields the likelihood function:

(8) $L_i=\int_{R^J}(\prod_t^T\prod_j^J P(y_{ijt}=0|H_j\omega_i)^{d_{ijt}}f(y_{ijt}|H_j\omega_i)^{1-d_{ijt}})\ (2\pi)^{-J/2}\exp(-1/2\omega'\omega)d\omega$

To sum up, we specify and estimate using Matlab a multivariate dynamic panel model of French agribusiness firms' exports to two aggregate markets (EU and Rest of the World). The model accounts for both zero level and positively skewed exports by adopting the Cragg (1971) logarithmic Tobit model. Unobserved firm-level heterogeneity is accounted for by introducing random effects which may be correlated across export markets. The initial conditions problem is treated by assuming that a component of the unobserved firm effect is conditional on initial values and exogenous variables (Wooldridge, 2005).

4 Results:

Our results show both the extent to which current export activity is affected by the past and the extent to which the current export activity is determined by the characteristics of the firms. In this paper we only distinguish between 2 groups of countries: the European Union, and the Rest of the World.

We maximize expression (8). We have data concerning 1461 firms (out of 1518 because of missing values) for 8 years (first two years are used to compute the initial conditions) leading to 11 688 observations.

Some variables describing the state of the firm are included in the model. The idea is to introduce variables picking up the competitiveness and the productivity of the firms. As in Roberts and Tybout (1997), or Kaiser and Kongsted (2008), in order to account for the size and competitiveness of the firms, we introduce the number of employees (*Ln (Employ)*) and the average wage of the firms (*Ln (Wage)*). Following Olley and Pakes (1996) and in order to proxy the productivity of the firms, we also chose to introduce the Capital (*Ln (Capital)*), investment (*Ln (Invest)*) , and the cross product of these two variables (*Ln (Inv)*Ln (Cap)*).

We introduce all these variables for each year and the means of the variables for the whole period (*Avg.Invest, Avg.Capital, Avg.Inv*Cap, Avg.Employ, Avg.Wage*).

Regarding the export history of the firms, we include the lagged export status in each market (two dummy variables noted *1.EUY(t-1)>0* and *1.ROWY(t-1)>0*; these variable equal one if the firm exported to the EU or to the ROW respectively in t-1) and the lagged export values (*EU LnY(t-1), ROW LnY(t-1)*). Export status and exported value are the two components gathering the whole information of the export history of the firms on a given market. We also include the two components of exports computed for the first two years of our sample for each firm and each destination (*EU LnY(t=0), 1.EU(t=0)>0* and *ROW LnY(t=0), 1.ROW(t=0)>0*) as suggested by Wooldridge (2005).

Yearly dummy variables are also included to account for annual effects specific to each market (to allow for business cycle and exchange rate effects).

From our specification and estimation, the degree of structural state dependence can be estimated for each export market. Table 4 presents our results.

First of all we have to note that the structural parameters (i.e. elements of H) of the random effect of Cragg model are positive and highly significant.

Secondly the estimated standard errors are computed using the methodology of White (1982) and thus should be robust with regard to distributional misspecification.

- **Role of initial conditions:**

The initial conditions were expected to play a significant positive role on the current export behaviour. It appears from our results that the value exported in the initial year (*EU LnY(t=0),*

and *ROW LnY(t=0)* has the expected role. Nevertheless, the dummy variable indicating export to a specific market in the initial year (*1.EU(t=0)>0* and *1.ROW(t=0)>0*) is not significant.

- **Role of firm specific variables:**

Among firm characteristics variables, current employment and wages appear as the main determinants of export to both the EU and the ROW. Current investment or capital or their cross product contribute little to the explanation of exports to the ROW.

Some of the average values of these variables have also an impact. Regarding exports to the EU, average investment has an expected and significant positive impact. More surprisingly, average employment has a negative impact—however the coefficients on the (current) employment variables are larger in absolute value which suggests that increases of employment over average levels are associated with increased exports.

Regarding exports to the ROW, only the average wage has a highly significant positive impact to export to the ROW.

Current export behaviour							
Export to the EU				**Export to the ROW**			
Param/Variable	Est.	SE	Z	Param/Variable	Est.	SE	Z
Alpha 1	-5.27	0.06	-87.72	Alpha 2	-5.20	0.08	-62.44
Sigma 1	0.53	0.02	25.60	Sigma 2	0.55	0.03	19.05
H11	0.87	0.07	13.21	H22	1.29	0.13	9.63
				H12	0.70	0.08	8.50
Const.	-0.91	0.87	-1.05	Const.	-3.75	1.50	-2.51
Ln (Invest)	-0.12	0.05	-2.15	Ln (Invest)	-0.03	0.09	-0.37
Ln (Capital)	-0.11	0.05	-2.07	Ln (Capital)	0.00	0.09	-0.01
Ln(Inv)*Ln(Cap)	0.15	0.07	2.25	Ln(Inv)*Ln(Cap)	0.04	0.11	0.36
Ln (Employ)	0.60	0.07	8.52	Ln (Employ)	0.55	0.10	5.46
Ln (Wage)	0.35	0.07	4.96	Ln (Wage)	0.35	0.12	2.93
EU LnY(t-1)	0.44	0.03	16.66	ROW LnY(t-1)	0.36	0.04	10.21
1.EUY(t-1)=1	-1.96	0.15	-13.37	1.ROWY(t-1)=1	-1.23	0.18	-6.94
EU LnY(t=0)	0.29	0.03	9.43	ROW LnY(t=0)	0.38	0.04	8.95
1.EU(t=0)>0	-0.11	0.21	-0.53	1.ROW(t=0)>0	0.16	0.30	0.55
Avg.Invest	0.53	0.11	4.68	Avg.Invest	0.22	0.18	1.22
Avg.Capital	0.18	0.10	1.81	Avg.Capital	0.06	0.15	0.39
Avg.Inv*Cap	-0.36	0.13	-2.75	Avg.Inv*Cap	-0.10	0.20	-0.52
Avg.Employ	-0.40	0.09	-4.54	Avg.Employ	-0.32	0.16	-2.04
Avg.Wage	0.33	0.14	2.29	Avg.Wage	0.96	0.27	3.56
Theta 1	1.14	0.06	18.24	Theta2	1.41	0.10	13.89
Year 98	0.05	0.04	1.49	Year 98	-0.02	0.05	-0.30
Year 99	0.02	0.03	0.63	Year 99	-0.06	0.05	-1.19
Year 00	0.00	0.03	-0.11	Year 00	-0.04	0.05	-0.91
Year 01	-0.04	0.03	-1.59	Year 01	-0.10	0.04	-2.58
Year 02	-0.03	0.03	-1.22	Year 02	0.10	0.04	2.54
Year 03	-0.01	0.02	-0.35	Year 03	-0.05	0.03	-1.53
Year 04	-0.02	0.02	-0.94	Year 04	-0.02	0.03	-0.62
Random Effects Variance/ Covariance:				Temporal Correlation of Composite Error Terms			
Σ11=0.76				EU ……0.73			
Σ12=0.61 (0.48corr)		Σ22=2.16		ROW …0.878			
Number of observations: 11688				Loglikelihood: -7003.84			

Table 6: Estimation of the Cragg model (53 parameters/variables estimated) accounting for the lagged export behaviour (status and value) and the initial conditions

- **The previous export experience as a key determinant of the current export:**

Previous export experience in both markets impacts significantly both the decision to export and the level of exports in each market, even after controlling for the characteristics of the firms and for the initial conditions.

These results confirm those obtained in the analysis of the raw data about previous export experience. From the estimation, it appears that there does exist a threshold below which the export is not persistent. This was highlighted in tables 5a and 5b by the non negligible transition rate from being in the first quartile of exports in *t-1* to being a non-exporter in year *t*. More precisely, for a firm exporting to the EU the previous year a volume $y_{EU,t-1}$, the impact on the export the current year will be through the two variables: the dummy indicating its previous status, and the log value of its previous export. Holding all other variables constant, the previous year's export experience will increase the probability of exporting in the current year when $-1.96+0.44*\log(y_{EU,t-1})>0$ for the EU market and $-1.23+0.36*\log(y_{ROW,t-1})>0$ for the ROW. From these expressions, it appears that the impact on the current year export probability will be positive if $log(y_{EU,t-1})$ is above 4.45 leading to $y_{EU,t-1}$ above 85.01 thousand Euros. The same holds for the exports to ROW and the threshold is 30.5 thousand Euros.

The existence of these two thresholds seems to confirm one of the stylised facts we had highlighted. One part of the highlighted exiting rate is explained by the existence of the thresholds. The remaining part is explained by the characteristics of the firm and the unobserved heterogeneity.

Going back to our data, we can look at the number of observations and number of firms concerned by these thresholds as shown in table 5:

Probability thresholds from estimates			
Market	Estimated Thresholds (in 1000s euro)	Observations below the thresholds	
		Number of observations	Number of firms
EU	85.01	259 (2.22%)	124 (8.49%)
ROW	30.50	108 (0.92%)	55 (3.76%)

Table 7 : Exit rate computed from our estimations

As a point of reference, we note that the first quartiles of exports are on average 495 thousand Euros for the EU and 262 thousand euros for the ROW. The exit thresholds concern small

exporters below the quartile. Once more, this result confirm the notion of short duration of small purchases (Besedeš, 2008).

- **The interdependence of export on both market:**

The random effects are correlated (parameter for *H12* is highly significant in table 6) showing an interrelation between exporting to the EU market and exporting to the ROW market.

- **The unobserved persistence:**

The temporal correlation of the composite error term is not negligible. This confirms as in a previous paper (as Roberts and Tybout, 1997) that the permanent unobserved firm effects are at play in the persistence we observe. Specifically given that the magnitude of Σ_{22} is nearly three times as large as Σ_{11} (table 6), we conclude that unobserved heterogeneity is substantially larger for exports outside EU.

- **Computations of predicted probabilities and value exported:**

Probabilities of Exporting Given Lagged Export status				
	1st Quartile of Exporters	2nd Quartile of Exporters	3rd Quartile of Exporters	4th Quartile of Exporters
EU	0.49	0.80	0.93	0.99
ROW	0.29	0.54	0.75	0.92
Expected Median Level of Exports Given Lagged Export Status (1000's €)				
	1st Quartile of Exporters	2nd Quartile of Exporters	3rd Quartile of Exporters	4th Quartile of Exporters
EU	180.5	810.6	2871	27014
ROW	46.68	226.7	1243	26720

Table 8: predicted probabilities and export values according to the destinations

Is there a different impact of export experience on the current export behaviour according to the destination markets? From the table 8, the impact of the lagged export behaviour appears as varying according to the size of exports. Globally, the persistence of the export status and of the size of the export over time is confirmed. The probability to export the current year is high for all quartile of exports except the first one. As mentioned before the existence of a threshold in exports explain the lower levels of probabilities for firms in the first quartile of exports.

More precisely, for the first quartile of exporters, the average firm (i.e. all state variables at the median of the first quartile sample), has a relatively lower probability to export to the ROW than to the EU. This would suggest that the persistence is stronger for the EU markets than for non-EU markets. This result, of course, is highly plausible and illustrates the value of export market disaggregation.

In the 4^{th} quartile of exports, difference in both components of export (status and export values) according to the destination decrease significantly.

The persistence we show, in line with most of the existing literature on dynamics of firm exports, seem in contradiction with the results obtained by Lawless (2009) on Irish exporting firms. The author shows that entry and exit to individual markets are more fluid than in our data. The point is that we do not account here for individual markets but for aggregated destinations.

5 Discussion

The main result of this paper is that we find important state dependence in exports. We confirm the existence of both observed (through firm characteristics and previous export history of the firms) and unobserved components (through random effect and temporal correlation of composite error term) in the export persistence.

From an econometric point of view, we specified and estimated a multivariate dynamic panel model of French agribusiness firms' exports to two aggregate markets (EU and Rest of the World). The model accounts for both zero level and positively skewed exports by adopting the Cragg (1971) logarithmic Tobit model. Unobserved firm-level heterogeneity is accounted for by introducing random effects which may be correlated across export markets. The initial conditions problem is treated by assuming that a component of the unobserved firm effect is conditional on initial values and exogenous variables (Wooldridge, 2005). As a consequence the degree of structural state dependence can be estimated for each export market. Previous export experience in both markets is shown to impact both the decision to export and the level of exports in each market. We find that previous year export levels do not unambiguously increase the probability of exporting in the current year, rather certain threshold levels must be achieved before this becomes the case.

In this paper, our analysis is limited to the comparison of two aggregated destinations from French exporters' point of view: the EU and the ROW. This is a rough analysis in the current state, however our aim was more to specify and estimate our model to determine whether

destinations matter. While the models for different export destinations share many qualitative similarities, there are substantial quantitative differences. Now further analyses can be done.

6 References

Besedeš T., 2008. “A search cost perspective on formation and duration of trade.” *Review of international economics* 16 (5), pp 835- 849.

Blanes-Cristóbal J. V., Dovis M., Milgram-Baleix J., Moro-Egido A.I., 2008. "Do sunk exporting costs differ among markets? Evidence from Spanish manufacturing firms." *Economics Letters* **101** (2), pp 110-112.

Campa J. M., 2004. "Exchange rates and trade: How important is hysteresis in trade?" *European Economic Review* **48** (3), pp 527-548.

Cragg J.G., 1971. “Some statistical models for limited dependent variables with application to the demand for durable goods”. *Econometrica*, **39** (5), pp 829-844.

Das S., Roberts M. J., Tybout J. R., 2007. "Market entry costs, producer heterogeneity, and export dynamics." *Econometrica* **75** (3), pp 837-873.

Kaiser U., Kongsted H.C., 2008. True versus spurious state dependence in firm performance. The case of German Exports. *Empirical economics,* **35** (2), pp 207-228.

Lawless M., 2009. Firm dynamics and the geography of trade. *Journal of international economics,* **77**, pp 245-254

Olley G. S., Pakes A., 1996. The dynamics of productivity in the telecommunications equipment industry. *Econometrica* 64, pp 1263-1297.

Özler S., Taymaz E., Yilmaz K., 2009. "History matters for the export decision: Plant-level evidence from Turkish manufacturing industry." *World Development* **37** (2), pp 479-488.

Roberts M. J., Tybout J. R., 1997. "The decision to export in Colombia: An empirical model of entry with sunk costs." *American Economic Review* 87 (4), pp 545-64.

White H., 1982. “Maximum likelihood estimation of misspecified models”. *Econometrica* 50, pp 1-25.

Wooldridge J. M., 2005. "Simple solutions to the initial conditions problem in dynamic, nonlinear panel data models with unobserved heterogeneity." *Journal of Applied Econometrics* 20 (1), pp 39-54.