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## On the micro-structure of the German export boom: Evidence from establishment panel data, 1995 - 2002

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# **HWWA Discussion Paper**

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**Joachim Wagner\***

HWWA Discussion Paper 249

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Head: Dr. Konrad Lammers

## **On the micro-structure of the German export boom: Evidence from establishment panel data, 1995 - 2002**

### **ABSTRACT**

This paper uses an unbalanced panel data set for exporting firms from manufacturing industries in one German federal state, Lower Saxony, to investigate the micro-structure of the recent export boom. Looking at data for 1995/96 to 2001/02 it is demonstrated that a considerable number of plants starts and stops exporting in each year, but that most of the export dynamics is due to positive and negative changes of exports in plants that continue to export. A small fraction made of four to five percent of all exporting plants is responsible for around 70 to 80 percent of the gross increase in exports. Firms with expanding and contracting exports are found simultaneously in all broad sectors, technology classes and firm size classes. Patterns of export behavior differ widely between the plants over the periods investigated.

**Keywords:** Exports, business cycle, establishment panel data

**JEL code:** F14, E32

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# 1 MOTIVATION

For many years now Germany is suffering from low rates of growth of the economy and increasing mass unemployment. During the recent past once again exports were the main positive factor as regards business cycle conditions while other components of activity grew less or even declined. While these basic macroeconomic facts are familiar to everyone interested in the German economy the micro-structure of this export boom is much less well understood: Did all exporting firms contribute to the increase in exports in the same way? What about differences by firm size classes, or high tech versus low tech firms? Which role did firms play that started to export during these years? How many firms decreased their exports or even stopped exporting completely? For short, what is behind the numbers reported by official statistics - does it make sense to think of a representative exporter and to ask why he increased his exports in such a "booming" way, or is the rate of growth measured at the macro level the result of rather heterogeneous and partly opposing developments at the micro level with export starters and stoppers, and firms with decreasing and increasing exports, acting simultaneously? And if exporters are heterogeneous, what explains whether a firm contributed positively or negatively to the export boom (and thereby to the overall economic activity)?

This paper contributes to the emerging literature on the microeconometrics of exports by investigating the role played by five different types of exporting firms - export starters; establishments with either increased, or constant, or decreased exports; and export stoppers - from four broad sectors of manufacturing, three technology classes, and six firm size classes during the period 1995/96 to 2001/02.<sup>1</sup> For this empirical investigation a unique establishment level panel data set is used that covers the manufacturing sector of one German federal state, Lower Saxony.<sup>2</sup>

The rest of the paper is organized as follows: Section 2 introduces the data; section 3 presents evidence on the role of the five types of exporting firms by broad sector, technology class, and plant size class; and section 4 concludes.

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1 This paper extends my past work on this topic (published in German in a regional official statistics journal and in two workshop proceedings volumes, see *Wagner* (1998, 2001a) and *Strotmann and Wagner* (1999)) by looking at a much longer time period and at long-run export dynamics at the firm level. For similar work using data from the US in 1987 and 1992, see *Bernard and Jensen* (2002).

2 These data from official statistics in Lower Saxony have been used in microeconomic studies of various other aspects of exports before; see *Bernard and Wagner* (1997, 2001), and *Wagner* (1993, 1995a, 2001b, 2002, 2003).

## 2 DATA

The empirical investigation uses data from an unbalanced panel of establishments (local production units, plants)<sup>3</sup> built from cross section data collected in regular surveys by the Statistical Office of Lower Saxony, one of the 'old' federal states of Germany. The surveys cover all establishments from manufacturing industries that employ at least twenty persons in the local production unit or in the company that owns the unit. Participation of firms in the survey is mandated in official statistics law, and the firms have to report the true figures. In this paper annual data for 1995 (when the new WZ93 classification scheme and the new definition of the population of establishments to be surveyed was introduced) to 2002 are used. Note that the micro level data are strictly confidential and for use inside the Statistical Office only, but not exclusive. Further information on the content of the data set and how to access it is given in *Wagner (2000)*.

It should be noted that in this data set *export* means the amount of sales to a customer in a foreign country plus sales to a German export trading company; indirect exports (for example, tires produced in a plant in Lower Saxony that are delivered to a German manufacturer of cars who exports some of his products) are not covered by this definition. Furthermore, note that single or multiple establishment enterprises with less than 20 employees in total do not report to the survey. However, the contribution of these very small firms to total exports can be expected to be negligible. Therefore, the panel data set used here can be considered to cover nearly all of the (directly) exporting firms from manufacturing industries in Lower Saxony.

## 3 A DECOMPOSITION OF EXPORT DYNAMICS

### 3.1 Method of analysis

The panel data set described in section 2 allows to follow firms over time. The basic idea on how to look behind the veil of aggregate figures of export dynamics familiar from publications of official statistics is to apply a technique widely used in the analysis of job turnover<sup>4</sup> in a slightly modified way. When firms are compared between two years - say, 2001 and 2002 - there are some which did not export in both years. These firms are ignored in the analysis. Each of the other firms belongs to one of five types:

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- 3 In this paper we will use the terms *firm*, *establishment*, and *plant* interchangeably to describe the (local production) unit of analysis.
  - 4 A comprehensive description of this method of analysis for job creation and destruction can be found in OECD (1987); an application using the panel data for manufacturing firms from Lower Saxony is *Gerlach and Wagner (1993)*.

- (1) *Export starters* (firms that did not report exports in 2001 but in 2002).
- (2) *Establishments with increased exports* between 2001 and 2002.
- (3) *Establishments with constant exports* in both years.
- (4) *Establishments with decreased exports* between 2001 and 2002.
- (5) *Export stoppers* (firms that did report exports in 2001 but not in 2002).

The net change in total exports between the two years is the sum of the positive gross changes by the first two types and the negative gross changes by the last two types of firms. The percentage rate of change in total exports can be decomposed accordingly to show the relative contribution of each of these types of firms to total export dynamics.<sup>5</sup>

This decomposition analysis can be performed for establishments from manufacturing industries as a whole and for various subsets of firms. In this paper we will look separately at plants from four broad sub-sectors of manufacturing (basic goods, investment goods, durable consumer goods, other consumer goods), three technology classes (high technology, medium technology, and other industries)<sup>6</sup> and six size classes (measured by the number of employees: 1-19, 20 - 49, 50 - 99, 100 - 249, 250 - 499, and 500 and more)<sup>7</sup>.

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- 5 Due to the construction of the panel data set some remarks on the interpretation of *export starters* and *export stoppers* are necessary: The group of export starters includes plants which exported in earlier years but which did not have to report to the survey because they were too small (for example, a firm with 18 employees in 2001 and 21 in 2002), did not belong to the manufacturing sector (for example, an establishment that earned more than half of its revenues from farm sector activities in 2001 but more than half from manufacturing activities in 2002), or relocated to Lower Saxony from another German federal state (or a foreign country) between 2001 and 2002. Similarly, the group of export stoppers includes plants which continued to export in later years but which did not have to report to the survey any longer because they became too small, did not belong to the manufacturing sector any more, or relocated out of Lower Saxony. This fuzziness in the classification of firms as export starters and stoppers could be reduced only by checking the files kept in the statistical office by hand - which is not possible due to time constraints (binding for the people from official statistics) and data protection laws (binding for me).
  - 6 The classification of firms into one of these three technology classes is based on the so-called NIW/ISI-list of high and medium technology industries. The high tech sector covers industries with a ratio of research and development (R&D) spendings to sales that is higher than 8.5 percent, while this ratio is between 3.5 percent and 8.5 percent in the medium technology industries. This list is used in the official government reports on the state of technology in Germany; for details, see Bundesministerium für Bildung und Forschung (2002) and Grupp et al. (2000). A copy of the list is available from the author on request. Note that the survey and the panel data set used here does not contain any information on the R&D spendings of the manufacturing firms; for the classification the information on the 4digit industry identifier was used.
  - 7 Plants are classified into a size class according to the average number of employees in the two years under consideration. If the number of persons was missing in the data set in one year (for reasons, see footnote 5), the figure from the other year was used. The number of employees in the base (first) year was not used to compute the size class because of the role of transitory employment shocks and the related regression-to-the-mean fallacy. For a discussion of this problem in the context of job creation and destruction in the US see Davis, Haltiwanger and Schuh (1996); Wagner (1995b) shows that this is relevant for the Lower Saxonian plant level panel data, too. Note that results for the smallest size class (1 - 19 employees) should be looked at rather carefully because according to the definition of the population of the survey only plants from multi-establishment enterprises are covered here (see section 2).



### 3.2 Results for 1995/96 to 2001/02

The empirical investigation was performed for all seven two-years periods between 1995/96 and 2001/02.<sup>8</sup> Results are collected in fourteen tables - seven reporting for each period the numbers and shares of the five types of firms for manufacturing as a whole and for the thirteen groups of plants defined above, and seven reporting total exports in both years, the net change in exports, and the decomposition into gross changes by export starters, establishments with increased or decreased exports, and export stoppers, again for manufacturing as a whole and for the thirteen groups of plants. For a detailed interpretation we will focus on one of these periods, 1997/98, because these two years saw the highest rate of growth of exports between 1995 and 2002 - exports from manufacturing industries in Lower Saxony increased by no less than 20 percent measured at constant prices!

Detailed results for types of exporters and the decomposition of export dynamics in the period 1997/98 are reported in table 1 and table 2, respectively.<sup>9</sup>

From table 1, column 1, it can be seen that 2115 plants from Lower Saxonian manufacturing industries were exporting in 1997/98. While the bulk of these firms (85.7 percent) was active in exports in both years, export starters and stoppers<sup>10</sup> can be observed at non-negligible rates (6.6 percent and 7.7 percent, respectively). About the same amount of turnover of exporting firms is found for the other two-years periods investigated here with entry and exit rates between 6.6 and 9.4 percent and between 5.9 and 8.6 percent, respectively. Note that there are no plants reporting constant exports.<sup>11</sup>

Surprisingly (at least for readers not familiar with the job creation and destruction literature, or with the earlier studies on export dynamics based on firm level panel data mentioned above) even in this period of an extreme export boom there were very many plants with decreasing exports - some 44 percent of all firms fall into this group (see table 1, column 1, row 4 and 5). Similar figures are observed for other periods with high net rates of growth of real

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8 All computations were done with Stata/SE 8.0 (see StataCorp 2003). The nominal export values reported in the survey were deflated using the index of export prices (1995=100) reported by the Deutsche Bundesbank; see Deutsche Bundesbank (2000), p. 65\* (for 1996-1998) and (2003), p. 65\* (for 1999-2002).

9 A complete set of all fourteen tables for the seven periods investigated in this study is available in an unpublished appendix from the author on request.

10 For an analysis of export starters and stoppers based on the type of data used here see *Bernard and Wagner* (2001); *Wagner* (2002) investigates the plant-level consequences of starting to export, while *Girma, Greenaway and Kneller* (2003) look at the consequences of export market exit.

11 This is in part due to the use of a deflator when transforming the nominal export values reported by the plants into the real export values (measured in constant 1995 prices) used in the calculations here.

exports. For example, in 1996/97 (1999/2000) real exports grew by 11.5 (12.0) percent, but 31.9 (31.4) percent of all exporting firms decreased exports, and 8.6 (7.0) percent stopped exporting at all.

Results for the various groups of firms reported in columns 2 to 14 show a rather similar broad picture. Export starters and stoppers exist in every group (except among the largest plants with 500 or more employees), and about a third of all firms in each group decreased its exports during this boom period. To state this differently, neither the sub-sector of manufacturing, nor technology intensity, nor size class determines to which of the five types of exporting firms a plant belongs. The same broad picture holds true for all the other periods investigated.<sup>12</sup>

Table 2 reports total exports for all firms and the firms from the thirteen subgroups for both years, the percentage rate of (net) changes, and the components of net change due to each of the four types of exporting firms. Row three of this table reveals large differences in the net change of exports among firms from the various groups.

From column 1 it can be concluded that export starters and stoppers contributed only marginally to the overall change in exports. This holds true for all but one of the other periods investigated here with (absolute) values for these rates of change below one percentage point. The only exception is the period 1998/99 where export starters contributed 2.13 percent to a net change in exports of 8.17 percent. Note that this is not necessarily the case when some of the subgroups of plants are considered (see, for example, the impact of export stoppers on the change in exports by producers of durable consumer goods documented in column 4 or by plants with 20 to 49 employees detailed in column 10 of table 2, respectively). Often positive net changes of exports and comparably large or even larger negative gross changes due to plants with decreased exports are documented (see, for example, column 2 or column 8 of table 2). Evidence for such a high degree of turbulence abounds when the other periods are investigated, too.

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<sup>12</sup> For details, see the appendix tables (see footnote 9).

**Table 1: Types of Exporters in Manufacturing Industries – Lower Saxony, 1997/98**

			[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
			All Estab- lishments	Producers of basic goods	Producers of investment goods	Producers of durable consumer goods	Producers of other consumer goods	Establish- ments from high tech industries	Establish- ments from medium tech industries	Establish- ments from other industries
[1]	Export Starters	Number of establishments Share (percent)	140 6.62	63 6.19	48 7.86	6 5.71	23 6.02	4 4.44	36 6.25	100 6.90
[2]	Establishments with increased exports	Number of establishments Share (percent)	1040 49.17	505 49.66	311 50.90	48 45.71	176 46.07	51 56.67	283 49.13	706 48.72
[3]	Establishments with constant exports	Number of establishments Share (percent)	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
[4]	Establishments with decreased exports	Number of establishments Share (percent)	773 36.55	385 37.86	194 31.75	40 38.10	154 40.31	33 36.67	207 35.94	533 36.78
[5]	Export Stoppers	Number of establishments Share (percent)	162 7.66	64 6.29	58 9.49	11 10.48	29 7.59	2 2.22	50 8.68	110 7.59

		[9]	[10]	[11]	[12]	[13]	[14]	
		Establishments with 1-19 employees	Establishments with 20-49 employees	Establishments with 50-99 employees	Establishments with 100-249 employees	Establishments with 250-499 employees	Establishments with >= 500 employees	
[1]	Export Starters	Number of establishments Share (percent)	14 17.07	71 10.25	28 5.48	23 4.78	4 1.92	0 0
[2]	Establishments with increased exports	Number of establishments Share (percent)	16 19.51	300 43.29	267 52.25	252 52.39	120 57.69	85 60.71
[3]	Establishments with constant exports	Number of establishments Share (percent)	0 0	0 0	0 0	0 0	0 0	0 0
[4]	Establishments with decreased exports	Number of establishments Share (percent)	21 25.61	243 35.06	187 36.59	189 39.29	79 37.98	54 38.57
[5]	Export Stoppers	Number of establishments Share (percent)	31 37.80	79 11.40	29 5.68	17 3.53	5 2.40	1 0.71

**Table 2: Decomposition of Export Dynamics in Manufacturing Industries – Lower Saxony, 1997/98**

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
	All Estab- lishments	Producers of basic goods	Producers of investment goods	Producers of durable con- sumer goods	Producers of other consumer goods	Establish- ments from high tech in- dustries	Establish- ments from medium tech industries	Establish- ments from other industries
[1] Total exports in 1997 (Millions DM)	69900	22300	41200	1796	4627	3039	46300	20500
[2] Total exports in 1998 (Millions DM)	83900	23500	53400	1713	5263	3554	58600	21700
[3] Rate of change of exports (percent)	+19.98	+5.27	+29.72	-4.61	+13.75	+16.94	+26.47	+5.76
[4] Increase of exports due to export starters (percent of [1])	+0.69	+0.27	+0.20	+0.06	+7.37	+0.45	+0.14	+1.97
[5] Increase of exports due to establishments With increased exports (percent of [1])	+23.55	+10.80	+31.86	+5.54	+18.09	+18.88	+29.13	+11.65
[6] Decrease of exports due to establishments With decreased exports (percent of [1])	-3.57	-5.32	-1.93	-2.67	-10.09	-2.31	-2.20	-6.85
[7] Decrease of exports due to export stoppers (percent of [1])	-0.70	-0.48	-0.41	-7.54	-1.62	-0.08	-0.60	-1.01

	[9]	[10]	[11]	[12]	[13]	[14]
	Establishments with 1-19 employees	Establishments with 20-49 employees	Establishments with 50-99 employees	Establishments with 100-249 employees	Establishments with 250-499 employees	Establishments with >= 500 employees
[1] Total exports in 1997 (Millions DM)	40.67	1056	2536	6721	7538	52000
[2] Total exports in 1998 (Millions DM)	38.56	1138	2569	7181	8408	64500
[3] Rate of change of exports (percent)	-5.18	+7.69	+1.31	+6.85	+11.55	+24.07
[4] Increase of exports due to export starters (percent of [1])	+13.28	+3.38	+1.20	+4.82	+1.17	0
[5] Increase of exports due to establishments with increased exports (percent of [1])	+9.70	+23.41	+13.55	+14.35	+15.24	+26.45
[6] Decrease of exports due to establishments With decreased exports (percent of [1])	-13.75	-10.43	-9.77	-10.22	-4.49	-2.13
[7] Decrease of exports due to export stoppers (percent of [1])	-14.41	-8.67	-3.67	-2.10	-0.38	-0.24

All in all, exporting firms show a rather heterogeneous performance, even within the subgroups considered here, and the same broad impression holds for the other periods investigated in this study.<sup>13</sup> This again illustrates what James Heckman in his nobel lecture named the most important discovery from microeconomic investigations - the evidence on the pervasiveness of heterogeneity and diversity in economic life (*Heckman* 2001, 674).

### 3.3 Who are the engines of the export boom?

Results reported in tables 1 and 2 reveal one more striking fact: The export boom of 1997/98 was nearly completely driven by a small number of plants with 500 or more employees. To see this, look at column 14 of table 2, and compute the increase in exports

due to expanding firms - some 13,750 millions DM. The overall net (gross) increase in exports computed from column 1 is 14,000 (16,944) millions DM. Therefore, some 81 percent of the gross increase in exports (amounting to nearly all of the net increase) came from expanding plants from the largest firm size class. According to table 1, column 14, this group consisted of 85 plants - or 4 percent of all exporting firms.

For the other periods of high rates of growth of real exports between 1996/97 and 1999/2000 we find a similar picture: four to five percent of all exporting firms, all from the largest plant size class, contributed about 70 percent of the gross increase in exports.<sup>14</sup> A big step forward in understanding the micro structure of the recent export boom, therefore, would involve a closer look at these export champions: What are their firm specific advantages that makes them so successful? In which countries do they sell their exports,<sup>15</sup> which role did exchange rate changes and business cycle conditions in these countries play? However, data protection laws prohibit an identification of these engines of the export boom using the data from official statistics.

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13 For details, see the appendix tables (see footnote 9).

14 For details, see the appendix tables (see footnote 9).

15 There is no information about the regional structure of exports in the panel data used here; see *Wagner* (2000).

### 3.4 Patterns of exporting behavior over time

One main conclusion from the descriptive exercise performed here is that there is no such thing as a representative exporting firm. This becomes even more clear when the data are pooled over more than two years, and when the individual patterns of export behavior at the plant level are investigated over the whole time span from 1995 to 2002. From the total of 6,051 establishments in the panel about one half (3,103 or 51.3 percent) never participated in export activities. Of the 2,948 plants that exported in at least one year, 2,290 did so in at least three of the seven periods between 1995/96 and 2001/02. Only one third of these (774 firms) increased their exports over three or more periods in a row, and only 50 did so in all seven periods (while only 4 firms decreased exports in all these periods). More than five hundred (!) different patterns of export behavior over time (measured by the sequence of exporter type as defined above, for example: starting in 1995/96 followed by an increase in 1996/1997 and 1997/98, a decrease in 1998/99 and 1999/2000, then stopping of exports in 2000/2001 and no exports in 2002/2002, represented by the pattern 1224450) can be found in the panel, and often a specific pattern is idiosyncratic, describing only one plant. To give an impression about the diversity of exporting patterns over time, a small excerpt from the complete listing covering all plants with expanding exports in the periods between 1995/96 and 1997/98 is reproduced in table 3.<sup>16</sup>

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<sup>16</sup> Details are documented in a (lengthy) appendix table available from the author on request.



**Table 3: Selected Types of Exporters in Manufacturing Industries in Lower Saxony 1995/96 to 2001/02**

Period	1	2	3	4	5	6	7	Frequency
Type	2	2	2	2	2	2	2	50
	2	2	2	2	2	2	4	30
	2	2	2	2	2	4	2	30
	2	2	2	2	2	4	4	27
	2	2	2	2	2	4	5	1
	2	2	2	2	2	5	0	2
	2	2	2	2	2	5	1	1
	2	2	2	2	4	2	2	21
	2	2	2	2	4	2	4	10
	2	2	2	2	4	4	2	11
	2	2	2	2	4	4	4	7
	2	2	2	2	4	4	5	1
	2	2	2	2	4	5	0	2
	2	2	2	2	5	0	0	2
	2	2	2	4	2	2	2	16
	2	2	2	4	2	2	4	25
	2	2	2	4	2	4	2	9
	2	2	2	4	2	4	4	18
	2	2	2	4	2	4	5	1
	2	2	2	4	4	2	2	9
	2	2	2	4	4	2	4	10
	2	2	2	4	4	2	5	1
	2	2	2	4	4	4	2	12
	2	2	2	4	4	4	4	6
	2	2	2	4	4	4	5	2
	2	2	2	4	4	5	0	1
	2	2	2	4	5	0	0	4
	2	2	2	4	5	1	4	1
	2	2	2	4	5	1	5	1
	2	2	2	5	0	0	0	3

Note: Period 1 refers to 1995/96, period 2 to 1996/97 etc.

Types of exporters are defined as follows:

- 0 no exports in both years of period
- 1 no exports in first year of period, exports in second year
- 2 higher exports in second year of period compared to first year
- 3 same amount of exports in both years of period
- 4 lower exports in second year of period compared to first year
- 5 exports in first year of period, no exports in second year

These findings - which are hidden behind the veil of the numbers for net changes of exports (and other economic aggregates) published by official statistics and only revealed when the confidential micro data can be accessed and combined over time to form a panel - have important implications for economic theory: models of exporting should abandon the representative agent paradigm.

## 4 CONCLUDING REMARKS

This paper uses an unbalanced panel data set for exporting firms from manufacturing industries in one German federal state, Lower Saxony, to investigate the micro structure of the recent export boom. The main findings can be summarized as follows:

Looking at data for seven two-years periods from 1995/96 to 2001/02 it is demonstrated that a considerable number of plants starts and stops exporting in each year, but that most of the export dynamics is due to positive and negative changes of exports in plants that continue to export. A small fraction made of four to five percent of all exporting plants (which cannot be identified and researched further due to data protection laws) are responsible for around 70 to 80 percent of the gross increase in exports. Furthermore, it is shown that a large fraction of plants reduced their exports even in years when real exports grew at high rates, and firms with expanding and contracting exports are found simultaneously in all broad sectors, technology classes and firm size classes. Patterns of export behavior differ widely between the plants over the periods investigated. Looking behind the veils of figures for aggregate net changes in exports published by the statistical offices reveals that there is no such thing as a representative exporting firm and that, therefore, it should not be used in theoretical models of exporting firms.

While important aspects of the export boom can be better understood based on the data and method of analysis used here the limits of the investigation performed are obvious, too: Information in the panel data set is scarce as regards characteristics and strategies of the firms, and totally missing regarding the countries the exports are delivered to. Therefore, it is impossible to determine what makes a successful export boomer with these data. However, it is at least possible to point out where to look for the most important firms in this export boom - among the few very large exporting firms that expanded their exports. Identifying these export champions and their successful strategies should be part of the research agenda in the microeconometrics of exports for the future.

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