Export sentiment survey

Methodology

State Secretariat for Trade

Ministry of Economy, Trade and Business

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ÍNDICE

1. Introduction

1.1. The importance of the foreign sector for the Spanish economy

Currently, one of the main characteristics of the Spanish economy is its notable openness to the foreign market[1]. The liberalization of the Spanish economy has been a gradual process, although with moments of special relevance: the Stabilization Plan (1959), entry into the Common Market (1986), the creation of the Internal Market (1992) and the incorporation into the Economic and Monetary Union (1999).

The opening of the Spanish economy has not occurred in isolation but has been coupled with a very notable increase in trade on a world scale. In this sense, it is worth noting the importance that the intense negotiations carried out in multilateral forums (such as the World Trade Organization) have had for this opening, as well as the formation and greater integration of a series of regional trade blocks (such as the European Union, USMCA or MERCOSUR).

All these reasons justify that the Spanish Administrations paying as much attention as possible to the foreign sector, and therefore dedicating the available resources to analyse its evolution. One of the instruments available to the General Administration of the State for said analysis is the *Export sentiment survey*. This statistical operation is prepared by the *Studies and Evaluation of Trade Policy Instruments of the State Secretariat for Trade of the Ministry of Economy, Trade and Business* and has been carried out since 1994.

1.2. The *Export sentiment survey*

1.2.1. Background

In the 1980s, the State Secretariat for Trade (then attached to the Ministry of Economy, Industry and Treasure) began to conduct an opinion poll about certain issues that were considered of interest in order to obtain a better knowledge of the Spanish exporting sector. This survey was published in collaboration with the *Chambers of Commerce*.

[1] According to data from the Spanish National Accounts, the degree of openness of the Spanish economy (ratio of the sum of exports and imports of goods and services over the GDP as a whole) has gone from 32.0% in 1980 to 70,3% in 2024 (advanced data).

Over time, the survey lost its usefulness, mostly for two reasons: a) the increasing difficulty of obtaining information with minimum levels of quality, and b) the lengthening of the periods for collecting and treating the information obtained (which reduced its use as an advanced indicator of the evolution of foreign trade in goods).

Facing this situation, the *General Technical Secretariat* of the former *Ministry of Industry, Trade and Tourism* proposed conducting a new survey on the foreign sector, which would serve as a short-term analysis instrument of the export situation.

This initiative was reflected in Royal Decree 136/93, of January 29, which approved the National Statistical Plan 1993-96. Said plan included, among the "new statistical operations", the so-called Foreign Trade Situation Survey (in project). In addition, it was pointed out that this survey would be carried out by the Ministry of Industry, Trade and Tourism.

According to said Royal Decree, the population under study would be made up of Spanish companies that carried out merchandise export operations. The information would be obtained from a sample and would serve to know the evolution of sentiment exports. In this sense, information would be requested about the opinion of the evolution of the export order portfolio, the explanatory factors of said evolution and the evolution of export prices.

Since its creation, the Export sentiment survey has been included in all the following[2] National Statistical Plans (PEN) and currently is the operation no. 9245 of the National Statistical Plan 2025-2028.

The unit in charge of carrying out the Export sentiment survey is the General Sub-directorate for Studies and Evaluation of Trade Policy Instruments of the State Secretariat for Trade of the Ministry of Economy, Trade and Business.

1.2.2. Modifications on the Export sentiment survey

Since its beginning, the main modification that the Export sentiment survey has undergone was carried out throughout 2006, analysing the whole survey deeply with the aim of making a series of changes that could improve the quality of this statistical operation. Said changes came into force since the first quarter of 2007. Among them, the directory from which the quarterly

[2] *National Statistical Plan (PEN)* of the quadrenniums 1997-2000 (approved by the *Royal Decree* 2200/1998 of the 16th October); 2001-2004 (*Royal Decree* 1126/2000 of the 16th June); 2005-2008 (*Royal Decree* 1911/2004 of the 17th of September); 2009-2012 (*Royal Decree* 1663/2008 of the 17th of October); 2013-2016 (*Royal Decree* 1658/2012 of the 7th of December); 2017-2020 (*Royal Decree* 410/2016 of the 31st of October); 2021-2024 (*Royal Decree* 1110/2020 of the 15th of December); y 2025 – 2028 (Royal Decree 1225/2024 of the 3th of December).

sample of researched companies is extracted, referring to regular exporting companies[3] corresponding to the 2000-2005 period. Simultaneously, the design was modified and the stratification of the population was simplified. Likewise, the questionnaire was modified, and a new general indicator was created, in order to synthesize and helps to interpret the collected information[4]. Lastly, the dissemination process was modified, presenting a new results report, and expanding the available information for general query in the website, currently, of the State Secretariat for Trade of the Ministry of Economy, Trade and Business (www.comercio.gob.es).

In the first months of 2013, a new update of the companies directory was carried out, as the time reference of the previous one was very distant (2002-2005). The Spanish economy had experimented major changes from that reference period to the time of the modification. On the one hand, there had been changes in the company stratification according to their export value, while some companies might have changed their activities as a result of the crisis, or their company name. In addition, throughout all the period, some companies had stopped their exporting activity, while others had begun it. Because of that, the most recent statistical information was revised and the new directory referred of the 2008-2011 period, the last one with available information in the moment of the collection of the sample information, corresponding to the first quarter of 2014. Regarding the sample design it's worth noting that it's been maintained the methodology used in the change of 2006, as well as the indicators and publications. Likewise, the sample size has been maintained at 1.900 companies per quarter, a change introduced in 2012.

In 2014, new questions related to employment were introduced. These questions were about the evolution of hired workers performing exports tasks by companies and the degree of dedication of the staff to export tasks.

Since then, only four additional modifications have been carried out, with directory updates in the years 2015, 2017, 2019, 2021 and 2023 selecting the regular exporting companies in the periods of 2010-2013, 2012-2015, 2014-2017, 2016-2019 and 2019-2022.

[3] Companies that have exported for four consecutive years.

[4] This indicator receives the name of Synthetic Indicator of the Exporting Activity (SIEA).

2. Main characteristics of the *Export sentiment survey*

2.1. Goals

The Export sentiment survey is carried out to have a deeper understanding of the situation of the Spanish export sector. In this way, it's set the main objective of this statistical operation as its use as an instrument for the analysis of the sentiment evolution of the export activity.

This objective is specified in obtaining information about the current situation of the companies' export order portfolio, as well as its short- and medium-term evolution expectations (three and twelve months, respectively). Therefore, this survey can be used as an advanced indicator in relation to the export trend activity of Spanish companies.

Likewise, it provides information on other aspects of interest regarding the company's export activity. These are evolution of prices and export margins, influence on exports of certain factors (external and internal demand, international competition, exchange rates, etc.), evolution of the number of workers dedicated to carrying out export tasks and the degree of their dedication to export activities. Finally, an analysis of the export destinations in the reference quarter and their forecast in the short and medium term.

In short, this opinion survey offers a preview of the trend of some of the main variables that measure the evolution of our exports (export volume, export destinations, most influential factors, etc.). It does not collect quantitative data, but it can be used as a complement to them. Currently, in the same area of work, the monthly report on foreign trade (COMEX) is carried out, with the data also provided by the Customs and Special Taxes Department of the Tax Agency. This report is indeed prepared with the numerical data of real exports and is published with a time lag of two months. The survey has the advantage of collecting opinions on the evolution of said data from both the present and the future exporter, but based on subjective data.

2.2. Survey design

2.2.1. Scope

The scope of the survey refers to the investigated population, time and space.

a) Population scope

The population under study of the Export sentiment survey is made up of all Spanish companies continuously [5] carrying out merchandise export operations[6].

b) Time scope

The Export sentiment survey is carried out on a quarterly basis. The reference period for the information requested is, generally, the quarter in which the survey is carried out.

b) Geographic or territorial scope

All companies located in the territory of the Spanish State are subject to investigation.

2.2.2. Statistical units

The statistical unit is that element or component of the population that can be observed and investigated. Likewise, the tabulated data and the statistical aggregates obtained in the survey refer to said statistical units. In the Export sentiment survey, those companies that continuously carry out goods export activities are considered as statistical units.

These companies are also the informant units, since they are perfectly defined and located, and have the necessary information to correctly answer the questions requested[7].

[5] In the section 2.2.3. Survey Framework: directory, is precisely defined what companies comply with this condition

[6] For the matters of this survey, both proper export (that is, sales to countries outside the European Union), and the so-called expeditionary operations (sales to destinations within the EU) are considered.

[7] Inside the informing units (companies), the requested information by the survey provide by the personnel of that department having a complete knowledge of the exporting activity of the company.

2.2.3. Survey framework: directory

As previously indicated, all those Spanish companies with continuous export activity are the object of study of the *Export sentiment survey*.

For the effects of this survey, considered that a company has a continuous exporting activity if carried out export operations for a values superior to 30,000 euros per year, in each of the four years in the 2019-2022 period. In order to determine which companies meet this condition, it's used the information related to the foreign trade, provided by the Department of Customs and Special Taxes of the Tax Agency, that is the collaborating entity for the elaboration of the survey. From this information, the directory used to obtain the quarterly sample for the Export sentiment survey is updated.

The data to elaborate it are extracted from the data of the actual exports provided by the Department of Customs and Special Taxes of the State Tax Administration corresponding to the declared commerce[8], which doesn't include the total of the exports within the EU but does include the total of the exports outside the Union. However, in terms of export volume, the commerce included altogether with the undeclared doesn't exceed the 2% of the exports.

Once the companies with an export volume of more than 30,000 euros in each of the years from 2019 to 2022 have been selected and after a process of treatment and purification of these data, a final directory of 26,662 companies is obtained.

In terms of coverage, these 26,662 companies are responsible for 92.4% of Spanish merchandise exports for the 2019-2022 period (90% in the previous directory). Therefore, we can affirm that the directory of the Export sentiment survey is representative of the universe of Spanish exporting companies, by including the companies that carry out the majority of Spanish merchandise exports.

2.2.4. Sampling plan

a) Sample size

The quarterly sample of the Export sentiment survey is composed of a total of 1,900 units (companies). Those companies are selected from the aforementioned directory.

[8] The declared commerce includes all the exports outside the European Union, but excludes some carried out within the EU, for having an export volume during the previous year below a minimum threshold fixed every year. The methodological notes of these data can be seen at www.sede.agenciatributaria.gob.es

The global sampling fraction (that is, the percentage of the population surveyed each quarter) is 7.1%.

b) Sampling type

The sample has been obtained from a stratified random sampling procedure. Quarterly, between 20-25% of the sample is renewed in order to reduce the response burden according to the principles, included in the PEN 2021-2024, which govern the activity of the Statistical System of the State Administration.

c) Stratification

Two variables are used to stratify the population of exporting companies included in the directory: sector and size.

Chart 2.2.1. Directory of the Export sentiment survey: number of companies by stratum

Population (Nij, Number of companies by sector and size)	Size (Average annual export in 2019-2022, million €)				
SECTOR	a) 0.03 - 0.6	b) 0.6 - 3	c) 3 - 15	d) > 15	TOTAL
1. Food, beverages and tobacco	2,026	2,516	1,634	665	**6,841**
2. Energy	40	34	26	44	**144**
3. Raw materials	280	386	212	67	**945**
4. No chemical semimanufactures	676	840	552	331	**2,399**
5. Chemical products	1,041	1,128	783	438	**3,390**
6. Capital goods	2,578	2,587	1,333	541	**7,039**
7. Vehicles	280	283	272	173	**1,008**
8. Durable goods	380	293	160	54	**887**
9. Consumer goods	1,626	1,520	684	179	**4,009**
TOTAL	**8,927**	**9,587**	**5,656**	**2,492**	**26,662**

The companies are assigned to the different sectors based on the type of goods they export. In this sense, the companies are classified in 9 categories or sectors. The nine sectors considered are the same that the State Secretariat for Trade uses to publish broken down information about foreign trade in goods by sector. These sectors are the following: 1) Food, beverages and tobacco, 2) Energy, 3) Raw materials, 4) Non-chemical semimanufactures, 5) Chemical products, 6) Team goods, 7) Vehicles, 8) Durable goods, and 9) Consumer goods.

The variable used for the size is the average size of the exports of the companies in the 2019-2022 period. A total of 4 categories or sizes are considered. The four exporting sizes considered are: a) annual average

export between 0.03 and 0.6 million euros, b) between 0.6 and 3 million, c) between 3 and 15 million, and d) higher than 15 million.

The companies are included in the different strata based on these two variables. In this way, the total number of strata is 36, the result of crossing the 9 categories considered in the sector variable and the 4 in the size variable.

As far as the allocation of the companies to the different sectors is concerned, it should be noted that a company can export goods corresponding to different sectors. For this reason, in principle a company could belong to more than one sector (and stratum).

In order for each company to be classified in one and only one stratum, the companies of the directory are assigned to a single sector. Said sector will be the one for which the company registered a larger value in their exports in the 2019-2022 period.

That is, the percentage represented by the exports of the main sector (to which the company has been assigned) over the total exports of the company in the four-year period 2019-2022. The companies that present their highest export value in the "Other merchandise" group, have been included in that sector with the second highest export value in that period, provided that this value exceeds 25% of total exports. This group of "Other merchandise" has not been included in the classification due to the heterogeneity of its companies and it has been decided to eliminate them from the directory together with the companies without location data, most of them foreigners.

d) Sample design: allocation

Chart 2.2.2. Sample by stratum: number of companies per stratum

Theorical sample nij	Volume (Average annual export in 2019-2022, mill. €)				
SECTOR	a) 0.03 - 0.6	b) 0.6 - 3	c) 3 - 15	d) > 15	TOTAL
1. Food, beverages and tobacco	78	109	104	162	**453**
2. Energy	8	8	8	18	**42**
3. Raw materials	11	17	13	15	**56**
4. No chemical semimanufactures	26	37	36	110	**209**
5. Chemical products	41	48	51	135	**275**
6. Capital goods	100	112	83	169	**464**
7. Vehicles	11	12	17	69	**109**
8. Durable goods	15	13	10	11	**49**
9. Consumer goods	63	66	42	72	**243**
TOTAL	**353**	**422**	**364**	**761**	**1,900**

Next, we study how the quarterly sample of 1,900 companies is distributed among the 36 strata in which the population is divided[9].

A mixed criterium is followed to distribute the sample in the different strata: proportional to both the number of companies and the value of exports by stratum.

Chart 2.2.3. Sample by stratum: percentual distribution (%)

Relative sample by stratum nij/n	Volume (Average annual export in 2019-2022, mill. €)				
SECTOR	a) 0.03 - 0.6	b) 0.6 - 3	c) 3 - 15	d) > 15	TOTAL
1. Food, beverages and tobacco	3.9	5.4	5.1	7.9	**22.3**
2. Energy	0.1	0.1	0.1	4.1	**4.4**
3. Raw materials	0.5	0.8	0.6	0.7	**2.7**
4. No chemical semimanufactures	1.3	1.8	1.7	5.3	**10.2**
5. Chemical products	2.0	2.4	2.5	6.6	**13.5**
6. Capital goods	5.0	5.5	4.1	8.2	**22.8**
7. Vehicles	0.5	0.6	0.9	7.5	**9.5**
8. Durable goods	0.7	0.6	0.5	0.5	**2.4**
9. Consumer goods	3.1	3.3	2.1	3.8	**12.3**
TOTAL	**17.2**	**20.6**	**17.6**	**44.6**	**100.0**

In this way, the initial sample in each of the 36 considered strata will be equal to:

$$n_{ij} = \frac{n}{2}\left(\frac{N_{ij}}{N} + \frac{X_{ij}}{X}\right)$$

where,

n_{ij} = sample in the stratum ij

n = global sample (1,900)

N_{ij} = number of companies in directory belonging to the stratum ij

N = total number of companies in the directory (26,662)

X_{ij} = value of the exports of the companies of the stratum ij in the 2019-2022 period

X = value of the exports of the set of the companies of the directory in the 2019-2022 period.

[9] Initially, three alternative allocations were studied: a) proportional to the number of companies per stratum (Nij), b) proportional to the value of exports per stratum (Xij) and c) proportional to both the number of companies and the value of exports per stratum (Nij and Xij). Finally, the third option was chosen as it was the one that provided a greater precision (that is, a lower sampling error), both globally and in the different sectors and sizes.

Chart 2.2.4. Sample by stratum: fractions of sampling (%) per stratum

Sampling fraction nij/Nij	Volume (Average annual export in 2019-2022, mill. €)				
SECTOR	a) 0.03 - 0.6	b) 0.6 - 3	c) 3 - 15	d) > 15	TOTAL
1. Food, beverages and tobacco	3.8%	4.3%	6.4%	24.4%	**6.6%**
2. Energy	20.0%	23.5%	30.8%	40.9%	**29.2%**
3. Raw materials	3.9%	4.4%	6.1%	22.4%	**5.9%**
4. No chemical semimanufactures	3.8%	4.4%	6.5%	33.2%	**8.7%**
5. Chemical products	3.9%	4.3%	6.5%	30.8%	**8.1%**
6. Capital goods	3.9%	4.3%	6.2%	31.2%	**6.6%**
7. Vehicles	3.9%	4.2%	6.3%	39.9%	**10.8%**
8. Durable goods	3.9%	4.4%	6.3%	20.4%	**5.5%**
9. Consumer goods	3.9%	4.3%	6.1%	40.2%	**6.1%**
TOTAL	**4.0%**	**4.4%**	**6.4%**	**30.5%**	**7.1%**

Once the allocation has been made, the resulting sample is corrected in order to have the possible difficulties in obtaining a sample in certain strata and there is a minimum number of units per stratum. Currently, this limit has been set at five companies per stratum as the minimum number of companies that must respond in each of the 36 established strata. Usually, the sector that has the lowest number of companies in the total population is the energy products sector, so there is also a very low number of companies in this sector in the sample and that is why its sampling fraction is higher than in the rest of the strata[10].

In the Charts 2.2.2., 2.2.3. and 2.2.4. the distribution of the quarterly sample in the different strata is shown (both the number of companies and the percentage of the sample in each stratum), as well as the corresponding sampling fractions[11].

[10] This restriction is imposed by the fact that in some strata, where the sampling fraction is high, there could be problems in obtaining the requested sample in certain quarters in the event of a significant lack of response.

[11] That is, the percentage of population researched per stratum:

$$fm_{ij} = \frac{n_{ij}}{N_{ij}}$$

where, n is the sample obtained in the stratum ij and N_{ij} is the total population of the directory belonging to that stratum.

e) Selection of the sample

The selection[12] of the sample in each stratum is carried out by applying a procedure of random selection without replacement of the number of units (companies) requested.

2.3. Target study variables

2.3.1. Requested variables in the questionnaire

a) General characteristics of the questionnaire

The Questionnaire of the Export sentiment survey tries to meet two conditions: simplicity and brevity. For this reason the questionnaire includes a reduced number of questions, in order to make it easy to answer by the informant units (companies).

In order to comply with these conditions, only questions of qualitative nature are included. That is, the interviewees are asked about qualities, instead of quantities, relative to the variables of interest. For the interviewees is much easier provide qualitative information, rather than quantitative, since they don't need to extensively consult the company's accounting, thus ensuring that the questionnaire is quickly answered.

For the different questions included in the questionnaire, a reduced number of possible answer options is offered. In this sense, the majority of the answers of the questionnaire should be answered with one of these three options[13]:

i) Upward evolution of the variable of interest

ii) Downward evolution.

iii) Stable evolution

[12] The companies belonging to the initial sample that over time have been dropping due to various incidents (extinction, cessation of activity, etc.) have been replaced by others. It is belonging to the same stratum, also selected randomly. Since then, the sample can be approximated to a fixed panel of exporting companies, except for approximately 25% of substitutions, which is rotated quarterly for this reason and to reduce the response burden on informants.

[13] Likewise, a fourth option is considered that includes the lack of response or refusal to answer the question (does not know/does not answer). In the case of the questions related to the factors that influence export activity, the answer options are the following: positive influence, negative influence or no influence.

b) Questionnaire sctructure

The Export sentiment survey questionnaire is structured in such a way as to facilitate both the understanding and the completion of the questions included in it by the informant units. To do this, it is divided into eight sections:

1. Export activity of the company
2. Hiring in export tasks
3. Other indicators of exporting activity
4. Influential factors in the exporting activity for the company
5. Evolution by destination markets

1. Export activity of the company

Information is requested on the evolution of the company's export order portfolio, both in the reference quarter as for forecasts of its evolution in the short and medium term. Specifically, this section consists of three questions:

1.1. Evolution of the export order portfolio in the referenced quarter, compared with the previous quarter.

1.2. Expectations of the evolution of the company's export order portfolio in the next quarter, compared to the current quarter.

1.3. Expectations for the evolution of the company's export order book in the next twelve months, compared to the current quarter

2. Hiring in export tasks

Questions are asked about the evolution of the workforce hired by the company to carry out export tasks, both in the referenced quarter and in the short and medium term forecasts about evolution. Information is also requested on the evolution of the degree of dedication of the staff to export tasks. This section consists of four questions:

2.1. Evolution of the workforce hired to carry out export tasks in the reference quarter, in relation to the previous quarter.
2.2. Perceptions for the evolution of the workforce hired to carry out export tasks in the next quarter, in relation to the current quarter
2.3. Perceptions for the evolution of the workforce hired to carry out export tasks in the next twelve months, in relation to the current quarter.

Evolution of the degree[14] of dedication for the workforce to export tasks in the referenced quarter, related to the previous quarter

As in the case of the questions to the previous section, the options of answer are three: upwards, downwards or stable evolution.

3. *Other indicators of exporting activity*

In the questionnaire, companies are asked to provide certain complementary information on the export activity. This way, companies are asked about the evolution of prices and export margins of the company itself in the reference quarter. Specifically, the two questions considered are the following:

3.1. Evolution in the current quarter of the export prices of the company, compared with the previous quarter.
3.2. Evolution in the current quarter of the company's export commercial profit margin, in relation to that of the previous quarter.

As in the case of the questions to the previous section, the options of answer are three: upwards, downwards or stable evolution.

4. *Factors that influence the exporting activity of the company*

A series of factors that can have a positive or negative influence on the company's export activity are considered. The number of factors included is small.

In the case of the questions in this section, four answers options are offered (positively influences, negatively influences, does not affect and does not know, no answer). The number of factors considered may vary over time. Currently, companies are asked about the influence of the following factors:

- Evolution of external demand
- International price competition
- International quality competition
- Exchange rate

[14] Could be in terms of:
a) Number of workers employed in export tasks as a proportion of the total workforce
b) Number of hours dedicated to export tasks as a proportion of the total hours worked by the workforce

- Oil price
- Raw material prices
- Availability of external financing
- Human resources[15] (availability of workers with experience in exporting, with languages, availability to travel, etc.).

5. *Evolution by destination markets*

In the next section of the questionnare, information is requested about the exporting activity of the company in certain world markets.

In this sense, for the different markets considered, the company is requested to answer the following questions:

5.1. Does the company export regularly[16] to said market?
5.2. If yes, what has been the evolution in the current quarter of exports to said market (upward, downward or stable evolution)? In addition, of the areas to which it does indeed export regularly, the company is asked to specify which are the main destination countries for the order book in the reference quarter (open list of countries)[17].
5.3. If yes to question 5.1., what is the expected evolution for the next quarter of exports to said market (upward, downward or stable evolution)?
5.4. Companies are asked too for the countries to which the company has better export expectations (open list of countries)[18]

As for the markets considered, they are the following:

- Countries of the European Union (EU-27): euro zone and other member countries of the European Union
- Rest of Europe
- North America
- Latin America
- Asia: China and other countries of the Asian continent
- Africa
- Oceania

[15] This section is included from the first quarter of 2014

[16] Considering regular that the company has made exports during the last four years

[17] This question is introduced since the second quarter 2012

[18] This question is introduced since the second quarter 2012

2.3.2. Construction of indicators

The main results of the Export sentiment survey are offered through the percentages that, for each question, exist of companies that indicate an upward, downward or stable evolution of the variable of interest.

However, it is difficult to interpret and compare the results obtained over time, when the simultaneous evolution over time of the three previous percentages is analyzed.

For a given question in the questionnaire (for instance, the l-th question), its defined the balance indicator ((V^l) as the difference between the percentage of companies indicating for this question an upward evolution (Al) and the percentage of thos indicating downward evolution (B^l):

$$V^l = A^l - B^l$$

The balance indicator can take values between -100 and 100. Its value will be equal to 100 in a completely optimistic situation (all companies indicate an upward trend in the variable of interest). On the contrary, the value -100 would be reached if all companies indicated a downward evolution.

Therefore, positive (negative) values of the index imply that the percentage of companies that show upward (downward) evolution is greater than that of companies with downward (upward) evolution.

A. INDICATORS OF ORDER PORT FOLIO. SIMPLE AND COMPOSED INDICATORS. SIEA

In the Export sentiment survey it's pointed, as we commented, if there has been an evolution in the export portfolio with an upward, downward or stable trend. But it is difficult to interpret what has been the general evolution of the export activity from the joint study of these percentages. For this reason and in order to facilitate the interpretation of the results, it is advisable to construct an indicator or index based on the three previous percentages. In this way, indicators are constructed that summarize the information provided by said percentages in a single value.

This indicator doesn't take into account the intermediate position (that is, the percentage of interviewees that point a stable evolution in the interest variable). However, this data has to be valued when making the corresponding analysis of results. In this sense, the changes in the percentages of interviewees who indicate a stable evolution can be interpreted as an indicator of the change in the degree of uncertainty of the interviewees regarding the evolution of the variable of interest.

1. Simple indicators

The simple indicators are those that are constructed directly from the percentages of interviewees that show upward and downward of the variable of interest in each of the three questions previously indicated, corrected considering the percentage of those who don't answer ((%upwards - % downwards)*100) / (100 - % Don't know, no answer.). This way, three indicators are initially obtained:

1.1. Balance indicator of the current export orders portfolio: indicator built as the difference between the percentages of companies that point an upward evolution and a downward evolution in the export orders portfolio in the reference quarter.

1.2. Balance indicator of export expectations in the next three months: indicator built as a difference between the percentages of companies that expect an upward evolution and a downward one in the export orders portfolio in the next quarter.

1.3. Balance indicator of export expectations in the next twelve months: indicator built as a difference between the percentages of companies that expect an upward evolution and a downward one in the export orders portfolio in the next twelve months.

2. Composite indicators

2.1. Exporting expectations

From the two last indicators, it can be built a sole indicator of export expectations. This indicator would collectively pick up the information related to the expectations of evolution in the three-month and twelve month periods, and is defined the like this:

$$\textit{Export expectations} = (0.6 \times \textit{Three months expectations}) + (0.4 \times \textit{Twelve months expectations})$$

As observed, this indicator is the weighted average of the previous two simple indicators. The three month expectations have a bigger weight than the twelve month expectations, once it's assumed the hypothesis that the expectations of the companies for the three month period are more accurate with a temporal horizon of twelve months.

2.2. Construction of the Synthetic Indicator of Export Activity (SIEA)

The Synthetic Indicator of Export Activity (SIEA, Spanish acronym ISAE) is born with the objective of summing up in an only value the information provided by the companies. It is about the opinion they have about the evolution of their exporting activity through their order portfolio (both in the reference quarter and in the expectations about it in the short and medium term). So, the ISAE can be considered as a measure of the exporting climate of the Spanish companies.

The ISAE is constructed as a weighted average of the balance of the current export order portfolio and balance of export expectations, that measured the evolution of the export order portfolio in the reference quarter and the expectations about it in three and twelve months.

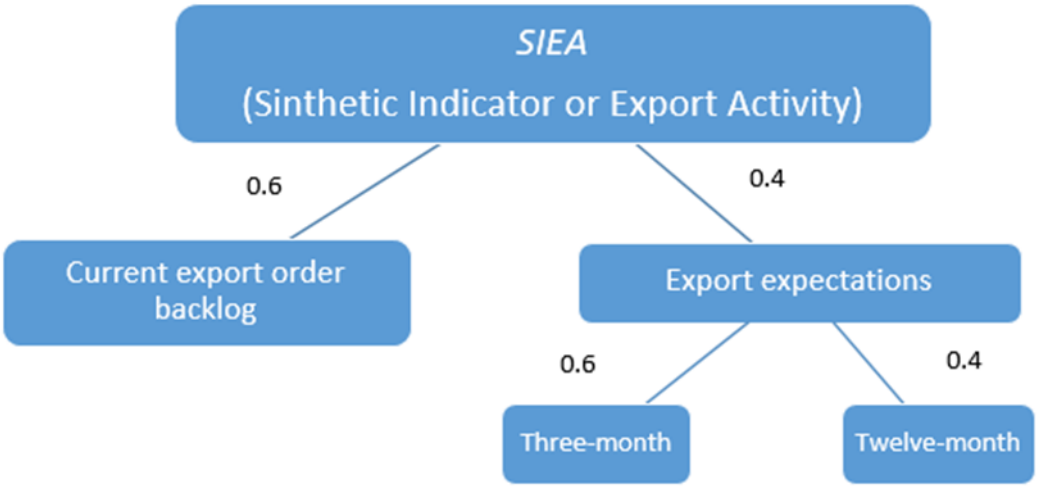
Its formula is the following:

$$SIEA = (0.6 \times \textit{Current portfolio}) + (0.4 \times \textit{expectations}) =$$

$$= (0.6 \times \textit{Current portfolio}) + (0.24 \times \textit{Three-month expectations}) +$$

$$+ (0.16 \times \textit{Twelve-month expectations})$$

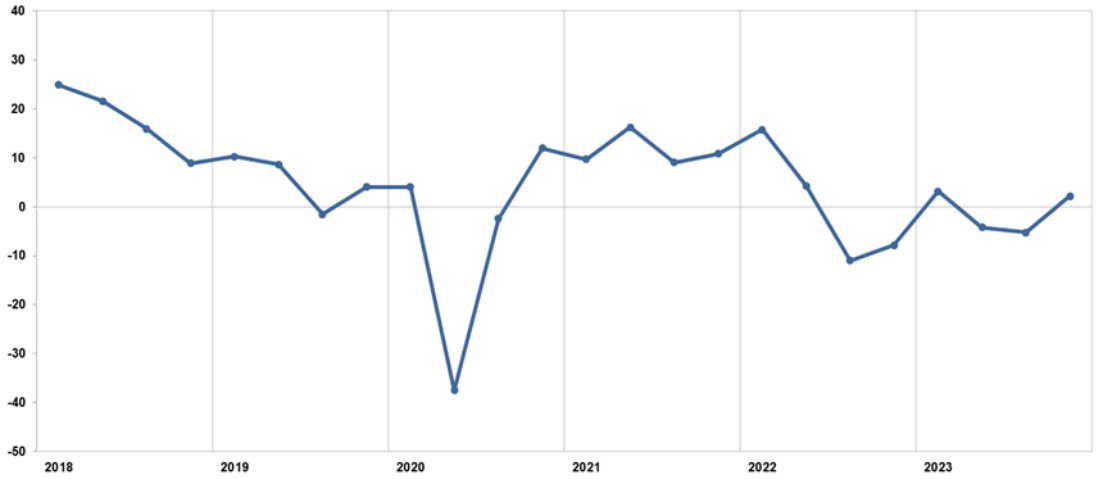
Graphic 2.2.1. Construction of the Synthetic Indicator of Export Activity (SIEA) through the indicators of the current portfolio and export expectations



The ISAE is a summary of the opinion of the interviewed companies about the exporting climate. In order to do so, it considers both the opinions about the current export activity, and the opinions about what will be the future evolution of said activity.

The weights of the three simple indicators are interviewed in the building of the ISAE are different. This way, it's considered more about the opinion about the current situation of the exporting activity than the previsions about it. Likewise, within the expectations, have bigger weight the indicator of three months expectations than the twelve months expectations.

Graphic 2.2.2. Synthetic Indicator of Export Activity (SIEA) and indexs that make it up



B. EMPLOYMENT IN EXPORT ACTIVITIES: INDICATORS

Similarly, simple indicators are built in order to analyze the evolution of the employment dedicated to export activities. These indicators sum up in a sole value the opinion of the companies regarding the evolution of the hired workforce in export tasks in the current quarter (or the referenced quarter), as well as their expectations to three and twelve months. They can take values between -100 and +100, so that positive (negative) values indicate a better (worse) perception of the interviewees about the evolution of the hired workforce in export tasks, either in the current quarter or its expectations future to three to twelve months. Calling them balance indicator of hired workforce in current exporting activities and balance indicators of personnel perspectives employed in activities exported to three and twelve months. They are built as a difference between the percentage of companies that point out an upward evolution and those who indicate a downward evolution, corrected considering the percentage of those not answering: ((% upwards - % downwards)*100) / (100- % dk/da).

Likewise, it is calculated a fourth balance indicator to measure the evolution of the degree of dedication of the workforce in export tasks called balance indicator of the degree of dedication of the workforce in exporting activities, built in the same fashion as the previous (percentage of upwards minus downwards divided between the total percentage, discarding those who do not answer).

2.1. Balance indicator of current employment in export activities: it measures the evolution of the hired workforce in export tasks in the current quarter. It is calculated as the difference between the percentage of companies that answer an upward and a downward evolution of the hired workforce in tasks related to export activities in the reference quarter.

2.2. Balance indicator of employment expectations in three months to export activities: it measures the evolution of the workforce hired in export tasks in the next quarter. It is calculated as the difference between the percentage of companies that answer an upward and a downward evolution of the hired workforce in tasks related to export activities in the next quarter.

2.3. Balance indicator of employment expectations in twelve months to export activities: it measures the evolution of the workforce hired in export tasks in the next twelve months. It is calculated as the difference between the percentage of companies that answer an upward and a downward evolution of the hired workforce in tasks related to export activities in the next twelve months.

2.4. Balance indicator of the degree of dedication of the hired workforce in export activities: it measures the evolution of the degree of dedication of the workforce in export tasks in the reference quarter. It is calculated as the difference between the percentage of companies that answer an upward and a downward evolution of the dedication of the workforce in export activities.

2.3.3. Classification variables

The information provided by the companies to carrying out the Export sentiment survey is presented two classification criteria:

1. Export sector
2. Company size[19]

Said variables are the same as used for the stratification of the population in other to obtain the quarterly sample for the survey. Thus, information is given

[19] According to the average value of their exports in the 2019-2022 period.

away, both global (for the set of Spanish exporting companies), and for the corresponding nine sectors and four sizes in which the population under study is divided.

As complement to the exposed information and as a consequence of the importance that shows the knowledge of the evolution of the foreign sector geographically, it is included information of the evolution by destination markets, both of the current order portfolio and the exporting expectations, by regions and for the main countries of destination.

3. Population parameters and estimators

3.1 General approach

As we already saw in the previous section, the main questions of the Export sentiment survey are of qualitative nature. In this sense, three possible answer options are offered:

a) Upward evolution of the interest variable

b) The interest variable remains stable

c) Downward evolution of the interest variable

$$A_{ijk} = \begin{cases} 1, \text{ if the company answers "upward evolution"} \\ 0, \text{ otherwise} \end{cases}$$

$$B_{ijk} = \begin{cases} 1, \text{ if the company answers "downward evolution"} \\ 0, \text{ otherwise} \end{cases}$$

$$C_{ijk} = \begin{cases} 1, \text{ if the company answers "stable evolution"} \\ 0, \text{ otherwise} \end{cases}$$

where

$i = 1, 2, \ldots, I$ Number of sectors (altogether, 9)

$j = 1, 2, \ldots, J$ Number of sizes (altogether, 4)

$k = 1, 2, \ldots, N_{ij}$ Number of companies in the ij stratum, (result of crossing the sector i with the size j)

From these variables, we build a certain variable Vijk that is defined as

$$V_{ijk} = A_{ijk} - B_{ijk}$$

This variable is a summary of the results of the other three and can take the following three values:

$$V_{ijk} = \begin{cases} 1, \text{ if the company } ijk \text{ points out "upward evolution"} \\ 0, \text{ if the company } ijk \text{ points out "stable evolution"} \\ -1, \text{ f the company } ijk \text{ points out "downward evolution"} \end{cases}$$

As a matter of fact,

if $A_{ijk} = 1$ y $B_{ijk} = C_{ijk} = 0$, then $V_{ijk} = 1$

if $B_{ijk} = 1$ y $A_{ijk} = C_{ijk} = 0$, then $V_{ijk} = -1$

if $C_{ijk} = 1$ y $A_{ijk} = B_{ijk} = 0$, then $V_{ijk} = 0$

3.1. Parameters and estimators in the *ij* stratum

3.2.1. Population parameters

It is defined the **proportion** of companies in the population in the *ij* stratum that answer each of the three options considered as the average of the answers of the different companies belonging to that stratum:

$$A_{ij} = \frac{1}{N_{ij}} \sum_{k=1}^{N_{ij}} A_{ijk} \qquad \text{(Proportion of upward answers)}$$

$$B_{ij} = \frac{1}{N_{ij}} \sum_{k=1}^{N_{ij}} B_{ijk} \qquad \text{(Proportion of downward answers)}$$

$$C_{ij} = \frac{1}{N_{ij}} \sum_{k=1}^{N_{ij}} C_{ijk} = 1 - A_{ij} - B_{ij} \qquad \text{(Proportion of stable answers)}$$

From these population parameters, we define the variable *Vij* (that we call **balance indicator** in the *ij* stratum), as the difference between the percentage of upward answers and the percentage of downward answers in the population belonging to the *ij* stratum:

$$V_{ij} = A_{ij} - B_{ij} = \frac{1}{N_{ij}} \sum_{k=1}^{N_{ij}} A_{ijk} - \frac{1}{N_{ij}} \sum_{k=1}^{N_{ij}} B_{ijk} = \frac{1}{N_{ij}} \sum_{k=1}^{N_{ij}} V_{ijk}$$

The range of variation of the population proportions is [0,1]. So, for instance, *Aij* takes the value 1 when all the companies in the stratum show an upward evolution, while it takes the value of 0 in no company in the stratum indicates said upward evolution.

On the other hand, *Vij* varies between [-1,1]. Its value will be equal to -1 when all the companies in the stratum point downward evolution, while it'll take a valor equal to 1 if all companies indicate upward evolution. Also, its value will be equal to zero if in the stratum the number of companies pointing an upward evolution is the same as those indicating downward evolution.

3.2.2. Population Parameter Estimators

We suppose it is extracted a simple random sample (s.r.s) with a size of nij in the ij stratum. From this sample, the following estimators of the previous population parameters can be obtained:

$$a_{ij} = \frac{1}{n_{ij}} \sum_{k=1}^{n_{ij}} a_{ijk}$$

$$b_{ij} = \frac{1}{n_{ij}} \sum_{k=1}^{n_{ij}} b_{ijk}$$

$$c_{ij} = \frac{1}{n_{ij}} \sum_{k=1}^{n_{ij}} c_{ijk} = 1 - a_{ij} - b_{ij}$$

$$v_{ij} = a_{ij} - b_{ij} = \frac{1}{n_{ij}} \sum_{k=1}^{n_{ij}} \left(a_{ijk} - b_{ijk} \right) = \frac{1}{n_{ij}} \sum_{k=1}^{n_{ij}} v_{ijk}$$

3.2.3. Propierties of the estimators

a) Mathematical hope

It is proved that the proposed estimators are unbiaised.

b) Variances and covariances[20]

The variances of the estimators of Aij, Bij y Cij can be expressed as:

[20] The expressions of said variances and covariances are obtained for the case of sampling without replacement.

$$\mathrm{var}\left(a_{ij}\right)=\sigma_{a_{ij}}^{2}=F_{ij}\frac{A_{ij}\left(1-A_{ij}\right)}{n_{ij}}$$

$$\mathrm{var}\left(b_{ij}\right)=\sigma_{a_{ij}}^{2}=F_{ij}\frac{B_{ij}\left(1-B_{ij}\right)}{n_{ij}}$$

$$\mathrm{var}\left(c_{ij}\right)=\sigma_{a_{ij}}^{2}=F_{ij}\frac{C_{ij}\left(1-C_{ij}\right)}{n_{ij}}$$

Where, $F_{ij}=\frac{N_{ij}-n_{ij}}{N_{ij}-1}$ is the correction factor in finite populations.

For its part, the covariance between *aij* and *bij* equals

$$\mathrm{cov}\left(a_{ij},b_{ij}\right)=\sigma_{a_{ij},b_{ij}}=-F_{ij}\frac{A_{ij}B_{ij}}{n_{ij}}$$

Thus, we can obtain the variance of the balance estimator (v_{ij})

$$\mathrm{var}\left(v_{ij}\right)=F_{ij}\left[\frac{A_{ij}\left(1-A_{ij}\right)+B_{ij}\left(1-B_{ij}\right)+2A_{ij}B_{ij}}{n_{ij}}\right]$$

c) Estimators of the variances and covariances of the estimator

From a s.r.s sized n_{ij} in the *ij* stratum, the following unbiased estimators for the variances and covariances are obtained:

$$\hat{\sigma}_{a_{ij}}^{2}=F_{ij}\frac{a_{ij}\left(1-a_{ij}\right)}{n_{ij}-1}$$

$$\hat{\sigma}_{b_{ij}}^{2}=F_{ij}\frac{b_{ij}\left(1-b_{ij}\right)}{n_{ij}-1}$$

$$\hat{\sigma}_{c_{ij}}^{2}=F_{ij}\frac{c_{ij}\left(1-c_{ij}\right)}{n_{ij}-1}$$

$$\hat{\sigma}_{a_{ij},b_{ij}}=-F_{ij}\frac{a_{ij}b_{ij}}{n_{ij}-1}$$

$$\hat{\sigma}_{v_{ij}}^{2}=F_{ij}\left[\frac{a_{ij}\left(1-a_{ij}\right)+b_{ij}\left(1-b_{ij}\right)+2a_{ij}b_{ij}}{\left(n_{ij}-1\right)}\right]$$ where $F_{ij}=(N_{ij}- n_{ij})/N_{ij}$

d) Confidence intervals for the population parameters in the *ij* stratum

IC (A_{ij}): $A_{ij} \in \left\{a_{ij} \pm z_{\alpha/2}\hat{\sigma}_{a_{ij}}\right\} \rightarrow A_{ij} \in \left\{a_{ij} \pm z_{\alpha/2}\sqrt{F_{ij}\,\frac{a_{ij}\left(1-a_{ij}\right)}{\left(n_{ij}-1\right)}}\right\}$

IC (B_{ij}): $B_{ij} \in \left\{b_{ij} \pm z_{\alpha/2}\hat{\sigma}_{b_{ij}}\right\} \rightarrow B_{ij} \in \left\{b_{ij} \pm z_{\alpha/2}\sqrt{F_{ij}\,\frac{b_{ij}\left(1-b_{ij}\right)}{\left(n_{ij}-1\right)}}\right\}$

IC (C_{ij}): $C_{ij} \in \left\{c_{ij} \pm z_{\alpha/2}\hat{\sigma}_{c_{ij}}\right\} \rightarrow C_{ij} \in \left\{c_{ij} \pm z_{\alpha/2}\sqrt{F_{ij}\,\frac{c_{ij}\left(1-c_{ij}\right)}{\left(n_{ij}-1\right)}}\right\}$

IC (V_{ij}): $V_{ij} \in \left\{v_{ij} \pm z_{\alpha/2}\hat{\sigma}_{v_{ij}}\right\} \rightarrow V_{ij} \in \left\{v_{ij} \pm z_{\alpha/2}\sqrt{F_{ij}\,\frac{a_{ij}\left(1-a_{ij}\right)+b_{ij}\left(1-b_{ij}\right)+2a_{ij}b_{ij}}{\left(n_{ij}-1\right)}}\right\}$

where, $z_{\alpha/2}$ is the critical value in tables of a distribution $N(0,1$*for a signification level of* $\alpha/2\%$.

e) Variation of Coefficients or sampling mistakes related to the population parameters in the *ij* stratum

CV ($\mathbf{A}_{ij}$)$=\frac{\sigma_{A_{ij}}}{A_{ij}} = \frac{\sqrt{F_{ij}\frac{A_{ij}\left(1-A_{ij}\right)}{n_{ij}}}}{A_{ij}}$

CV ($\mathbf{B}_{ij}$)$=\frac{\sigma_{B_{ij}}}{\mathbf{B}_{ij}} = \frac{\sqrt{F_{ij}\frac{B_{ij}\left(1-B_{ij}\right)}{n_{ij}}}}{B_{ij}}$

CV ($\mathbf{C}_{ij}$)$=\frac{\sigma_{C_{ij}}}{\mathbf{C}_{ij}} = \frac{\sqrt{F_{ij}\frac{C_{ij}\left(1-C_{ij}\right)}{n_{ij}}}}{C_{ij}}$

CV (V_{ij})$=\frac{\sigma_{V_{ij}}}{V_{ij}} = \frac{\sqrt{F_{ij}\frac{A_{ij}\left(1-A_{ij}\right)+B_{ij}\left(1-B_{ij}\right)+2A_{ij}B_{ij}}{n_{ij}}}}{V_{ij}}$ where $F_{ij}=(N_{ij}- n_{ij})/(N_{ij}-1)$

f) Variation coefficients or sampling errors related to the estimators in the *ij* stratum

$$\text{CV}\ (\widehat{A}_{ij})=\frac{\widehat{\sigma}_{a_{ij}}}{\widehat{A}_{ij}}=\frac{\sqrt{F_{ij}\frac{a_{ij}\left(1-a_{ij}\right)}{n_{ij}-1}}}{a_{ij}}$$

$$\text{CV}\ (\widehat{B}_{ij})=\frac{\widehat{\sigma}_{b_{ij}}}{\widehat{B}_{ij}}=\frac{\sqrt{F_{ij}\frac{b_{ij}\left(1-b_{ij}\right)}{n_{ij}-1}}}{b_{ij}}$$

$$\text{CV}\ (\widehat{C}_{ij})=\frac{\widehat{\sigma}_{c_{ij}}}{\widehat{C}_{ij}}=\frac{\sqrt{F_{ij}\frac{c_{ij}\left(1-c_{ij}\right)}{n_{ij}-1}}}{c_{ij}}$$

$$\text{CV}\ (\widehat{V}_{ij})=\frac{\widehat{\sigma}_{v_{ij}}}{\widehat{V}_{ij}}=\frac{\sqrt{F_{ij}\frac{a_{ij}\left(1-a_{ij}\right)+b_{ij}\left(1-b_{ij}\right)+2a_{ij}b_{ij}}{n_{ij}-1}}}{v_{ij}}$$ donde $F_{ij}=(N_{ij}- n_{ij})/N_{ij}$

3.2. Parameters and estimators in the *i* sector

3.3.1. Population parameters

The population parameters in the i sector are constructed as the weighted average of the obtained parameters obtained in each stratum in said sector.

$$A_{i\cdot}=\sum_{j=1}^{J}W_{ij}A_{ij}$$

$$B_{i\cdot}=\sum_{j=1}^{J}W_{ij}B_{ij}$$

$$C_{i\cdot}=\sum_{j=1}^{J}W_{ij}C_{ij}=1-A_{i\cdot}-B_{i\cdot}$$

$$V_{i\cdot}=A_{i\cdot}-B_{i\cdot}=\sum_{j=1}^{J}W_{ij}V_{ij}=\sum_{j=1}^{J}W_{ij}\left(A_{ij}-B_{ij}\right)$$

It's supposed that weightings are constructed based on the value of the exports of the companies included in the strata. Therefore, these weightings equal:

$$W_{ij}=\frac{X_{ij}}{X_{i\cdot}}$$

where, X_{ij} s the value of the exports of the companies in the *ij* stratum in the 2019-2022 period and $X_{i\cdot}$ the value of the in said period for the set of the companies in the *i* sector.

This way, the population parameters in the i sector can be written as:

$$A_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} A_{ij} = \sum_{j=1}^{J} \sum_{k=1}^{N_{ij}} \frac{X_{ij}}{X_{i\cdot} N_{ij}} A_{ijk}$$

$$B_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} B_{ij} = \sum_{j=1}^{J} \sum_{k=1}^{N_{ij}} \frac{X_{ij}}{X_{i\cdot} N_{ij}} B_{ijk}$$

$$C_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} C_{ij} = \sum_{j=1}^{J} \sum_{k=1}^{N_{ij}} \frac{X_{ij}}{X_{i\cdot} N_{ij}} C_{ijk} = 1 - A_{i\cdot} - B_{i\cdot}$$

$$V_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} V_{ij} = \sum_{j=1}^{J} \sum_{k=1}^{N_{ij}} \frac{X_{ij}}{X_{i\cdot} N_{ij}} V_{ijk} = \sum_{j=1}^{J} \sum_{k=1}^{N_{ij}} \frac{X_{ij}}{X_{i\cdot} N_{ij}} \left(A_{ijk} - B_{ijk} \right) =$$

$$= \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} \left(A_{ij} - B_{ij} \right) = A_{i\cdot} - B_{i\cdot}$$

3.3.2. Estimators of the population parameters

We can easily obtain the unbiased estimator of the population parameter $A_{i\cdot}$:

$$a_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} a_{ij}$$

where, a_{ij} is the unbiased estiamtor of the population proportion in the *ij* stratum (A_{ij}):

$$a_{ij} = \frac{1}{n_{ij}} \sum_{k=1}^{n_{ij}} a_{ijk}$$

Similarly, we obtain the unbiased estimator of the rest of population parameters:

$$b_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} b_{ij}$$

$$c_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} c_{ij} = 1 - a_{i\cdot} - b_{i\cdot}$$

$$v_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} v_{ij} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} \left(a_{ij} - b_{ij} \right) = a_{i\cdot} - b_{i\cdot}$$

3.3.3. Variances of the estimators and confidence intervals for population parameters

a) Variances and covariances of the estimators

$$\sigma^2_{a_{i\cdot}} = \sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\,\frac{A_{ij}\left(1-A_{ij}\right)}{n_{ij}} \qquad \sigma^2_{b_{i\cdot}} = \sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\,\frac{B_{ij}\left(1-B_{ij}\right)}{n_{ij}}$$

$$\sigma^2_{c_{i\cdot}} = \sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\,\frac{C_{ij}\left(1-C_{ij}\right)}{n_{ij}}$$

$$\sigma_{a_{i\cdot},b_{i\cdot}} = -\sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\,\frac{A_{ij}B_{ij}}{n_{ij}}$$

$$\sigma^2_{v_{i\cdot}} = \sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\left[\frac{A_{ij}\left(1-A_{ij}\right)+B_{ij}\left(1-B_{ij}\right)+2A_{ij}B_{ij}}{n_{ij}}\right] \text{ Where, } F_{ij}=\frac{N_{ij}-n_{ij}}{N_{ij}-1}$$

b) Estimators of the variances and covariances of the estimators

$$\hat{\sigma}^2_{a_{i\cdot}} = \sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\,\frac{a_{ij}\left(1-a_{ij}\right)}{n_{ij}-1} \qquad \hat{\sigma}^2_{b_{i\cdot}} = \sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\,\frac{b_{ij}\left(1-b_{ij}\right)}{n_{ij}-1}$$

$$\hat{\sigma}^2_{c_{i\cdot}} = \sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\,\frac{c_{ij}\left(1-c_{ij}\right)}{n_{ij}-1}$$

$$\hat{\sigma}_{a_i b_{i\cdot}} = -\sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\,\frac{a_{ij}b_{ij}}{n_{ij}-1}$$

$$\sigma^2_{v_{i\cdot}} = \sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\left[\frac{a_{ij}\left(1-a_{ij}\right)+b_{ij}\left(1-b_{ij}\right)+2a_{ij}b_{ij}}{\left(n_{ij}-1\right)}\right] \text{ Where, } F_{ij}=(N_{ij}-n_{ij})/N_{ij}$$

c) Confidence intervals

IC ($A_{i\cdot}$): $A_{i\cdot} \in \left\{a_{i\cdot} \pm z_{\alpha/2}\hat{\sigma}_{a_{i\cdot}}\right\} \rightarrow A_{i\cdot} \in \left\{a_{i\cdot} \pm z_{\alpha/2}\sqrt{\sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\,\frac{a_{ij}\left(1-a_{ij}\right)}{n_{ij}-1}}\right\}$

IC ($B_{i\cdot}$): $B_{i\cdot} \in \left\{ b_{i\cdot} \pm z_{\alpha/2}\hat{\sigma}_{b_{i\cdot}} \right\} \rightarrow B_{i\cdot} \in \left\{ b_{i\cdot} \pm z_{\alpha/2} \sqrt{\sum_{j=1}^{J} \left(\frac{X_{ij}}{X_{i\cdot}} \right)^2 F_{ij} \frac{b_{ij}\left(1-b_{ij}\right)}{n_{ij}-1}} \right\}$

IC ($C_{i\cdot}$): $C_{i\cdot} \in \left\{ c_{i\cdot} \pm z_{\alpha/2}\hat{\sigma}_{c_{i\cdot}} \right\} \rightarrow C_{i\cdot} \in \left\{ c_{i\cdot} \pm z_{\alpha/2} \sqrt{\sum_{j=1}^{J} \left(\frac{X_{ij}}{X_{i\cdot}} \right)^2 F_{ij} \frac{c_{ij}\left(1-c_{ij}\right)}{n_{ij}-1}} \right\}$

IC ($V_{i\cdot}$): $V_{i\cdot} \in \left\{ v_{i\cdot} \pm z_{\alpha/2}\hat{\sigma}_{v_{i\cdot}} \right\} \rightarrow V_{i\cdot} \in \left\{ v_{i\cdot} \pm z_{\alpha/2} \sqrt{\sum_{j=1}^{J} \left(\frac{X_{ij}}{X_{i\cdot}} \right)^2 F_{ij} \frac{a_{ij}\left(1-a_{ij}\right)+b_{ij}\left(1-b_{ij}\right)+2a_{ij}b_{ij}}{n_{ij}-1}} \right\}$

Where, $F_{ij}=(N_{ij}- n_{ij})/N_{ij}$

e) Variation Coefficients or sampling mistakes related to the estimators in the *i* sector

CV $(\widehat{A}_{i\cdot}) = \frac{\hat{\sigma}_{a_{i\cdot}}}{\widehat{A}_{i\cdot}} = \frac{\sqrt{\sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\frac{a_{ij}\left(1-a_{ij}\right)}{n_{ij}-1}}}{a_{i\cdot}}$

CV $(\widehat{B}_{i\cdot}) = \frac{\hat{\sigma}_{b_{i\cdot}}}{\widehat{B}_{i\cdot}} = \frac{\sqrt{\sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\frac{b_{ij}\left(1-b_{ij}\right)}{n_{ij}-1}}}{b_{i\cdot}}$

CV $(\widehat{C}_{i\cdot}) = \frac{\hat{\sigma}_{c_{i\cdot}}}{\widehat{C}_{i\cdot}} = \frac{\sqrt{\sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\frac{c_{ij}\left(1-c_{ij}\right)}{n_{ij}-1}}}{c_{i\cdot}}$

CV $(\widehat{V}_{i\cdot}) = \frac{\hat{\sigma}_{V_{i\cdot}}}{\widehat{V}_{i\cdot}} = \frac{\sqrt{\sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\frac{a_{ij}\left(1-a_{ij}\right)+b_{ij}\left(1-b_{ij}\right)+2a_{ij}b_{ij}}{n_{ij}-1}}}{v_{i\cdot}}$ where $F_{ij}=(N_{ij}- n_{ij})/N_{ij}$

3.4. Parameters and estimators in the size *j*

The same way we obtained the population parameters and the estimators in the sector *i*, we act to derive the corresponding expressions in the size *j*:

$$A_{\cdot j} = \sum_{i=1}^{I} \frac{X_{ij}}{X_{\cdot i}} A_{ij} = \sum_{i=1}^{I}\sum_{k=1}^{N_{ij}} \frac{X_{ij}}{X_{\cdot j} N_{ij}} A_{ijk} \rightarrow a_{\cdot j} = \sum_{i=1}^{I} \frac{X_{ij}}{X_{\cdot j}} a_{ij} = \sum_{i=1}^{I}\sum_{k=1}^{n_{ij}} \frac{X_{ij}}{X_{\cdot j} n_{ij}} a_{ijk}$$

$$B_{\cdot j}=\sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot i}}B_{ij}=\sum_{i=1}^{I}\sum_{k=1}^{N_{ij}}\frac{X_{ij}}{X_{\cdot j}N_{ij}}B_{ijk} \rightarrow b_{\cdot j}=\sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot j}}b_{ij}=\sum_{i=1}^{I}\sum_{k=1}^{n_{ij}}\frac{X_{ij}}{X_{\cdot j}n_{ij}}b_{ijk}$$

$$C_{\cdot j}=\sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot i}}C_{ij}=\sum_{i=1}^{I}\sum_{k=1}^{N_{ij}}\frac{X_{ij}}{X_{\cdot j}N_{ij}}C_{ijk}=1-A_{i\cdot}-B_{i\cdot} \rightarrow c_{\cdot j}=\sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot j}}c_{ij}=\sum_{i=1}^{I}\sum_{k=1}^{n_{ij}}\frac{X_{ij}}{X_{\cdot j}n_{ij}}c_{ijk}=1-a_{i}-b_{i}$$

$$V_{\cdot j}=\sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot j}}V_{ij}=\sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot j}}\left(A_{ij}-B_{ij}\right)=A_{\cdot j}-B_{\cdot j} \rightarrow v_{\cdot j}=\sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot j}}v_{ij}=\sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot j}}\left(a_{ij}-b_{ij}\right)=a_{\cdot j}-b_{\cdot j}$$

For its part, the confidence intervals are obtained from the following expressions:

IC ($A_{\cdot j}$): $$A_{\cdot j}\in\left\{a_{\cdot j}\pm z_{\alpha/2}\hat{\sigma}_{a_{\cdot j}}\right\} \rightarrow A_{j}\in\left\{a_{\cdot j}\pm z_{\alpha/2}\sqrt{\sum_{i=1}^{I}\left(\frac{X_{ij}}{X_{\cdot j}}\right)^{2}F_{ij}\frac{a_{ij}\left(1-a_{ij}\right)}{n_{ij}-1}}\right\}$$

IC ($B_{\cdot j}$): $$B_{\cdot j}\in\left\{b_{\cdot j}\pm z_{\alpha/2}\hat{\sigma}_{b_{\cdot j}}\right\} \rightarrow B_{\cdot j}\in\left\{b_{\cdot j}\pm z_{\alpha/2}\sqrt{\sum_{i=1}^{I}\left(\frac{X_{ij}}{X_{\cdot j}}\right)^{2}F_{ij}\frac{b_{ij}\left(1-b_{ij}\right)}{n_{ij}-1}}\right\}$$

IC ($C_{\cdot j}$): $$C_{\cdot j}\in\left\{c_{\cdot j}\pm z_{\alpha/2}\hat{\sigma}_{c_{\cdot j}}\right\} \rightarrow C_{\cdot j}\in\left\{c_{\cdot j}\pm z_{\alpha/2}\sqrt{\sum_{i=1}^{I}\left(\frac{X_{ij}}{X_{\cdot j}}\right)^{2}F_{ij}\frac{c_{ij}\left(1-c_{ij}\right)}{n_{ij}-1}}\right\}$$

IC ($V_{\cdot j}$): $$V_{\cdot j}\in\left\{v_{\cdot j}\pm z_{\alpha/2}\hat{\sigma}_{v_{\cdot j}}\right\} \rightarrow V_{\cdot j}\in\left\{v_{\cdot j}\pm z_{\alpha/2}\sqrt{\sum_{i=1}^{I}\left(\frac{X_{ij}}{X_{\cdot j}}\right)^{2}F_{ij}\frac{a_{ij}\left(1-a_{ij}\right)+b_{ij}\left(1-b_{ij}\right)+2a_{ij}b_{ij}}{n_{ij}-1}}\right\}$$

Where, $F_{ij}=\dfrac{N_{ij}-n_{ij}}{N_{ij}-1}$

a) Variation coefficients or sampling mistakes related to the size estimators in the size *j*

$$\text{CV}\left(\widehat{\boldsymbol{A}}_{\cdot j}\right)=\frac{\hat{\sigma}_{a_j}}{\widehat{A}_{\cdot j}}=\frac{\sqrt{\sum_{i=1}^{I}\left(\frac{X_{ij}}{X_{\cdot j}}\right)^{2}F_{ij}\frac{a_{ij}\left(1-a_{ij}\right)}{n_{ij}-1}}}{a_{\cdot j}}$$

$$\text{CV}\left(\widehat{\boldsymbol{B}}_{\cdot j}\right)=\frac{\hat{\sigma}_{b_j}}{\widehat{B}_{\cdot j}}=\frac{\sqrt{\sum_{i=1}^{I}\left(\frac{X_{ij}}{X_{\cdot j}}\right)^{2}F_{ij}\frac{b_{ij}\left(1-b_{ij}\right)}{n_{ij}-1}}}{b_{\cdot j}}$$

$$\text{CV}\ (\widehat{C}_{.j})=\frac{\widehat{\sigma}_{c.j}}{\widehat{C}_{.j}}=\frac{\sqrt{\sum_{i=1}^{I}\left(\frac{X_{ij}}{X_{.j}}\right)^2 F_{ij}\frac{c_{ij}\left(1-c_{ij}\right)}{n_{ij}-1}}}{c_{.j}}$$

$$\text{CV}\ (\widehat{V}_{.j})=\frac{\widehat{\sigma}_{v.j}}{\widehat{V}_{.j}}=\frac{\sqrt{\sum_{i=1}^{I}\left(\frac{X_{ij}}{X_{.j}}\right)^2 F_{ij}\frac{a_{ij}\left(1-a_{ij}\right)+b_{ij}\left(1-b_{ij}\right)+2a_{ij}b_{ij}}{n_{ij}-1}}}{v_{.j}}$$ where $F_{ij}=(N_{ij}- n_{ij})/N_{ij}$

3.5. Parameters and estimators for the total population

3.5.1. Population parameters

As we already did for the sector *i* o or the size *j*, we build the parameters for the population altogether as the weighted average of the parameters obtained in said sectors or sizes:

$$A=\sum_{i=1}^{I}W_{i.}A_{i.}=\sum_{j=1}^{J}W_{.j}A_{.j}$$

$$B=\sum_{i=1}^{I}W_{i.}B_{i.}=\sum_{j=1}^{J}W_{.j}B_{.j}$$

$$C=\sum_{i=1}^{I}W_{i.}C_{i.}=\sum_{j=1}^{J}W_{.j}C_{.j}=1-A-B$$

$$V=\sum_{i=1}^{I}W_{i.}V_{i.}=\sum_{i=1}^{I}W_{i.}\left(A_{i.}-B_{i.}\right)=\sum_{j=1}^{J}W_{.j}V_{.j}=\sum_{j=1}^{J}W_{.j}\left(A_{.j}-B_{.j}\right)=A-B$$

The weighting used will be the ratio of the average value of the exports of the companies of each sector or size over the total sum of the average values for the 2019-2022 period of exports of the companies of the Directory. So:

$$W_{i.}=\frac{X_{i.}}{X}\qquad W_{.j}=\frac{X_{.j}}{X}$$

This way, the population parameters equal:

$$A = \sum_{i=1}^{I} \frac{X_{i\cdot}}{X} A_{i\cdot} = \sum_{j=1}^{J} \frac{X_{\cdot j}}{X} A_{j}$$

$$B = \sum_{i=1}^{I} \frac{X_{i\cdot}}{X} B_{i\cdot} = \sum_{j=1}^{J} \frac{X_{\cdot j}}{X} B_{\cdot j}$$

$$C = \sum_{i=1}^{I} \frac{X_{i\cdot}}{X} C_{i\cdot} = \sum_{j=1}^{J} \frac{X_{\cdot j}}{X} C_{\cdot j} = 1 - A - B$$

$$V = \sum_{i=1}^{I} \frac{X_{i\cdot}}{X} \left(A_{i\cdot} - B_{i\cdot}\right) = \sum_{j=1}^{J} \frac{X_{\cdot j}}{X} \left(A_{\cdot j} - B_{\cdot j}\right) = A - B$$

Replacing, we can get to express the parameters A, C, B and V depending the corresponding to the different stratum *ij* and the individual observations *ijk*:

$$A = \sum_{i=1}^{I} \sum_{j=1}^{J} \frac{X_{ij}}{X} A_{ij} = \sum_{i=1}^{I} \sum_{j=1}^{J} \sum_{k=1}^{N_{ij}} \frac{X_{ij}}{XN_{ij}} A_{ijk}$$

$$B = \sum_{i=1}^{I} \sum_{j=1}^{J} \frac{X_{ij}}{X} B_{ij} = \sum_{i=1}^{I} \sum_{j=1}^{J} \sum_{k=1}^{N_{ij}} \frac{X_{ij}}{XN_{ij}} B_{ijk}$$

$$C = \sum_{i=1}^{I} \sum_{j=1}^{J} \frac{X_{ij}}{X} C_{ij} = \sum_{i=1}^{I} \sum_{j=1}^{J} \sum_{k=1}^{N_{ij}} \frac{X_{ij}}{XN_{ij}} C_{ijk} = \sum_{i=1}^{I} \sum_{j=1}^{J} \sum_{k=1}^{N_{ij}} \frac{X_{ij}}{XN_{ij}} \left(1 - A_{ijk} - B_{ijk}\right)$$

$$V = \sum_{i=1}^{I} \sum_{j=1}^{J} \frac{X_{ij}}{X} V_{ij} = \sum_{i=1}^{I} \sum_{j=1}^{J} \sum_{k=1}^{N_{ij}} \frac{X_{ij}}{XN_{ij}} V_{ijk} = \sum_{i=1}^{I} \sum_{j=1}^{J} \sum_{k=1}^{N_{ij}} \frac{X_{ij}}{XN_{ij}} \left(A_{ijk} - B_{ijk}\right)$$

3.5.2. Estimators of the population parameters

The estimators of the population parameters to the set of the population are the following:

$$a = \sum_{i=1}^{I} \frac{X_{i\cdot}}{X} a_{i\cdot} = \sum_{j=1}^{J} \frac{X_{\cdot j}}{X} a_{\cdot j}$$

$$b = \sum_{i=1}^{I} \frac{X_{i\cdot}}{X} b_{i\cdot} = \sum_{j=1}^{J} \frac{X_{\cdot j}}{X} b_{\cdot j}$$

$$c = \sum_{i=1}^{I} \frac{X_{i\cdot}}{X} c_{i\cdot} = \sum_{j=1}^{J} \frac{X_{\cdot j}}{X} c_{\cdot j} = 1 - a - b$$

$$v = \sum_{i=1}^{I} \frac{X_{i\cdot}}{X} v_{i\cdot} = \sum_{j=1}^{J} \frac{X_{\cdot j}}{X} v_{\cdot j} = a - b$$

Replacing, we can manage to express these estimators depending on the individual observations of the different random samples obtained in the different strata ij:

$$a = \sum_{i=1}^{I}\sum_{j=1}^{J} \frac{X_{ij}}{X} a_{ij} = \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{n_{ij}} \frac{X_{ij}}{Xn_{ij}} a_{ijk}$$

$$b = \sum_{i=1}^{I}\sum_{j=1}^{J} \frac{X_{ij}}{X} b_{ij} = \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{n_{ij}} \frac{X_{ij}}{Xn_{ij}} b_{ijk}$$

$$c = \sum_{i=1}^{I}\sum_{j=1}^{J} \frac{X_{ij}}{X} c_{ij} = \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{n_{ij}} \frac{X_{ij}}{Xn_{ij}} c_{ijk} = \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{n_{ij}} \frac{X_{ij}}{Xn_{ij}} \left(1 - a_{ijk} - b_{ijk}\right)$$

$$v = \sum_{i=1}^{I}\sum_{j=1}^{J} \frac{X_{ij}}{X} v_{ij} = \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{n_{ij}} \frac{X_{ij}}{Xn_{ij}} v_{ijk} = \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{n_{ij}} \frac{X_{ij}}{Xn_{ij}} \left(a_{ijk} - b_{ijk}\right)$$

As it happened previously with the estimators calculated for the different sectors, sizes and strata, these estimators fulfill the condition of unbiasedness.

3.5.3. Variances of the estimators and confidence intervals for population parameters

a) Variances and covariances of the estimators

$$\sigma_a^2 = \sum_{i=1}^{I}\sum_{j=1}^{J} \left(\frac{X_{ij}}{X}\right)^2 F_{ij} \frac{A_{ij}\left(1 - A_{ij}\right)}{n_{ij}}$$

$$\sigma_b^2 = \sum_{i=1}^{I}\sum_{j=1}^{J} \left(\frac{X_{ij}}{X}\right)^2 F_{ij} \frac{B_{ij}\left(1 - B_{ij}\right)}{n_{ij}}$$

$$\sigma_c^2 = \sum_{i=1}^{I}\sum_{j=1}^{J} \left(\frac{X_{ij}}{X}\right)^2 F_{ij} \frac{C_{ij}\left(1 - C_{ij}\right)}{n_{ij}}$$

$$\sigma_{a,b} = -\sum_{i=1}^{I}\sum_{j=1}^{J} \left(\frac{X_{ij}}{X}\right)^2 F_{ij} \frac{A_{ij} B_{ij}}{n_{ij}}$$

$$\sigma^2_{v_{i\cdot}} = \sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\left[\frac{A_{ij}\left(1-A_{ij}\right)+B_{ij}\left(1-B_{ij}\right)+2A_{ij}B_{ij}}{n_{ij}}\right] \text{ where, } F_{ij}=\frac{N_{ij}-n_{ij}}{N_{ij}-1}$$

b) Estimators of the variances and covariances of the estimators

$$\hat{\sigma}^2_a = \sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X}\right)^2 F_{ij}\,\frac{a_{ij}\left(1-a_{ij}\right)}{n_{ij}-1}$$

$$\hat{\sigma}^2_b = \sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X}\right)^2 F_{ij}\,\frac{b_{ij}\left(1-b_{ij}\right)}{n_{ij}-1}$$

$$\hat{\sigma}^2_c = \sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X}\right)^2 F_{ij}\,\frac{c_{ij}\left(1-c_{ij}\right)}{n_{ij}-1}$$

$$\hat{\sigma}_{a_i b_{i\cdot}} = -\sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\,\frac{a_{ij}b_{ij}}{n_{ij}-1}$$

$$\sigma^2_{v_{i\cdot}} = \sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X_{i\cdot}}\right)^2 F_{ij}\left[\frac{a_{ij}\left(1-a_{ij}\right)+b_{ij}\left(1-b_{ij}\right)+2a_{ij}b_{ij}}{\left(n_{ij}-1\right)}\right] \text{ where } F_{ij}=(N_{ij}-n_{ij})/N_{ij}$$

Confidence intervals

IC (A): $A \in \left\{a \pm z_{\alpha/2}\hat{\sigma}_a\right\} \rightarrow A \in \left\{a \pm z_{\alpha/2}\sqrt{\sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X}\right)^2 F_{ij}\,\frac{a_{ij}\left(1-a_{ij}\right)}{n_{ij}-1}}\right\}$

IC (B): $B \in \left\{b \pm z_{\alpha/2}\hat{\sigma}_b\right\} \rightarrow B \in \left\{b \pm z_{\alpha/2}\sqrt{\sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X}\right)^2 F_{ij}\,\frac{b_{ij}\left(1-b_{ij}\right)}{n_{ij}-1}}\right\}$

IC (C): $C \in \left\{c \pm z_{\alpha/2}\hat{\sigma}_c\right\} \rightarrow C \in \left\{c \pm z_{\alpha/2}\sqrt{\sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X}\right)^2 F_{ij}\,\frac{c_{ij}\left(1-c_{ij}\right)}{n_{ij}-1}}\right\}$

IC (V): $V \in \left\{v \pm z_{\alpha/2}\hat{\sigma}_v\right\} \rightarrow V \in \left\{v \pm z_{\alpha/2}\sqrt{\sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X}\right)^2 F_{ij}\left[\frac{a_{ij}\left(1-a_{ij}\right)+b_{ij}\left(1-b_{ij}\right)+2a_{ij}b_{ij}}{n_{ij}-1}\right]}\right\}$

where $F_{ij}=\frac{N_{ij}-n_{ij}}{N_{ij}-1}$

d) Coefficients of Variation or sampling mistakes related to the estimators

$$CV(\widehat{A}) = \frac{\widehat{\sigma}_a}{\widehat{A}} = \frac{\sqrt{\sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X}\right)^2 F_{ij}\frac{a_{ij}\left(1-a_{ij}\right)}{n_{ij}-1}}}{a}$$

$$CV(\widehat{B}) = \frac{\widehat{\sigma}_b}{\widehat{B}} = \frac{\sqrt{\sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X}\right)^2 F_{ij}\frac{b_{ij}\left(1-b_{ij}\right)}{n_{ij}-1}}}{b}$$

$$CV(\widehat{B}) = \frac{\widehat{\sigma}_c}{\widehat{C}} = \frac{\sqrt{\sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X}\right)^2 F_{ij}\frac{c_{ij}\left(1-c_{ij}\right)}{n_{ij}-1}}}{c}$$

$$CV(\widehat{V}) = \frac{\widehat{\sigma}_v}{\widehat{V}} = \frac{\sqrt{\sum_{i=1}^{I}\sum_{j=1}^{J}\left(\frac{X_{ij}}{X}\right)^2 F_{ij}\frac{a_{ij}\left(1-a_{ij}\right)+b_{ij}\left(1-b_{ij}\right)+2a_{ij}b_{ij}}{n_{ij}-1}}}{v}$$ where $F_{ij}=(N_{ij}- n_{ij})/N_{ij}$

3.6. Calculation of the sampling error of the survey

Next, we will analyze the global theoretical sampling committed in the estimation of the different questions included in the Export sentiment survey.

To do so, we calculate the error that would be obtained with a sample size of 1,900 companies, using the allocation proportional to the number of companies and to the corrected value of export[21].

Also, the hypothesis that the dispersion of the responses is the maximum possible is assumed. Therefore, it's assumed that the proportion of upward responses (A), downward (B) or stable (C) is the same in all strata[22]:

$$A_{ij} = B_{ij} = C_{ij} = 1/3 \Rightarrow V_{ij} = 0 \qquad \forall i, j \qquad \textbf{n=1,900}$$

[21] As we saw in the *Section 2.2.4. Sample design*, the initial sample is corrected to take into account the possible difficulties of obtaining the sample in certain strata.

[22] And, therefore, said properties will also be the same in the different sectors and sizes, as well as in the total of the population.

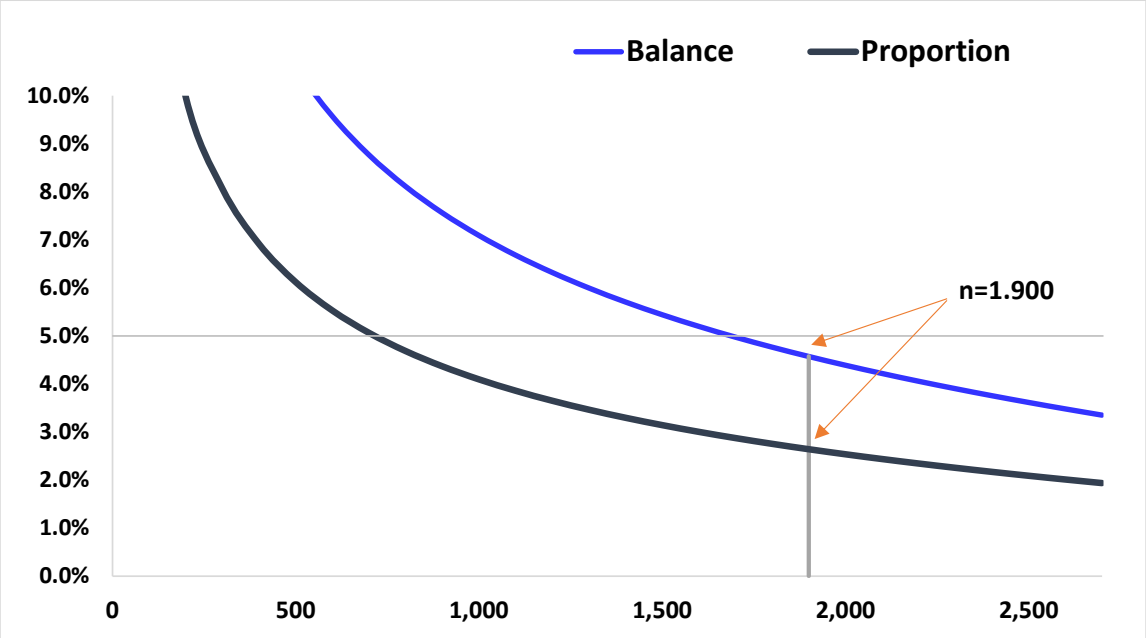
a) Population proportion

Under the previous hypothesis, the sampling error for the estimation of the population parameters for the total of the population (A, B or C) is **±2.6%** per a for a level of confidence of 95.0%.

b) Balance indicator

Under the previous hypothesis, the global sampling error for the estimation of V is **4.6%** for a confidence level of 95.0%.

Graphic 3.6.1. Sampling error for the estimation of the proportion and of the population indicator and a level of confidence of 95.0%, related to the sample size.



3.7. Correction of the balance indicators facing the lack of answer

The lack of answer appears when information cannot be obtained, in a total or partial fashion, from one of the companies selected to belong to the sample.

In the event of a lack of answer, the estimators of the *balance indicators* must be corrected to take into account this fact. Next, we briefly expose the procedure followed for the correction of the same in every of the three simple indicators calculated.

To do so, we start showing how this correction is carried out within a stratum, to go next to analyze how the lack of answer is corrected in the respective sectors, sizes and total of the population.

a) *ij* stratum

We suppose that we analyze the answers given in certain answer of the questionnaire. To the stratum *ij*, we will have four population parameters:

$$A_{ij} = \frac{1}{N_{ij}} \sum_{k=1}^{N_{ij}} A_{ijk} \qquad \text{(}\textit{Proportion of upward answers}\text{)}$$

$$B_{ij} = \frac{1}{N_{ij}} \sum_{k=1}^{N_{ij}} B_{ijk} \qquad \text{(}\textit{Proportion of downward answers}\text{)}$$

$$C_{ij} = \frac{1}{N_{ij}} \sum_{k=1}^{N_{ij}} C_{ijk} \qquad \text{(}\textit{Proportion of stable answers}\text{)}$$

$$D_{ij} = \frac{1}{N_{ij}} \sum_{k=1}^{N_{ij}} D_{ijk} = 1 - A_{ij} - B_{ij} - C_{ij} \qquad \text{(}\textit{Proportion of non-answer ratio}\text{)}$$

For its part, the balance indicator in the *ij* stratum will be equal to

$$V_{ij} = A_{ij} - B_{ij}$$

The corresponding estimators unbiased of the previous parameter are obtained from the following expressions:

$$a_{ij} = \frac{1}{n_{ij}} \sum_{k=1}^{n_{ij}} a_{ijk} \qquad b_{ij} = \frac{1}{n_{ij}} \sum_{k=1}^{n_{ij}} b_{ijk} \qquad c_{ij} = \frac{1}{n_{ij}} \sum_{k=1}^{n_{ij}} c_{ijk}$$

$$d_{ij} = 1 - a_{ij} - b_{ij} - c_{ij} \qquad v_{ij} = a_{ij} - b_{ij}$$

The correction of the lack of response will consist in distributing the corresponding percentage of companies that commit it (that is, D_{ij}) between the other three percentages: upward evolution (A_{ij}), downward (B_{ij}) and stables (C_{ij}). In this sense, four possible options are considered:

a) All the lack of response belong to individuals that would answer upward.

$$A^*_{ij} = A_{ij} + D_{ij} \qquad B^*_{ij} = B_{ij} \qquad C^*_{ij} = C_{ij}$$

$$V^*_{ij} = A^*_{ij} - B^*_{ij} = A_{ij} + D_{ij} - B_{ij}$$

b) All the lack of response belong to individuals that would answer downward.

$$A^*_{ij} = A_{ij} \qquad B^*_{ij} = B_{ij} + D_{ij} \qquad C^*_{ij} = C_{ij}$$

$$V^*_{ij} = A^*_{ij} - B^*_{ij} = A_{ij} - B_{ij} - D_{ij}$$

c) All the lack of response belong to individuals that would answer stable.

$$A^*_{ij} = A_{ij} \qquad B^*_{ij} = B_{ij} \qquad C^*_{ij} = C_{ij} + D_{ij}$$

$$V^*_{ij} = A^*_{ij} - B^*_{ij} = A_{ij} - B_{ij} = V_{ij}$$

d) The distribution of the companies that present this lack of answer between those who would answer upward, downward and stable is the same observed in the companies that have already answered the question.

$$A^*_{ij} = \frac{A_{ij}}{1 - D_{ij}} \qquad B^*_{ij} = \frac{B_{ij}}{1 - D_{ij}} \qquad C^*_{ij} = \frac{C_{ij}}{1 - D_{ij}}$$

$$V^*_{ij} = A^*_{ij} - B^*_{ij} = \frac{A_{ij} - B_{ij}}{1 - D_{ij}} = \frac{V_{ij}}{1 - D_{ij}}$$

In the Export sentiment survey it's assumed that we work with this last situation. Therefore, the corrected balance indicator for the population in the *ij* stratum will equal:

$$V^*_{ij} = \frac{V_{ij}}{1 - D_{ij}} = \frac{\left(A_{ij} - B_{ij}\right)}{1 - D_{ij}} = \frac{\sum_{k=1}^{N_{ij}} \left(A_{ijk} - B_{ijk}\right)}{N_{ij} - \sum_{k=1}^{N_{ij}} D_{ijk}}$$

For its part, the corrected estimator will be obtained from the following expression:

$$v^*_{ij} = \frac{v_{ij}}{1 - d_{ij}} = \frac{\left(a_{ij} - b_{ij}\right)}{1 - d_{ij}} = \frac{\sum_{k=1}^{n_{ij}} \left(a_{ijk} - b_{ijk}\right)}{n_{ij} - \sum_{k=1}^{N_{ij}} d_{ijk}}$$

This estimator is not unbiased, being a non linear function of the original estimators. Equally, the expressions of the variance and the confidence interval calculated for the event of null lack of confidence will not be answered.

However, if the lack of answer is reduced (that is, if D_{ij} takes a value next to zero), the bias committed will be minimum and the expressions calculated

previously for the variance and the confidence interval could be a good approximation of the true unknown expressions.

b) *i* sector

The population parameter in the i sector are obtained from the following expressions:

$$A_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} A_{ij} \qquad B_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} B_{ij} \qquad C_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} C_{ij}$$

$$D_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} D_{ij} = 1 - A_{i\cdot} - B_{i\cdot} - C_{i\cdot}$$

$$V_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} V_{ij} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} \left(A_{ij} - B_{ij}\right) = A_{i\cdot} - B_{i\cdot}$$

For its part, the corresponding unbiased are equal to

$$a_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} a_{ij} \qquad b_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} b_{ij} \qquad c_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} c_{ij}$$

$$d_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} d_{ij} = 1 - a_{i\cdot} - b_{i\cdot} - c_{i\cdot}$$

$$v_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} v_{ij} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} \left(a_{ij} - b_{ij}\right) = a_{i\cdot} - b_{i\cdot}$$

As we already saw with the case of the ij stratum, the correction of the lack of answers is made in a fashion that supposes that this lack of answer is distributed among those that would answer upward, downward and stable the same way it's observed in the companies that do have answered. In this sense, two options exist to carry out said correction:

a) The correction is made first within the strata.

$$V^*_{i\cdot} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} V^*_{ij} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} \frac{V_{ij}}{1 - D_{ij}} = \sum_{j=1}^{J} \frac{X_{ij}}{X_{i\cdot}} \frac{\left(A_{ij} - B_{ij}\right)}{1 - D_{ij}}$$

b) The correction is directly made for the whole sector:

$$V^{**}_{i\cdot} = \frac{V_{i\cdot}}{1-D_{i\cdot}} = \frac{A_{i\cdot}-B_{i\cdot}}{1-D_{i\cdot}} = \frac{\sum_{j=1}^{J}\frac{X_{ij}}{X_{i\cdot}}\left(A_{ij}-B_{ij}\right)}{1-\sum_{j=1}^{J}\frac{X_{ij}}{X_{i\cdot}}D_{ij}}$$

It is checked that the results obtained with both corrections do not coincide. Therefore, one or another option must be chosen. In this sense, it feels advisable to use the first option, because of its better properties in terms of consistency[23].

For its part, the estimator used for the corrected balance indicator of the population will equal:

$$v^{*}_{i\cdot} = \sum_{j=1}^{J}\frac{X_{ij}}{X_{i\cdot}}v^{*}_{ij} = \sum_{j=1}^{J}\frac{X_{ij}}{X_{i\cdot}}\frac{v_{ij}}{1-d_{ij}} = \sum_{j=1}^{J}\frac{X_{ij}}{X_{i\cdot}}\frac{\left(a_{ij}-b_{ij}\right)}{1-d_{ij}}$$

c) *j* size

Similarly to the case of the i sector, the corrected indicator of the population for the *j* size and its corresponding estimator are obtained:

$$V^{*}_{\cdot j} = \sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot j}}V^{*}_{ij} = \sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot j}}\frac{V_{ij}}{1-D_{ij}} = \sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot j}}\frac{\left(A_{ij}-B_{ij}\right)}{1-D_{ij}}$$

$$v^{*}_{\cdot j} = \sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot j}}v^{*}_{ij} = \sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot j}}\frac{v_{ij}}{1-d_{ij}} = \sum_{i=1}^{I}\frac{X_{ij}}{X_{\cdot j}}\frac{\left(a_{ij}-b_{ij}\right)}{1-d_{ij}}$$

d) Total population

Last, the corrected population balance indicator for the whole set of the population and its corresponding estimator equal:

$$V^{*} = \sum_{i=1}^{I}\sum_{j=1}^{J}\frac{X_{ij}}{X}V^{*}_{ij} = \sum_{i=1}^{I}\sum_{j=1}^{J}\frac{X_{ij}}{X}\frac{A_{ij}-B_{ij}}{1-D_{ij}} = \sum_{i=1}^{I}\frac{X_{i\cdot}}{X}V^{*}_{i\cdot} = \sum_{j=1}^{J}\frac{X_{\cdot j}}{X}V^{*}_{\cdot j}$$

[23] With this option, it's maintained the consistency among the estimations obtained in the different, strata, sectors, sizes and global.
This way, the estimator corrected in a determined sector (or size) is obtained from the corresponding estimators corrected in the strata that make it up.
In a similar way, the corrected global estimator is obtained directly from the corrected estimators of the different sectors, sizes and strata.

$$v^* = \sum_{i=1}^{I}\sum_{j=1}^{J}\frac{X_{ij}}{X}v^*_{ij} = \sum_{i=1}^{I}\sum_{j=1}^{J}\frac{X_{ij}}{X}\frac{a_{ij}-b_{ij}}{1-d_{ij}} = \sum_{i=1}^{I}\frac{X_{i\cdot}}{X}v^*_{i\cdot} = \sum_{j=1}^{J}\frac{X_{\cdot j}}{X}v^*_{\cdot j}$$

COLLECTION, TREATMENT AND DISSEMINATION OF THE INFORMATION

4.1. Collection of the information

The collection of the information is made through web and/or phone interviews to the person in charge of exports in the selected companies to belong to the sample.

4.2. Treatment of the information

The treatment of the information obtained from the informing units is carried out in three phases.

In the first, at the same time the information is collected a first depuration and codification of the same. Next, once the questionnaires have been recorded, the file of data undergoes a series of informatic controls with the aim of detecting errors, incoherencies and inconsistencies that can be corrected. In the end, the aggregated results obtained are analyzed, both total and for strata, sectors and sizes.

4.3. Dissemination of the information

The dissemination of the information obtained in *the Export sentiment survey* is carried out by different means and to different groups of users: quarterly publishing of results, forwarding information to the informing units and *available information on the Internet*.

4.3.1. Quarterly publishing of results

The quarterly results of the Export sentiment survey are presented in different formats:

a) *Press release*, which is sent to the media [24]. In said release are summarized the main results obtained with the survey in the reference quarter.

[24] Said press release can also be consulted too by the general public in the webpage of the Ministry of Economy, Trade and Business.

b) *Quarterly report,* with an analysis of the global results, as well as by sectors and sizes. This report presents a series of graphs and tables that facilitate the interpretation of the results.

c) *Statistical tables*, with the main results obtained in the reference quarter. It can be consulted quarterly in the same previous link of the quarterly report.

4.3.2. Sending information to reporting units

The General Subdirection of Studies and Evaluation of Trade Policy Instruments of the State Secretariat for Trade of the Ministry of Economy, Trade and Business is aware of the effort that represents for companies collaborating in the completion of this survey. For this reason, wants to thank them their participation with the forwarding of a synthesis of the main results obtained each quarter.

To do so, the *General Subdirection of Studies and Evaluation of Trade Policy Instruments* sends via email both the Quarterly report and the *Statistical charts* to the companies collaborating in the making of the survey (both in the reference quarter and in the previous) and that request it.

4.3.3. Information available on the Internet

The General Subdirection of Studies and Evaluation of Trade Policy Instruments of the State Secretariat for Trade of the Ministry of Economy, Trade and Business makes available for the general public in their web the following information related to the *Export sentiment survey*:

- Quarterly report.
- Statistical charts.
- Current methodology of elaboration of the survey.
- Historical series since 2011.

Last, as it was previously noted, it's available for consultation the Press release with the main quarterly results of the survey in the webpage of the *Ministry of Economy, Trade and Business*.