Measuring Innovation in Complex Enterprises

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Summary

There are multiple ways to produce statistics about enterprises, and choices must be made to satisfy multiple goals simultaneously. In a complex enterprise comprising multiple legal units, the priority is to describe one innovation process. In this analysis data from the 2022 wave of the Community Innovation Survey (CIS) is used to compare consolidation and the representative approach.

The analysis shows that aggregated results for the main indicators are very similar between the two methods. However, isolating the difference for large and small complex enterprises indicates that consolidation may give false descriptions of the innovation activities of the enterprise, especially relating to expenditure.

Using the demographic properties of the statistical unit enterprise (SUE) increases the population of large enterprises with 49.4 percentage points compared to the legal unit's (LEU) own number of employees. For all main indicators the difference in results between consolidation and the representative approach is mostly prevalent for large enterprises. Looking only at specific cases of large complex enterprises, consolidation results in a higher degree of innovation activities and higher total expenditure, unweighted. For these enterprises, consolidation of expenditure results in a higher level of expenditure, however when displaying results per NACE activity a majority of some expenditures are originating from other activities than that of the enterprise. Since 66.8 percent of complex enterprises consisted of five or fewer legal units, we also looked at less complex enterprises. When looking at these cases the problem with expenditure from other NACE activities were less prominent.

Since consolidation and the representative approach give similar aggregated results on the main indicators, a key determinant of which method to use is the interpretation of the data. Without the isolation of the innovation process in the representative legal unit, spurious relationships between variables affecting innovation could be misinterpreted as causal. The representative unit is the dominating unit in the enterprise. Although this unit is perceived as the one whose answers can represent the enterprise these are not always the innovation or R&D active units. Considering this, neither consolidation nor the representative approach accurately describes the reality of activities in the business enterprise sector.

Using the representative approach with consolidation of R&D units is a compromise between capturing activities and expenditure, ensuring quality and by extension being able to describe the innovation process, while also maintaining quality in the data on R&D expenditure. This, in

turn, has to be evaluated and problems concerning intra-group flows have to be considered in order to avoid overestimating expenditure.

Abbreviations

SUE – Statistical Unit Enterprise

LEU – Legal Unit

EBS – European Business Statistics

CIS – Community Innovation Survey

R&D – Research and Development

NSI – National Statistical Institute

Measuring Innovation in Complex Enterprises

Background

Innovation is a key determinant of economic growth and societal wellbeing, as well as an important part of Sweden's many successful global enterprises. With the implementation of the European Business Statistics regulation, the definition of the statistical unit enterprise (SUE) was fully applied in statistical business registers (SBR), starting with reference year 2021. In Sweden, the implementation of the SUE in the SBR first affected the innovation statistics covering the reference period 2020-2022, and with it a new method of producing enterprise statistics was introduced.

The enterprise is defined as "*the smallest combination of legal units that is an organisational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making …*"[1]. Following this definition, a group of legal units can in many cases be regarded as an enterprise as there are interdependencies within this group. There are multiple ways to produce statistics about enterprises, and choices must be made to satisfy multiple goals simultaneously. The quality of the data must be high, and it must describe the enterprise. The response burden must be minimised at the same time as the statistics must meet the policy needs that motivate the use of a survey. To meet these criteria, Sweden chose to implement what is here referred to as the representative approach.

To accurately describe the impact of innovation on key performance indicators of an enterprise, such as productivity and value added, a common statistical unit in economic statistics is necessary. This is the basis for the changes made to the production of the innovation statistics.

The Community Innovation Survey (CIS) is an economic survey that describes economic activities stemming from a process of innovation. The definition of an economic activity per NACE Rev. 2 states that "*[a]n economic activity takes place when resources such as capital goods, labour, manufacturing techniques or intermediary products are combined to produce specific goods or services*"[2]. This definition describes the

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[1] Council Regulation (EEC) No 696/93 of March 1993, section III.

[2] NACE Rev.2, Statistical classification of economic activities in the European Community. Eurostat, p. 15.

production function of an enterprise, but labour and manufacturing techniques also include for example digitalisation, research and development (R&D) and innovation. Processes critical to the competitiveness of the business.

In a complex enterprise comprising multiple legal units, the priority is to describe one innovation process. Sometimes enterprises divide functions between legal units to improve efficiency in the activities undertaken or other reasons, for example tax purposes. These units then provide services to the entire business. To better understand the innovation process and its determinants, the representative approach focuses on the dominating legal unit that best reflects the characteristics of the enterprise (for criteria when appointing a representative, see Annex 1). Without the isolation of the innovation process in the representative legal unit, spurious relationships between variables affecting innovation might be interpreted as causal. If the representative legal unit, for example, is innovative in the sense of the survey and have the in-house capabilities to develop and deploy innovations without outside support, a parallel innovation process in a different legal unit within the same complex enterprise can distort the enterprise data under consolidation rules. If that second legal unit receives government support for its innovation activities but fails to innovate, a false conclusion can be drawn from the resulting statistics where the enterprise would be successful in their innovation activities while receiving government support. A relationship that has not been observed in the data, but rather created through statistical production.

This paper describes and compares consolidation and the representative approach through survey data from the Community Innovation Survey 2020-2022 (CIS2022). It also describes the combination of the two methods in what is referred to as the representative approach with R&D units. All with the aim of providing reference on how high quality in official innovation statistics can be maintained under new circumstances.

Methods for producing statistics covering complex enterprises

As previously stated, an enterprise is the smallest combination of legal units that is producing goods or services and benefits from certain autonomy in decision-making. For most of the population there is a one-to-one relationship between enterprise and legal unit (enterprise = legal unit). However, in the Swedish business register there are still over 50 000 enterprises that consist of more than one legal unit. These are called complex enterprises.

Seeing as data are collected at the legal unit level it is necessary to develop a method to produce enterprise statistics for complex enterprises. Eurostat recommends using one of two methods described in the European Business Statistics Manual for the CIS: consolidation or the representative approach. In addition to the representative approach there is a recommendation in the manual to include R&D performing units, labeled in this paper as the representative approach with R&D units. These three methods are explained in more detail in this section.

In this paper the terms statistical unit enterprise (SUE) and enterprise are synonyms and will be used interchangeably.

Consolidation

The method of consolidation entails collecting data for all legal units, except purely administrative units, within a complex enterprise and consolidating their answers using a set of aggregation rules depending on the variable (see Annex 2 for aggregation rules). The consolidated data are then assumed to be representative for the enterprise.

For the 2022 round of the CIS limitations were made regarding the inclusion of legal units within complex enterprises. Only legal units within the scope (considering size class and NACE activity) were included. The total sample size was 6 855 enterprises and 10 309 legal units. All legal units were surveyed. Out of these, 81 percent answered the survey[3] resulting in data for 5 564 enterprises and 8 369 legal units.

The representative approach

The representative approach is a method where one representative legal unit is identified and surveyed. The legal unit is chosen based on a set of criteria (see Annex 1). The answers from this unit are assumed to be representative for the entire enterprise.

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[3] Response rate is calculated on number of surveyed objects who answered the survey out of all objects that received the survey. Therefore, this is calculated on the level of the legal unit.

If the representative approach is applied on the 2022 CIS sample, the total sample size was 6 855 enterprises and 6 852 legal units[4]. Out of these, 81 percent answered the survey, resulting in data for 5 564 enterprises and 5 564 legal units.

The representative approach with R&D units

The representative approach with inclusion of R&D units is the same as the representative approach described above, but with consolidation of R&D units. From the sampled enterprises a representative is chosen based on the same criteria as referred to above. R&D units belonging to the sampled enterprises are identified through the survey R&D in the Business Enterprise Sector. If an enterprise consists of two or more surveyed legal units, the answers from these units are consolidated in accordance with the aggregation rules (Annex 2).

When applying this method, the total sample size for CIS2022 was 6 855 enterprises and 7 025 legal units. Out of these, 81 percent answered the survey, resulting in data for 5 564 enterprises and 5 710 legal units.

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[4] The number of legal units were less than the number of enterprises due to there being enterprises with legal units that are not considered producing units, only helping units.

Comparing methods

By using CIS2022 data and applying consolidation and the representative method respectively we can compare results. Since the properties of the SUE are used in both approaches, the results are based on the same enterprise population.

Some of the main indicators in the CIS are innovation activities, product innovation and business process innovation (which constitute innovation), innovation expenditure, and turnover from product innovations. Innovation activities include innovation, R&D, and ongoing, abandoned, and completed innovation activities that did not result in any innovation. Looking at the weighted share of innovation active enterprises using the two different methods, the difference is 1.4 percentage points. The share of innovation active enterprises is higher when using consolidation, however the difference is not substantial. Using the positive consolidation rule for binary variables, i.e. if one unit answers yes the answer for the enterprise is yes, increases the likelihood of the enterprise being innovation active.

Figure 1. The share of innovation active enterprises with the representative approach and consolidation, 2020-2022.
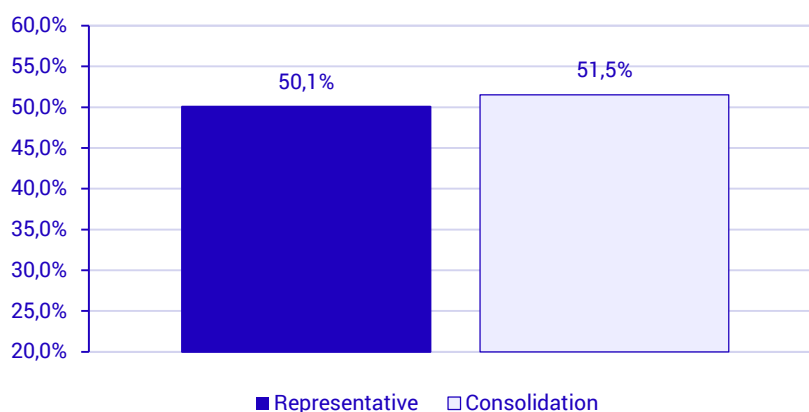
To identify where the difference between the processing methods is the most significant, number of employees can be used. Grouping enterprises according to the size classes specified in the EBS manual, the difference in share of innovation active enterprises is higher for large enterprises. This is because large enterprises, to a greater extent, are complex. A description of this is given in the section "The effect of different demographic properties" below. Focusing only on large enterprises, consolidation gives higher shares of innovative enterprises, both for product- and business process innovation. This trend is prevalent for all main indicators. More on the effect of metadata properties is discussed in the next section.

Figure 2. Share of innovation active enterprises by method and size class, and the difference between the methods, 2020-2022.
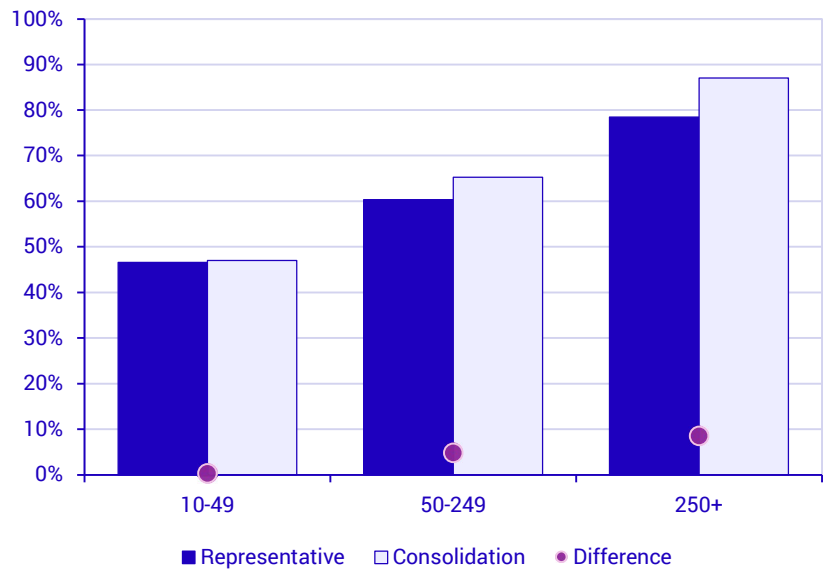
Figure 3. The share of product innovative and business process innovative enterprises, by method, 2020-2022.

Figure 3 bar chart. Y-axis 0% to 90%. Categories: Product innovation, Business process innovation. Legend: Representative (dark), Consolidation (light).

- Product innovation: Representative ~55%, Consolidation ~68%
- Business process innovation: Representative ~66%, Consolidation ~79%
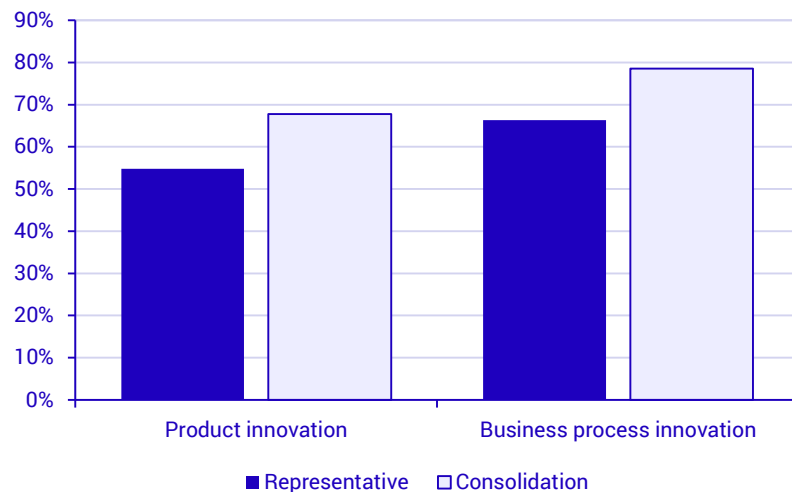
Figure 4. The share of product innovative enterprises of the population, and their novelty as a share of product innovative enterprises, by method, 2020-2022.
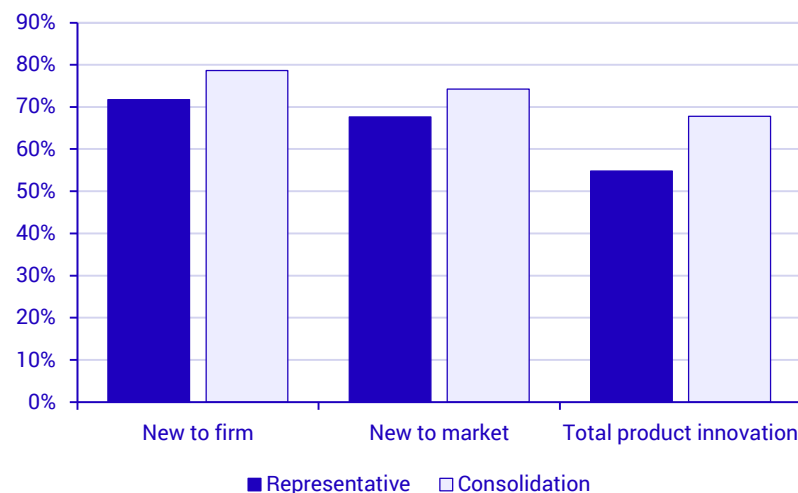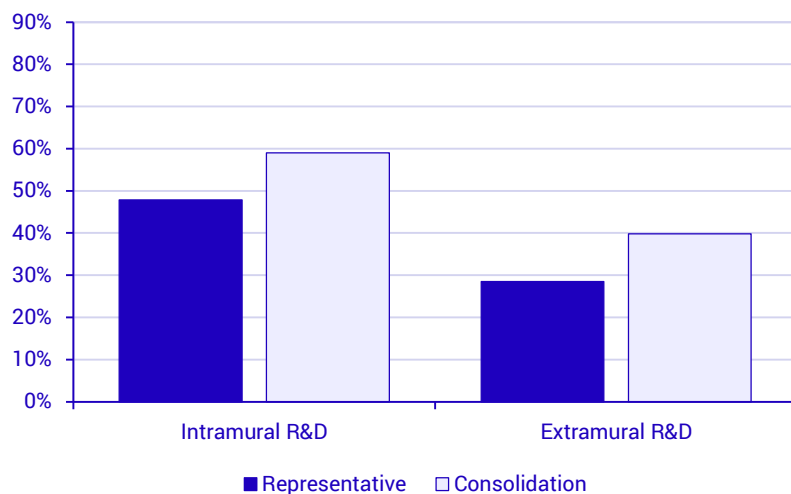

Figure 4 bar chart. Y-axis 0% to 90%. Categories: New to firm, New to market, Total product innovation. Legend: Representative, Consolidation.

- New to firm: Representative ~72%, Consolidation ~79%
- New to market: Representative ~68%, Consolidation ~74%
- Total product innovation: Representative ~55%, Consolidation ~68%

Figure 5. The share of enterprises with intramural and extramural R&D respectively, by method, 2020-2022.

Figure 5 bar chart. Y-axis 0% to 90%. Categories: Intramural R&D, Extramural R&D. Legend: Representative, Consolidation.

- Intramural R&D: Representative ~48%, Consolidation ~59%
- Extramural R&D: Representative ~29%, Consolidation ~40%

Figure 6. The share of innovation active enterprises cooperating on innovation activities and R&D activities respectively, by method, 2020-2022.

Figure 6 bar chart. Y-axis 0% to 90%. Categories: Cooperation on innovation activities, Cooperation on R&D activities. Legend: Representative, Consolidation.

- Cooperation on innovation activities: Representative ~70%, Consolidation ~78%
- Cooperation on R&D activities: Representative ~46%, Consolidation ~53%
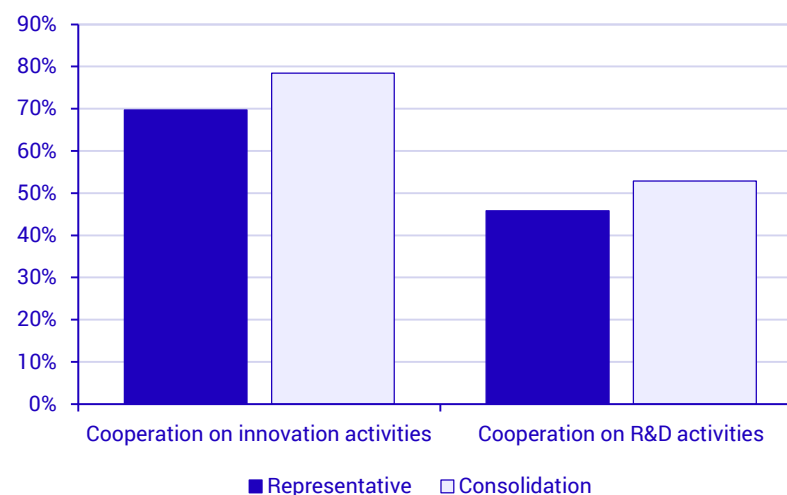
The effect of different demographic properties

Size class

The implementation of the statistical unit 'enterprise' in Sweden entailed profiling of complex units. The population of complex enterprises increased which in turn lead to a bigger population of large enterprises. Comparing the distribution of legal units in complex enterprises grouped by size class when applying size class of the legal unit and the enterprise respectively highlights the effect.

If we apply the demographic properties of the individual legal units, in the LEU population within complex enterprises in the sample, 57.3 percent of them were considered small (10-49 employees). If we instead use the properties of the enterprise, the percentage of the LEU population within the small size class decreases by 54.1 percentage points to 3.2 percent. The shares of medium and large units increase by 4.6 and 49.4 percentage points respectively. A majority of the small LEUs are redistributed to the large size class with SUE properties. Note that this only regards complex enterprises.

Table 1. Distribution of legal units in complex enterprises, grouped by size class for the legal unit and the enterprise respectively. The Swedish CIS2022 sample.

Size class	Complex SUE: distribution of legal units		
	LEU size class	SUE size class	Difference (% - points)
Small (10-49 employees)	57.3%	3.2%	- 54.1
Medium (50-249 employees)	31.9%	36.5%	4.6
Large (250 or more employees)	10.9%	60.3%	49.4

Considering the entire sample and not only complex enterprises, the effect is less dramatic but nonetheless clear. When aggregating from LEU to SUE the share of small units decreases by 8.5 percentage points. These units are redistributed between medium and large units. A majority of this share is redistributed to large units, 5.3 percentage points. Both table 1 and figure 7 indicate that the difference is most significant for large enterprises.

Figure 7. Difference in distribution of units per size class when aggregating from legal unit to statistical unit Enterprise, sample CIS2022.

☐ Difference in distribution
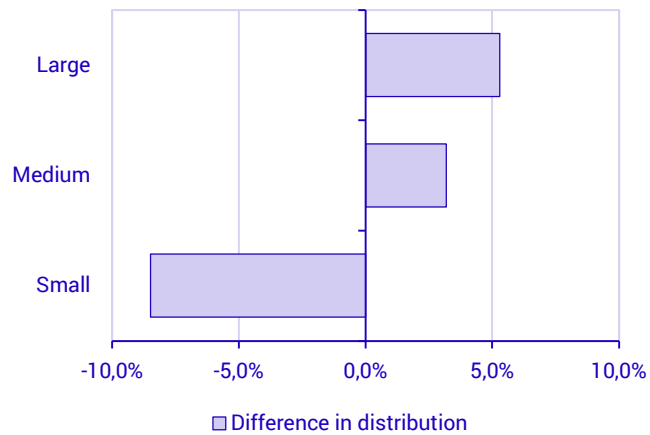
NACE

Comparing the population of LEU and SUE grouped by NACE category (two-digit), the difference is overall smaller than that of size class. In some NACE categories it is closer to zero percent. The largest deviations are found in NACE category 46 (Wholesale trade, except of motor vehicles and motorcycles) and 10-33 (Manufacturing) where the population decreases with 2.7 and increases with 2.5 percentage points respectively.

Figure 8. The difference in distribution of units per NACE category when aggregating from legal unit to statistical unit Enterprise, sample CIS2022.
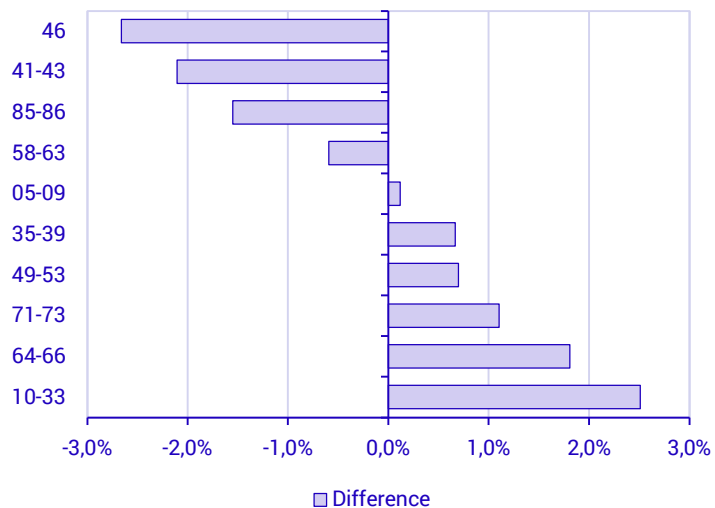
☐ Difference

For derived variables the differences in data between the representative approach and consolidation are small when grouping by NACE category. This is the case for qualitative indicators. However, when computing quantitative statistics, the difference is more visible. More on this in the section on case studies.

Large complex enterprises: case studies

In order to understand the effect of consolidation versus the representative approach on data, case studies are appropriate. Four large complex enterprises in different NACE categories were selected from the Swedish CIS2022 survey data. The table below contains the answers of each enterprise when applying the two different approaches. For every case, consolidation led to positive answers on all indicators. In most of these cases, except Case 1, the representative unit performed all but one of the innovation activities. For the qualitative variables in table 2, the main difference between the two methods is found in R&D activities. However, this is not the case when looking at aggregated data where the biggest difference concerns product- and business process innovation (figure 3-6).

Another result that stands out in table 2 is the difference in expenditures between the two methods for all cases. The overall expenditure for each enterprise increases significantly with consolidation. With the higher expenditures generated by consolidation, however, also comes a risk that some of these expenditures might be double counted within the enterprise.

Except for a limited number of enterprises, almost all complex enterprises are also equal to an enterprise group. When using consolidation to aggregate data on legal unit to enterprise, intra-group flows, especially expenditure, have to be considered. This could concern financing of R&D activities within the group that one unit reports as extramural R&D and another as intramural R&D. Due to legal restrictions, Statistics Sweden cannot ask reporting units to account for expenditures concerning other units in the sample. Instead, Statistics Sweden has to use other sources to identify relations within the enterprise group such as web scraping. Sometimes reporting units will provide information about intra-group flows when contacted with other questions, in which case this information can also be used. Priorities have to be made when identifying and treating intra-group flows.

The Swedish enterprise population contains many complex enterprises, and the information of intra-group flows is scarce. Therefore, efforts have to be focused on large enterprises where the percentage of complex enterprises is the highest. Statistics Sweden has also chosen to make limitations regarding type of expenditure to only include R&D expenditures. Other innovation expenditures (excluding R&D) include both internal and external funding, which makes it more difficult to differentiate between these flows. In table 2 these flows have not been accounted for. Therefore, the difference in expenditure between the representative approach and consolidation might, to some extent, be explained by double counting through inclusion of intra-group expenditures.

Table 2. Results on main indicators for cases when applying different methods.

1 = Yes, 0 = No. All expenditure in thousand Euro.

Methods	Cases							
	Case 1		Case 2		Case 3		Case 4	
	Representative	Consolidation	Representative	Consolidation	Representative	Consolidation	Representative	Consolidation
Variables								
Product innovation	0	1	1	1	1	1	1	1
Business process innovation	1	1	1	1	1	1	1	1
Intramural R&D	0	1	1	1	0	1	1	1
Extramural R&D	0	1	0	1	1	1	0	1
Innovation expenditure excl. R&D	2.8	2 666	4 839	6 106	0	21 198	419	3 664
Intramural R&D expenditure	.	2 102	4 839	8 652	.	958 243	353	2 140
Extramural R&D expenditure	.	248	.	94	1 583 479	1 607 375	.	470
Total innovation expenditure including R&D	2.8	5 016	9 678	14 852	1 583 479	2 586 816	772	6 274

Exchange rate for Swedish krona, 10.6296. From CIS2022 Eurostat dissemination.

. = data not available

Let us look closer at two of these cases separately, case 1 and 3.

Case 1

This complex enterprise consists of 62 LEUs in the business register and its primary economic activity is in NACE 46. In the sample, the number of LEUs are limited to 40, since the others were out of scope. In the data collection, 36 out of those 40 responded to the survey. As seen in table 2, when applying the representative approach to collected data the SUE is only process innovative with innovation expenditure (excl. R&D) of €2.8 thousand. When using consolidation, the SUE has conducted and had expenditure for all activities with total innovation expenditures including R&D amounting to €5 million

The representative has the same NACE category as the SUE, which is also the case for 69 percent of the LEUs within this enterprise. The remaining LEUs are active in other NACE categories. When applying consolidation, the SUE can be presented as having innovation activities that are occurring within legal units in other NACE categories. Looking at consolidated expenditure, this becomes clear. For Case 1, only 4 percent of the intramural R&D expenditures came from NACE 46. A majority of the extramural R&D expenditures for this SUE came from NACE 26 (computer, electronic, and optical products).

Figure 9. The distribution of consolidated expenditure for case one per NACE and type of expenditure, 2022.
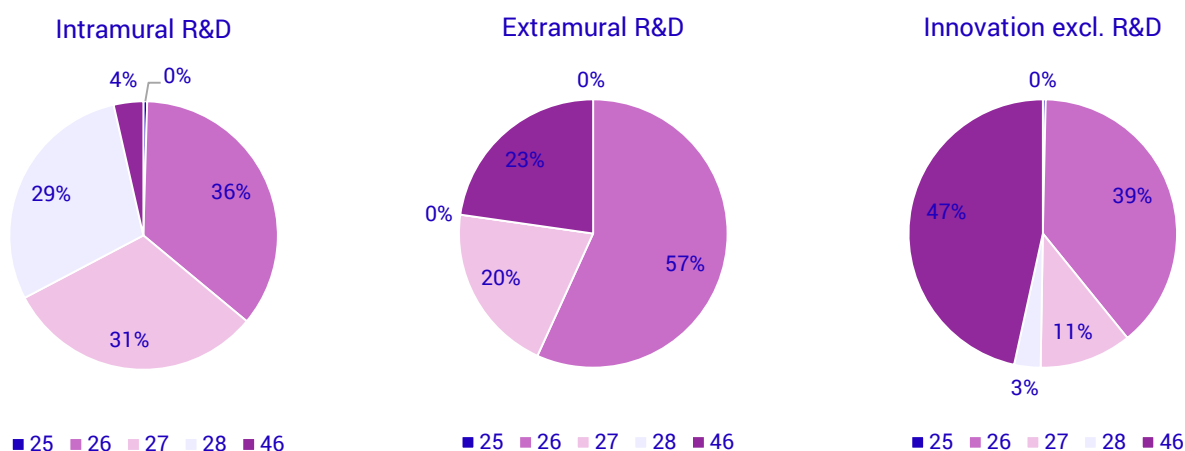
Case 3

Case 3 in table 2 is slightly less complex than Case 1. This enterprise consists of 29 LEUs, 15 of which are out of scope thus only 14 were in the sample. Data was collected for 12 out of the 14 LEUs. The SUE is active in NACE 29 (manufacture of motor vehicles, trailers, and semi-trailers). The representative LEU only had expenditure on extramural R&D. However, these expenditures accounted for 98.5 percent of the consolidated extramural R&D expenditure. Only one other LEU in the same NACE category had extramural R&D expenditures.

For intramural R&D only 10 percent of the consolidated expenditure came from NACE 29, 86 percent came from a research unit in NACE 72 (scientific research and development). None of the innovation expenditure came from NACE 29 when using consolidation. Instead, 83 percent of the expenditure came from two units active in NACE 62 (computer programming, consultancy, and related activities) and 61 (telecommunications).

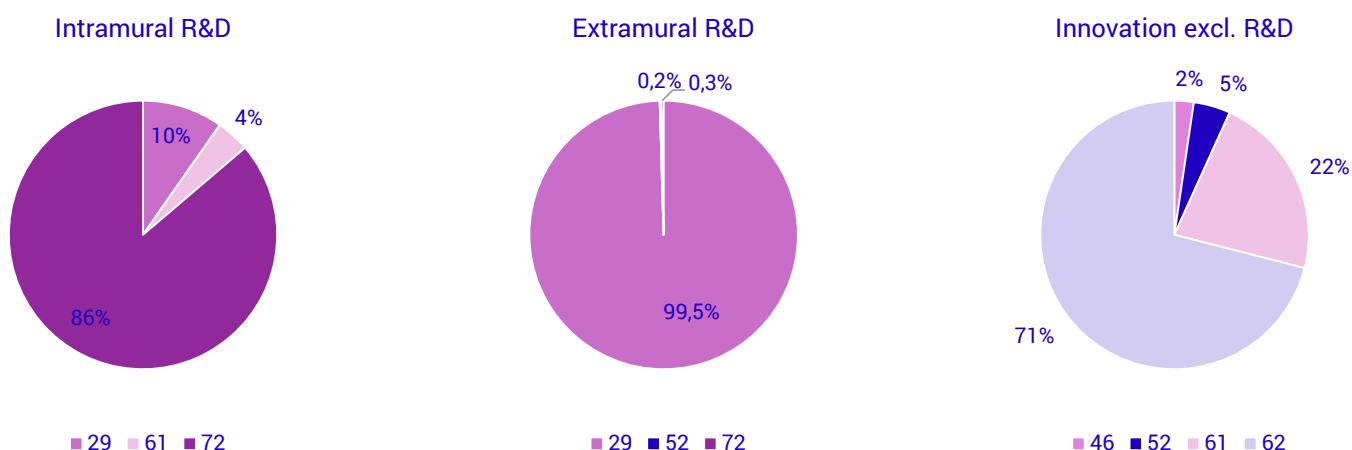**Figure 10. The distribution of consolidated expenditure for case three per NACE and type of expenditure, 2022.**

Intramural R&D

Extramural R&D

Innovation excl. R&D

Case 3 illustrates the problem described adjacent to table 2, regarding intra-group flows. The representative unit is active in NACE 29, which is also the primary economic activity for the enterprise. The representative is also the head unit of the group. From previous information we know that this unit only has extramural R&D. The recipient of these extramural R&D funds is the main R&D performer in the group, a unit in NACE 72. The extramural R&D expenditure that the representative unit reports are reported as intramural R&D expenditures within the R&D performer in NACE 72. In this case, consolidation will, all else equal, result in double counting. Since the extramural R&D expenditures are directed to another unit within the group where they are spent, these expenditures should be removed in the reporting in favor of the corresponding intramural R&D expenditures. For this enterprise group we have information about the intra-group relations, which makes this possible. However, this information is not available for a majority of complex enterprises.

Small complex enterprises: case studies

The cases above only represent the top 14 percent of the population of complex enterprises regarding number of LEUs. 66.8 percent of the complex enterprise population in CIS2022 consisted of 5 or fewer legal units. To give a general example of the effect of consolidation versus the representative approach on data, we look at four randomly selected cases of different complexity, ranging from two to five LEUs. As for the cases described earlier, these enterprises had more innovation activities when using consolidation. This is especially relevant for Case 2 and 3, with three and four LEUs respectively.

Table 3. Results on main indicators for cases when applying different methods.
1 = Yes, 0 = No. All expenditure in thousand Euro.

|	Cases							
	Case 1		Case 2		Case 3		Case 4	
Methods	Representative	Consolidation	Representative	Consolidation	Representative	Consolidation	Representative	Consolidation
Complexity (number of LEU in SUE)	**1**	**2**	**1**	**3**	**1**	**4**	**1**	**5**
Variables								
Product innovation	1	1	0	1	0	1	1	1
Business process innovation	1	1	0	1	0	1	1	1
Intramural R&D	1	1	1	1	0	1	1	1
Extramural R&D	1	1	1	1	0	0	1	1
Innovation expenditure excl. R&D	565	606	14	183	.	517	2 446	3 135
Intramural R&D expenditure	188	188	14	108	.	47	2 745	3 253
Extramural R&D expenditure	47	47	7	54	.	.	376	470
Total innovation expenditure including R&D	800	841	35	345	.	564	5 567	6 858

Exchange rate for Swedish krona, 10.6296. From CIS2022 Eurostat dissemination.
. = data not available

Using consolidation captures more expenditure. For Case 2 the expenditures increased with 1 200 percent for innovation and approximately 670 percent for R&D. The overall problem with expenditure from outside the NACE of the enterprise, which was present in large complex enterprises, is not as common for smaller complex enterprises. In smaller complex enterprises many legal units are in the same NACE code.

Comparing the two cases used as examples for large complex enterprises with Case 4 in this section, the majority of the total innovation expenditure including R&D came from NACE 28 (manufacture of machinery and equipment), which was the NACE code of the enterprise. The enterprise consisted of legal units in NACE 46 and 27 (manufacture of electrical equipment) as well. The distribution of total expenditure (innovation including R&D) for this case shows that 14 percent came from outside the NACE activity for the SUE.

Figure 11. The distribution of consolidated total innovation expenditure including R&D per NACE for Case 4, 2022.
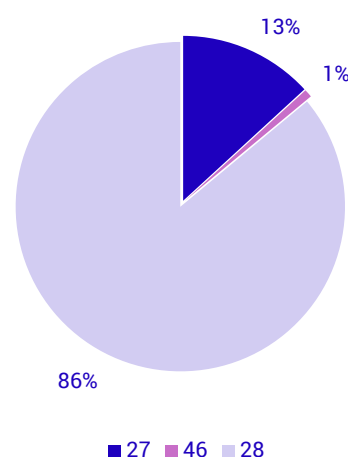
Interpreting the data

The impending question is: What can we say with the data? The purpose of implementing the EEC regulation no 696/93 of 1993 on the statistical unit is to have a consistent classification across all statistical institutions and products. However, the way the SUE was implemented and how it is treated in the data processing is different across countries. Therefore, we still have problems with inconsistent comparisons across nations.

The aim of the CIS is to describe the innovation activity in the business enterprise sector of the specific country. The questionnaire contains sections regarding the characteristics of the firm, their situation on the market, what kind of activities they have, the prerequisites of those

activities, how they conduct the activities, and the effect of them. NACE is used as a proxy to describe the research and innovation activities of the enterprise, and the survey is constructed to follow that process. By consolidating it is not possible to distinguish the process since, as presented earlier, activities and expenditure reported for the consolidated enterprise is a combination of multiple LEUs from different NACE activities.

Although, the representative approach isolates the innovation process of the main legal unit from other units, possibly active in other NACE or size classes, there is a risk of losing information regarding expenditures, particularly R&D expenditure. The representative unit is chosen on criteria that do not consider R&D or innovation activities. This excludes some important innovation active firms and leads to a loss of information on R&D expenditure. Since data from the CIS is used for estimations in the R&D survey for even reference years, this can cause issues in the comparability over time series. For this reason, Statistics Sweden has looked at combining the methods.

Combined methods

In order to minimise the loss of information regarding R&D activities and expenditure, Statistics Sweden has decided to include all of the R&D active LEUs in the sampled population for the 2024 wave of the CIS. In the CIS EBS manual (2024), if it is not possible for one legal unit to produce data for the entire enterprise, the recommendations are that both the producing unit and the R&D unit should be included in the sample. Data for these units should be aggregated to the level of the enterprise, if the enterprise consists of more than one producing unit, or a unit which conducts R&D activities[5]. In the Swedish perspective this is interpreted as including the representative unit as well as the R&D unit identified within the complex enterprise in the sample. For this analysis of CIS2022 data, intra-group flows have not been accounted for.

Looking at some of the same qualitative indicators as in the first section of the analysis, with the combined method (representative and consolidation), the results are not significantly different from those when applying the representative approach. Total innovation activity is approximately the same for all the three methods applied. For the population of large enterprises there were a more substantial difference between the three methods. The pattern was the same for the qualitative R&D variables.
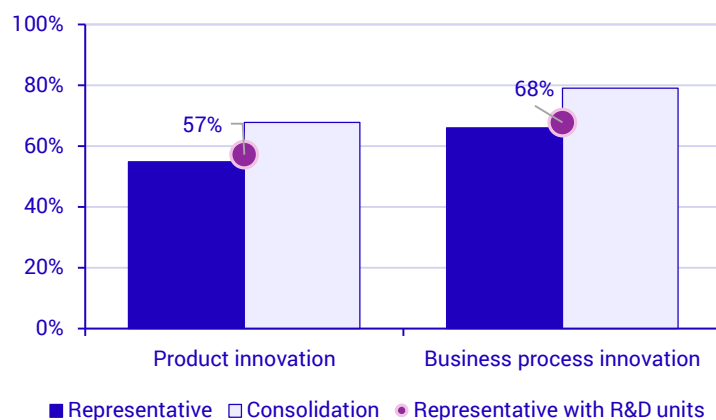

[5] EBS CIS Manual (2024) Eurostat. P.105.

Figure 12. The share of innovation active enterprises per method, 2020-2022.

Legend: ■ Representative □ Consolidation ● Representative with R&D units
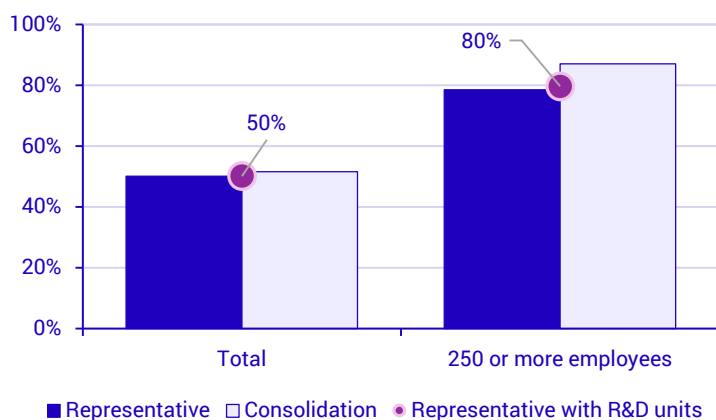
Figure 13. The share of product innovative and business process innovative enterprises, per method, 2020-2022.

Legend: ■ Representative □ Consolidation ● Representative with R&D units

Figure 14. The share of enterprises with intramural and extramural R&D respectively, per method, 2020-2022.

Legend: ■ Representative □ Consolidation ● Representative with R&D units
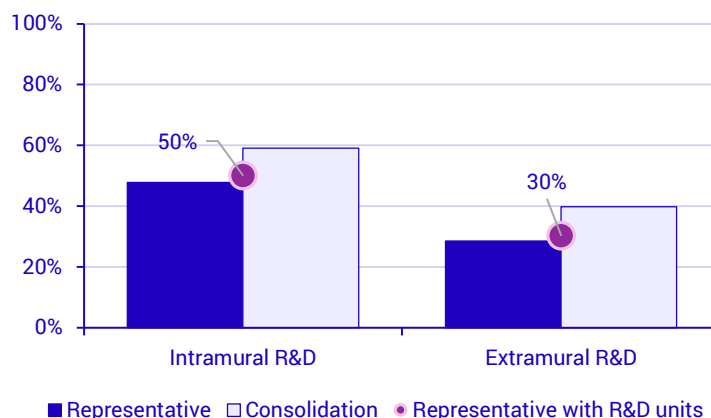
For the 2022 wave of the CIS the representative approach excluded 15 percent of the identified R&D units[6]. In relation to the total amount of R&D expenditures (intramural and extramural) for the representative units, the expenditures for the excluded R&D units were one twelfth of the total. When consolidating the R&D expenditures, the excluded R&D units from the CIS2022 accounted for 7 percent.

The unweighted intramural R&D expenditures were 15.2 percent higher when using consolidation compared to the representative approach. When including the R&D units in the estimations the unweighted total result came closer to that of the consolidated data, with a 12,5 percent

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[6] R&D units identified through the survey R&D in the business enterprise sector 2021.

increase from the representative approach and approximately 2 percent lower than when applying consolidation. The most interesting outcome of this exercise regards small enterprises, where consolidation increased the intramural R&D expenditure with 31.4 percent. When including R&D units with the representatives, the expenditure increases with 8.2 percent, which is significantly less than with consolidation. There are many possible reasons for this. One explaining factor could be that for the small complex enterprises, there are not many identified R&D performers in background data, which results in only the representative being included in the computation even when identified R&D units are included.

For the 2021 survey round of the R&D survey in the business enterprise sector, where the R&D units are identified, the SUE was not yet implemented in the Business Register, therefore the populations for R&D 2021 were different than that of the CIS2022. For the 2023 survey round of R&D in the business enterprise sector, changes were made to the survey design and it is now conducted as a census (includes all R&D enterprises). The coverage of R&D units for CIS2024 might therefore be better than CIS2022, increasing the probability of capturing more of the R&D expenditure.

Table 4. The percentual difference between the representative approach and other methods for unweighted intramural R&D expenditure, per size class, 2022.
Base: Representative approach

Size class	Consolidation	Representative with R&D units
Small (10−49)	+31.4%	+8.2%
Medium (50−249)	+4.4%	+1.6%
Large (250+)	+15.5%	+14.0%
Total	+15.2%	+12.5%

Concluding remarks

Sweden decided to implement the representative approach in the Community Innovation Survey 2020-2022 to facilitate the different needs that simultaneously arose when the statistical unit enterprise was implemented. The choice was made based on recommendations in the CIS EBS manual, consideration to the aim of the survey and national legal restrictions. Although the method comes with limitations, it was deemed that this method would be the most suitable solution given the situation.

This analysis indicates that there are advantages to both consolidation and the representative approach. The representative approach fulfils the purpose of capturing the innovation process. For indicators such as the innovation profiles, which categorise enterprises based on

innovation activities and capabilities, this is important. However, consolidation fulfils another purpose with the survey, capturing the innovation activities and the related expenditure within complex enterprises. The representative unit is chosen on criteria that does not consider innovation or R&D activities, which leads to a loss of information. Although there are advantages of consolidation, it can lead to false conclusions from computed statistics, especially viewed in relation to size class and NACE activity.

The representative unit is the dominating legal unit in a complex enterprise. This unit usually has the same NACE activity as the enterprise, the most employees and/or the most turnover of all legal units. Although this unit is perceived as the one whose answers can represent the enterprise these are not always the innovation or R&D active units. Considering this, neither consolidation nor the representative approach perfectly describes the reality of activities in the business enterprise sector. Data on R&D expenditures are also used to estimate even year intramural R&D expenditure in the R&D survey for the business enterprise sector. Using the representative approach with consolidation of R&D units is a compromise between capturing a cohesive innovation process and a complete picture of all innovation and R&D expenditure, ensuring quality and by extension being able to describe the innovation process, while also maintaining quality in the data on R&D expenditure. This, in turn, has to be evaluated and problems concerning intra-group flows have to be considered in order to avoid overestimating expenditure.

Considering other effects of implementing a representative approach, it is a cost-efficient alternative. All things equal, the representative approach entailed a decrease in respondents by approximately 3 500 legal units while still maintaining the same number of enterprises in the sample. This both reduces the cost for the national statistical institute (NSI) and the response burden. If the NSI wishes, they can extend the frame population in regard to size class and/or NACE without sampling more legal units than would have been the case with consolidation.

With the representative approach including R&D units the sample increases with a few hundred units from the approach with only a representative (173 in the case of CIS2022). With this method we capture more expenditure and innovation activities that would be lost with the representative approach while still reducing costs and lowering response burden compared to consolidation.

Information about the survey

The Community Innovation survey (CIS) is an EU regulated survey about firm level innovation. The questionnaire follows a Harmonised data collection questionnaire constructed by Eurostat together with member states. The survey is conducted every other year and has a three year reference period. Metadata, quantitative variables and some qualitative variables only refers to the last year of the reference period.

Metadata and quality description for the CIS2022 is available at Eurostat [Community innovation survey 2022 (CIS2022) (inn_cis13)](#). Swedish quality and production reports are available at Statistics Sweden under the headline 'Dokumentation' [Innovation i företagssektorn](#).

Statistics Sweden is responsible for conducting the survey and publishing results. More information can be found on [Community Innovation Survey](#)

Data is also published at Eurostat [Database - Science, technology, and innovation - Eurostat](#)

Results for CIS2024 is published 2025-11-13 at Statistics Sweden.

List of terms

Innovation activities Innovation activities include all developmental, financial, and commercial activities undertaken by a firm that are **intended to result in an innovation** for the firm. Innovation activities can be ongoing, abandoned, suspended, or completed. An innovation activity can therefore be an activity that has not, yet, or ever, resulted in a new or significantly improved product or process, even if it was the purpose of the activity.

The Oslo Manual defines eight types of activities that firms can undertake with the intention of introducing an innovation:

- Research and development (R&D)
- Engineering, design, and other creative work activities
- Marketing and brand equity activities
- IP-related activities
- Employee training activities
- Software development and database activities
- Activities related to the acquisition or lease of tangible assets
- Innovation management activities

Innovation Innovation is a new or significantly improved product (good or service), process, or combination thereof, that **differs significantly** from the firm's previous products or processes and that has been **made available to potential users or brought into use** by the firm.

Product innovation A product innovation is a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced to potential users.

Business process innovation A business process innovation is a new or improved business process for one or more business functions that differs significantly from the firm's previous business processes

and that has been brought into use by the firm.

Research and development (R&D)

Research and development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge and to devise new applications of available knowledge.

Intramural R&D

Intramural R&D is R&D activities carried out in Sweden by the firm's own personnel, or by consultants in an R&D project led by the firm, where the firm's personnel have worked together with consultants. R&D performed for another party (contract research) is considered intramural R&D.

Extramural R&D

Extramural R&D is R&D activities that the firm has commissioned others to carry out as well as support for R&D that the firm has provided to others, for example grants to universities and colleges.

References

CIS2022 Community Innovation Survey

EEC regulation no 696/93 of 15 March 1993 on the statistical units for the observation and analysis of the production system in the community

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Annex

Annex 1. Criteria for choosing a representative unit

The criterion for choosing a representative unit follows the recommendations laid out in the CIS EBS Manual (2024) . For each enterprise in the sample, a representative legal unit is selected based on the following criteria:

i.   The legal unit with the NACE code closest to that of the enterprise
ii.   The legal unit with the largest number of employees or self-employed persons
iii.   The legal unit with the largest turnover

The criteria are hierarchical, only if a definitive selection cannot be made based on the first criterion does the second come into effect and so on.

Annex 2. Aggregation rules

The aggregation rules for consolidation follows the recommendations laid out in the CIS EBS Manual (2024). They are listed below:

- Expenditure: sum of expenditure of all units excluding double counting through exclusion of intra-group flows.
- Share of turnover from product innovation: average weighted share of all units, using turnover for each unit as weight.
- Binary variables (yes/no): if one observed unit has a positive answer (yes) then the enterprise receives a positive answer (yes).
- Categorical variables (likert scale): if more than two observed units the mode is used, otherwise the highest value among observed units.
- Nominal variables (without inherent order): representative units answer applies

For nominal variables exceptions are made for variables regarding equity and debt funding, where a constructed order is assumed. If at least one unit has received funding, the enterprise has received funding. If no unit has received funding but at least one has applied for funding, the enterprise has applied for funding. If none of the above apply, the enterprise has not applied for funding.