



MAIN REVISION OF R&D STATISTICS

EXPLANATORY NOTE

TurkStat Directorate of Sectoral Statistics

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Abbreviations

R&D: Research and experimental development

TurkStat: Turkish Statistical Institute

OECD: Organisation for Economic Co-operation and Development

Eurostat: European Union Statistical Office

TUBITAK: The Scientific and Technological Research Council of Türkiye

KOSGEB: Small and Medium Enterprises Development Organization

TTGV: Turkish Technology Development Foundation.

KAYSIS: Electronic Public Information Management System

SRC: Scientific Research Projects

FTE: Full Time Equivalent

Introduction

Research and experimental development (R&D) statistics are considered one of the key elements for the economic development goals of countries. These statistics have been regularly produced annually by the Turkish Statistical Institute (TurkStat) since 1990. Within the scope of the research, all R&D activities carried out in the reference period within the borders of Türkiye. R&D expenditure and source of funds, the field of R&D activities, prioritized socio-economic objectives, human resources, and its qualifications, etc. are compiled.

Studies on R&D statistics are performed following the international methodology according to the Frascati Manual prepared by the Organization for Economic Cooperation and Development (OECD).

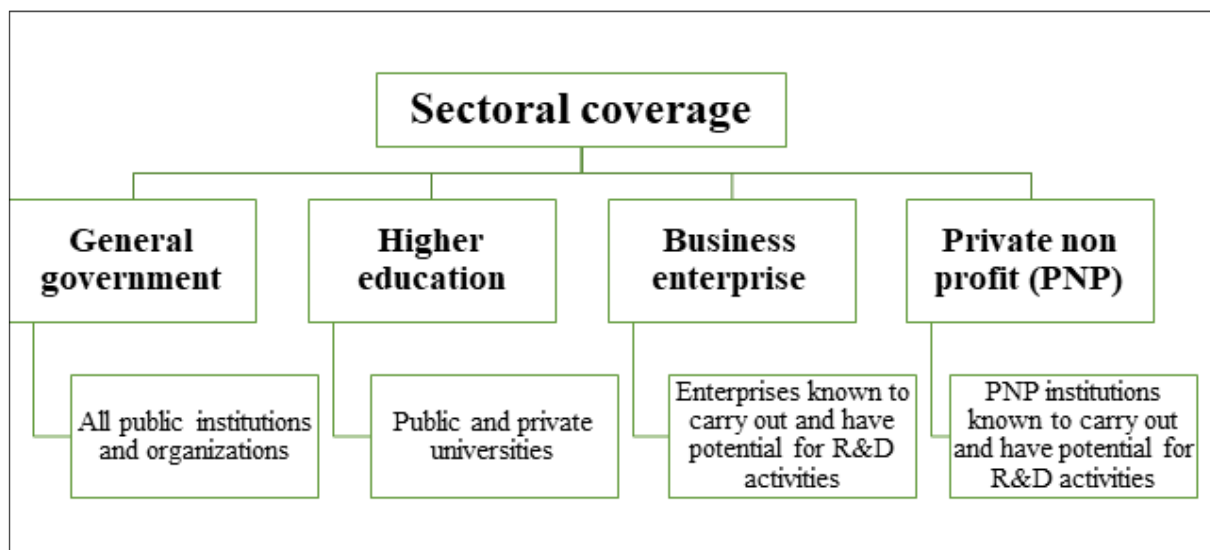
Countries use the definitions and recommendations in this manual in their science and technology policies, regulations, and the legal basis. Through the manual, a common language is formed in the development of statistics in other fields and the discussion in the field of science, technology, and information society. Development areas in measurement are discussed by experts from OECD, European Union Statistical Office (Eurostat), and other international organizations, and guidelines are developed in line with the good practices presented. These developments are also followed by our institution and integrated into the national statistical system.

In our country, support for R&D activities has increased in recent years, and university-industry collaborations have been institutionalized. The traditional approach has started to fall short in analyzing the complex fund flows with the increase in new administrative registry data. Therefore, the current calculation method has been revised and the method has been changed in the light of current data. Under the new calculation method, the available data were revised until 2015.

Part 1. Current status before revision

Currently, data are compiled from four national sectors. The sectors covered, statistical units, and data collection methods are given in Figure 1.

Figure 1 Compilation of R&D sectors



1.1 Business enterprise sector

The sectoral coverage is on the basis of the assumption of the census over the statistical units known to be involved in all R&D activities and the records that are likely to engage in R&D activities within certain criteria.

- Enterprises known to carry out R&D activities (based on previous research results),
- Enterprises supported by The Scientific and Technological Research Council of Türkiye (TUBITAK) in R&D activities in the reference year,
- Enterprises cooperated with TUBITAK in R&D and innovation activities,
- Enterprises supported by Small and Medium Enterprises Development Organization (KOSGEB) in the reference year,
- Enterprises in R&D centers and Technology development zones,
- Turkish Patent and Trademark Office database,
- Enterprises benefiting from indirect R&D supports under Law No. 5746,
- Administrative records of Revenue Administration,
- Enterprises included in the framework within the scope of Biotechnology and Innovation surveys,
- Enterprises applied for the R&D support of Turkish Technology Development Foundation (TTGV).

The data are compiled by the enterprises via an electronic questionnaire. Administrative records are used for control purposes during field studies.

1.2 General government sector and private non profit institutions

According to the Frascati Manual, all public institutions should be included. However, applying the questionnaire to all units of local governments is practically inefficient. Non-profit institutions are compiled with a questionnaire in accordance with the manual and the results are shared under the general government sector figures.

- All public institutions compiled from (KAYSIS) Electronic Public Information Management System (including institutes and laboratories),
- All research hospitals under the government control,
- All metropolitan and central municipalities,
- All district municipalities with 200 thousand inhabitants or more,
- All the foundations that have R&D expenditures in balance sheet basis,
- Associations that have R&D expenditures in intangible assets and education or research field.

The data are compiled by the authorities of the relevant institutions and organizations via an electronic questionnaire. Administrative records are used for control purposes during field studies.

1.3 Higher education sector

All public and private universities are in the scope. Different approaches are used in the calculations for this sector.

Researchers

R&D personnel expenditure derives from the number of researchers, time allocated to R&D (full-time equivalent, FTE), and gross salary according to the formula below. The FTE coefficient is based on the results of the time-use survey.

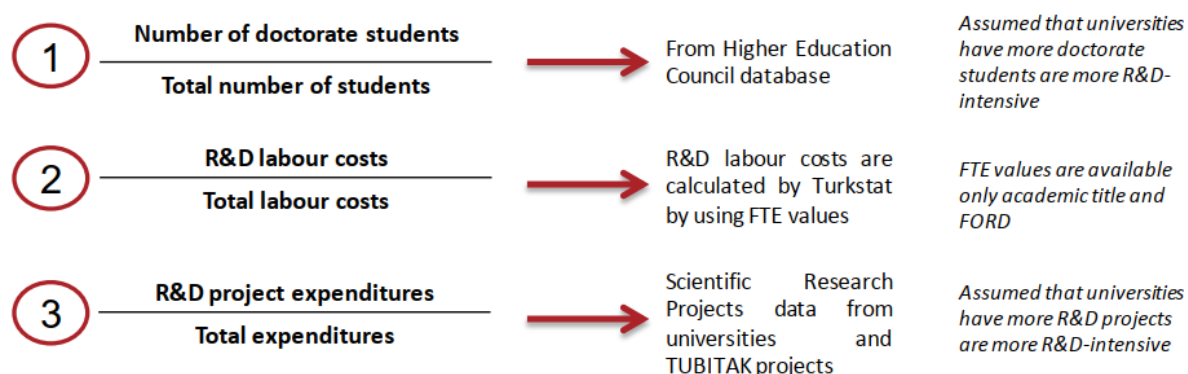
Figure 2 Researcher expenditure calculation formula



Technicians and other supporting staff

It is not possible to find a solution based on administrative records to determine the number of technicians, equivalent personnel, and other support personnel. For this reason, the information of this personnel is requested from all universities with a questionnaire. On the other hand, since the answers do not provide a complete representation of all universities, a composite indicator set is created by using the coefficients given below.

Figure 3 Indicators used for composite coefficient



Other current costs and capital expenditures

Other current costs and capital expenditures in private universities are compiled through a questionnaire due to the inadequacy of the available data.

Although the own fund and budget data in public universities are treated in accordance with the economic and functional classification in the general budget, they cannot be used directly. The reasons for this are listed below:

- R&D share of expenditures for salary, premium, allowances, etc. paid to academicians is not included in the budget data.
- Only expenditures for Scientific Research Projects (SRC) and laboratories are taken part in R&D budget functions.
- It is not possible to calculate the R&D content of machinery and equipment and land and buildings by using budget data since R&D activities cannot be fully separated and recorded in the budget.
- University-industry collaborations, TÜBİTAK, etc., have a considerable part in the R&D studies of universities. Project revenues are kept in a separate account.

The main subjects do not make it possible to use only budget figures in the higher education sector. In line with the recommendation of the Frascati Manual, these figures are calculated by model estimation compiled with international methodology.

In addition to the projects supported by TÜBİTAK, the projects that can be traced in the administrative records are compiled. Apart from this, project expenditures are requested from universities with a questionnaire.

Part 2. Revision

Revision studies were carried out in business enterprises and the higher education sectors. The changes made are summarized below.

2.1 Business enterprise sector

Despite the recommendation of the Frascati Manual, some indicators related to other current costs in this sector could not be calculated due to the lack of data in previous years. The works carried out in this regard with the revision are summarized below.

Rents for facilities: Some areas or facilities such as research centers, technology development zones, etc. are allocated by the government to the private sector free of charge or below the market value. Rental fees related to this are generally not accounted for by firms' books. In the manual, it is recommended to include expenditure data for all R&D-related fees and rents.

The allocated land and building information has been obtained from Republic of Turkey Ministry of Industry and Technology. However, it was not sufficient for a realistic rental price. As a result, it would be more sensible to compile it through both administrative records and by questionnaire for upcoming periods.

Administrative and other overhead costs: R&D share of administrative and other overhead costs (e.g. security, cleaning, storage, repair, maintenance of buildings and equipment, IT services) could not be accounted for by firms. The manual emphasizes that it should be prorated and included.

The diversity and reliability of data sources are important for a comparable estimation. Information on these expenditures, which could not be included before, was estimated for the business enterprise sector with the revision process.

2.2. Higher education sector

FTE coefficient: Frascati Manual recommends that the distinction between R&D and other activities in the higher education sector should be identified by time use survey. Allocated time for R&D activities by the personnel is obtained by this survey.

“Time Use Survey for Researchers in Higher Education Sector” was last carried out in 2014. Along with the revision studies, the research was performed between October 2022 and January 2023.

Researchers

Theoretically, the salary paid to the R&D personnel is directly related to the time allocated to R&D activities in the reference year and the wage at this rate. For this reason, the basic principle remained the same, but it was necessary to revise the variables that would be input into the R&D personnel expenditure for more accurate measurement:

Figure 4 Revised researcher expenditure calculation formula

$$\text{Personnel Expenditure} = \frac{\text{Gross salary paid to academician on payroll}}{\text{Gross salary paid to total personnel on payroll}} \times \text{Central government budget personnel expenditure} \times \text{FTE}$$

The annual gross salary for academicians was analyzed at the micro level, based on the declarations to the Social Security Institution and the payroll data obtained from the Directorate General of Public Accounts. Researcher R&D personnel expenditures have been updated in accordance with the formula mentioned above over updated data.

Technicians and other supporting staff

In the concept of R&D activities, there is no administrative record for technicians and equivalent personnel and other supporting staff at universities. In addition, there is no information about how many of these personnel carry out R&D activities. Therefore, the calculations were continued with the current method.

R&D estimation of other current expenditures

Frascati Manual and the OECD state that other current R&D expenditures have a direct correlation with the time devoted to R&D. Therefore, a similar method used for the calculation of R&D personnel expenditure is also utilized for other current R&D expenditures.

For public universities, the budget and own funds of each university are divided into expenditure groups according to economic classification. Other current R&D expenditure figures were estimated according to the formula below by multiplying the FTE coefficients over these decomposed figures.

Figure 5 Revised other current expenditure calculation formula

Estimation of other current R&D expenditures based on the budget data of public universities:

$$\text{Other current expenditure} = \text{FTE} \times \text{Other current expenditures excluding personnel in central government budget}$$

Estimation of other current R&D expenditures based on the own fund data of public universities:

$$\text{Other current expenditure} = \text{FTE} \times \text{Other current expenditures excluding personnel in own funds}$$

Estimation of other current R&D expenditures over the total expenditure of private universities:

$$\text{Other current expenditure} = \text{FTE} \times \text{Other current expenditures excluding personnel in university budget}$$

R&D estimation of capital expenditures

According to Frascati Manual and the OECD recommendations, R&D estimation of capital expenditures should be requested from relevant statistical unit. This method has some drawbacks: The respondent is expected to have some parameters and sufficient knowledge about R&D for an accurate estimation. In addition, past experiences indicated that proper results can not be obtained from universities. Consequently, the method will lead to an underestimation of the R&D share of investment expenditures.

Following the revision, in order to determine the R&D content of capital expenditures, budget and own fund data were separated to expenditure groups. Coefficients were obtained over the level of importance given by universities to R&D. By using these coefficients, budget, own funds, and R&D capital expenditures were estimated. A similar method was performed by using annual total expenditures of private universities.

Figure 6 Revised capital expenditure calculation formula

Estimation of R&D capital expenditures based on the budget data of public universities:

$$\text{Capital Expenditure} = \frac{\text{Calculated R\&D current expenditure}}{\text{Total current expenditure (Budget)}} \times \text{Capital expenditures in central government budget}$$

Estimation of R&D capital expenditures based on the own fund data of public universities:

$$\text{Capital Expenditure} = \frac{\text{Calculated R\&D current expenditure}}{\text{Total current expenditure (Own funds)}} \times \text{Capital expenditures in own funds}$$

Estimation of R&D capital expenditures over the total expenditure of private universities:

$$\text{Capital Expenditure} = \frac{\text{Calculated R\&D current expenditure}}{\text{Total current expenditure}} \times \text{Capital expenditures in university budget}$$

Universities also perform R&D activities with some projects by various source of funds other than budget and own funds. These projects which can not be obtained from administrative records, budget, and own funds, were compiled by a field study.

Retrospective revision results

Indicators given in the tables below have been revised until 2015, and reflected in the press release and statistical tables.

Table 1 Gross domestic expenditure on R&D by sector of performance, 2015-2021

Time Series Before Revision				
Years	Total	Financial and non-financial corporations	General government ⁽¹⁾	Higher education
2015	20,615,247,954	10,308,737,689	2,130,766,481	8,175,743,784
2016	24,641,251,935	13,359,011,600	2,338,372,843	8,943,867,493
2017	29,855,477,805	16,980,836,067	2,858,435,052	10,016,206,686
2018	38,533,672,884	23,289,367,294	3,559,213,870	11,685,091,720
2019	45,953,691,096	29,500,710,718	3,044,485,454	13,408,494,924
2020	54,956,827,217	35,623,334,563	3,716,726,729	15,616,765,925
2021	81,922,009,094	57,883,690,189	4,583,609,094	19,454,709,811
Time Series After Revision				
Years	Total	Financial and non-financial corporations	General government ⁽¹⁾	Higher education
2015	22,741,100,883	11,207,003,438	2,130,766,481	9,403,330,964
2016	29,411,867,411	14,580,948,519	2,338,372,843	12,492,546,049
2017	36,862,357,978	18,415,556,216	2,858,435,052	15,588,366,710
2018	47,801,863,438	25,326,867,512	3,559,213,870	18,915,782,056
2019	56,977,709,236	31,940,686,522	3,044,485,454	21,992,537,260
2020	69,038,125,507	38,505,512,999	3,716,726,729	26,815,885,779
2021	101,737,887,655	62,400,169,966	4,583,609,094	34,754,108,595
Revision Effect				
Years	Total	Financial and non-financial corporations	General government ⁽¹⁾	Higher education
2015	2,125,852,929	898,265,749	0	1,227,587,180
2016	4,770,615,475	1,221,936,919	0	3,548,678,556
2017	7,006,880,173	1,434,720,149	0	5,572,160,024
2018	9,268,190,554	2,037,500,218	0	7,230,690,336
2019	11,024,018,140	2,439,975,804	0	8,584,042,336
2020	14,081,298,290	2,882,178,436	0	11,199,119,854
2021	19,815,878,561	4,516,479,777	0	15,299,398,784
Change (%)				
Years	Total	Financial and non-financial corporations	General government ⁽¹⁾	Higher education
2015	10.3	8.7	0.0	15.0
2016	19.4	9.1	0.0	39.7
2017	23.5	8.4	0.0	55.6
2018	24.1	8.7	0.0	61.9
2019	24.0	8.3	0.0	64.0
2020	25.6	8.1	0.0	71.7
2021	24.2	7.8	0.0	78.6

(1): Including private non-profit sector.

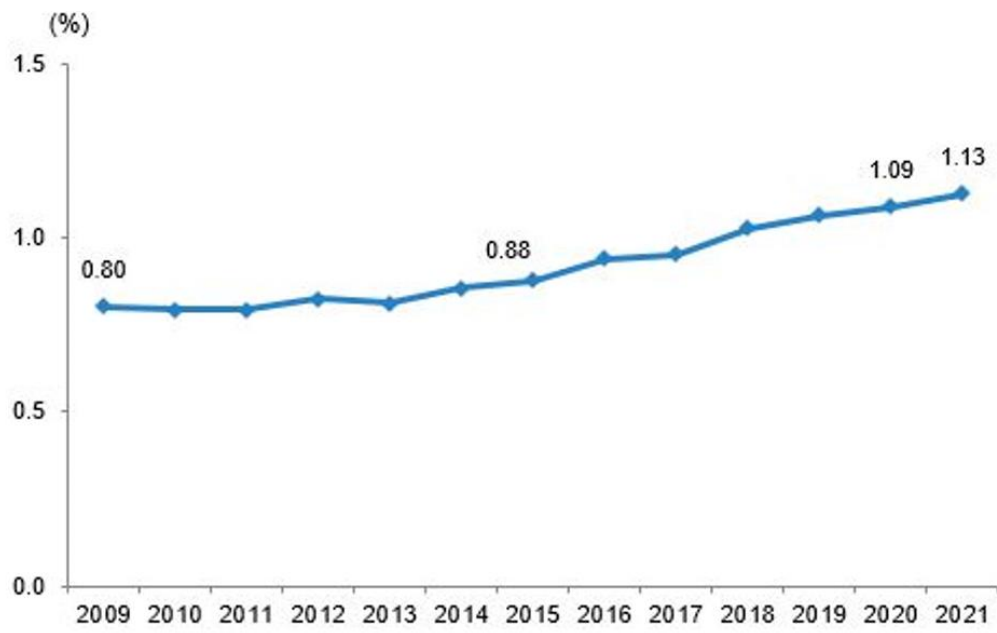
Table 2 Gross domestic expenditure on R&D by type of cost, 2015-2021

Time Series Before Revision									
Years	Total	Sub-total current cost	Labour cost	Other current cost	Sub-total capital cost	Machinery and equipment	Land and buildings	Capitalised computer software	Other intellectual property products
2015	20,615,247,954	18,265,186,873	11,054,399,404	7,210,787,469	2,350,061,081	1,710,115,251	639,945,830	-	-
2016	24,641,251,935	21,878,093,737	12,308,650,274	9,569,443,464	2,763,158,198	1,694,634,883	788,016,948	194,557,464	85,948,902
2017	29,855,477,805	26,753,688,698	15,167,428,953	11,586,259,745	3,101,789,107	2,060,835,956	710,743,816	211,508,597	118,700,737
2018	38,533,672,884	34,120,471,099	18,905,226,170	15,215,244,929	4,413,201,785	2,676,414,612	1,218,563,138	416,429,325	101,794,710
2019	45,953,691,096	41,964,120,165	23,692,709,953	18,271,410,212	3,989,570,931	2,565,036,005	936,831,267	418,180,518	69,523,141
2020	54,956,827,217	50,511,833,326	29,003,684,444	21,508,148,882	4,444,993,891	2,742,370,492	989,161,555	511,842,430	201,619,414
2021	81,922,009,094	75,188,999,732	40,563,469,213	34,625,530,519	6,733,009,362	4,198,015,151	1,326,055,050	927,031,650	281,907,511
Time Series After Revision									
Years	Total	Sub-total current cost	Labour cost	Other current cost	Sub-total capital cost	Machinery and equipment	Land and buildings	Capitalised computer software	Other intellectual property products
2015	22,741,100,883	19,560,391,333	10,363,482,407	9,196,908,926	3,180,709,550	1,740,152,504	1,440,557,046	-	-
2016	29,411,867,411	25,985,819,500	13,445,243,527	12,540,575,973	3,426,047,911	1,650,103,181	1,496,665,516	191,358,252	87,920,962
2017	36,862,357,978	32,630,907,304	16,959,598,260	15,671,309,044	4,231,450,674	2,028,507,162	1,876,628,904	199,922,710	126,391,898
2018	47,801,863,438	42,530,024,783	21,987,579,894	20,542,444,889	5,271,838,655	2,588,164,011	2,169,907,525	409,842,042	103,925,077
2019	56,977,709,236	51,904,893,308	27,853,941,141	24,050,952,167	5,072,815,928	2,661,776,244	1,903,507,109	433,215,045	74,317,530
2020	69,038,125,507	63,327,411,261	35,310,934,960	28,016,476,301	5,710,714,246	2,870,141,941	2,099,386,951	537,314,054	203,871,300
2021	101,737,887,655	93,567,341,485	49,720,281,156	43,847,060,329	8,170,546,170	4,352,516,711	2,554,122,808	969,691,536	294,215,115
Revision Effect									
Years	Total	Sub-total current cost	Labour cost	Other current cost	Sub-total capital cost	Machinery and equipment	Land and buildings	Capitalised computer software	Other intellectual property products
2015	2,125,852,929	1,295,204,460	-690,916,997	1,986,121,457	830,648,469	30,037,253	800,611,216	-	-
2016	4,770,615,475	4,107,725,762	1,136,593,253	2,971,132,509	662,889,713	-44,531,702	708,648,568	-3,199,212	1,972,060
2017	7,006,880,173	5,877,218,606	1,792,169,307	4,085,049,299	1,129,661,567	-32,328,794	1,165,885,088	-11,585,887	7,691,161
2018	9,268,190,554	8,409,553,684	3,082,353,724	5,327,199,960	858,636,870	-88,250,601	951,344,387	-6,587,283	2,130,367
2019	11,024,018,140	9,940,773,143	4,161,231,188	5,779,541,955	1,083,244,997	96,740,239	966,675,842	15,034,527	4,794,389
2020	14,081,298,290	12,815,577,935	6,307,250,516	6,508,327,419	1,265,720,355	127,771,449	1,110,225,396	25,471,624	2,251,886
2021	19,815,878,561	18,378,341,753	9,156,811,943	9,221,529,810	1,437,536,808	154,501,560	1,228,067,758	42,659,886	12,307,604
Change (%)									
Years	Total	Sub-total current cost	Labour cost	Other current cost	Sub-total capital cost	Machinery and equipment	Land and buildings	Capitalised computer software	Other intellectual property products
2015	10.3	7.1	-6.3	27.5	35.3	1.8	125.1	-	-
2016	19.4	18.8	9.2	31.0	24.0	-2.6	89.9	-1.6	2.3
2017	23.5	22.0	11.8	35.3	36.4	-1.6	164.0	-5.5	6.5
2018	24.1	24.6	16.3	35.0	19.5	-3.3	78.1	-1.6	2.1
2019	24.0	23.7	17.6	31.6	27.2	3.8	103.2	3.6	6.9
2020	25.6	25.4	21.7	30.3	28.5	4.7	112.2	5.0	1.1
2021	24.2	24.4	22.6	26.6	21.4	3.7	92.6	4.6	4.4

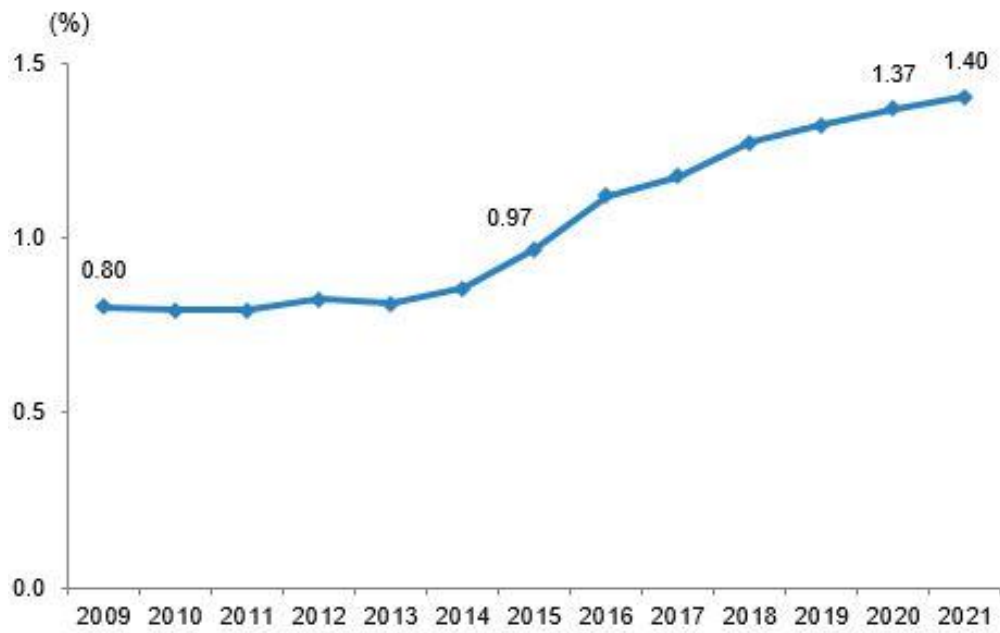
Table 3 Gross domestic expenditure on R&D by source of funds, 2015-2021

Time Series Before Revision							
Years	Total	Sub-total national funds	Financial and non-financial corporations	General government	Higher education	Other national funds	Funds from abroad
2015	20,615,247,954	20,219,110,093	9,188,570,773	7,930,039,633	3,092,930,233	7,569,453	396,137,861
2016	24,641,251,935	23,740,061,638	11,504,500,084	8,654,388,362	3,551,059,792	30,113,400	901,190,298
2017	29,855,477,805	28,815,586,995	14,763,008,904	10,033,407,187	3,977,868,612	41,302,292	1,039,890,810
2018	38,533,672,884	37,768,930,062	20,655,000,973	12,436,955,150	4,666,844,558	10,129,381	764,742,822
2019	45,953,691,096	45,260,392,722	25,892,369,788	13,487,889,484	5,871,576,527	8,556,923	693,298,374
2020	54,956,827,217	53,860,543,326	31,459,216,579	15,606,346,677	6,752,305,912	42,674,158	1,096,283,891
2021	81,922,009,094	80,377,148,265	51,136,108,165	20,540,196,421	8,668,401,550	32,442,129	1,544,860,829
Time Series After Revision							
Years	Total	Sub-total national funds	Financial and non-financial corporations	General government	Higher education	Other national funds	Funds from abroad
2015	22,741,100,883	22,473,430,678	10,032,141,189	8,060,960,755	4,372,811,661	7,517,073	267,670,205
2016	29,411,867,411	28,510,677,113	12,668,938,904	10,030,650,731	5,780,974,077	30,113,400	901,190,298
2017	36,862,357,978	35,822,467,168	16,126,653,427	12,102,333,391	7,552,178,058	41,302,292	1,039,890,810
2018	47,801,863,438	47,037,120,616	22,605,064,688	15,405,300,746	9,016,625,801	10,129,381	764,742,822
2019	56,977,709,236	56,284,410,862	28,246,600,442	17,561,983,128	10,467,270,369	8,556,923	693,298,374
2020	69,038,125,507	67,941,841,616	34,258,827,813	20,772,950,004	12,867,389,641	42,674,158	1,096,283,891
2021	101,737,887,655	100,193,026,826	55,525,775,879	27,931,053,186	16,703,755,632	32,442,129	1,544,860,829
Revision Effect							
Years	Total	Sub-total national funds	Financial and non-financial corporations	General government	Higher education	Other national funds	Funds from abroad
2015	2,125,852,929	2,254,320,585	843,570,416	130,921,122	1,279,881,428	-52,380	-128,467,656
2016	4,770,615,476	4,770,615,475	1,164,438,820	1,376,262,369	2,229,914,285	0	0
2017	7,006,880,173	7,006,880,173	1,363,644,523	2,068,926,204	3,574,309,446	0	0
2018	9,268,190,554	9,268,190,554	1,950,063,715	2,968,345,596	4,349,781,243	0	0
2019	11,024,018,140	11,024,018,140	2,354,230,654	4,074,093,644	4,595,693,842	0	0
2020	14,081,298,290	14,081,298,290	2,799,611,234	5,166,603,327	6,115,083,729	0	0
2021	19,815,878,561	19,815,878,561	4,389,667,714	7,390,856,765	8,035,354,082	0	0
Change (%)							
Years	Total	Sub-total national funds	Financial and non-financial corporations	General government	Higher education	Other national funds	Funds from abroad
2015	10.3	11.1	9.2	1.7	41.4	-0.7	-32.4
2016	19.4	20.1	10.1	15.9	62.8	0.0	0.0
2017	23.5	24.3	9.2	20.6	89.9	0.0	0.0
2018	24.1	24.5	9.4	23.9	93.2	0.0	0.0
2019	24.0	24.4	9.1	30.2	78.3	0.0	0.0
2020	25.6	26.1	8.9	33.1	90.6	0.0	0.0
2021	24.2	24.7	8.6	36.0	92.7	0.0	0.0

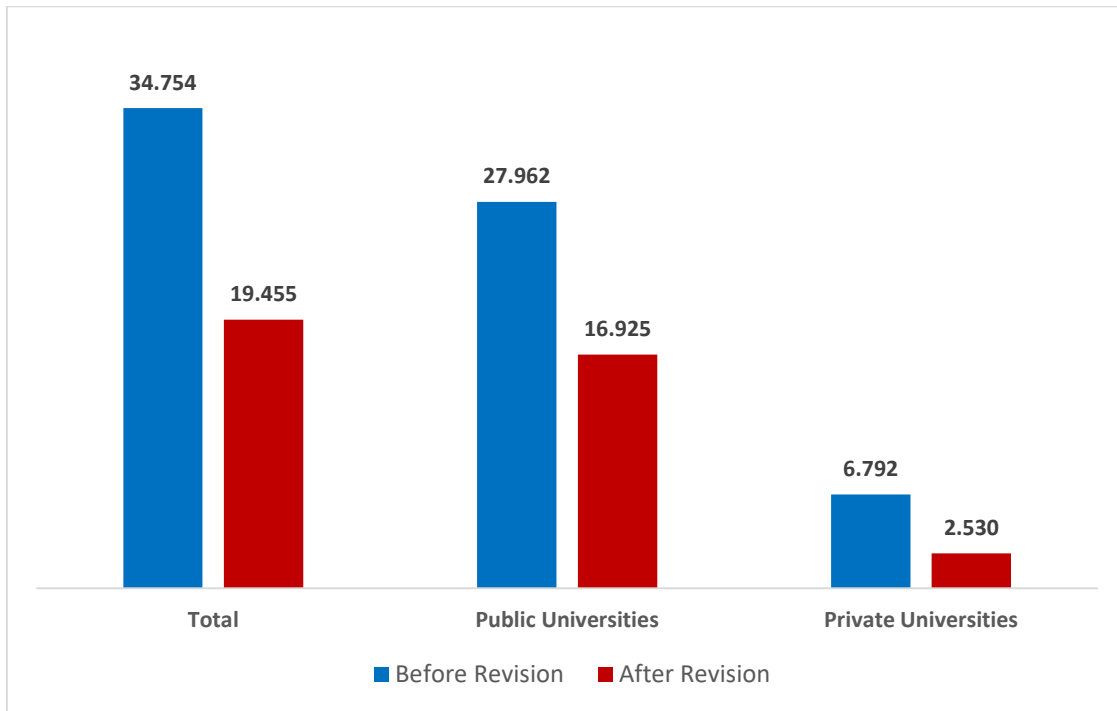
Graph 1 GERD as a percentage of GDP, 2009-2021 (before revision)



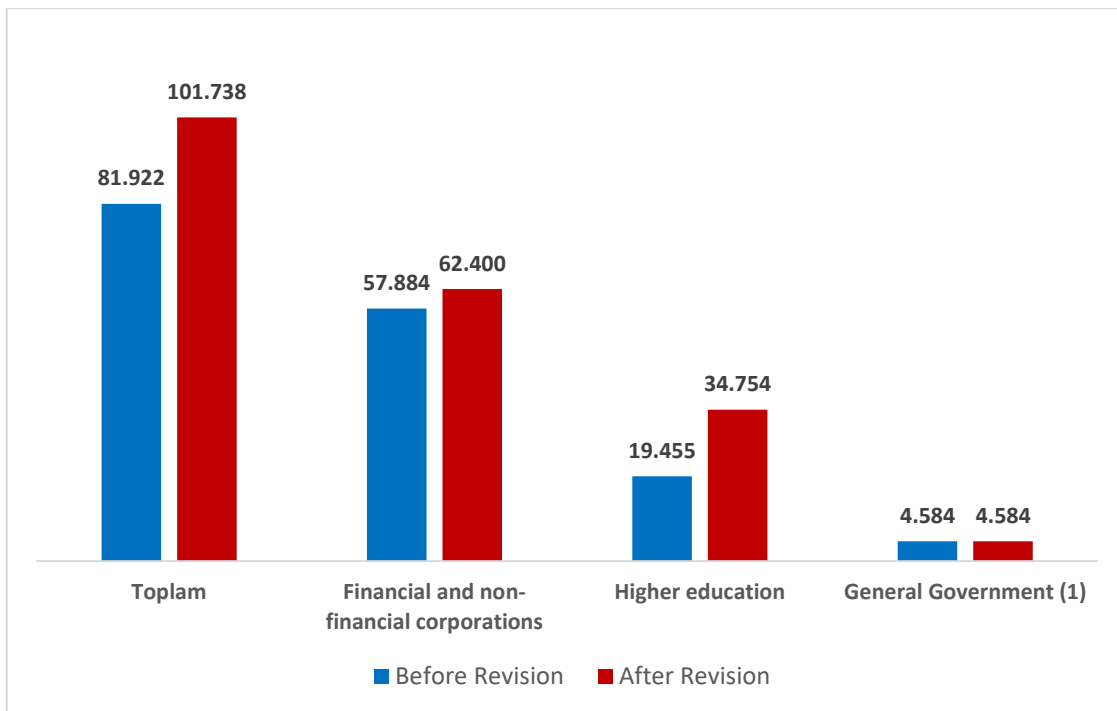
Graph 2 GERD as a percentage of GDP, 2009-2021 (after revision)



Graph 3 Distribution of R&D expenditures by university type, 2021 (Million TRY)



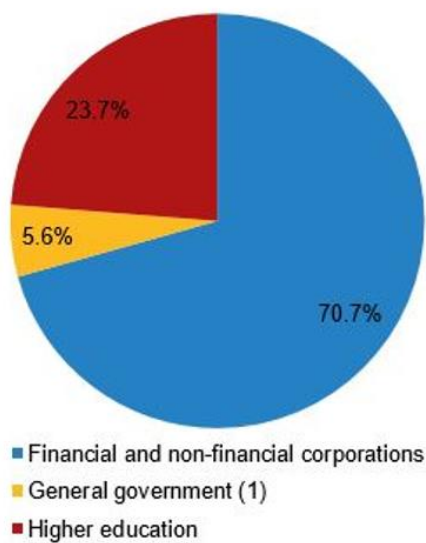
Graph 4 Distribution of R&D expenditures by sector of performance, 2021 (Million TRY)



(1): Including private non-profit sector.

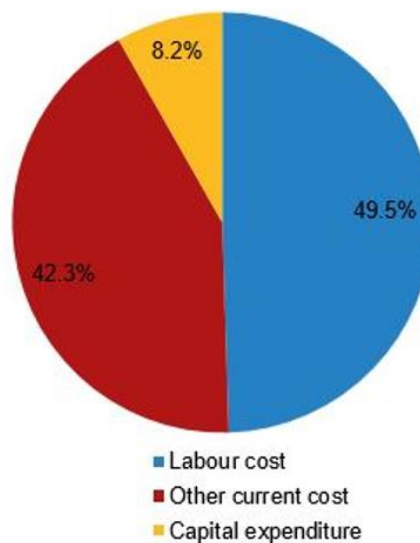
Graph 5 Distribution of R&D expenditures (before revision)

Gross domestic expenditure on R&D by sectors, 2021



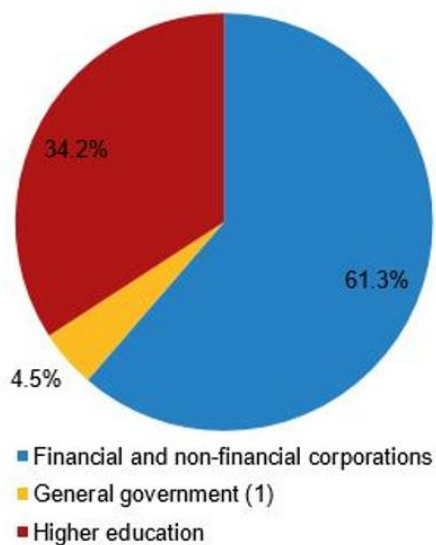
(1) Including private non-profit sector.

Gross domestic expenditure on R&D by type of cost, 2021



Graph 6 Distribution of R&D expenditures (after revision)

Gross domestic expenditure on R&D by sectors, 2021



(1) Including private non-profit sector.

Gross domestic expenditure on R&D by type of cost, 2021

