



THE IMPACT OF AND POLICIES FOR THE 2023 KAHRAMANMARAŞ EARTHQUAKE

POLICY NOTE

This policy paper examines the economic impact of the two earthquakes that occurred on February 6, 2023, in Pazarcık and Elbistan districts of Kahramanmaraş, of magnitude (Mw) 7.7 and 7.6, causing a great number of fatalities, destruction and damage in 11 provinces in the region, and recommends structural and economic recovery policies. The paper shows that the death toll and the loss of capital in the earthquake region and the cost of re-construction and rehabilitation will have significant and long-term negative impact on the Turkish economy, especially on the growth, employment, inflation, fiscal, financial, wealth and poverty dynamics. The preliminary study with the first data after the earthquake shows that the cost of the redevelopment plan of the region will reach approximately US\$150 billion throughout a 5-year period, and this cost will negatively affect Turkish public finance and financial risk indicators. In 2023, we expect economic growth to be 1.2 percentage points lower than the baseline scenario. The risks on growth may vary in a wide range depending on the post-earthquake economic policies and financial conditions, as well as the speed of the reconstruction process. This paper proposes post-earthquake economic recovery policies, taking into account the economic impact of the earthquake, sustainable development needs of the nation, and international best practices. These policies aim to carry out the post-earthquake recovery program in the most effective way, and to make Turkey, and in particular the Marmara region, sheltered against natural disasters. In order to enhance the efficiency and the effectiveness of the program, we recommend cooperation with international financial institutions.

¹https://www.tepav.org.tr/en/ekibimiz/s/1452/Burcu+Aydin+Ozudogru_+PhD

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I. INTRODUCTION

Natural disasters reduce the growth potential of countries according to the size of the disaster, and the economic and institutional structure of the region. Economic studies on the impact of natural disasters, such as earthquakes, tsunamis, floods and fires show various kinds of impact on the economy, in particular on the production, services and employment capacity of the economy. These studies show that the size and the duration of economic loss depends on the magnitude of the disaster, the loss of human capital, property, superstructure and infrastructure, the economic conditions of the country, and the quality of institutions (Hallegatte et al. 2022, Cavallo et al. 2013, DuRose 2023, Lackner 2018, Noy 2009, Toya and Skidmore 2007).

The Kahramanmaraş-centered earthquake caused a high level of fatalities, destruction and damage in a large geography covering 11 provinces. On February 6, 2023, two earthquakes with a magnitude of Mw 7.7 and 7.6, which occurred in Pazarcık and Elbistan districts of Kahramanmaraş, caused fatalities and destruction in 11 provinces in the vicinity. These provinces are Adana, Adıyaman, Diyarbakır, Elazığ, Gaziantep, Hatay, Kahramanmaraş, Kilis, Malatya, Osmaniye, and Şanlıurfa. Our estimates show that 40% of the building stock in the earthquake zone was slightly, moderately or severely damaged, or collapsed due to the earthquake.

The magnitude of the destruction caused by the earthquake, and Turkey's construction capacity and development needs indicate that the reconstruction of the region will take a 5-year period. The number of buildings that should be reconstructed is above both the annual construction capacity of the region and that of Turkey. We estimate that 650 thousand independent units, such as dwellings and nonresidential structures, are demolished or severely damaged due to the earthquake. 650 thousand independent units indicate a scale of construction that is approximately 7 times the number of residential permits granted in the earthquake zone in 2022.² It is also higher than the number of residential permits issued in the entire country in 2022. In addition to the units that have been demolished or severely damaged by the earthquake, 170 thousand units are moderately damaged, and 1.4 million units are slightly damaged. Considering the reconstruction, strengthening and repair need of the building stock that is moderately or slightly damaged due to the earthquake, and the ongoing construction necessities of the households and companies throughout the country, we anticipate that it is not possible to complete the whole reconstruction and rehabilitation of the region in one year.

We estimate that the earthquake will create a financing need of approximately US\$150 billion over a 5-year period. The biggest part of this cost is the construction, reinforcement and repair costs of the superstructure and infrastructure of the building and capital stock in the region. We estimate the cost of construction services at around US\$88 billion, and assume

² In 2022, 96 thousand residential permits were granted in the 11 provinces affected by the earthquake, and 632 thousand in the entire country.

that half of the cost will be borne by public resources.³ The second biggest expenditure item is due to the damage or loss on the capital stock such as vehicles, inventories, stocks and consumer goods. We estimate the size of this item at US\$35 billion. The third biggest expenditure item is due to the household transfers. We propose a 3-year plan to provide for the housing and living expenses of the households in the region, and to support for their work and employment opportunities. We recommend pursuing these household transfers at a decreasing rate over 3 years, in order to ensure minimum living standards in the region and to prevent extreme poverty. We estimate these household transfers at US\$24 billion.

The Kahramanmaraş-centered earthquake happened while economic growth and quality of institutions have been deteriorating, and macro-financial risks have been rising in Turkey. The earthquake occurred at a time in Turkey, when the policymakers had moved away from generally accepted best economic practices, inflation and financial risks have skyrocketed, the purchasing power of households has decreased, and poverty and income inequality have risen. The slowdown in global trade and a deterioration in the economic and political outlook of the country have already pointed out to a sub-potential growth in the economic activity and employment opportunities in 2023 and 2024. The earthquake will amplify this cyclical deviation by inducing physical and financial losses, and lower activity and employment.

We forecast the earthquake to put a drag on economic growth by 1.2 percentage points in 2023. The preliminary study with the first data after the earthquake shows that the economic growth will be around 2.9% in 2023, 1.2 percentage points (ppt) lower than the expected baseline scenario. In 2024, despite the positive impact of the construction and housing services on the economic activity, we estimate economic growth at 2.8%, mainly due to tighter macro-financial conditions. The risks on growth will vary widely depending on the speed of the reconstruction process, as well as the economic policies that Turkey will implement in this period and its capacity to access external financing.

The earthquake will increase poverty and income inequality throughout Turkey. Income per capita and socio-economic development indicators are already much lower in the earthquake provinces compared to the whole nation. Further, in the region, employment rate is low, informality is high and the quality of the human capital is low. In addition, 96 percent of the companies in the region are micro level companies, with less than 10 employees. The value-added of these companies and the level of their institutional capacity are also low. Last, the share of the residential units covered by the Compulsory Earthquake Insurance, under the Turkish Catastrophe Insurance Pool (TCIP), is very low both compared to the number of the total residential stock in the region, as well as the loss coverage ratio. All of these factors indicate that there may be a high and permanent decline in social welfare in the region after the earthquake.

We recommend the implementation of universal basic income schemes to the households most affected by the earthquake, in order to maintain minimum living

³ Based on the statements made by the official authorities, we expect the construction of residential units to be undertaken predominantly by the public sector. To stimulate regional economic activity, we expect the public sector to undertake half of the nonresidential construction services. On the other hand, we anticipate that the owner will cover all the repair and strengthening costs of the residential and nonresidential units.

standards in the region. We recommend providing basic income to the households whose dwellings or workplaces have been severely damaged or destroyed due to the earthquake. Universal basic income will be of utmost importance in order to prevent extreme poverty after the earthquake, considering the quality of the human capital stock and businesses in the region. In addition, we recommend the implementation of basic income over a 3-year period at a decreasing coverage rate in order to revitalize economic activity the region and to encourage the return of the households back to the region.

The earthquake will increase the risks on public finance. Before the Kahramanmaraş Earthquake, Turkey had already deteriorating fiscal balances due to the increasing number of populist/expansionary policies, such as tax amnesties or enabling early retirement to more than 2 million workers. The additional expenditure items needed after the earthquake will further increase the pressure on the public accounts. We anticipate that the earthquake-related fiscal expenditures will require a 5-year financing plan, and will create an additional financing need of 2.5%-3.5% of GDP annually in the first two years, and reach up to 8% in total. In addition, Turkey's need to improve the quality of its total building stock against disasters, such as earthquakes in the Marmara region and flooding in the Black Sea, will create a significant additional burden on the public finances over the next 10 years.

The earthquake will increase Turkey's external financing needs. We expect that Turkey's production and export potential will decrease due to the earthquake and imports will increase with the rise of the construction services. The foreign trade deficit, which has already deteriorated due to the rise in global commodity prices, the real exchange rate appreciation and the slowdown in external demand, will continue to deteriorate as a share of GDP in the aftermath of the earthquake. The historically low levels of portfolio and foreign direct investments inflows to Turkey will increase the financing risks of the foreign trade deficit and external debt. We also presume that the earthquake will have a negative impact on tourism and foreign exchange earnings, and therefore on the balance of payments.

The earthquake will push up the consumer and producer prices in the short term. We anticipate that the consumer and producer inflation will be above the 2023 baseline forecast due to the supply chain problems caused by the earthquake, the impact of the regional migration dynamics on the provincial supply-demand balances, rising imports as a share of GDP, and the buildup of pressure on the exchange rate.

We recommend the implementation of internationally accepted best economic policies, especially in the field of monetary policy, in order to manage the macro-financial risks post-earthquake. Financial risks, which have already reached historically high levels in Turkey, will continue to rise due to the economic losses and the rehabilitation cost of the earthquake. In order to manage these costs, we recommend the implication of prudent policies and international best practices in monetary and fiscal economics.

We recommend the most efficient use of internal and external resources in the cost management and financing of the earthquake related expenses. Even though Turkey has a relatively low debt-to-GDP ratio, we believe not all earthquake related expenses can be financed solely by increasing the debt stock, mainly because such a policy will put further pressure on inflation, exchange rate and financial risk indicators, which are already at historically high levels. Financing mainly via foreign debt would not be either possible due to

Turkey's limited share in the international bond markets. Meeting the financing needs of the earthquake by cutting other fiscal expenses or increasing tax rates will lead to a sharp contraction in the economy at a time when the activity is already slowing down and inflation is at historical high levels. We recommend that the financing of the earthquake related expenditures should be managed more comprehensively by taking into account the growth and development needs of the whole nation over a 5-year period and by taking account of disaster and climate policies. Therefore, for the macro-financial management of a more comprehensive and inclusive structural program, we recommend the best use of internal and external resources, including the use of grants and credits from international financial institutions.

In the last section of this paper, we propose post-earthquake economic policies, considering the economic impact of the earthquake, Turkey's development needs, and international best practices. In this paper, we propose these policies as short-term and medium-to-long-term economic policies.

With short-term policies, we focus on rapidly improving the health and safety conditions, and basic needs in the region. In this context, the prominent policy recommendations are as follows. We offer public investment and services ensuring shelter for households in the region, improving sanitary, health and security conditions, and ensuring education services. We propose the effective use of universal basic income schemes to households that are severely affected by the earthquake. We believe this policy will help prevent extreme poverty considering the high level of informality and low employment rate in the region. We also propose, employment subsidies, cash transfers and credit policies, and tax relief to the affected companies.

We advise long-term economic policies by taking into account the need to combat the global climate change, and prevent fatalities and capital losses due to natural disasters. We suggest that the post-earthquake recovery program should be prepared comprehensively taking into account the long-term development needs of the country. We believe, this program should not only reconstruct the earthquake-hit region, but also improve the earthquake resistance of all the infrastructure and superstructure throughout Turkey, and make the country more sheltered against disasters. These policies should be addressed in an inclusive framework, covering environment and urbanization, transportation, production, energy and employment policies. It should improve the zoning standards and inspections throughout Turkey. In order to provide financing for such a structural program, we recommend to reduce the share of shadow/informal economy, expand the tax base, and rationalize public expenditures. In addition, we propose the establishment of an earthquake and disaster fund, and to improve the scope and effectiveness of TCIP, in order to provide financing for future disasters.

We recommend cooperation with international financial institutions (IFIs), in order to carry out the post-earthquake recovery program in the most efficient and effective way. We recommend cooperation with IFIs to tap into their institutional capacity to plan the post-earthquake program with the best international practices, to reduce financing needs, and to increase transparency of the spending programs.

We prepared this paper by examining the experience and policy recommendations from earthquakes and major disasters that took place over the last 30 years. In this context, we examined the impact of the 1999 Marmara and the 2011 Van earthquake in Turkey, and the earthquakes with a magnitude of larger than Mw7 globally that happened since 1990.

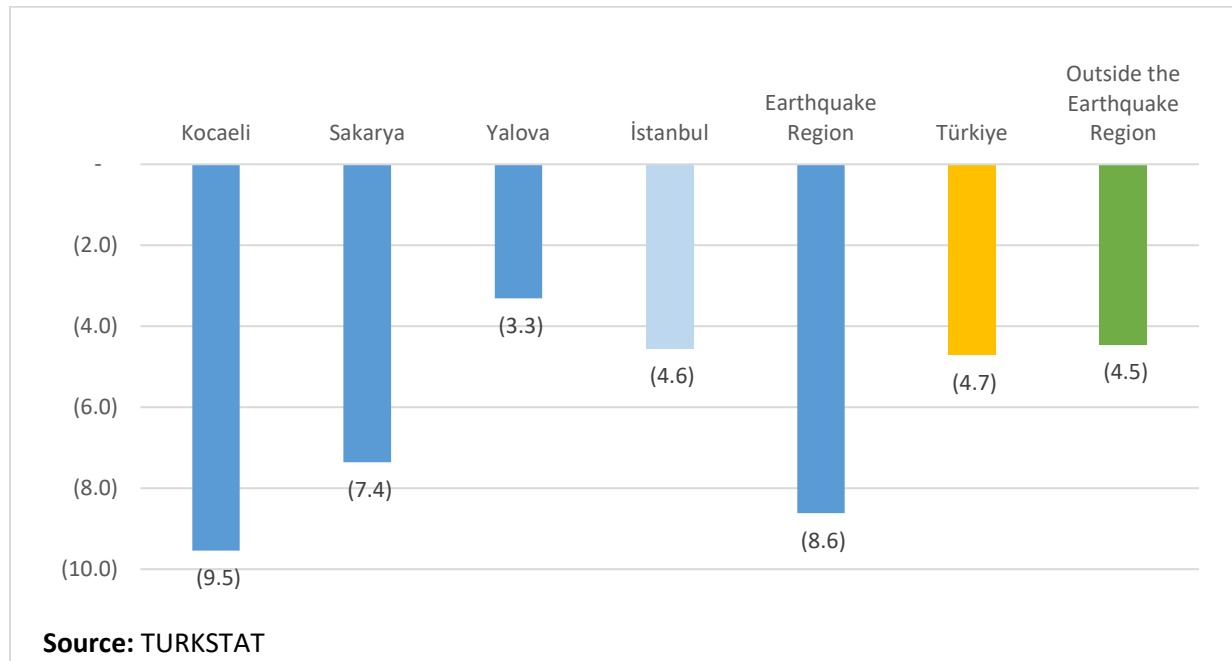
There are some caveats to the analysis in this paper. The main constraint is that there was limited information on the extent of the destruction caused by the earthquake. Further, there are some discrepancies among the official data related to the damage to the physical capital stock and physical and human capital statistics of the region.

II. The 1999 Marmara Earthquake

There are many similarities between the 1999 Marmara earthquake and the 2023 Kahramanmaraş-centered earthquake. The 1999 Marmara earthquake took place at a time when Turkey's macroeconomic and structural dynamics were quite weak. High inflation rate, economic boom-bust cycles, and high financial risk indicators provide a similar background for both periods. However, one should note that the public debt dynamics and the banking sector are quite sound in the latter period.

The Marmara earthquake happened in the economically most affluent region in Turkey. The earthquake disaster in Marmara, recorded as 7.4 on the Richter scale on August 17, 1999, covered the provinces of Kocaeli, Sakarya, Yalova, İstanbul, Bolu, Bursa and Eskişehir, and caused a significant number of fatalities and loss of physical capital in Kocaeli, Sakarya and Yalova. The three provinces that were most heavily affected by the earthquake are in very close proximity to İstanbul, and had a share of around 6% in the Turkish GDP.

Figure 1: The 1999 Earthquake and Economic Recession (%)



Industrial production and economic activity shrank due to the physical losses experienced after the Marmara earthquake. The economy of Kocaeli, Sakarya and Yalova, contracted by 8.6% on average in 1999. In the same year, the GDP of Istanbul contracted by 4.6% and the GDP of the non-earthquake region contracted by 4.5%. However, one should also note that the economic contraction in 1999 was amplified by the economic and financial problems at that time.

Various fiscal measures were taken to cover the cost of the 1999 Marmara earthquake. The cost of the 1999 Marmara earthquake ranges between US\$12 billion and US\$20 billion based on the World Bank and TUSIAD. This corresponds to 5% - 8% of GDP in 1999. In order to cover the costs caused by the earthquake, the government took fiscal measures increasing the tax burden, such as the introduction of the Special Communication Tax.

The Kahramanmaraş-centered earthquake also signals a need for external financing and fiscal measures. We estimate the total cost of the earthquake close at 16.5 percent of GDP and anticipate half of this cost to be financed by the government. We propose a fiscal-external financing mix to be put in place for the financing of the earthquake related spending in order to alleviate its cost on the economy. We support the use of grants, loans and credit from IFIs, in the external financing mix.

III. 2011 Van Earthquake

On October 23, 2011, an earthquake with a magnitude of Mw 7.2 in Van caused destruction in the city center, Erciş and many villages. According to the statements made by AFAD experts, 644 people died due to the earthquake. 31,870 houses out of 147,622 houses were reported as damaged and 18,181 as moderately damaged. In residential buildings, 8,849 of 18,735 workplaces in the region were reported as damaged.

Since the Van earthquake did not cause loss of life and property in other provinces, the reconstruction of the region was more manageable. The building permits for the reconstruction process was completed within 3 years after the earthquake. According to TURKSTAT occupancy permit statistics, 1,411 permits were granted for residences in Van, in 2010, the year before the earthquake. During 2012-14, around 23 thousands residential permits were granted in Van, of which 6% was granted in 2012 and 67 percent in 2013. This indicates that it took around 3 years to complete the reconstruction of the region. The total occupancy permits obtained in Van during these years are approximately 1% of the total permits granted in the whole nation. This shows that the post-earthquake reconstruction of Van was much more manageable.

The reconstruction period of the Van earthquake had a boom-bust impact on the provincial economy. The Van earthquake took place in November 2011, when the Turkish economy grew at a record level. While the Turkish economy grew by 11 percent annually in 2011, the economic growth of Van was limited to 7 percent. In the following year, Van's real national income increased by 29 percent due to the construction activities that started rapidly, while it contracted by 10.3 percent in the following year. It took about 5 years for the economy to catch up with its pre-earthquake trend growth.

The economic impact of the Van earthquake in Turkey were limited. There was no significant and permanent decline in the Turkish economic growth due to the Van earthquake. This was mainly because the share of the provincial economic activity is very low in the whole national income, the total destruction caused by the earthquake was manageable to reconstruct without putting a burden on the economy.

Figure 2: The 2011 Van Earthquake and Economic Growth (Real GDP, 2010 = 100)

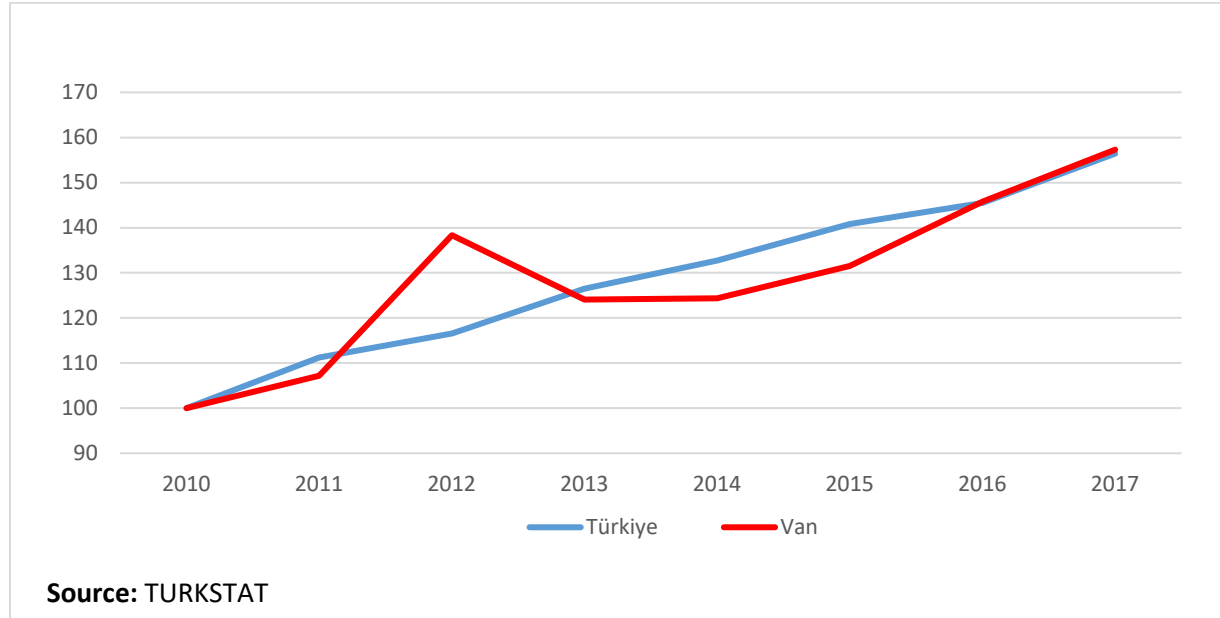
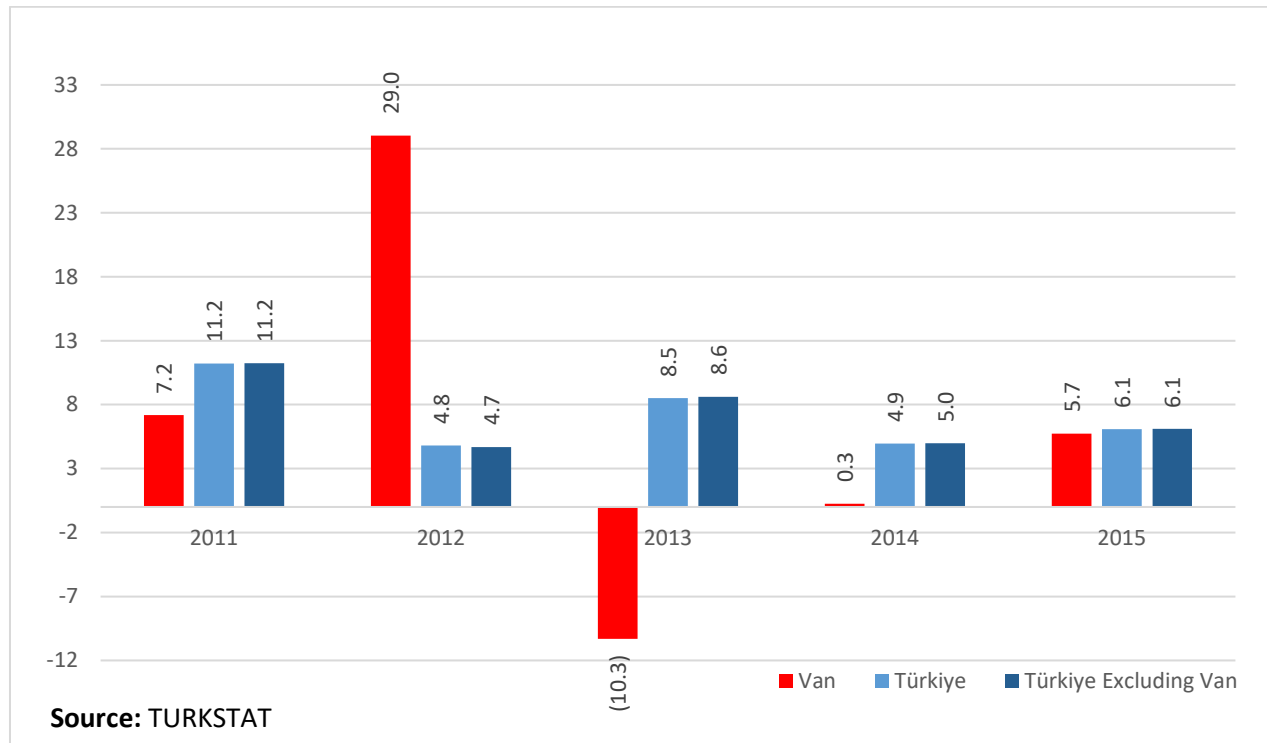


Figure 3: The 2011 Van Earthquake and Economic Growth (GDP, %)



The experience of the Van earthquake shows that the impact of the Kahramanmaraş-centered earthquake on the Turkish economy will be much deeper and the rehabilitation period will be much longer. As we will explain in detail in the following sections, the destruction caused by the Kahramanmaraş-centered earthquake took place in a wider geography covering 11 provinces, and the rate of destruction within the region was much worse.

IV. The Cost Analysis of the 2023 Kahramanmaraş Earthquake

In this part of the paper, we analyze the reconstruction costs of the provinces affected by the Kahramanmaraş-centered earthquake. We first assess the size of the damage on physical and human capital, and then come up with a plan to recover this loss. The plan includes the reconstruction of the region, recovery of the capital stock, and household transfers to promote employment and economic activity in the region as well to avoid extreme poverty. In particular, we focus on the following items.

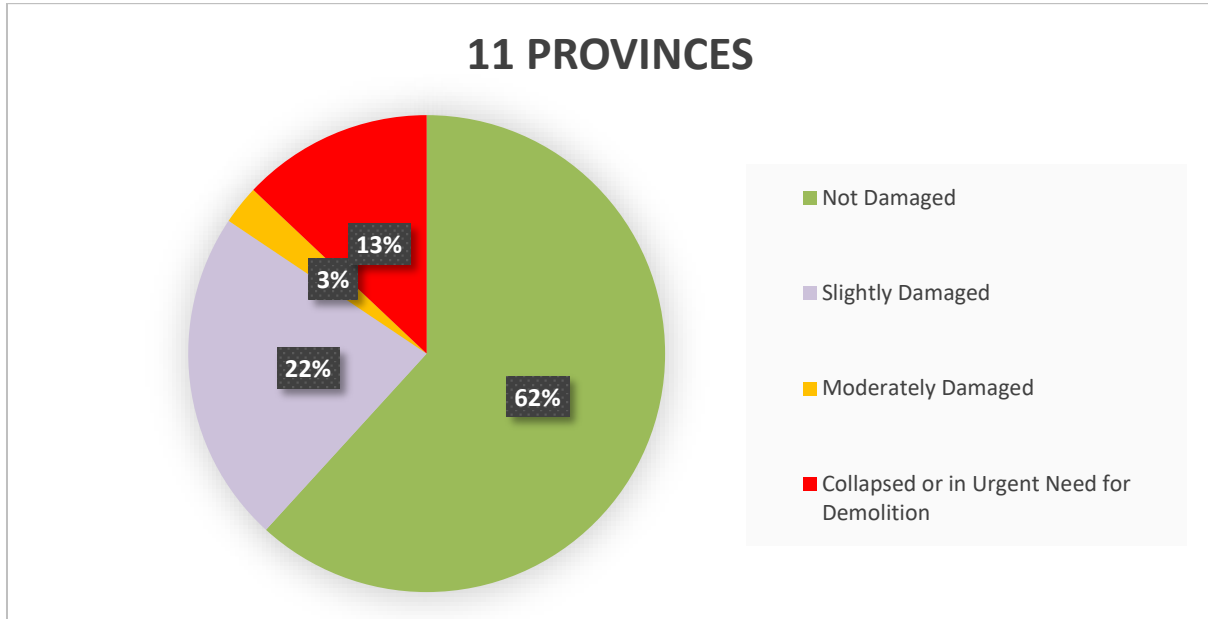
- Reconstruction of the region
- Recovery of the physical capital
- Household transfers
- Total financing requirement
- Economic growth
- Unemployment and poverty
- Inflation
- External trade and finance
- Financial sector
- Public finance
- Urban planning

The Size of Damage on the Building Stock and the Cost of Reconstruction

The Kahramanmaraş-centered earthquake caused high levels of destruction and damage in a large geography covering 11 provinces. On February 6, 2023, two earthquakes with a magnitude of Mw 7.7 and 7.6, occurred in Pazarcık and Elbistan districts of Kahramanmaraş. These earthquakes caused a significant number of fatalities and loss of capital in 11 provinces, namely Adana, Adıyaman, Diyarbakır, Elazığ, Gaziantep, Hatay, Kahramanmaraş, Kilis, Malatya, Osmaniye and Şanlıurfa. Our estimates show that 1.4 million independent units, such as houses and workplaces, are slightly damaged, 170 thousand units are moderately damaged, and 650 thousand units are demolished or are in need of urgent demolition.⁴ In this context, we estimate that 40% of the total building stock in these 11 provinces in the region was damaged or demolished at various levels.

⁴ According to the Ministry of Environment, Urbanization and Climate Change, the damage assessment is as following:

Figure 4: Estimated Damage and Destruction Rate in the Building Stock of the Earthquake Zone (% , Building Stock)



The Kahramanmaraş-centered earthquake caused different levels of damage and destruction among the 11 provinces in the region. The following tables show the estimated proportions of undamaged, slightly damaged, moderately damaged and demolished buildings in the total building stock on a provincial basis.

The cities that suffered the most damage due to the earthquake are Adıyaman, Hatay, Malatya and Kahramanmaraş. We estimate that between one-fourth to one-third of the buildings in these provinces are either collapsed or should be urgently demolished. The share of undamaged buildings in the provincial building stock is less than 30 percent. This table shows that these four provinces with a total population of 4.3 million should almost be totally reconstructed.

Undamaged Buildings: A building that has not suffered any damage due to the earthquake. (Damages and defects in the building before the earthquake are disregarded.) There is no harm in using the building.

Slightly Damaged Buildings: These are the buildings with thin cracks in the paint, plaster and/or walls of the building due to the earthquake, and/or plaster falling from the walls. (Damages and defects in the building before the earthquake are disregarded.) There is no harm in using the building.

Moderately Damaged Buildings: These are the buildings in which there are cracks in the walls of the building and thin cracks in the load-bearing elements due to the earthquake. Damages and defects in the building that occurred before the earthquake are disregarded. These buildings should be evacuated and not be used until the decline in the bearing capacity is repaired, ie the structure is repaired or it is strengthened.

Heavily Damaged Buildings: These are the buildings in which there are wide and widespread shear breaks / separations in the load-bearing elements of the building due to the earthquake. “Heavily” damaged structures are defined as buildings with irreparable loss of bearing capacity and irreversible (in terms of strength and economy) damage.

Buildings in Urgent need of Demolishment: These are the buildings in which the structural elements of the building are permanently displaced and partially or completely demolished due to the earthquake. These buildings, cannot be used in any way, including evacuation of goods in them.

Table 1: Estimated Number of Independent Units Damaged by the Earthquake

Number of Independent Units	Total	Not Damaged	Slightly Damaged	Moderately Damaged	Collapsed or in Urgent Need for Demolition	Provincial Population (2022)	GDP Per Capita (\$, 2021)
SUM	6,087,286	3,885,605	1,378,155	170,382	653,144	13,962,957	5,688
ADANA	1,116,776	1,079,515	22,573	12,267	2,421	2,274,106	6,977
ADİYAMAN	257,964	70,683	80,244	19,440	87,597	635,169	4,092
DİYARBAKIR	614,794	529,365	71,249	6,776	7,404	1,804,880	3,893
ELAZIĞ	323,230	302,752	13,399	1,071	6,009	541,258	6,272
GAZİANTEP	916,374	487,413	302,087	39,828	87,046	2,154,051	7,819
HATAY	850,411	350,269	261,856	52,796	185,490	1,686,043	6,785
KAHRAMANMARAŞ	540,639	160,317	229,081	15,025	136,216	1,177,436	5,997
KİLİS	73,539	29,884	34,134	2,208	7,314	147,919	5,406
MALATYA	416,720	173,310	127,336	12,156	103,919	812,580	5,355
OSMANİYE	269,858	155,461	85,722	3,369	25,306	559,405	6,256
ŞANLIURFA	706,980	546,638	150,475	5,444	4,422	2,170,110	3,012

Source: 11th Development Plan (2019-2023), Housing Policies Special Expert Commission Report.

2020 Annual Program of the Presidency of the Republic, Ministry of Environment and Urbanization Press Releases, TURKSTAT

Ministry of Environment, Urbanization and Climate Change and Governorship Press Releases

Explanation: We estimated the total number of building stock based on building permits, population and income data.

Table 2: Estimated Number of Buildings Damaged by the Earthquake

Number of Buildings	Total	Not Damaged	Slightly Damaged	Moderately Damaged	Collapsed or in Urgent Need for Demolition	Provincial Population (2022)	GDP Per Capita (\$, 2021)
SUM	1,765,026	1,097,660	402,118	47,013	230,229	13,962,957	5,688
ADANA	325,537	318,168	4,879	1,890	600	2,274,106	6,977
ADİYAMAN	77,184	17,719	24,437	4,822	30,206	635,169	4,092
DİYARBAKIR	179,965	154,572	20,856	1,984	2,553	1,804,880	3,893
ELAZIĞ	94,490	88,188	3,917	313	2,072	541,258	6,272
GAZİANTEP	260,545	133,315	85,890	11,324	30,016	2,154,051	7,819
HATAY	246,285	88,913	75,835	15,290	66,246	1,686,043	6,785
KAHRAMANMARAŞ	166,841	42,861	70,694	4,637	48,649	1,177,436	5,997
KİLİS	21,472	8,339	9,967	645	2,522	147,919	5,406
MALATYA	121,952	44,016	37,265	3,557	37,114	812,580	5,355
OSMANİYE	78,207	43,662	24,843	977	8,726	559,405	6,256
ŞANLIURFA	204,540	157,906	43,535	1,575	1,525	2,170,110	3,012

Source: 11th Development Plan (2019-2023), Housing Policies Special Expert Commission Report.

2020 Annual Program of the Presidency of the Republic, Ministry of Environment and Urbanization Press Releases, TURKSTAT

Ministry of Environment, Urbanization and Climate Change and Governorship Press Releases

Explanation: We estimated the total number of building stock based on building permits, population and income data.

The second most affected provinces by the earthquake are Gaziantep, Kilis and Osmaniye. Throughout Gaziantep, especially İslahiye and Nurdağı districts have been subject to a high level of destruction due to the earthquake.

The impact of the earthquake were limited in Elazığ and Adana. Therefore, in the following sections, we eliminate these provinces from the impact analyses on the economic activity and growth.

Table 3: Estimated Share of Damaged Buildings by Province (% , Building Stock)

	Not Damaged	Slightly Damaged	Moderately Damaged	Collapsed or in Urgent Need for Demolition
SUM	62	23	3	13
ADANA	98	1	1	0
ADIYAMAN	23	32	6	39
DİYARBAKIR	86	12	1	1
ELAZIĞ	93	4	0	2
GAZİANTEP	51	33	4	12
HATAY	36	31	6	27
KAHRAMANMARAŞ	26	42	3	29
KİLİS	39	46	3	12
MALATYA	36	31	3	30
OSMANİYE	56	32	1	11
ŞANLIURFA	77	21	1	1
Source: Press Releases of TURKSTAT and Ministry of Environment, Urbanization and Climate Change dated 19th. February 2023 and 23rd. February 2023.				
Explanation: We estimated the total number of building stock based on building permits, population and income data.				

We expect the reconstruction of the region to take a 5-year period, based on the size of the destruction, Turkey's construction capacity and general development needs of the country. The building stock that needs to be reconstructed is above the annual construction capacity of the region and as well as of that of Turkey. We estimate that 650 thousand independent units in the earthquake zone either are demolished or need to be demolished immediately, 170 thousand units are moderately damaged, and 1.4 million units are slightly damaged.⁵ 650 thousand independent units, destroyed or to be demolished due to the earthquake in the region, are approximately 7 times the number of residential permits granted in this region in 2022. It is also above the building occupancy permits issued in 2022 throughout the entire country. In addition to these 650 thousand units, we estimate that 1.5 million units are either slightly or moderately damaged due to the earthquake. We assess that it will not be possible to compensate for the damage caused by the earthquake in one year, considering

⁵ Independent units consist of various structures such as residences, workplaces, warehouses, public service units, etc.

the strengthening and repair activities of all these buildings, and the ongoing and general construction servicing needs throughout Turkey,.

The total number of houses that were or should be demolished in the earthquake zone is far above the production capacity of TOKİ.⁶ According to the 2022 Presidency Program, the number of social housing produced by TOKİ throughout Turkey is 98,891 in 2020 (T.R. Presidency of Strategy and Budget, 2021). In our paper, we estimate the number of independent units that are demolished or moderate to severely damaged at around 820 thousand. Considering the ongoing social housing projects of TOKİ and the size of the earthquake related construction, we assess that it will not be possible for TOKİ to rebuild the earthquake region even within a 10-year period.

The total number of houses that have been or should be demolished in the earthquake zone is equivalent to the 10-year construction capacity of the region. We estimate the size of the destruction in the nine provinces where the earthquake had the most devastating damage.⁷ Based on this analysis, we estimate that around 230 thousand buildings either have collapsed or should be urgently demolished (Figure 5). This is 3 times the building permit issued in the region over the last 10 years, and 29 times that of 2022. We did the same analysis based on the number of independent units, such as dwellings, workplaces, warehouses, etc. We estimate that close to 645 thousand independent units either have collapsed or should be urgently demolished (Figure 6). This is 9 times the residential permits issued in the region over the last 10 years. Reconstruction, strengthening and repair activities should also be carried out for structures with slight or moderate damage. We estimate that there are approximately 440 buildings and 1.5 million independent units in this category. In other words, we estimate that there are more than 665 thousand buildings and 2.1 million independent units that have collapsed or damaged due to the earthquake (Figures 5 and 6). This shows that very intense construction activities should be carried out in the earthquake zone. However, despite that, it does not seem possible for the region to normalize before a period of 5 years.

⁶ Housing Development Administration of the Republic of Türkiye (TOKİ),

⁷ Adıyaman, Diyarbakır, Gaziantep, Hatay, Kahramanmaraş, Kilis, Malatya, Osmaniye ve Şanlıurfa.

Figure 5: Damage to the Buildings in the 9 Provinces most Affected by the Earthquake

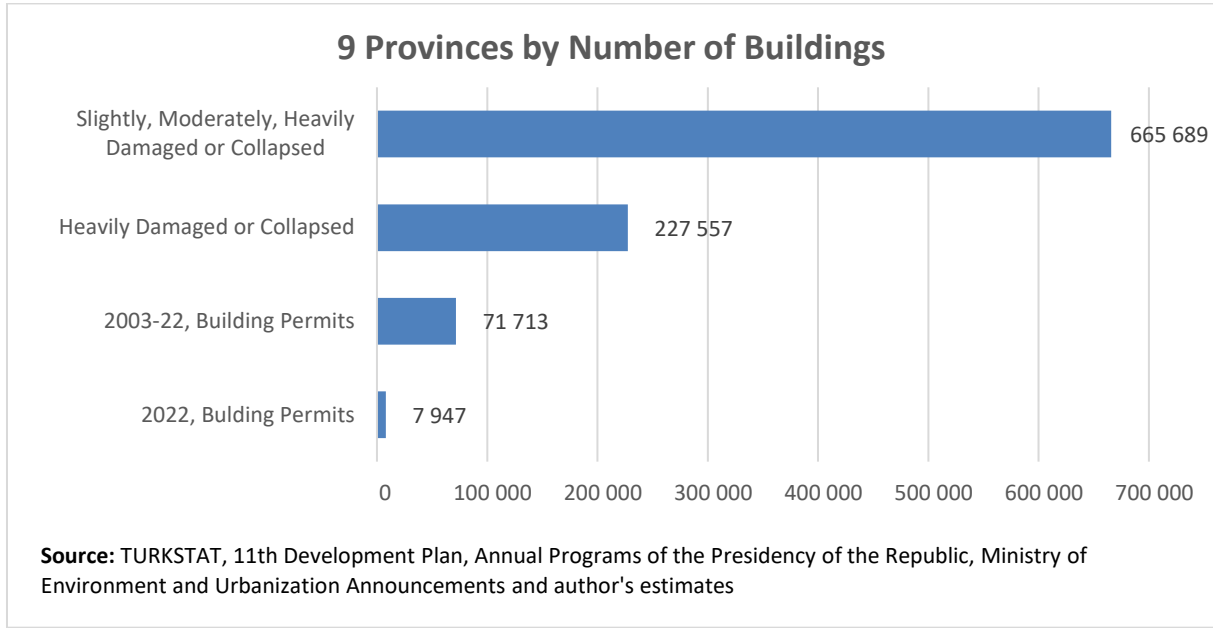
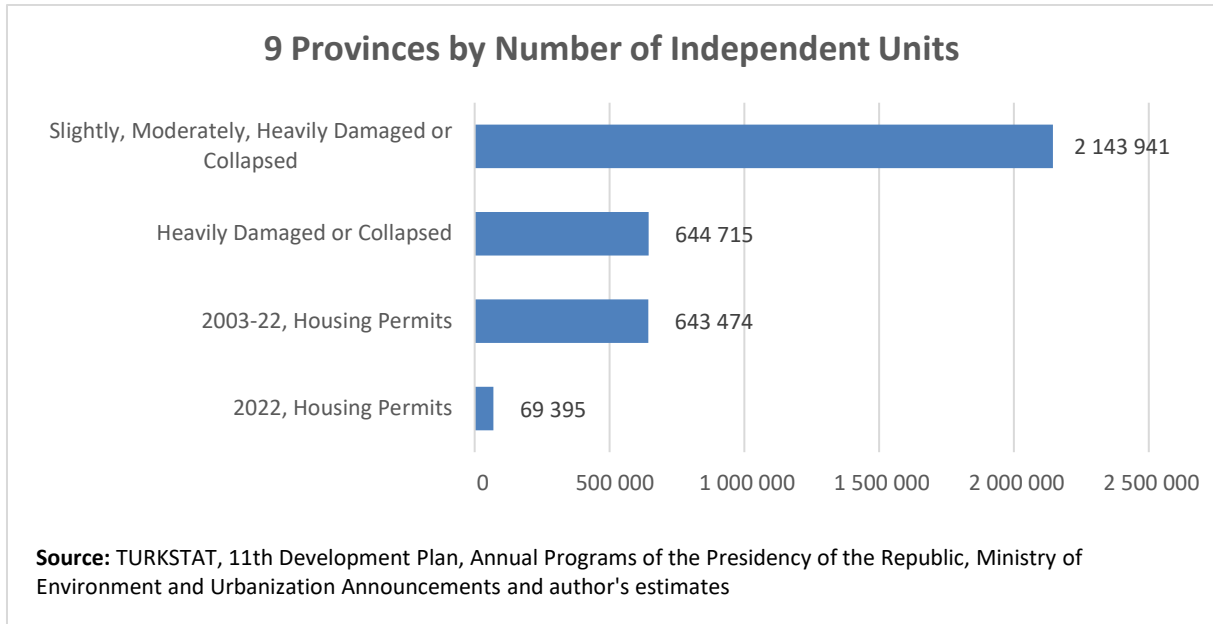


Figure 6: Independent Units in the 9 Provinces most Affected by the Earthquake



Recovery of the Physical Capital

We estimate the loss of physical capital such as vehicles, assets, stocks and consumption goods to reach approximately 660 billion TL (US\$35 billion). Among these losses, the biggest expenses belong to automotive, and personal and commercial property. We provide the details on this estimate in Annex-2.

Table 4: Loss of Property Due to the Earthquake

	(Billion TL)			(Billion \$)		
	Public	Private	Sum	Public	Private	Sum
Vehicles and Construction Equipment (1)	39.1	156.6	195.7	2.1	8.2	10.3
Fixtures (2)	56.1	224.5	280.6	3.0	11.8	14.8
Consumption Goods (3)	18.7	74.8	93.5	1.0	3.9	4.9
Stocks (3)	18.7	74.8	93.5	1.0	3.9	4.9
TOTAL	132.7	530.7	663.4	7.0	27.9	34.9
Assumptions						
(1) Foreseen as 30% of the number of automobiles in cities other than Adana and Elazığ.						
(2) Foreseen as 25% of the reconstruction cost.						
(3) Foreseen as 1/3 of the cost of fixtures.						

Household Transfers

We estimate the cost of household transfers around US\$24 billion. We propose a 3-year plan to provide for the housing and living expenses of the households in the region, and to support for their work and employment opportunities. We recommend pursuing these household transfers at a decreasing rate over 3 years, in order to ensure the minimum living standards in the region and to prevent extreme poverty.

The largest household transfer item comes from the cost of universal basic income and employment subsidies. We propose to provide a cash transfer of 10 thousand TL per household, covering 1.4 million families whose houses have either damaged or demolished by the earthquake. We propose to maintain the nominal US\$ value of this transfer over a 3 year period, at decreasing rates, in order to protect the minimum living standards in the region, to revive economic activity, and to create job and employment opportunities. We also support providing cash subsidies for employment. We anticipate that 400 thousand employees should be covered by this subsidy in the first year, and the coverage will fall in the following years.

We estimate the annual cost of temporary shelter supports US\$4 billion. The biggest item among these expenses is the container and container city needs. Based on the number of damaged/collapsed buildings, we assume that 520 thousand households will be in need of shelter during the first year. We assume that half of these households will live in container cities, and the other half to receive rental support. We propose to provide shelter support throughout the first two years at a decreasing rate.

Table 5: Temporary Housing, Household and Employment Support (Covers full cost only for the first year)

TOTAL:	322 Billion TL		17 Billion \$		
TEMPORARY SHELTERING		HOUSEHOLD SUBSIDIES		EMPLOYER AND EMPLOYMENT SUBSIDIES	
Tent	11	Universal Basic Income	166	Employment Allowance	32
Container	38	Fatality Aid	6	Premium / Tax Deferral	16
Area Needs (food, cleaning, etc.)	15	Relocation Subsidy	4	Cash Subsidies	12
Rent Subsidy	13			Agricultural Subsidies	8
Total	78	Total	175	Total	69
Assumptions					
Number of people estimated to have died in the earthquake:				90 000	
Number of households experiencing loss of life due to earthquake:				60 000	
Number of households affected by the earthquake (those residing in slightly, moderately, heavily damaged or collapsed housing)				1 380 000	
Number of households whose houses were collapsed, or moderately or heavily damaged:				510 000	
Estimated number of households to receive rental subsidy				255 000	
Average monthly rental subsidy amount (based on weighted share of homeowners and renters)				4 300	
Explanations					
Current payments are calculated for 12 months.					
Rent Subsidy: Rental subsidy of 5,000 TL per month for homeowners and 2,000 TL per month for renters for those who will shelter outside container cities					
According to TURKSTAT data, 65% of households in Adıyaman, Hatay, Kahramanmaraş and Malatya are homeowners.					
Universal Basic Income: 10,000 TL per month to earthquake affected households					
Fatality Aid: 100,000 TL for households that suffered loss of life in the earthquake.					
Relocation Subsidy: 15,000 TL for those whose houses are heavily damaged and who demand a container.					
Employment Allowance: 6,004.80 TL per month for minimum wage earners; maximum 15,000 TL. It is assumed that there are 400,000 employees in the scope and 60% of them will be minimum wage earners.					

Total Financing Requirement

This study shows that the earthquake will create a financing need of approximately US\$150 billion in a 5-year period. The highest part of this cost is the reconstruction, reinforcement and repair costs of the superstructure and infrastructure caused by the demolition in the region. Calculations and assumptions on the construction, reinforcement and repair costs of the building stock are provided in Annex-1. According to these estimates, the superstructure and infrastructure construction, reinforcement and repair costs will be around US\$88 billion. We expect that half of this cost will be financed by public resources. The second biggest cost item is due to the property losses such as such as the damage on the vehicles, fixtures, stocks and consumer goods. We estimate the recovery of the loss at US\$35 billion. We foresee one-fifth of the cost to be borne by public resources. We predict household transfer to cover for the temporary housing, living, work and employment need at US\$24 billion over a 3-year period.

We expect the recovery of physical superstructure in the region will last 5 years because the destruction caused by the earthquake is far above the local construction capacity, and other construction needs continue throughout the country. We expect that public construction activities will be carried out mainly in the first years, and households and enterprises will intensify their construction activities following the completion of the essential infrastructure. We propose to support households by direct transfers over a 3-year period in order to protect the humane living standards and to promote the move back to the region. In the table below, we present a 5-year financing plan for the aforementioned spending items. In this context, the total financing need in the first 2 years is around US\$40 billion, or at 4.5% of GDP in 2023 and 2024.

Table 6: Financing Need for the Earthquake-Related Expenses (Billion US\$, 2023 Prices)

Cost (Billion US\$)	2023	2024	2025	2026	2027	TOPLAM
Construction Costs	21.9	24.1	19.7	13.1	8.8	87.6
Property Losses	4.5	12.2	11.5	5.2	1.4	34.9
Temporary Sheltering	3.8	0.7	0.3	-	-	4.9
Household Transfers	7.8	4.4	1.7	-	-	13.9
Employment Support	3.0	1.8	0.7	-	-	5.5
TOTAL	41.1	43.2	34.0	18.4	10.2	146.8

We expect the earthquake to increase public financing needs significantly, especially in 2023-25. In the table below, we present the rise in the earthquake-related public spending over a 5-year period. Accordingly, we expect that the annual cost of the public spending in the first two years to be in the range of US\$25 to US\$35 billion.

Figure 7: 5-Year Public-Private Financing Requirement for the Earthquake-Related Expenditures (Billion US\$)

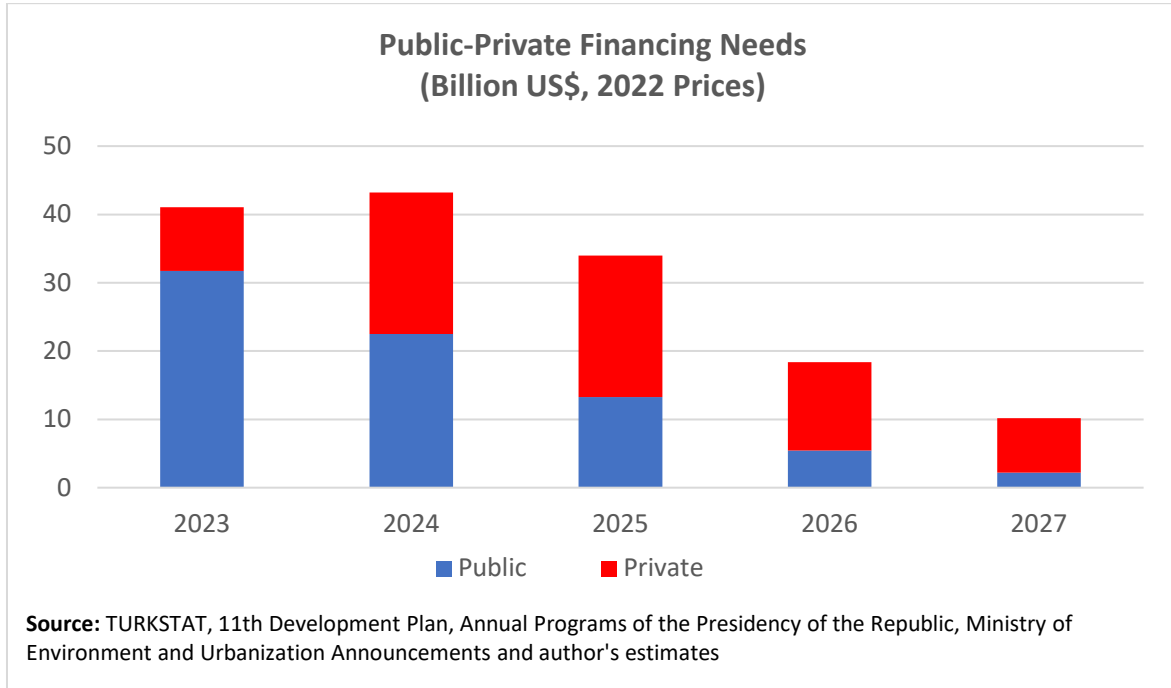
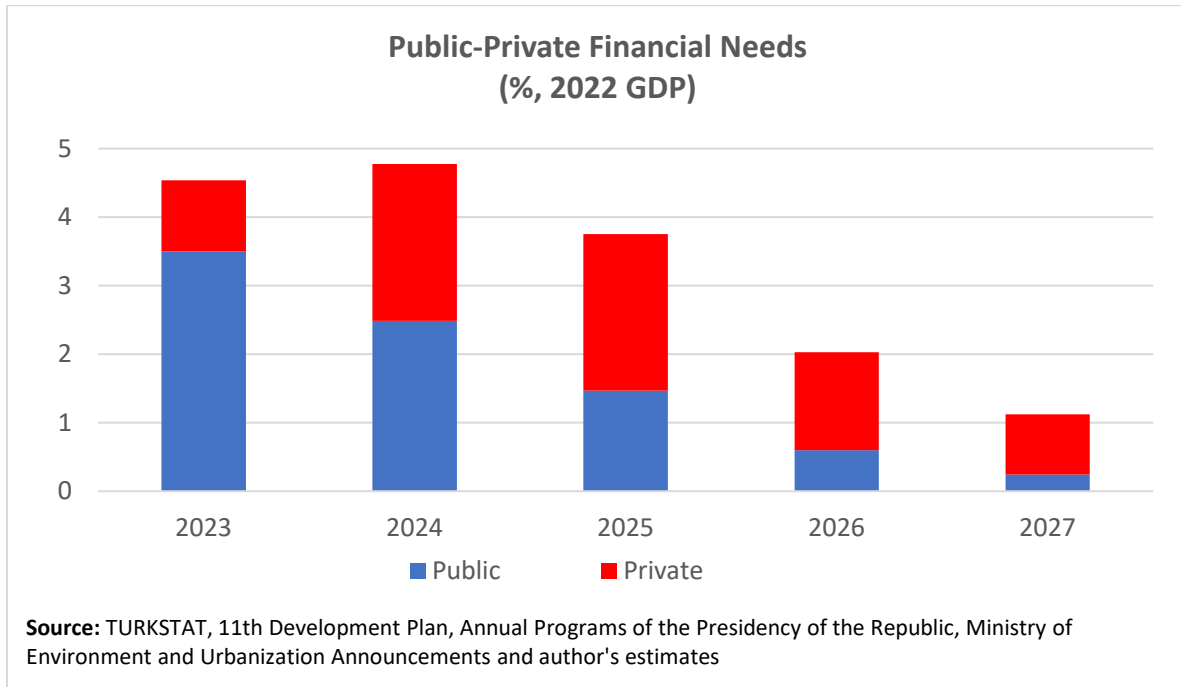


Figure 8: 5-Year Public-Private Financing Requirement for the Earthquake-Related Expenditures (% of GDP)

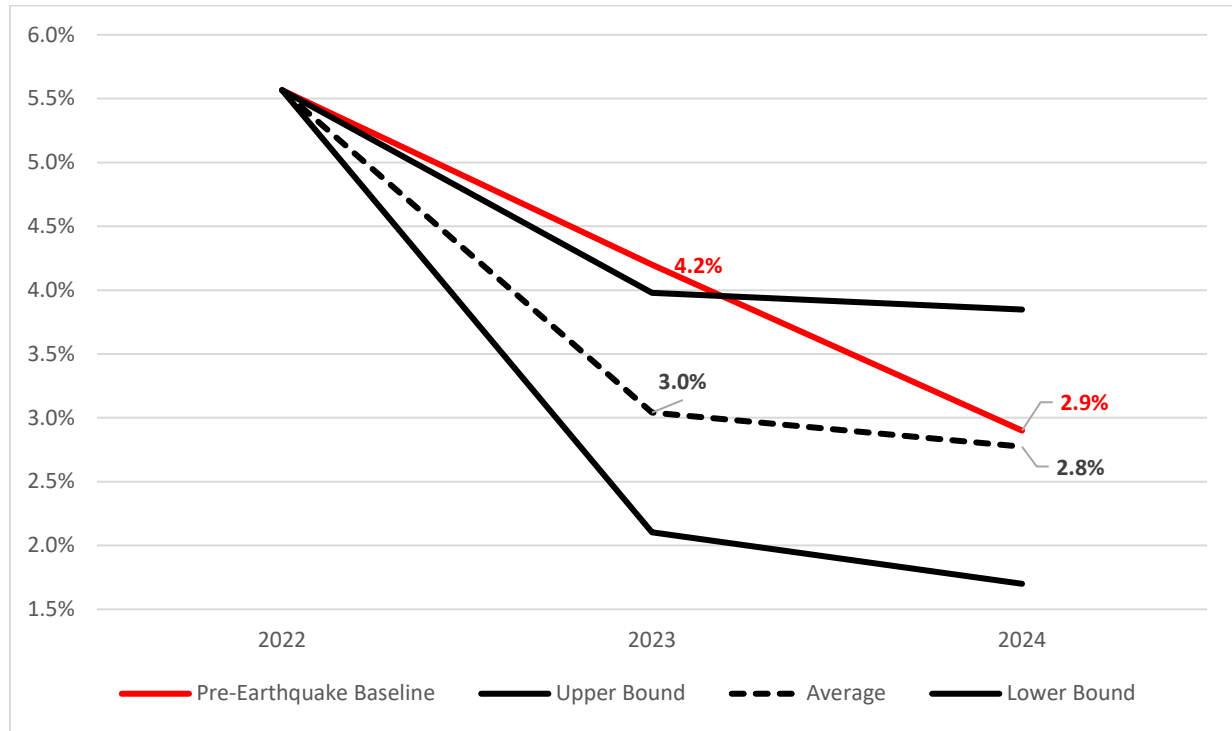


Economic Growth

Studies on natural disasters present that the cost of the disaster on the economy depends on the size of the disaster, the economic conditions in the country, and the quality of the institutions. The literature on the impact of natural disasters such as earthquakes, tsunamis and floods show various impacts on the economy. These studies generally indicate there is an adverse impact on the production, services and employment structure of the economy, and the size and duration of this shock depends on the pre-disaster economic conditions and the quality of institutions in the country (Hallegatte et al. 2022, Cavallo et al. 2013, DuRose 2023, Lackner 2018, Noy 2009, Taya and Skidmore 2007).

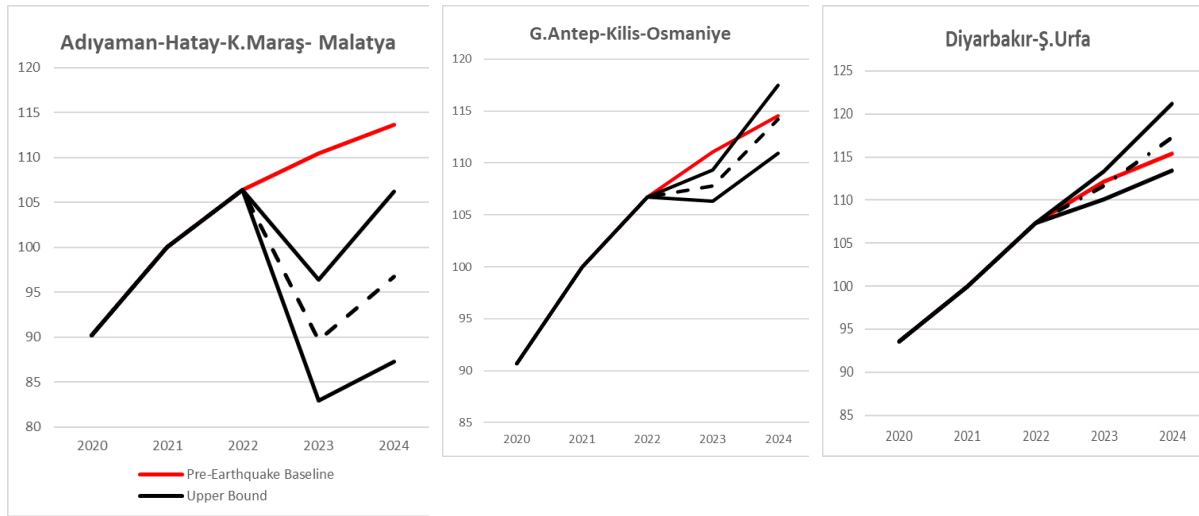
The Kahramanmaraş-centered earthquake happened while economic growth and quality of institutions have been deteriorating, and macro-financial risks have been rising in Turkey. The Turkish policymakers had moved away from the generally accepted best economic practices, inflation and financial risks have skyrocketed, the purchasing power of households has decreased, and poverty and income inequality have risen. The slowdown in global trade and a deterioration in the economic and political outlook of the country have already pointed out to a sub-potential growth in the economic activity and employment opportunities in 2023 and 2024.

The earthquake will amplify the cyclical deviation in the Turkish economy by inducing physical and financial losses, and lower activity and employment. The fact that the earthquake coincided with a period when the economy slowed down and macro-financial risks have increased, shows that the impact of the earthquake on the economy would be higher. We estimate economic growth in 2023 at 3%, 1.2 percentage points lower than the pre-earthquake baseline scenario. In 2024, despite the positive impact of the construction activities we expect growth at 2.8% due to the toll of the macro-financial correction on the economy. The figure below presents the economic growth forecasts for 2023 and 2024. The risks on growth will vary widely depending on the speed of the reconstruction process, as well as the economic policies that Turkey will implement in this period and its capacity to access external financing.

Figure 9: Economic Growth Projections (2023-24)

We estimated the growth impact of the earthquake zone based on the damage of the disaster on the residential building stock. The share of the 9 provinces most affected by the earthquake is around 7% of the national income. The share of Adıyaman, Hatay, Kahramanmaraş and Malatya provinces, which have the highest rate of destruction and damage, is around 3% of the national income. We expect in these provinces, economic growth will contract in the range of 10-20% in 2023. Gaziantep, Kilis and Osmaniye provinces have the second highest damage rate. We expect in these provinces, economic growth in the range of 0% to 2.5% in 2023. Last, we forecast economic growth of Diyarbakır and Şanlıurfa to be in the range of 2.5% to 5.5% in 2023.

In 2024, economic activity will vary widely depending on the speed of the reconstruction process, the macroeconomic, and Turkey's access external financing. We expect economic rebound to be limited in the provinces of Adıyaman, Hatay, Kahramanmaraş and Malatya. Because the share of the damage in these provinces are very high, and it will take more than one year to compensate for this loss. We anticipate a very intense re-construction process; however only a 30 percent compensation rate in the first year. In the provinces of Diyarbakır, Gaziantep and Şanlıurfa, we expect higher than baseline growth, because we expect these provinces will attract immigrant from other earthquake-damaged provinces, and therefore will have a faster rebound in economic activity. In the non-earthquake provinces, we expect economic growth in the range of 1.5% and 3.5% depending on the economic policies pursued by the government and external financing conditions.

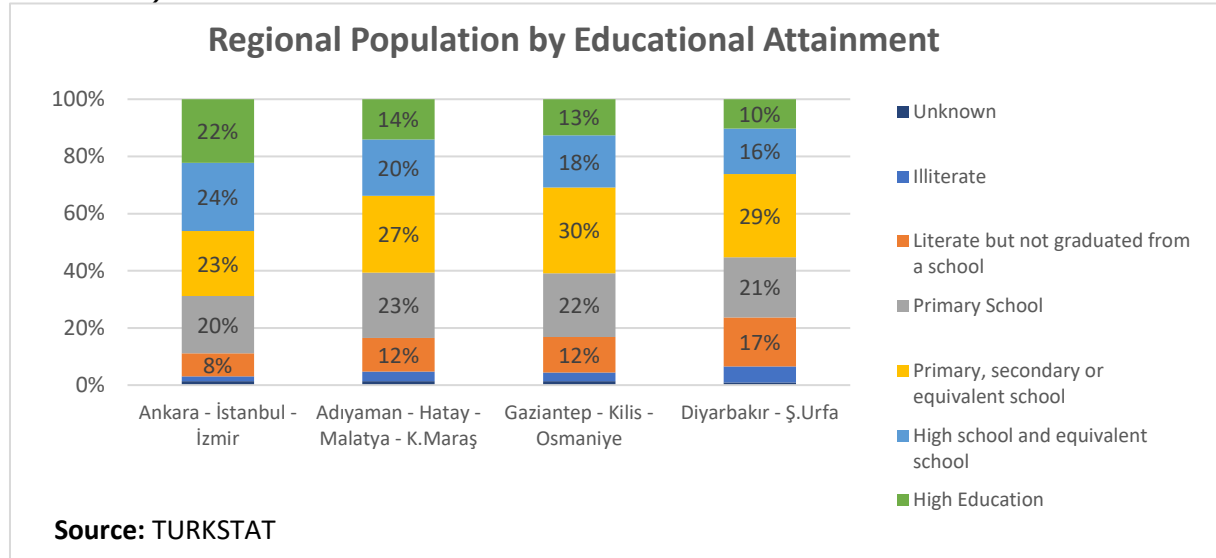
Figure 10: Regional GDP (2021 = 100)

Unemployment and Poverty

The economic literature on disasters present that the highest burden of the disaster fall on the low- and middle-income households. Generally, the lower income households live in disaster-prone dwellings, and therefore the share of fatalities and capital loss is higher on them. Studies show that those most affected by natural disasters are the poorer segments of the society (Colmer 2021).

The provinces where the earthquake took place are the regions where the average income and socio-economic development level are lower than in Turkey in general. The employment rate in the region is low, informality is high, and the quality of the workforce is low. Some districts in the region have the highest poverty rate in Turkey. Further, half of the Syrian immigrants in Turkey reside in the provinces where the earthquake happened.

The companies in the earthquake zone are small, less institutional and have limited productivity. The companies in the region are mainly composed of micro companies with less than 10 employees. The productivity of these companies and the quality of their institutional structure are low. These indicate that there may be a high and permanent decline in the level of economic activity, employment and income in the region after the earthquake.

Figure 11: Population of the Region by Education Attainment (% of Provincial Workforce)

The earthquake will increase poverty and income inequality in the region. Economic literature also shows that poverty rate and income inequality increase after disasters. The structure of the companies in the region and the quality of their workforce show that the economic activity and employment losses after the earthquake will be high and it will take a long time to compensate for these losses.

Loss of physical capital due to earthquake will trigger poverty. The ability of the low-income group to compensate the loss of their basic financial assets, homes and/or businesses is very low. Firms and households whose houses, workplaces or movable/immovable properties are destroyed or damaged in the earthquake are expected to suffer high financial losses. According to the statements made by the Turkish Catastrophe Insurance Pool (TCIP), the number of insured residences in the earthquake zone is 1.1 million. In this paper, we estimate that there are 5.4 million residences and 3.7 million households in the region. As shown in the table below, the insurance rate is 21% per residence and 30% per household. According to the statements made by TCIP, the highest compensation amount that will be paid to a household per dwelling is 640 thousand TL. In this paper, we forecast that 584 thousand houses should be reconstructed. For these houses, the max amount TCIP will pay is 79 billion TL, where as we estimate the reconstruction cost at 964 billion TL. Therefore the damage recovery rate by TCIP is only at 8%.

Table 7: Houses and Households with the TCIP Insurance

CITIES	Number of Insured Houses	Premium Amount (Million TL)	Number of Houses	Number of Households	Rate of Insured Houses	Insured Houses / Households
Adana	217,166	32.8	1,002,655	670,745	22%	32%
Adıyaman	38,640	10.3	231,427	164,712	17%	23%
Diyarbakır	77,720	11.3	554,293	425,931	14%	18%
Elazığ	85,324	46.6	291,029	189,199	29%	45%
Gaziantep	213,339	25.6	802,480	556,356	27%	38%
Hatay	122,887	34.0	758,557	477,434	16%	26%
Kahramanmaraş	109,782	22.8	483,228	331,006	23%	33%
Kilis	14,591	1.6	66,135	43,655	22%	33%
Malatya	95,983	29.3	375,613	245,885	26%	39%
Osmaniye	42,381	9.9	240,879	166,473	18%	25%
Şanlıurfa	101,197	8.3	629,984	451,354	16%	22%
Sum	1,119,010	233	5,436,280	3,722,750	21%	30%
Source: TCIP, TURKSTAT, Eleventh Development Plan (2019-2023), Housing Policies Special Expert Commission Report						
Explanation: The number of houses is an estimate, including seasonal dwelling and that are under construction.						

Inflation

The earthquake will trigger consumer and producer prices up in the short term. We expect consumer and producer inflation to be above the pre-earthquake baseline in 2023. There are various reasons triggering inflation upward. First, we anticipate a deterioration in the supply chain within the country that depend on production coming from the earthquake zone. Second, the internal migration within the country will lead to regional supply-demand imbalances, in particular in food and housing inflation. Third, lost production and the reconstruction of the region will push up imports and put a burden on the exchange rate dynamics.

Food prices will increase more in 2023. We anticipate a decline in agricultural production and animal husbandry activities in the earthquake-affected zone. This will negatively affect food prices in 2023. The reconstruction activities in the earthquake zone, including the removal of the debris areas, should stay outside the farmland or the land that may affect agricultural production adversely. Otherwise, Turkey may experience a structural capacity loss in agricultural production.

Long-term price pressure on housing and rental prices will last in the long-term. We expect it will take 5 years to complete the rebuilding, strengthening and repair activities in the earthquake zone. This will trigger supply-demand imbalances in the housing market both within the region but also throughout Turkey. Further, Turkey needs to strengthen its total building stock, especially those in the Marmara region, in order to make the country more secure against natural disasters. This indicates a long-term pressure on housing prices.

External Trade and Finance

We expect the trade deficit to stay high as a share of GDP. Turkish trade balance has been on a deteriorating trend over the past few years. There are several reasons behind this, such

as the high global commodity prices, slowing global trade and appreciation of the real exchange rate. We expect the earthquake to contribute to Turkey's foreign trade deficit in the short-to-medium term. The main reasons for this are as following:

- Higher imports due to the reconstruction of the earthquake zone
- Higher imports, especially in agriculture, due to production losses in the region
- Lower exports due to production losses within the region

The earthquake may have a negative impact on tourism revenues in 2023. The earthquake may adversely affect the perception of international tourists, especially those destined towards regions that are more susceptible to an earthquake risk, such as Istanbul.

The risks on external financing are likely to escalate. International portfolio inflows to Turkey are already at historically low levels. Turkey's CDS risk spread remains very high compared to other emerging markets. These risks will likely to remain high considering the toll of the earthquake on fiscal and external finance dynamics should Turkish authorities continue to implement the same policy mix.

Financial Sector

The impact of the earthquake on the banking sector will be limited but negative. The main adverse impacts will be due to the decline in deposits due to loss of assets in the region and rising NPLs. Further, a lower growth rate in Turkey will also negatively affect the quality of the asset structure of the banking sector.

Public finance

The impact of the earthquake on public finances will be negative. This effect will manifest itself mainly as increased public expenditures. The burden will mainly depend on the implementation of construction activities in the area. We anticipate very intense construction activities in the region, especially in the next 3 years.

Figure 12: Earthquake-Related Public Financing Need (Billion US\$, 2022 Prices)

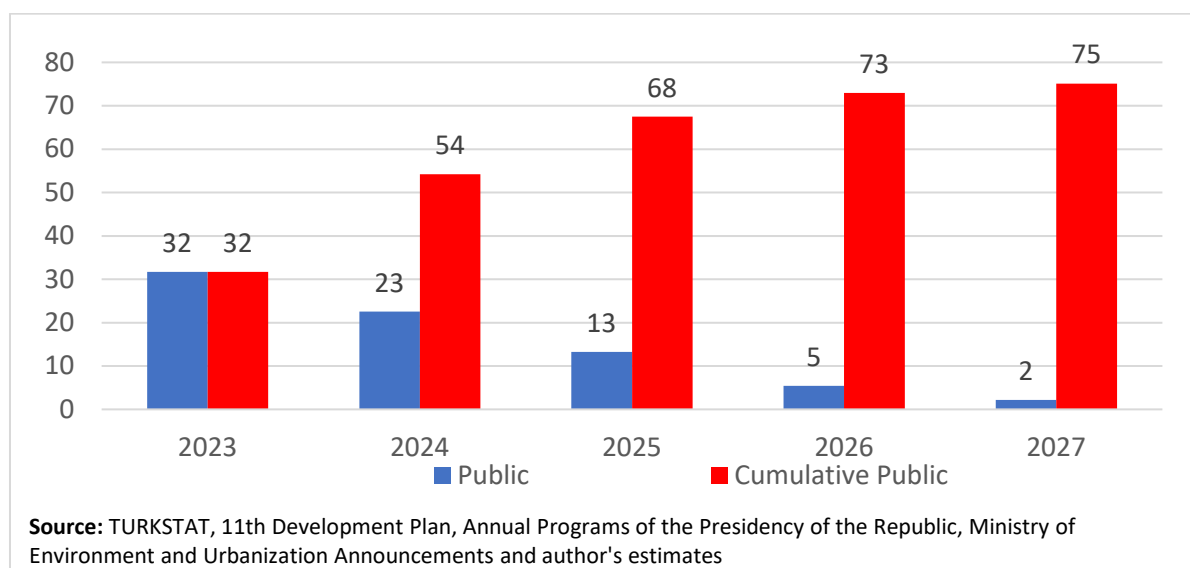
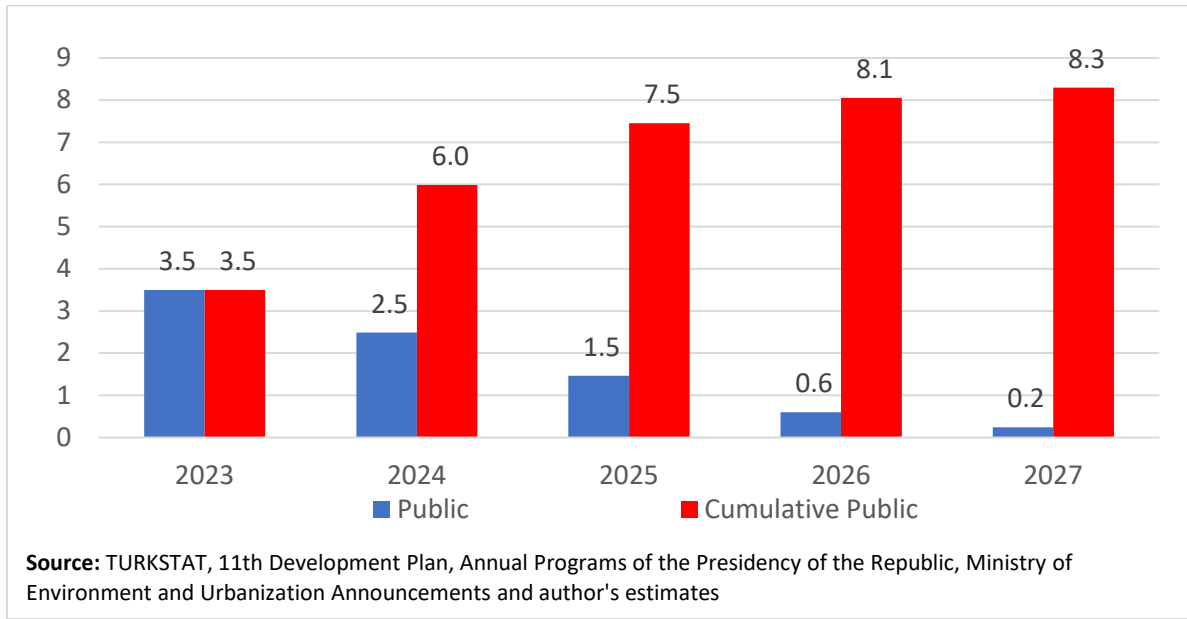
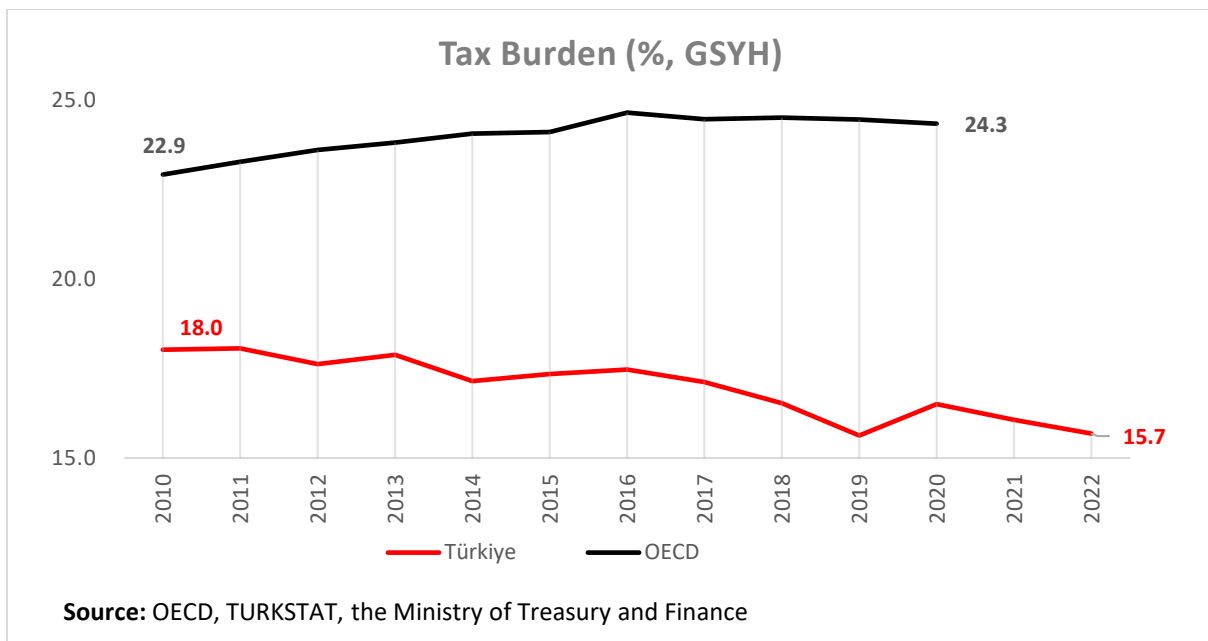


Figure 13: Earthquake-Related Public Financing Need (% of 2022 GDP)

Tax revenues are decreasing structurally. Although, in nominal value, tax revenue outcomes stay above the budget revenue targets, real revenues have been declining due to high inflation, new tax exemptions and breaks, tax avoidance, and the size of the informal economy. In addition, the new regulation allowing for early retirement (EYT) will also reduce the tax base. In 2022, the share of tax revenues fell down to 15.7% of GDP from 18% in 2010. During the same period, tax revenues increased to 14.3% from 22.9% in the OECD countries. We anticipate the additional financing requirement of the earthquake-related spending will reach up to one-fifth of total tax revenues.

Figure 14: Tax Revenues in Turkey and the OECD (% of GDP)

Higher expenditures will increase the public debt stock. There are important expenditure items that are not included in the budget in 2023. Among these, we expect the Early Retirement Deal to contribute to around 200 billion TL, and the earthquake an additional expenditure of 600 billion TL. In a slowing economy, the government is likely to finance a significant portion of these expenses by borrowing. This will increase the ratio of debt stock to national income by approximately 4.5 points.

Urban Planning

The age of the building stock in Turkey has been the disguise of the earthquake-related damage, but international experiences do not support this argument. About half of the buildings in Turkey were built post-2000s. More than 50% of the buildings in the earthquake zone were built post-2000s. In this section, we compare Turkey with another earthquake country, Japan. In Japanese households reside in older dwellings compared to that of Turkish households (Graph 17: Construction Year of Residential Buildings in Turkey and Japan). This shows that standards and the quality of inspections are far more important than the age of the building stock.

Figure 15: Construction Year of Residences in Turkey and Japan

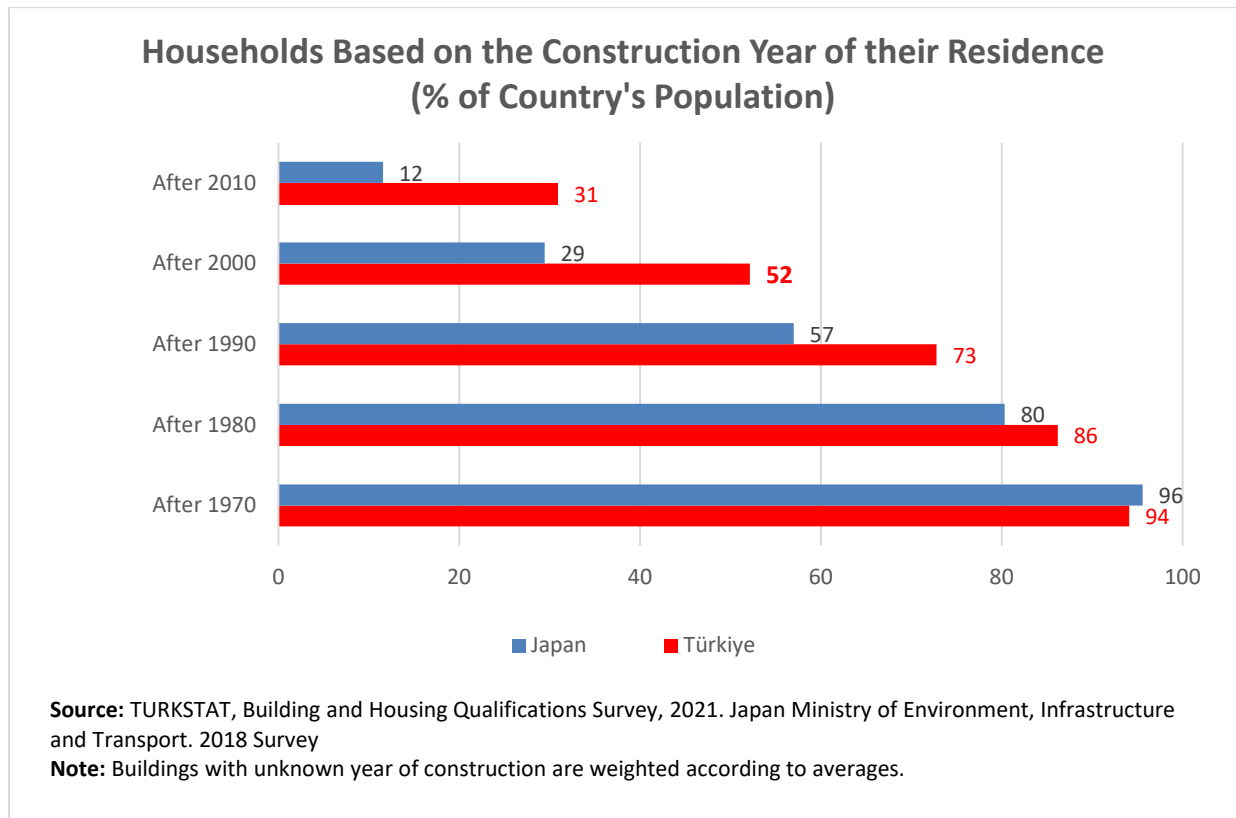


Figure 16: Number of Buildings with Occupancy Permit and Distribution by Construction Type (%)

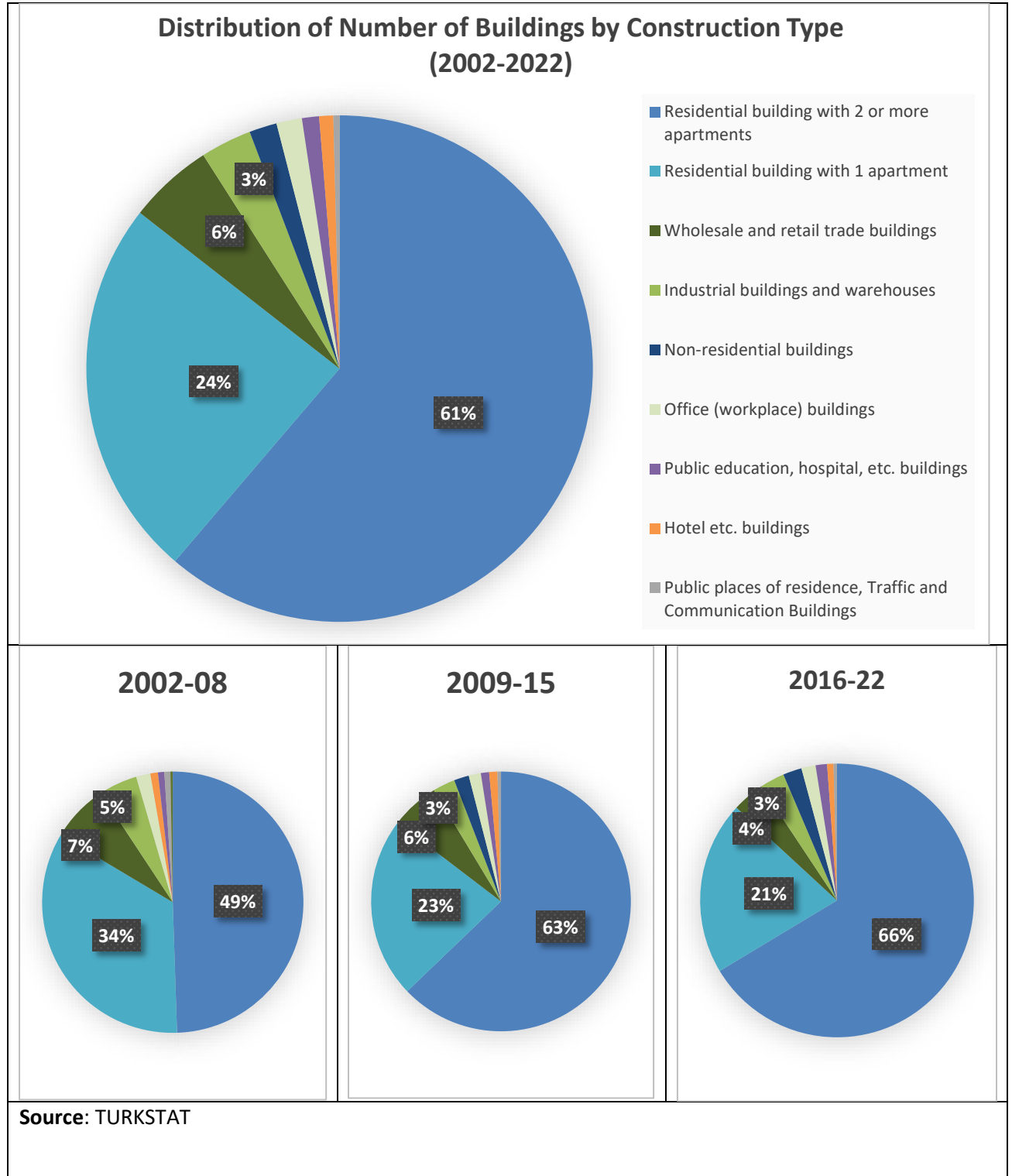
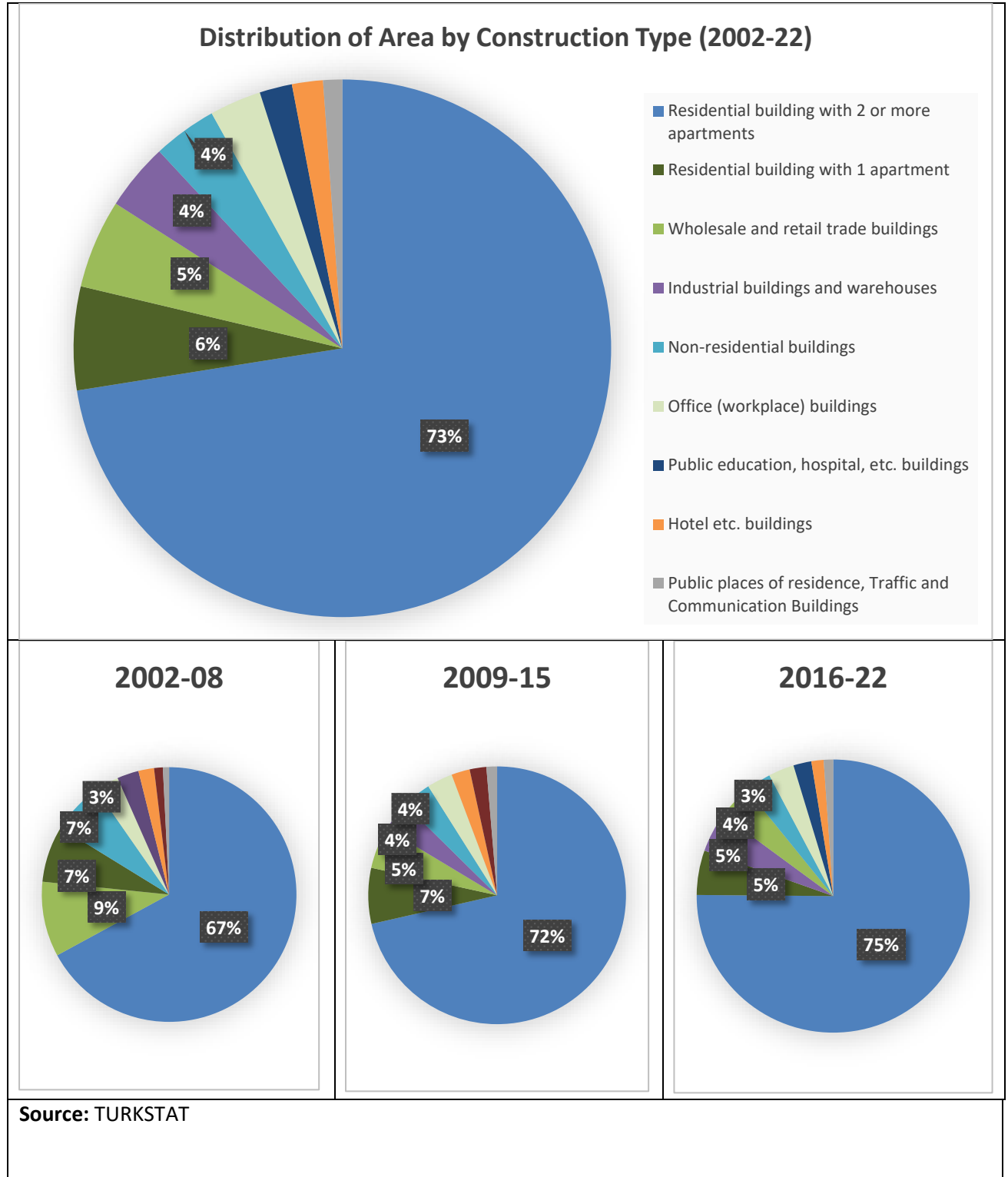


Figure 17: Distribution of Buildings with Occupancy Permits by Area of Use and Area of Use (%)



The share of high-rise buildings has increased in the last 20 years in Turkey. If we look at the period after the 1999 Earthquake, according to the data announced by the Turkish Statistical Institute, the buildings that have been put into use in the last 21 years are predominantly residential buildings. Building permits obtained between residential buildings have also been in favor of high-rise buildings over the recent years. The graphs above show the number of buildings by construction type and the distribution by construction area of buildings that received occupancy permits in the 2002-22 period. In these charts, we present the total number and surface area of buildings that have received building occupancy permits based on the construction type of the buildings. As we present on the first panel, 61% of the 2.2 million buildings that received building permits in 2002-22 are residential buildings with 2-or-more flats, and 24% are residential buildings with only one flat. The share of multi-storey buildings are rising in the last 20 years, in particular based on the surface area. As we present above on the second panel, 73% of the total construction that received a building permit in 2002-22, consists of residential buildings with 2-or-more flats. This ratio has increased to 75% during the 2016-22 period.

Turkish zoning and urbanization standards should better and more transparent. The business models of construction companies in Turkey are based on the construction of residential and multi-storey buildings. Both the reconstruction of the region experiencing the 2023 earthquake disaster and the quality of the existing building stock in Turkey with high earthquake risk show that the whole urban planning model should be redesigned. We argue that a committee, composed of central and local government officials, scientists and representatives from the construction sector, should determine both the number of construction permits granted in an area as well as the materials that will be used in the construction zone. In addition to the regulations, the principles of implementation should also be more effectively audited. In accordance with the principle of accountability, financial responsibility should be given to the public and private sector officials who make the certifications in order to increase the efficiency in the audit.

V. Policy Recommendations

In this paper, we provide short-term and long-term policy recommendations. Short-term policy recommendations are those that should be implemented within the first 3 months. Medium-long term recommendations are those that should be implemented in the first year and thereafter.

Short-Term Policy Recommendations

We recommend the implementation of the following policies within the first 3 months after the earthquake:

1. For the prevention of epidemics in the earthquake zone:
 - a. Effective planning and supervision of debris removal
 - b. Rapid completion of clean water and wastewater infrastructure
 - c. Effective garbage collection and city cleaning
2. To create civilized urban areas in the earthquake zone
 - a. Repair of electricity, natural gas and communication networks

- b. Accessibility of healthcare centers
 - c. Providing education services
3. Ensuring security in the earthquake zone
4. Effectively fighting against poverty, increasing household transfers, implementing universal basic income to households whose houses/workplaces had been severely damaged or destroyed by the earthquake
5. Providing cash, credit, tax or debt deferral/relief support to companies on a sectoral basis (agriculture, industry, trade and services) based on the rate of damage their businesses have been exposed to
6. Fast and effective implementation of employment support through İŞKUR and KOSGEB
7. Deferral/relief of household utility bills based on the rate of damage that they have been subject to
8. In order to reduce macro-financial risks, implementation of internationally accepted and prudent economic policies
9. Preparing and implementing a back to business plan in earthquake hit provinces.
10. Planning the new cities that will be constructed in the earthquake zone considering the agricultural and livestock production needs of Turkey
11. Planning and execution of the region's recovery and development program together with international financial institutions
12. Providing loan/grant support from international financial institutions in order to keep the financing cost of the earthquake at reasonable levels amid a slowing economy

Medium-Long-Term Policy Recommendations

Medium and long-term policy recommendations are those that will take one year or more to implement. These recommendations are as follows:

1. Preparation of a strategy to combat disasters and global climate change; preparation of annual and medium-term economic and development programs in line with this strategy
2. Establishment of an Earthquake and Disaster Fund, creating a financial area to meet Turkey's financial losses in the face of various natural disasters such as earthquakes, floods, forest fires and droughts.
3. Reducing shadow economy and increasing the tax base in order to create financial means for earthquake-related expenses.
4. Expanding the tax base by reducing tax cuts and exemptions based on equity and efficiency
5. Rationalization and increasing the efficiency of public expenditures
6. Expanding the scope and effectiveness of TCIP
7. Planning of cities by considering natural disasters and global climate change
8. Making the infrastructure and superstructure earthquake-resistant in areas under earthquake risk
9. Improving the standards of the zoning plans based on international best practices
10. Bringing accountability to public officials in charge of zoning plan
11. Giving financial responsibility to building inspection companies

12. Implementing macroeconomic policies by considering natural disasters and global climate change
13. Incorporating disaster drills and readiness to emergencies in the work plan of workplace security companies
14. Bringing disaster risk management to the business plan of local governments and increasing the efficiency and readiness of local governments against disasters
15. Determination of emergency assembly, access and evacuation routes and priorities in cities according to population density
16. Increasing the participation of NGOs in the fight against disasters and raising the quality and quantity of volunteers who can participate in emergency situations by providing training opportunities
17. Establishing uninterrupted and reliable communication systems, ensuring an effective response and rapid recovery after disasters
18. Strengthening the transportation, energy, water and sewerage infrastructures, which are critically important after a disaster
19. Preparing a risk analysis of cities against disasters such as earthquakes, floods and fires, and improving urban planning and construction standards accordingly
20. Starting a 5-year rolling building inspection plan, based on the joint assessment of local governments and building inspection companies

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APPENDICES

APPENDIX-1: Reconstruction Costs of the Earthquake Zone

In this paper, we determined the cost of the earthquake on the building stock as following: According to the statements made by the official authorities, we know that the public sector will bear the reconstruction cost of houses, where the homeowners reside. Based on TURKSTAT statistics, we estimate that households reside in 70% of the residential building stock, and the rest are seasonal houses, vacant or under construction. We estimate that 60% of the residents in the region are homeowners. We anticipate that the public will bear half of the reconstruction cost of the nonresidential buildings in order to stimulate the move back to the region. On the other hand, we foresee that the households and companies will bear all the repair and strengthening expenses of building stock. Therefore, we estimated that approximately half of the reconstruction costs of housing, workplaces, public buildings and infrastructure will be undertaken by the public. We distribute the damage on the public and private building stock, and on the residential and nonresidential use of buildings based on TURKSTAT, Presidency 2020 Annual Program and Eleventh Development Plan (2019-2023), Housing Policies Specialization Commission Report. Again, based on these reports and the number of households in the provinces, we determine 70% of the residential building stock will be reconstructed or repaired, and the rest will be a net wealth loss for households (Table 8).

Housing construction costs are based on TOKİ's regional tender prices. In this context, we use average reconstruction cost of a residential unit at 1.570 thousand TL with an exchange rate of 19 TL per US\$ (Table 9: Provincial and District Based Housing Tenders). We project the unit reconstruction cost at 5.8 million TL for workplaces and 24.7 million TL for public buildings, based on the average size of workplaces and public buildings reported by TOKİ. We foresee reinforcement costs as one quarter of reconstruction costs, and repair costs as half of the latter.

We estimate total construction, reinforcement and repair costs at TL 1.7 trillion (US\$88 billion). We estimate that the reconstruction cost will be 70% of the US\$88 billion, and the remaining 30% will be due to the reinforcement and repair expenses. We foresee that the public will undertake half of the burden of the total construction financing.

We anticipate that the debris removal, transportation and infrastructure investments required for the reconstruction and restructuring of the region will be 170 billion TL (US\$9 billion). We estimate debris removal expenses at 58 billion TL according to the approximate cost calculations from the sector (including debris transportation and bulking). We expect the cost of infrastructure and superstructure work, such as communication, energy, drinking water and sewerage needed for damaged and rebuilt settlements, at 115 billion TL.

Table 8: Infrastructure and Superstructure Construction Cost

TL	Total Costs (Billion TL)						Unit Costs (Thousand TL)		
	SUM	PUBLIC	PRIVATE	Construction	Strengthening	Repairing	Construction (1)	Strengthening (2)	Repairing (3)
TOTAL CONSTRUCTION AND REPAIR	1,664	833	831	1,122	73	296			
TOTAL SUPERSTRUCTURE	1,492	660	831	1,122	73	296			
Residences (4)	852	385	467	641	42	169	1,570	393	196
Workplaces	546	206	341	411	27	108	6,134	1,534	767
Public Buildings	93	70	23	70	5	19	24,748	6,187	3,093
TOTAL INFRASTRUCTURE	173	173							
Wreckage Removal	58	58							
Transport, energy, water, sewerage, etc.	115	115							
Assumptions:									
(1) Construction cost is based on TOKİ's first tenders and is TL 1.6 million per house including land.									
Construction costs of workplaces and public buildings are based on average square meter building sizes according to TURKSTAT data.									
(2) Strengthening Cost is foreseen as 1/4 of the reconstruction cost.									
(3) The cost of repairs is estimated at 1/8 of the cost of reconstruction.									
(4) Based on the number of dwellings/households in the region, it is assumed that 30% of the existing dwellings are summer houses, vacant or under construction and 70% of the dwellings will be reconstructed, strengthened and repaired.									

Table 9: Post-Earthquake Housing Tenders

Province	Subprovince	Number of Houses	Number of Shops / Workplaces	Tender Price (Million TL)	House Price (Average, Million TL)
Adıyaman	Kahta	297	4	469	1.6
Gaziantep	Nurdağı	456		777	1.7
Gaziantep	Islahiye	399	12	519	1.3
Kilis	Merkez	645	4	1,124	1.7
Adana	Sarıçam	590		810	1.4
Kahramanmaraş	Afşin	501	18	788	1.5
Kahramanmaraş	Pazarcık	518		809	1.6
Hatay	Altınözü	364	5	594	1.6
Kahramanmaraş	Dulkadiroğlu	256		400	1.6
Şanlıurfa	Eyyübiye	363	5	640	1.7
Malatya	Battalgazi	599		919	1.5
Malatya	Battalgazi	474	10	834	1.7
Kahramanmaraş	Elbistan	714		1,212	1.7
Hatay	İskenderun	492		895	1.8
Hatay	Payas	821	36	1,145	1.3
Sum		7,489	94	11,934	1.6
Source: Toker (2023a, 2023b)					

ANNEX-2: Loss of Property and Movables

We estimate the loss of property based on the number of vehicles in the earthquake zone. Based on the damage on the building stock, we expect a damage ratio 30% on the 1.1 million vehicles registered in the region. We use average recovery price of a vehicle at 600 thousand TL. We estimate the damage on other fixtures, consumer goods and stocks based on the damage to the building stock.

Table 10: Number of Vehicles in the Earthquake Zone

Province	Sum	Automobile	Minibus	Bus	Pickup Truck	Truck	Motorcycle	Special Purpose	Tractor
Adıyaman	122 253	55 710	4 231	370	17 096	3 608	20 361	352	20 525
Diyarbakır	135 172	57 940	6 007	1 423	22 308	6 489	13 897	1 199	25 909
Gaziantep	601 997	266 073	12 828	4 736	105 437	22 439	145 712	1 349	43 423
Hatay	557 264	242 866	9 628	3 937	69 090	22 489	182 463	1 055	25 736
Malatya	202 351	108 491	4 226	1 746	39 353	5 690	13 285	601	28 959
Kahramanmaraş	272 341	154 838	6 774	1 976	48 514	8 345	25 368	847	25 679
Şanlıurfa	273 435	96 955	8 312	1 686	28 560	15 238	79 250	981	42 453
Kilis	53 279	11 566	862	163	4 123	1 126	27 838	215	7 386
Osmaniye	188 858	92 981	3 716	1 088	26 337	4 309	40 540	471	19 416
Sum	2 406 950	1 087 420	56 584	17 125	360 818	89 733	548 714	7 070	239 486

Source: TURKSTAT