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Annex G

This annex contains the detailed results of tests referenced in the Methods section.

G-I-   Temporal Consistency Check

The objective of the temporal consistency check is to test if the GDP and final expenditure components' quarterly chain-linked Laspeyres volume indices and values at current prices are temporally consistent with their annual counterparts. For chain-linked Laspeyres volume indices, temporal consistency means that the series of annual averages of the quarterly indices matches the series of annual indices. For values at current prices, temporal consistency means that the series of annual sums of the quarterly values matches the series of annual values.

Note: The variable definitions and notations from Subsection A-III, "Treatment of Data Category 1: GDP and Final Expenditure Components," are maintained in this subsection (see A-III-2.2, 'Variable Definitions and Notations').

G-I-1.   Chain-Linked Laspeyres Volume Indices

To test the temporal consistency of the chain-linked Laspeyres volume indices with reference year 2009 for component i in the period from 1998 to 2023, we tested if the below equation holds over the period.

$$\frac{1}{4} * \sum_{s=1}^{4} Q_i^{2009\rightarrow(s,y)} = Q_i^{2009\rightarrow y}$$

Therefore, we calculated the following metrics for GDP and final expenditure components for years 1998 to 2023:

- The absolute difference, $\Delta_{Q,i}^{y}$, between the right-hand side and the left-hand side terms of the above equation. If the difference is null, or roughly null due to rounding errors, then the above equation holds, and so does the temporal consistency property.

$$\Delta_{Q,i}^{y} = \left| \frac{1}{4} * \sum_{s=1}^{4} Q_i^{2009\to(s,y)} - Q_i^{2009\to y} \right|$$

- The absolute difference in monetary terms obtained by multiplying $\Delta_{Q,i}^{y}$ by the value at current prices of component i in year 2009, C_i^{2009}. This measure helped us spot significant differences.

$$C_i^{2009} * \Delta_{Q,i}^{y}$$

- The absolute deviation of $\frac{1}{4} * \sum_{s=1}^{4} Q_i^{2009\to(s,y)}$ from $Q_i^{2009\to y}$ obtained by dividing $\Delta_{Q,i}^{y}$ by $\left| Q_i^{2009\to y} \right|$.

$$\frac{\Delta_{Q,i}^{y}}{\left| Q_i^{2009\to y} \right|}$$

We computed the metrics for both unadjusted, and seasonally and calendar adjusted quarterly chain-linked Laspeyres volume indices with respect to each of annual unadjusted and annual calendar adjusted indices. The results of the comparison with annual unadjusted indices are summarized in table 1.1, while those of the comparison with annual calendar adjusted indices are summarized in table 1.2. The complete test is available in the attached code file, "Data-Processing-1," under Subheading 2.2.1.1, "Volume Indices," within heading 2.2.1, "Temporal Consistency Check."

Table 1.1 shows low maximum values of the metrics for quarterly unadjusted series if we exclude one deviation in the GDP series in year 1998. This means that quarterly unadjusted series are temporally consistent with their annual unadjusted counterparts. In fact, the temporal consistency is maintained in unadjusted volume indices thanks to the use of the annual overlap technique to chain-link quarterly volume indices (IMF 2018).

We remark in Table 1.1 that some quarterly seasonally and calendar adjusted volume index series—Exports of Goods and Services, Imports of Goods and Services, and Final Consumption Expenditure of NPISH—are consistent with their corresponding annual unadjusted series. This result is in line with the TUIK's methodology, which is described in the quarterly national accounts metadata, indicating that the seasonally and calendar adjusted versions of quarterly volume index series that do not contain significant calendar effects are benchmarked against their annual unadjusted counterparts (TUIK 2024).

Table 1.1.
Temporal Consistency Check Results for Quarterly Unadjusted and Seasonally and Calendar Adjusted Volume Indices with Respect to Annual Unadjusted Volume Indices.

		Absolute Difference in indices		Absolute Difference in monetary terms (Thousand 2009 TRY)		Absolute Percentage Deviation (%)	
Series		Avg.	Max.	Avg.	Max.	Avg.	Max.
Final Consumption Expenditure of Households	V1	8.10^{-15}	6.10^{-14}	5.10^{-8}	4.10^{-7}	5.10^{-15}	2.10^{-14}
	V2	2.10^{-1}	7.10^{-1}	1.10^{6}	4.10^{6}	1.10^{-1}	3.10^{-1}
Final Consumption Expenditure of NPISH	V1	2.10^{-12}	4.10^{-11}	6.10^{-8}	2.10^{-6}	2.10^{-18}	4.10^{-11}
	V2	5.10^{-9}	3.10^{-8}	2.10^{-4}	8.10^{-4}	2.10^{-9}	1.10^{-8}
Government Final Consumption Expenditure	V1	2.10^{-15}	3.10^{-14}	4.10^{-9}	4.10^{-8}	2.10^{-15}	2.10^{-14}
	V2	1.10^{-1}	6.10^{-1}	2.10^{5}	9.10^{5}	8.10^{-2}	4.10^{-1}
Gross Fixed Capital Formation	V1	9.10^{-15}	3.10^{-14}	2.10^{-8}	6.10^{-8}	6.10^{-15}	2.10^{-14}
	V2	4.10^{-3}	3.10^{-2}	8.10^{3}	6.10^{4}	4.10^{-3}	3.10^{-2}
Exports of Goods and Services	V1	8.10^{-14}	2.10^{-12}	2.10^{-7}	5.10^{-6}	8.10^{-14}	2.10^{-12}
	V2	2.10^{-11}	5.10^{-11}	4.10^{-5}	1.10^{-4}	1.10^{-11}	3.10^{-11}
	V1	7.10^{-14}	2.10^{-12}	2.10^{-7}	4.10^{-6}	7.10^{-14}	3.10^{-12}

		Avg.	Max.	Avg.	Max.	Avg.	Max.
Imports of Goods and Services	V2	3.10^{-11}	1.10^{-10}	6.10^{-5}	2.10^{-4}	2.10^{-11}	5.10^{-11}
GDP	V1ᶜ	6.10^{-15}	3.10^{-14}	6.10^{-8}	3.10^{-7}	4.10^{-15}	2.10^{-14}
	V2	9.10^{-2}	3.10^{-1}	9.10^{5}	3.10^{6}	7.10^{-2}	2.10^{-1}

a.   V1 refers to the unadjusted version of the series, and V2 refers to the seasonally and calendar adjusted version of the series.

b.   "Avg." is an abbreviation for "Average"; "Max." is an abbreviation for "Maximum."

c.   Excluding year 1998, where the difference in indices amounts to 6.10^{-3} and to 6.10^{4} thousand 2009 TRY in monetary terms, and the absolute percentage deviation is equal to 8.10^{-3}.

d.   Results are expressed to one significant figure

Table 1.2.
Temporal Consistency Check Results for Quarterly Unadjusted and Seasonally and Calendar Adjusted Volume Indices with Respect to Annual Calendar Adjusted Volume Indices.

		Absolute Difference in indices		Absolute Difference in monetary terms (Thousand 2009 TRY)		Absolute Percentage Deviation (%)	
Series		Avg.	Max.	Avg.	Max.	Avg.	Max.
Final Consumption Expenditure of Households	V1	2.10^{-1}	7.10^{-1}	1.10^{6}	4.10^{6}	1.10^{-1}	3.10^{-1}
	V2	2.10^{-11}	1.10^{-10}	1.10^{-4}	9.10^{-4}	1.10^{-11}	6.10^{-11}
Final Consumption Expenditure of NPISH	V1	2.10^{-11}	4.10^{-11}	6.10^{-7}	2.10^{-6}	2.10^{-11}	4.10^{-11}
	V2	4.10^{-9}	3.10^{-8}	2.10^{-4}	8.10^{-4}	2.10^{-9}	1.10^{-8}
Government Final Consumption Expenditure	V1	2.10^{-1}	6.10^{-1}	3.10^{5}	9.10^{5}	1.10^{-1}	4.10^{-1}
	V2	4.10^{-2}	2.10^{-1}	7.10^{4}	3.10^{5}	6.10^{-2}	2.10^{-1}
Gross Fixed Capital Formation	V1	4.10^{-3}	3.10^{-2}	8.10^{3}	6.10^{4}	4.10^{-3}	3.10^{-2}
	V2	4.10^{-11}	2.10^{-10}	9.10^{-5}	4.10^{-4}	2.10^{-11}	6.10^{-11}
Exports of Goods and Services	V1	8.10^{-13}	2.10^{-12}	2.10^{-6}	5.10^{-6}	1.10^{-12}	2.10^{-12}
	V2	1.10^{-11}	5.10^{-11}	3.10^{-5}	1.10^{-4}	9.10^{-12}	3.10^{-11}

Imports of Goods and Services	V1	7.10^{-13}	2.10^{-12}	2.10^{-6}	5.10^{-6}	8.10^{-13}	2.10^{-12}
	V2	2.10^{-11}	1.10^{-10}	6.10^{-5}	2.10^{-4}	1.10^{-11}	5.10^{-11}
GDP	V1	9.10^{-2}	3.10^{-1}	9.10^{5}	3.10^{6}	7.10^{-2}	2.10^{-1}
	V2	3.10^{-3}	2.10^{-2}	3.10^{4}	2.10^{5}	4.10^{-3}	2.10^{-2}

a. V1 refers to the unadjusted version of the series, and V2 refers to the seasonally and calendar adjusted version of the series.

b. "Avg." is an abbreviation for "Average"; "Max." is an abbreviation for "Maximum."

c. Results are expressed to one significant figure

Table 1.2 indicates that the quarterly seasonally and calendar adjusted Final Consumption Expenditure of Households and Gross Fixed Capital Formation volume index series, which we deem temporally inconsistent with their annual unadjusted counterparts, are temporally consistent with their annual calendar adjusted counterparts. Meanwhile, quarterly seasonally and calendar adjusted GDP and Government Final Consumption Expenditure series aren't temporally consistent with both versions of their annual counterparts. Comparing the quarterly calendar adjusted versions of these series (available on the TUIK's website) to the quarterly unadjusted ones revealed the existence of relatively strong calendar effects. Therefore, based on the TUIK's methodology indicating that the seasonally and calendar adjusted versions of quarterly volume index series with significant calendar effects are benchmarked against their annual calendar adjusted counterpart series, the temporal inconsistency with respect to the annual unadjusted series is justifiable. Whereas, for the same reasons, the inconsistency with respect to the annual calendar adjusted series is surprising. Moreover, after examining the results in more detail, we found that the inconsistency with respect to the annual calendar adjusted series for both is limited to the period between 1998 and 2008.

G-I-2.   Values at Current Prices

To test the temporal consistency of the values at current prices for component i in the period from 1998 to 2023, we tested if the below equation holds over the period.

$$\sum_{s=1}^{4} C_i^{(s,y)} = C_i^y$$

Therefore, we calculated the following metrics for GDP and final expenditure components for years 1998 to 2023:

- The absolute nominal difference, $\Delta_{C,i}^y$, between the right-hand side and left-hand side terms of the above equation. If the difference is null, or roughly null due to rounding errors, then the above equation holds, and so does the temporal consistency property.

$$\Delta_{C,i}^y = \left| \sum_{s=1}^{4} C_i^{(s,y)} - C_i^y \right|$$

- The absolute percentage deviation of $\sum_{s=1}^{4} C_i^{(s,y)}$ from C_i^y obtained by dividing $\Delta_{C,i}^y$ by $|C_i^y|$.

$$\frac{\Delta_{C,i}^y}{|C_i^y|}$$

We computed the above metrics for both unadjusted and seasonally adjusted quarterly values at current prices with respect to annual unadjusted values at current prices. Results are summarized in tables 1.3. Furthermore, the complete test is available in the attached code file, "Data-Processing-1," under Subheading 2.2.1.2, "Values at Current Prices," within heading 2.2.1, "Temporal Consistency Check."

Table 1.3 demonstrates the temporal consistency of both unadjusted and seasonally adjusted quarterly values at current prices with respect to annual unadjusted ones. In fact, the largest absolute nominal difference is recorded for the seasonally adjusted Change in Stocks component, amounting to approximately one TRY.

Table 1.3:
Temporal Consistency Check Results for Quarterly Unadjusted and Seasonally Adjusted Values at Current Prices with Respect to Annual Unadjusted Values at Current Prices.

Series		Absolute Nominal Difference (Thousand TRY)		Absolute Percentage Deviation (%)	
		Avg.	Max.	Avg.	Max.
Final Consumption Expenditure of Households	V1	1.10^{-6}	4.10^{-6}	3.10^{-13}	2.10^{-12}
	V2	8.10^{-5}	3.10^{-4}	1.10^{-11}	6.10^{-11}
Final Consumption Expenditure of NPISH	V1	5.10^{-9}	4.10^{-8}	9.10^{-14}	4.10^{-13}
	V2	8.10^{-5}	7.10^{-4}	3.10^{-9}	3.10^{-8}
Government Final Consumption Expenditure	V1	8.10^{-8}	1.10^{-6}	1.10^{-14}	4.10^{-14}
	V2	1.10^{-4}	3.10^{-4}	1.10^{-10}	9.10^{-10}
Gross Fixed Capital Formation	V1	9.10^{-6}	2.10^{-4}	2.10^{-12}	9.10^{-12}
	V2	4.10^{-5}	2.10^{-4}	2.10^{-11}	9.10^{-11}
Change in Stocks	V1	2.10^{-5}	4.10^{-4}	1.10^{-10}	2.10^{-9}
	V2	4.10^{-4}	1.10^{-3}	6.10^{-9}	5.10^{-8}
Exports of Goods and Services	V1	5.10^{-7}	3.10^{-6}	3.10^{-13}	2.10^{-12}
	V2	5.10^{-5}	1.10^{-4}	4.10^{-11}	3.10^{-10}
Imports of Goods and Services	V1	9.10^{-7}	6.10^{-6}	3.10^{-13}	2.10^{-12}
	V2	7.10^{-5}	2.10^{-4}	3.10^{-11}	1.10^{-10}
GDP	V1	3.10^{-5}	4.10^{-4}	1.10^{-12}	9.10^{-12}
	V2	3.10^{-5}	4.10^{-4}	6.10^{-13}	9.10^{-12}

a. V1 refers to the unadjusted version of the series, and V2 refers to the seasonally adjusted version of the series.

b. "Avg." is an abbreviation for "Average"; "Max." is an abbreviation for "Maximum."

c. Results are expressed to one significant figure