

BOX 1: AN UPDATED ANALYSIS OF REVISIONS TO MALTESE NATIONAL ACCOUNTS DATA¹

Data revisions are necessary for diverse reasons, such as to reflect newly available information or to implement methodological or regulatory changes. This notwithstanding, revisions implicitly create some uncertainty when interpreting economic data in real time. In turn, this uncertainty is likely to limit policymakers' ability to make accurate judgments of the true economic performance in real time, with potential consequences to the effectiveness of policymaking. Indeed, Gerberding et al. (2004) show that *ex-post* conclusions about the strategies adopted by monetary authorities can differ substantially, depending on whether they are based on real-time or revised data.²

In this light, significant research effort has gone into obtaining a better understanding of some of the main statistical properties of data revisions, such as their size, bias, and volatility.³ Much of this research has been made possible by the increased availability of real-time macroeconomic datasets. Such datasets, which facilitate analysis of data revisions by bringing together historical data releases, or vintages, into a single database, are nowadays available for numerous countries, including the United States and the United Kingdom, among many others.

In the local context, the Central Bank of Malta compiled the first real-time macroeconomic database for Malta in 2018. This dataset comprises quarterly vintages of Maltese national accounts data releases and incorporates 14 different series, namely GDP and its main expenditure components, all measured both in *real* and *nominal* values. The first vintage available in this database is that published in 2002Q1, and the database includes all successive quarterly vintages to date. Each vintage dated at period contains data points up to period $t - 1$, reflecting the typical one-quarter delay in the release of GDP data.^{4,5}

In the first analysis of the Maltese national accounts data up to the 2018Q1 vintage, Grech (2018) found revisions to be quite sizeable, biased upwards, volatile, and rising over the publication horizon. In light of subsequent events which inevitably affected data collection and reporting, namely the COVID-19 pandemic and the benchmark revision published in the third quarter of 2020, this article sets out to update the analysis undertaken by Grech (2018) by considering all subsequent vintages published up to and including the 2024Q2 vintage, as recorded in the Bank's real-time database. In order to identify any recent changes in the size, bias, and volatility of data revisions, a full-sample analysis is

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² Gerberding, C., Worms, A., and Seitz, F. (2004), "How the Bundesbank really conducted monetary policy: An analysis based on real-time data", *Technical report*, Discussion Paper Series 1.

³ See for example, Van Walbeek, C. (2006), "Official revisions to South African National Accounts data: Magnitudes and Implications", *South African Journal of Economics*, 74(4): 745-765.

⁴ A vintage represents a time series of the latest data available at a point in time and each vintage is dated according to its publication date. Given the typical one-quarter delay in the release of Maltese GDP data, the date of each vintage is therefore one quarter ahead of the final datapoint of the underlying time series. For instance, the data vintage published during the first quarter of 2018 is referred to as the "2018Q1 vintage" and comprises a time series up to and including 2017Q4 data.

⁵ For more detail about the Maltese real-time database, see Grech, O. (2018), "An Analysis of Revisions to Maltese GDP data", Central Bank of Malta *Research Bulletin*, 1(1): 27-34.

complemented by a separate analysis over the vintages dated 2018Q2 onwards only, thus all subsequent vintages not featured in the work of Grech (2018). Moreover, this article also assesses revisions to the expenditure components of GDP and their respective contribution to overall real GDP revisions, thereby shedding light on the sources behind the size, bias, and volatility of overall GDP data revisions.

Analysis of real GDP data revisions

We first consider the revisions made by the NSO to aggregate real GDP data. In particular, as in Grech (2018), we examine the magnitude, bias, and volatility of revisions to year-on-year real GDP growth rates. This in-depth examination of data revisions should be useful to data users insofar as it provides valuable insights into interpreting national accounts data over successive vintages.

The main results of the analysis of real GDP data revisions are documented in Table 1. We consider the revisions that take place within the first year from the initial release, and, for each set of revisions, we conduct the analysis on three separate collections of vintages. Specifically, for each of the first four revisions analysed in Table 1, the first row reflects the revisions analysis undertaken on all the vintages available in the Maltese real-time database to date (i.e. based on the 2002Q1-2024Q2 vintages). As such, these can be interpreted as an update to the analysis found in Grech (2018), which relied on the 2002Q1-2018Q1 vintages. For ease of reference, the latter set of results are re-produced in square brackets in the second row of each revision horizon

Table 1
REVISION ANALYSIS OF AGGREGATE REAL GDP ANNUAL GROWTH DATA

	Vintages covered	Mean Absolute Revision	Mean Revision	Proportion of Positive Revisions	Deviation of Revisions	Maximum Negative Revisions	Maximum Positive Revision	Sample Size
		Percentage points	Per cent	Per cent	Percentage points	Percentage points	Percentage points	
1 st vs 2 nd release	2002Q1-2024Q2	0.60	0.31	65	0.79	-2.24	2.98	88
	2002Q1-2018Q1	[0.51]	[0.20]	[57]	[0.71]	[-2.24]	[2.00]	[63]
	2018Q2-2024Q2	(0.81)	(0.62)	(84)	(0.91)	(-1.66)	(2.98)	(25)
1 st vs 3 rd release	2002Q1-2024Q2	0.82	0.39	71	1.09	-3.38	4.34	86
	2002Q1-2018Q1	[0.73]	[0.21]	[64]	[0.98]	[-3.38]	[2.29]	[61]
	2018Q2-2024Q2	(1.03)	(0.85)	(88)	(1.20)	(-1.85)	(4.34)	(25)
1 st vs 4 th release	2002Q1-2024Q2	1.01	0.48	69	1.27	-3.69	4.31	84
	2002Q1-2018Q1	[0.87]	[0.23]	[61]	[1.14]	[-3.69]	[2.58]	[59]
	2018Q2-2024Q2	(1.33)	(1.08)	(88)	(1.36)	(-1.67)	(4.31)	(25)
1 st vs 5 th release	2002Q1-2024Q2	1.13	0.53	68	1.43	-4.38	6.08	82
	2002Q1-2018Q1	[0.94]	[0.18]	[58]	[1.24]	[-4.38]	[2.72]	[57]
	2018Q2-2024Q2	(1.56)	(1.35)	(92)	(1.50)	(-1.80)	(6.08)	(25)

Source: Authors' calculations based on CBM's real-time macroeconomic database.

Note: For each set of revisions, the first row (i.e. figures not enclosed in parentheses) covers analysis based on the 2002Q1-2024Q2 vintages. The second row (i.e. figures enclosed in square parentheses) covers analysis based on the 2002Q1-2018Q1 vintage, thereby being the same figures recorded in Grech (2018). The third row (i.e. figures enclosed in round brackets) covers analysis based on the 2018Q2-2024Q2 vintages. Each of the four sets of revisions considers each reference quarter only once. For example, in the first set comparing the 1st vs 2nd release, we consider the corresponding first revision effected in all vintages dated 2002Q1 until 2024Q2. In light of some missing data, this adds up to 88 observations upon which we analyse the first revisions to historical real GDP growth rates.

analysed. Finally, the figures enclosed in round brackets in Table 1 depict results for the revisions made solely from the 2018Q2 vintage onwards, thus focusing exclusively on the revisions made in recent years, in particular during and after the COVID-19 pandemic.

Starting first with the analysis covering all the vintages dated 2002Q1-2024Q2, we note substantial revisions to initial real GDP growth data, with the average first revision amounting to 0.60 percentage point in absolute terms. This evidence of substantial revisions is in line with the results described in Grech (2018), as is the observation that deviations from the initial annual growth estimate generally widen with the revision horizon. Indeed, the absolute revision in the growth rate between the first release and the fifth release, i.e. the value one year later, increases to an average of 1.13 percentage points. Looking at any underlying bias in the revisions, both the average revision (AR) and the proportion of positive revisions indicate that the revisions to initial growth rates are typically positive. In fact, on the basis of the data published in all the vintages since 2002Q1, the mean revision indicator reveals that the growth rate in the second release is, on average, 0.31 percentage point higher than that in the first release. This rises progressively to 0.53 percentage point when the initial release is compared to that published four quarters later (i.e. the fifth release). Further analysis shows that around two-thirds of the revisions analysed are typically in an upward direction. This reflects a continuation of the positive bias observed in the revisions up to early 2018. Regarding volatility, the results indicate that revisions to initial estimates of aggregate real GDP growth exhibit considerable volatility, as evident from both the relatively large standard deviations (SD) and wide ranges of revisions. For instance, the revisions between the first and second estimates range from -2.24 to +2.98 percentage points.

While these findings are qualitatively similar to the patterns observed by Grech (2018), the analysis based on data up to the 2018Q1 vintage yields consistently smaller summary statistics than those based on all vintages up to and including the 2024Q2 vintage. For instance, the mean absolute revisions (MAR) covering the 2002Q1-2024Q2 vintages are all larger than the corresponding figures recorded in Grech (2018). This implies that revisions have, on average, been more pronounced since the 2018Q2 vintage, relative to those made in earlier vintages.⁶ Statistics of the AR, proportion of positive revisions, and SD also become more pronounced as the post-2018Q1 vintages are incorporated in the analysis. These patterns imply that Grech's (2018) conclusion of revisions which are "sizeable, biased upwards, volatile and increase with the horizon" is further reinforced with the inclusion of more recent vintages.

In Table 1, we also isolate data from the 2018Q2 vintage onwards to analyse patterns in the recent revisions made by the NSO. As implied by the trends documented previously, changes to initial releases have typically been more pronounced since the 2018Q2 vintage.⁷ Starting with the size of revisions, analysis of real GDP data from the 2018Q2-2024Q2 vintages reveals that the absolute revision between initial estimates and those published one year later (i.e. 1st vs 5th release) averaged 1.56 percentage points, compared to the 0.94

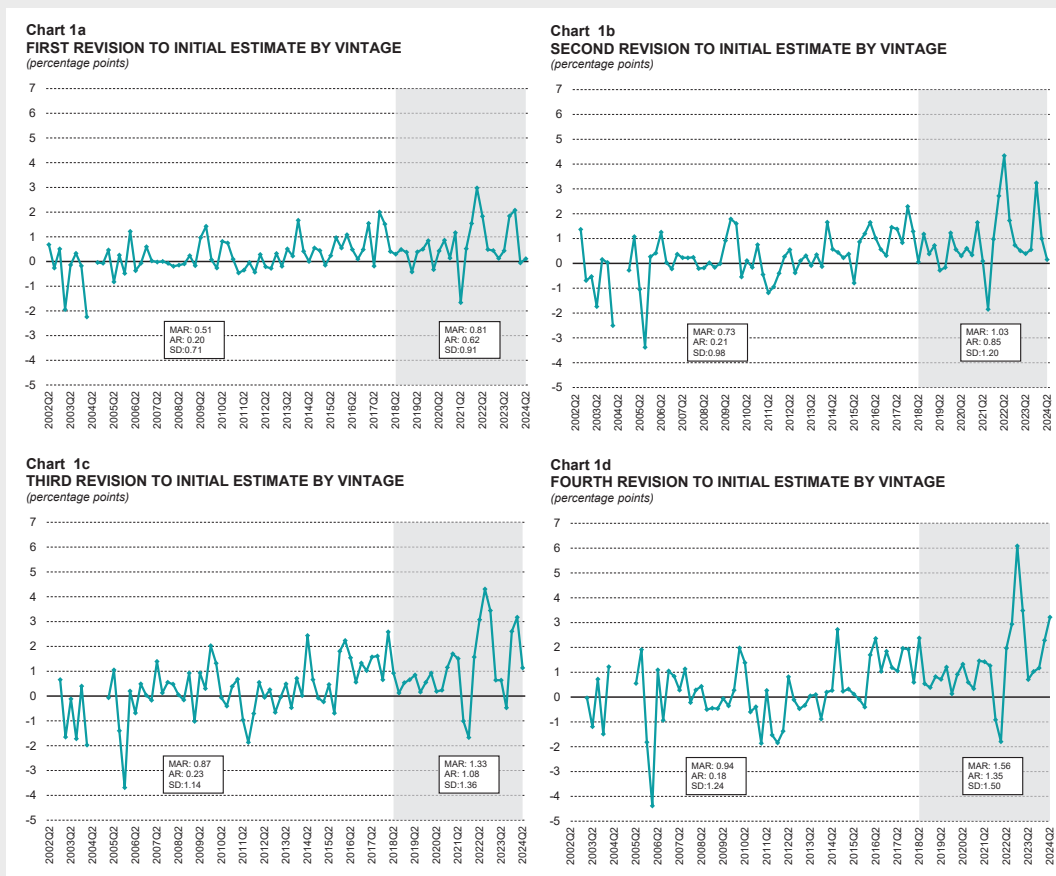
⁶ Inevitably, this is partly due to the fact that the underlying annual growth rates over the 2018Q2-2024Q2 period were on average significantly larger (in both average and absolute terms) than over the 2002Q1-2018Q1 period. Higher growth rates are typically susceptible to more substantial revisions than lower growth rates.

⁷ This statement comes with the caveat that it is based on a much smaller sample (2018Q2-2024Q2 vintages) than that analysed by Grech (2018).

percentage point recorded over all vintages prior to 2018Q2. In terms of direction, the positive bias is notably more significant from the 2018Q2 vintage onwards, with generally more than 85% of revisions being in an upward direction, compared to the *circa* 60% observed in prior vintages. Moreover, the mean (positive) revisions observed from the 2018Q2 vintage onwards are also noticeably stronger. Revisions made over the 2018Q2-2024Q2 vintages have also been slightly more volatile, with their SD consistently exceeding that of the revisions made up to the 2018Q1 vintage. Moreover, the maximum positive revisions are all considerably larger than those documented in the study by Grech (2018).

Charts 1a to 1d show the time-variation of revisions by depicting the first four revisions to initial annual real GDP growth data by vintage. The shaded area represents the 2018Q2 vintage onwards, thereby capturing the revisions not featured in the analysis of Grech (2018). We also include statistics of the MAR, AR, and SD for revisions made up to the 2018Q1 vintage, as well as for those over the 2018Q2-2024Q2 vintages.

As discussed previously, the first revision to initial estimates is typically positive, with this pattern persisting even beyond the 2018Q1 vintage, as seen in Chart 1a. There are some



Source: Authors' calculations.
 Note: For each revision i illustrated in Charts 1a to 1d, the vintage date corresponds to the vintage in which the i^{th} revision to the initial estimate takes place. For instance, the last datapoint corresponding to the 2024Q2 vintage in Chart 1b shows that by the second revision, the 2023Q3 real GDP growth rate was revised upwards by 0.15 percentage point when compared to the initial estimate published in the 2023Q4 vintage. Similarly, Chart 1d shows that by the fourth revision published in the 2022Q4 vintage, the real GDP growth rate for 2021Q3 was revised upwards by 6.08 percentage points from its initial estimate published in the 2021Q4 vintage. MAR refers to Mean Absolute Revision; AR refers to Average Revision; SD refers to Standard Deviation. For each revision horizon, the leftmost set of summary statistics showing the MAR, AR and SD are based on the revisions made over all vintages up to that dated 2018Q1. The rightmost set of statistics are based on the revisions made over the vintages dated 2018Q2-2024Q2. Breaks in respective plots represent missing national accounts data in the real-time database.

particularly sizeable and volatile revisions made in the vintages spanning 2021Q1-2022Q2, likely as a result of data collection and reporting issues during a time characterised by the COVID-19 pandemic. On the other hand, the pronounced revision in the 2023Q3 vintage is due to a pre-announced ad-hoc revision reflected in this vintage. Another sizeable revision is also observed in the following vintage dated 2023Q4, in which the initial real GDP growth rate for 2023Q2 was revised upwards by more than 2 percentage points. As shown in Charts 1b to 1d, sizeable and volatile revisions are also observed among the second, third, and fourth revisions made by the NSO to the initial release, with the post-2020 vintages again exhibiting the largest positive revisions made since 2002. For instance, the largest second revision made by the NSO since 2002 is recorded in the 2022Q2 vintage, when the 2021Q3 real GDP growth rate was revised upwards by 4.34 percentage points from the corresponding figure initially published in the 2021Q4 vintage. Concurrently, it is also noted that the vintages published from 2020 onwards also recorded some of the most pronounced negative revisions observed since 2002.

Analysis of real GDP components

In what follows, we extend the above analysis to the primary expenditure components of GDP, thus helping to shed further light on whether these patterns persist in the expenditure components. Results for each expenditure component of GDP are presented in Table 2.

Table 2

**PANEL A – REVISION ANALYSIS OF GDP COMPONENTS ANNUAL GROWTH DATA:
1st vs 2nd RELEASE**

	MAR	Mean Revision	Proportion of Positive Revisions	SD of Revisions	Maximum Negative Revisions	Maximum Positive Revision	Sample Size
	<i>Percentage points</i>	<i>Percentage points</i>	<i>Per cent</i>		<i>Percentage points</i>	<i>Percentage points</i>	
GDP	0.60 (0.81)	0.31 (0.62)	65 (84)	0.79 (0.91)	-2.24 (-1.66)	2.98 (2.98)	88 (25)
C	1.13 (0.94)	0.55 (0.55)	66 (64)	1.50 (1.21)	-5.76 (-1.01)	4.93 (4.93)	88 (25)
I	3.92 (3.35)	2.13 (1.89)	64 (64)	6.43 (7.09)	-10.07 (-4.91)	34.36 (34.36)	88 (25)
G	2.07 (2.90)	0.48 (0.96)	61 (68)	2.84 (3.42)	-7.66 (-7.66)	8.41 (6.95)	88 (25)
X	2.68 (2.27)	1.34 (1.88)	67 (72)	3.73 (2.96)	-7.40 (-2.29)	16.14 (10.34)	88 (25)
M	2.62 (2.32)	1.32 (2.11)	66 (76)	3.37 (2.74)	-8.03 (-1.34)	11.34 (9.40)	88 (25)

**PANEL B – REVISION ANALYSIS OF GDP COMPONENTS ANNUAL GROWTH DATA:
1st vs 5th RELEASE**

	MAR	Mean Revision	Proportion of Positive Revisions	SD of Revisions	Maximum Negative Revisions	Maximum Positive Revision	Sample Size
	<i>Percentage points</i>	<i>Percentage points</i>	<i>Per cent</i>		<i>Percentage points</i>	<i>Percentage points</i>	
GDP	1.13 (1.56)	0.53 (1.35)	68 (92)	1.43 (1.50)	-4.38 (-1.80)	6.08 (6.08)	82 (25)
C	1.74 (1.63)	0.59 (0.99)	70 (72)	2.21 (1.74)	-6.37 (-4.19)	7.87 (5.15)	82 (25)
I	8.32 (7.88)	3.11 (3.30)	63 (64)	12.99 (11.88)	-38.94 (-19.97)	48.20 (36.10)	82 (25)
G	2.63 (3.48)	0.70 (1.07)	60 (68)	3.29 (4.01)	-6.32 (-6.32)	8.28 (6.99)	82 (25)
X	4.19 (3.78)	2.66 (3.44)	74 (88)	4.49 (3.12)	-9.48 (-2.22)	15.10 (12.51)	82 (25)
M	4.00 (4.21)	2.58 (3.79)	78 (96)	4.39 (3.66)	-10.19 (-5.28)	13.76 (13.76)	82 (25)

Sources: Authors' calculations based on CBM's real-time macroeconomic database.

Note: The figures enclosed in parentheses are the calculations for 2018Q2-2024Q2 vintages whilst all other figures are based on the full sample of vintages dated 2002Q1-2024Q2. All GDP components presented in the table are considered in real terms.

For conciseness, the analysis is limited to two sets of revisions: Panel A shows the difference between the initially-released growth rate and that published one quarter later, while Panel B shows the difference between the initial release and the growth rate published a year later.⁸ The analysis is primarily based on the full sample of data covered by the 2002Q1-2024Q2 vintages, although estimates based on the 2018Q2-2024Q2 vintages are provided in parentheses so as to facilitate the understanding of any recent changes in data revision patterns.

Notably, results presented in Table 2 show that the characteristics of real GDP data revisions outlined earlier extend also to the primary expenditure components of GDP. However, consistent with the observation made by Grech (2018), the respective components are typically subject to greater revisions and higher volatility than the aggregate real GDP data, both in the full sample and when considering only the vintages dated 2018Q2 and later. Starting with the first revisions to initial estimates, Panel A shows that the respective GDP components display diverse levels of revision. This notwithstanding, with the proportion of positive revisions typically exceeding 60% for all components, and with the ARs also exhibiting a positive sign, revisions to the GDP components are typically of an upward nature. GFCF (I) is generally the most revised and volatile component, as evidenced by the MAR and SD, respectively. On both counts, it is generally followed by exports (X), and imports (M). Having said that, pronounced revisions and heightened volatility in government consumption (G) data are noted from the 2018Q2 vintage onwards, where the absolute size of the first revision over this period averaged 2.90 percentage points. This is slightly below that observed in the GFCF component and higher than the first revisions to exports and imports – a pattern not generally observed in historical revisions. The first revisions to private consumption expenditure (C) are typically the least pronounced and least volatile of the components.

The above patterns, in terms of size, direction, and volatility, hold also when considering the revisions made within one year of first release (see Panel B). In the case of all components, these revisions are typically larger than those made within one quarter of the initial release, thereby suggesting that revisions increase with the horizon. In fact, results presented here show that GDP components are typically subject to some pronounced revisions, which are predominantly positive in nature. GFCF is again subject to the strongest first-year revisions in absolute terms, and these revisions exhibit the greatest volatility. Smaller and less volatile revisions are generally effected to exports, imports, and government consumption, with private consumption remaining the least revised component.

Looking at some of the recent trends observed since the publication of the 2018Q2 vintage, it is noted that, for both pairs of revisions analysed in Table 2, private consumption, GFCF, and exports have recently been revised by less than the historical average in absolute terms. On average, the first revision to imports has also been less pronounced than that observed historically, although the fourth revision to this component has been marginally stronger since the 2018Q2 vintage (panel B). At the same time, revisions to these GDP components

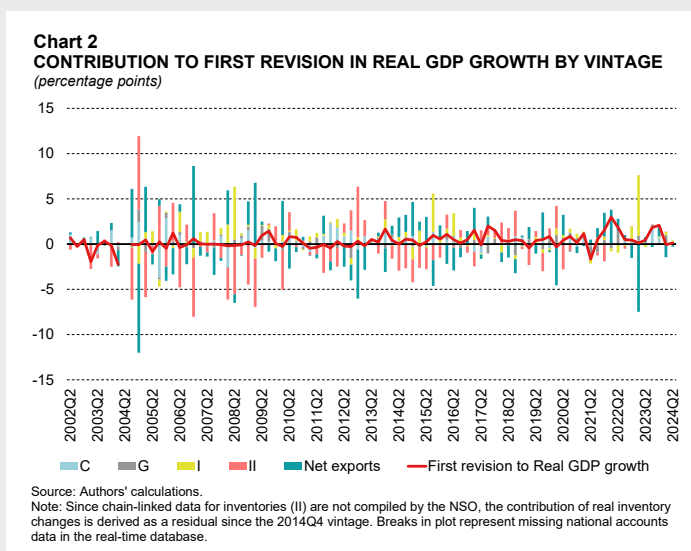
⁸ Analysis of other revision horizons can be obtained from the authors upon request.

have typically also been less volatile.⁹ On the other hand, revisions to government consumption data have been markedly stronger in recent years, with the average absolute size of the revisions since the 2018Q2 vintage being around 0.80 percentage point higher than the historical average observed over the whole sample, irrespective of whether one considers revisions made one quarter, or one year later. Revisions to this component have also become more volatile in recent years, as evidenced by the higher SD exhibited in recent revisions.

Contribution of real GDP components to the revision in aggregate real GDP

While revision analyses of the respective expenditure components of GDP help uncover patterns at a more disaggregated level, the extent to which such underlying revisions contribute to overall real GDP revisions depends heavily on the component's relative share in overall GDP. For instance, while Table 2 shows real government consumption to have been revised more heavily in recent years, the relatively small share of this component in Malta's GDP makes it unlikely that such revisions had any marked impact on output revisions. In contrast, real GDP growth is more likely to be affected by any revisions in exports and imports, which constitute a much larger share of economic activity.

To shed light on the drivers of real GDP revisions in Malta, Chart 2 dissects the first revision in real GDP annual growth by vintage into its underlying contributors.¹⁰ As expected, revisions to exports and imports have been the most important drivers of the first revisions to real GDP growth, with the average contribution of net exports registered at 1.80 percentage points in absolute terms since 2002. Delving deeper into the sub-components of net exports, we note that, historically, revisions in exports have contributed positively to overall real GDP revisions, whereas revisions in imports have generally been a negative contributor. These patterns are illustrative of the fact that both of these components are predominantly revised upwards, as indicated in Table 2.¹¹ With few exceptions, the contribution of the other components is typically relatively less pronounced. For instance,



⁹ The only exception relates to the first revision to GFCF, whose SD since the 2018Q2 vintage is slightly higher than that in the overall sample.

¹⁰ The descriptive results discussed henceforth remain qualitatively similar when considering the fourth revision in real GDP annual growth.

¹¹ *Ceteris paribus*, an upward revision in exports generates an upward revision in GDP growth, whereas any positive revisions in imports imply a downward revision in real GDP, thereby constituting a negative contribution to revisions in aggregate output growth. The resulting contribution of net exports is derived as the difference between the two, and its direction depends on the stronger sub-component of the two.

even though it is subject to the most sizeable and volatile revisions, the contribution of GFCF is often smaller in comparison. One recent exception is its 6.6 percentage points contribution to the first revision of the real GDP growth rate for 2022Q3, which is mostly due to a strong 34.4 percentage points revision in the growth rate of investment during this quarter. Similarly, the more sizeable and volatile revisions to real government consumption in recent years have not driven any substantial revisions to real GDP. Being the least revised component, private consumption expenditure is also typically a minor driver of overall revisions, especially over recent years. Lastly, the relatively strong contribution of real inventory changes (II) in the early years of the sample period has declined substantially over the years, such that its contribution has been much smaller than that of net exports in recent vintages.¹²

Concluding remarks

In conclusion, this analysis of Maltese national accounts data revisions, encompassing the vintages issued from 2002Q1 until 2024Q2, confirms previously accepted conclusions emanating from the work of Grech (2018). Thus, revisions to Maltese real GDP data remain sizeable, volatile, are typically upward in nature, and increase with the horizon. The size and volatility of the revisions to the components of GDP are generally more pronounced than those of aggregate real GDP, with investment in particular being subject to the largest revisions and volatility.

While confirming previous findings, this analysis also presents some new insights about recent trends in the revision process. In particular, it shows that, on average, revisions to aggregate real GDP data have become more pronounced and volatile since the last analysis of Maltese data revisions carried out in 2018. More detailed analysis shows particularly sizeable and volatile revisions to the data covering periods affected by the COVID-19 pandemic, which inevitably created data collection and reporting issues. Among the components, this analysis interestingly documents generally more pronounced revisions to government consumption data in recent years. This diverges from patterns observed until 2018, up to which point such revisions tended to be relatively small. In contrast, the other expenditure components generally exhibit smaller and less volatile revisions than those observed historically. Moreover, this analysis also showed that revisions to overall real GDP growth are generally driven by revisions in exports and imports, with the contribution of the other components being relatively small in comparison.

While useful for users to gain a more updated understanding of the revisions to Maltese National Accounts data, one has to bear in mind that statistics for recent years are based on a relatively small sample of data, further impacted heavily by the statistical challenges posed by the COVID-19 pandemic.¹³ The statistical and methodological challenges resulting from the COVID-19 pandemic are not limited solely to the Maltese context, and have

¹² This pattern is largely due to a reclassification of 'statistical discrepancies' arising as the difference between the 'output' and 'expenditure' approaches to measure GDP. Such discrepancies used to be included within the 'inventories' category but have been moved to 'net exports' in more recent years. For more information see NSO (2008), "Quarterly National Accounts Inventory" and NSO (2023), "Gross National Income Inventory Malta".

¹³ For detail provided by the NSO about these issues, see the methodological notes in the [News Release](#): NSO (2020), "Gross Domestic Product: Q2/2020".

been pronounced to the extent that they have also impacted real-time analyses.¹⁴ Results for recent years should therefore be interpreted within a context characterised by numerous difficulties for reporting agencies, which include delays in data availability, lower response rates and possible quality issues. Nonetheless, it remains crucial for policymakers, stakeholders and researchers to acknowledge the likelihood of data revisions when assessing the data available in real time.

¹⁴ See for example, Delle Monache, D., Emiliozzi, S., and Nobili, A. (2021), "Tracking Economic Growth during the Covid-19: A weekly indicator for Italy", *Banca d'Italia Note Covid-19*, January and Arias, J., Minchul, S. (2020), "Tracking U.S. Real GDP Growth During the Pandemic", *Federal Reserve Bank of Philadelphia*: 9-14.