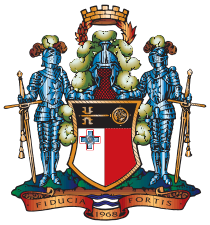

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AN ANALYSIS OF REVISIONS TO MALTESE GDP DATA

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AN ANALYSIS OF REVISIONS TO MALTESE GDP DATA

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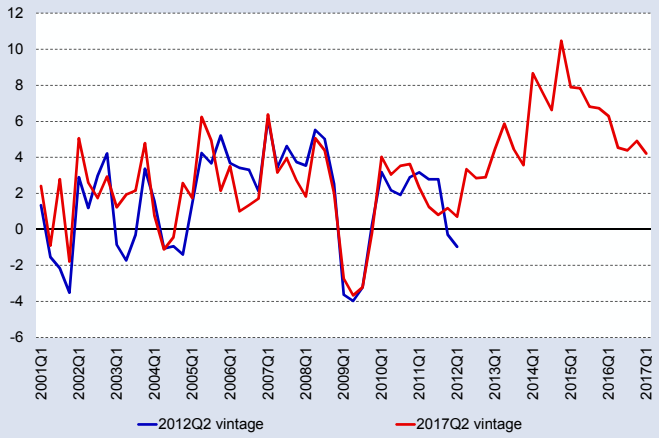
This study assesses the reliability of Maltese GDP data. In particular, it presents stylised facts of revisions to overall gross domestic product (GDP) and its main expenditure components, in both real and nominal terms, that occurred between 2002 and 2018. Towards this end, a number of revision indicators are employed that shed light on the magnitude, bias and volatility of these revisions. This article also presents a useful by-product of this research: Malta's first real-time macroeconomic database. The database covers 14 variables: real and nominal GDP and their main expenditure components. It includes all GDP vintages published by the National Statistics Office (NSO) between 2002Q1 and 2018Q1 and consists of over 30,000 data points. The results reveal that revisions to initial National Accounts data are sizeable, biased upwards, volatile and increase with the horizon. The size, bias and volatility of revisions to the components of GDP are generally larger than those to their aggregate counterparts. Moreover, revisions to private consumption and government consumption tend to be smaller in terms of size, bias and volatility than revisions to investment, exports and imports.

Introduction

GDP is a key macroeconomic variable that often features in the policy making process, including the formulation of monetary policy. As is the case with most data, the publication of GDP data is subject to a trade-off between timeliness and reliability. Data users require timely data that are published with a relatively short lag so they can base their assessment on relatively recent, and hence relevant, developments. However, timeliness comes at the expense of reliability. Data that are published promptly are often based on less complete information, making them subject to revisions as more comprehensive information is gathered. In this context, reliability refers to the closeness of the initial estimated value to subsequent estimated values (Carson and Laliberte, 2002). It should not be confused with the accuracy of these estimates, that is, the extent to which the estimates truly represent the full extent of economic activity in a given time period.

Malta's NSO publishes GDP data slightly more than two months after the end of the reference quarter. For instance, GDP data for the first quarter of the year are usually published in the first week of June.[2] While the first GDP estimate is arguably the most important for data users since it provides the first reading of national income in that particular quarter, it is based on limited information and is therefore revised in subsequent quarters to give a more complete picture of what the pace of economic activity is likely to have been. Chart 1 shows the vintage of real GDP growth published

Chart 1
REAL GDP GROWTH ACROSS DIFFERENT VINTAGES
(annual percentage changes)



Source: NSO.

[1] The author would like to thank Luisa Tolu and Bernice Amaira for excellent research assistance, Malta's National Statistics Office (NSO) for providing additional data that contributed towards populating the real-time database to the highest degree, as well as participants at an internal research seminar for valuable discussions, comments and suggestions. The views expressed are those of the author and do not necessarily reflect the views of the Central Bank of Malta. Any errors are the author's own. Email address: grecho@centralbankmalta.org.

[2] Unlike many other national statistical institutes, the NSO does not publish a flash estimate for GDP.

in 2012Q2 together with that published five years later in 2017Q2 and therefore provides an example of how GDP estimates are revised, sometimes substantially, in later quarters.

While revisions occur for a variety of reasons, it is possible to distinguish between two broad categories: informative and uninformative revisions.[3] Informative revisions arise as more complete information becomes available over time, whereas uninformative revisions result from changes in the methodology underlying the data, such as definitional changes, a change in the base year and the adoption of a new weighting system.

This study examines the reliability of Maltese GDP data. In particular, it presents stylised facts relating to the revisions to overall GDP from the expenditure side and its main components, in both real and nominal terms, that took place over the 16 year period spanning between 2002 and 2018. Towards this end, a number of revision indicators are employed that shed light on the magnitude, bias and volatility of these revisions. This article also presents a useful by-product of this research: Malta's first real-time macroeconomic database.

"This study examines the reliability of Maltese GDP data. It presents stylised facts relating to the revisions to overall GDP from the expenditure side and its main components, in both real and nominal terms"

Studying data revisions is of interest for at least two reasons. First, revision statistics equip data users with a tool that enhances their interpretation of data releases. For instance, if the first estimate of GDP is usually revised upwards in later releases, data users can reasonably conclude that economic activity in the previous quarter is likely to have been more buoyant than official statistics suggest. This is particularly useful for forecasters.[4] Second, revision statistics can be used to improve the reliability of the data by the statistical institute compiling it. Building on our earlier example, if the initial GDP estimate is generally revised upwards, the statistical institute can incorporate this information and publish first estimates of GDP that are higher than preliminary data suggest. This should make the data subject to lower revisions than would be the case if past revisions are not taken into account.

The data: a real-time macroeconomic database for Malta

In conducting revision analysis, a useful starting point is to construct a real-time database. A real-time database is a collection of data vintages, where, in this case, a vintage represents a time series that was the latest data at a particular point in time. Such a database therefore provides a snapshot of the data available in real time, that is, the data actually at the disposal of users at any given point in the past.

A real-time database has several applications. It can be used to study data revisions, as in this article, but also to examine whether empirical macroeconomic results are sensitive to the data vintage used, to evaluate policy actions ex-post and to evaluate forecasts.[5] In fact, several central banks, such as the Federal Reserve, the Bank of England and the European Central Bank have constructed real time databases in recent years.[6]

In light of the above, the Central Bank of Malta has constructed a real-time macroeconomic database for Malta. The database covers 14 variables: GDP, private consumption, government consumption, investment, changes in

[3] For example, in its Policy for Revisions of Official Statistics, the NSO (2004) explains that statistical revisions may be effected for at least eight reasons: (i) incorporation of source data that is more complete or superior, (ii) incorporation of source data that bears out concepts more closely, (iii) replacement by source data of judgement values or values derived largely by statistical techniques, (iv) incorporation of updated seasonal factors, (v) updating of base period, (vi) changes in statistical methods, (vii) changes in concepts, definitions and classifications and (viii) correction of errors in source data and computations.

[4] Revision statistics provide forecasters with information on how the data, on which their forecasts are based, are likely to be revised, which makes them better placed to produce accurate forecasts. Moreover, revision statistics shed light on the probable revisions to future outturns, against which their forecasts will be evaluated. This highlights a dilemma forecasters face: whether to select the first or final vintage as the target to forecast. If they seek to forecast the first vintage, initially they are likely to have a relatively small forecast error, which, however, will probably increase over time as more vintages are published. If, instead, forecasters choose to forecast the final vintage, the forecast error is likely to be relatively large initially, but this error is expected to decline over time. In other words, forecasters must decide whether they would rather have a small forecast error initially, when their forecasts are under the greatest scrutiny but at the expense of a forecast which is probably not the best projection of economic developments, or whether the opposite scenario is more desirable.

[5] See Croushore and Stark (1999) and Croushore and Stark (2000) for further details on the uses of real time databases and Croushore (2011) for an extensive list of studies that make use of real-time data.

[6] These databases are documented in Croushore and Stark (2001), Castle and Ellis (2002) and Giannone et al. (2010), respectively.

inventories and acquisitions less disposals of valuables, exports and imports, in both real and nominal terms, all measured from the expenditure side. It includes all GDP releases published by the NSO between 2002Q1 and 2018Q1, thus covering more than 16 years of data spread over 65 vintages. The database consists of over 30,000 data points. A large portion of the data was collected from the original GDP releases issued by the NSO. However, in some cases, the data release does not provide all the historical data for that vintage as required for the purposes of the database. In such instances, where available, additional data was kindly provided by the NSO.[7]

"The Central Bank of Malta has constructed a real-time macroeconomic database for Malta"

For illustrative purposes, Table 1 below shows a section of the database for real GDP. Each column represents a separate vintage, that is, the most updated time series for that variable – real GDP in this case – at a particular point in time. The heading of the column shows when that vintage was released. The last data point in each column is the first estimate for the preceding quarter. For example, the first vintage in the database was published in 2002Q1 and provides data between 2000Q1 and 2001Q4.[8] The last figure of this vintage – the figure of 835,313 (€ 000s) – is the first estimate for 2001Q4. In subsequent vintages, these data are revised and estimates for more recent quarters are provided. This gives the database its triangular form. Each row records all the readings for one particular quarter. In other words, a row shows how the estimate for an individual quarter changed across vintages. For instance, consider the row that corresponds to 2001Q4. This row shows how the estimate of real GDP for 2001Q4 changed across different data releases. The first estimate for this quarter, published in 2002Q1, amounted to 835,313 (€ 000s). In later vintages, this figure was revised, such that the last vintage in the database, published in 2018Q1, suggests that real GDP in 2001Q4 was actually 1,365,297 (€ 000s).[9]

Table 1
AN EXTRACT OF THE REAL-TIME DATABASE
EUR thousands

	Real GDP								
	2002Q1	2002Q2	2002Q3	2002Q4	…	2017Q2	2017Q3	2017Q4	2018Q1
2000Q1	779175	781039	776613	785465	…	1181627	1181627	1181627	1181627
2000Q2	815980	817377	813650	823899	…	1332755	1332755	1332755	1332755
2000Q3	839739	844864	839506	849522	…	1487128	1487128	1487128	1487128
2000Q4	860005	861402	853017	863732	…	1390128	1390128	1390128	1390128
2001Q1	777312	782437	779874	786629	…	1210044	1210044	1210044	1210044
2001Q2	810389	814116	809923	817610	…	1320719	1320719	1320719	1320719
2001Q3	837643	840438	839506	845563	…	1528369	1528369	1528369	1528369
2001Q4	835313	842534	840205	844631	…	1365297	1365297	1365297	1365297
2002Q1		793618	788959	792453	…	1271165	1271165	1271165	1271165
2002Q2			827741	839739	…	1354979	1354979	1354979	1354979
2002Q3				880037	…	1554838	1554838	1554838	1554838
…					…	…	…	…	…
2017Q1						2091478	2133391	2139124	2192328
2017Q2							2246812	2276517	2333566
2017Q3								2541595	2620963
2017Q4									2453170

Source: NSO.

[7] To promote research on real-time issues, the database is available from the author upon request and will be updated regularly.

[8] Some vintages, including that published in 2002Q1, extend further back than 2000Q1. However, since most vintages only provide data as from 2000Q1, we use this as the starting point for all vintages in the database.

[9] These revisions do not only reflect the arrival of new information but also methodological changes. For instance, the data published between 2002Q1 and 2004Q2 are based on the 1953 System of National Accounts (SNA) and the base year is 1995. Data issued between 2004Q3 and 2014Q3 are in line with the 1995 European System of National Accounts (ESA) with 2000 as the base year, while thereafter the data are consistent with the 2010 ESA and are chain-linked with 2010 as the reference year.

Methodology

A data revision is the difference between the data in a later vintage and that in an earlier vintage. This study considers revisions to the year-on-year growth rates of the data, rather than revisions to their levels, since users are generally interested in the former.[10]

We distinguish between eight types of revisions: those that occur between the first release and the release published one quarter, two quarters, three quarters, one year, two years, three years, four years and five years later. In other words, we consider revisions between the first estimate and the second, third, fourth, fifth, ninth, thirteenth, seventeenth and twenty-first estimate, respectively.[11]

In assessing the nature of revisions, three issues that are of particular interest are the size, sign and volatility of the revisions. Evaluating the size of revisions sheds light on whether there are large differences between the first estimate and subsequent estimates. This information is useful for interpreting data releases. Larger revisions imply that the corresponding first estimates are less reliable and later estimates are likely to be quite different than those in the initial release. The indicator used to gauge the magnitude of revisions is the average absolute revision (AAR), which is computed as the mean of the absolute value of the revisions, as described by the formula below:

$$\mathrm{AAR}_{j,j+t} = \frac{1}{n}\sum_{i=1}^{n}\left|g_{i,j+t} - g_{i,j}\right|$$

where $AAR_{j,j+t}$ is the average absolute revision between release *j* and the later release *j+t*, *n* is the number of revisions considered, $g_{i,j+t}$ is the estimate of GDP growth in period *i* as published in release *j+t* and $g_{i,j}$ is the estimate of GDP growth in the same period *i* as published in the earlier release *j*.

"Three issues that are of particular interest are the size, sign and volatility of the revisions"

Another issue of interest is whether revisions are, on average, positive or negative, that is, whether the first estimate is biased. Such information may also help considerably in interpreting data releases. For example, if past revisions to the first estimate were positive, on average, then it may be reasonable to expect future first releases to eventually be revised upwards as well. Two revision indicators have been employed to evaluate the sign of revisions: the average revision (AR) and the proportion of positive revisions. The average revision is computed as the mean value of the revisions, as described more formally below:

$$\mathrm{AR}_{j,j+t} = \frac{1}{n}\sum_{i=1}^{n}\left(g_{i,j+t} - g_{i,j}\right)$$

where the notation is identical to that above. The proportion of positive revisions is calculated as the number of upward revisions divided by the total number of revisions.

Another important question is whether revisions are volatile. Once again, insight into this issue will have implications for the interpretation of data releases: if revisions are highly volatile, it is much harder to predict the magnitude of future revisions. The standard deviation and the range of the revisions are used to gauge volatility. The standard deviation (σ) of the revisions is calculated as follows:

$$\sigma_{j,j+t} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(g_{i,j+t} - g_{i,j} - \mathrm{AR}_{j,j+t}\right)^2}$$

[10] That said, the availability of a real-time database makes it relatively straightforward to conduct a similar analysis in terms of the levels of the data. However, in the case of real variables, such an exercise can only extend until the 2014Q2 vintage since, thereafter, the NSO published chain-linked data which should not be subtracted.

[11] Although for conciseness we focus on eight types of revisions, using the real-time database, one can easily compute revision statistics for any two sets of estimates.

where, again, the notation is the same as that used previously. The range of the revisions is the difference between the maximum positive revision and the maximum negative revision but, for convenience, we report both of these figures.

Results

A number of useful stylised facts emerge from the results. A selection of these results – those for overall real GDP – is presented in Table 2 below.[12]

Table 2
REVISION STATISTICS FOR MALTESE REAL GDP GROWTH DATA

	Mean Absolute Revision	Mean Revision	Proportion of Positive Revisions	Standard Deviation of Revisions	Maximum Negative Revision	Maximum Positive Revision	Sample Size
	Percentage points		*Per cent*		*Percentage points*		
1st vs. 2nd release	0.51	0.20	57	0.71	-2.24	2.00	63
1st vs. 3rd release	0.73	0.21	64	0.98	-3.38	2.29	61
1st vs. 4th release	0.87	0.23	61	1.14	-3.69	2.58	59
1st vs. 5th release	0.94	0.18	58	1.24	-4.38	2.72	57
1st vs. 9th release	1.31	0.84	60	1.71	-1.32	6.51	43
1st vs. 13th release	1.71	1.42	73	1.77	-1.38	6.55	40
1st vs. 17th release	1.44	1.00	72	1.49	-2.10	4.21	36
1st vs. 21st release	1.31	0.75	61	1.43	-1.43	3.91	31

Source: Author's calculations.

Starting with the size of revisions, the results suggest that revisions to initial overall real GDP growth data are relatively large. For instance, the growth rate reported in the second release differs from that published in the first release one quarter earlier by around half a percentage point, on average. Moreover, the size of the revision tends to grow with the horizon. The revision, in absolute terms, between the first release and the fifth release published a year later increases to nearly one percentage point, on average, while the absolute revision between the first release and the twenty-first release published five years later rises to around 1.3 percentage points.

Turning to the sign, or direction, of revisions, initial overall real GDP growth figures tend to be revised upwards in later releases. In other words, revisions have a positive bias. For example, one of the revision indicators employed, the mean revision, shows that the growth rate published in the second release is 0.2 percentage point higher than that in the first release, on average. The other revision indicator used to gauge the direction of revisions, the proportion of positive revisions, also points towards a positive bias: 57 per cent of revisions between the first and second release are upward revisions. Furthermore, the degree of biasedness also tends to increase with the horizon, such that when one compares the first estimate to that published five years later, the mean revision rises to 0.75 percentage point and the proportion of positive revisions climbs to 61 per cent.

With regards to volatility, the results indicate that revisions to initial estimates of overall real GDP growth are considerably volatile. This is evidenced by both the relatively large standard deviations, as well as the wide ranges. For instance, the revision between the first and the second estimate ranges from -2.24 percentage points to 2.00 percentage points.[13]

The stylised facts documented so far, namely, that revisions to initial overall real GDP growth rates are sizeable, biased upwards, volatile and increase with the horizon, also hold for the main expenditure components of GDP: private

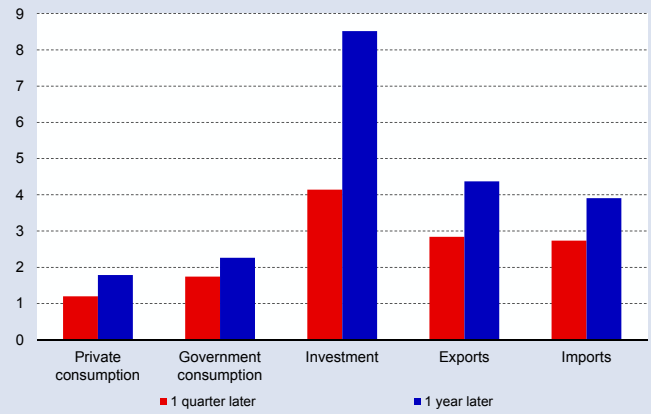
[12] Although, for brevity, we only show detailed results for overall real GDP, more comprehensive results for overall nominal GDP and for the main expenditure components of GDP, in both real and nominal terms, are available from the author upon request.

[13] Despite this volatility, t-tests suggest that, over most horizons, the positive bias in revisions to overall real GDP is statistically significant at conventional levels. This also holds for revisions to overall nominal GDP and their main expenditure components.

consumption, government consumption, investment, exports and imports.[14] However, revisions to these components are generally larger in terms of size, bias and volatility than the revisions to overall real GDP. This generally applies across all horizons. The size, bias and volatility of revisions to private consumption and government consumption tend to be smaller than revisions to investment, exports and imports (see Charts 2 and 3).

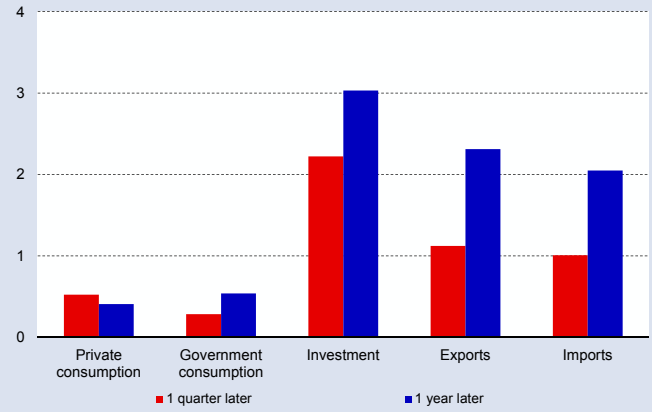
"Revisions to initial overall real GDP growth rates are sizeable, biased upwards, volatile and increase with the horizon"

Chart 2
MEAN ABSOLUTE REVISIONS TO FIRST ESTIMATES OF GROWTH IN MAIN EXPENDITURE COMPONENTS OF REAL GDP
(percentage points)



Source: Author's calculations.

Chart 3
MEAN REVISIONS TO FIRST ESTIMATES OF GROWTH IN MAIN EXPENDITURE COMPONENTS OF REAL GDP
(percentage points)



Source: Author's calculations.

Turning to the nominal side, the stylised facts that emerge for overall nominal GDP growth and its components are identical to those discussed above for the real side. Since the NSO first compiles GDP data in nominal terms, which are then deflated to produce real variables, an important implication of this is that much of the revisions stem from adjustments to the nominal side, rather than to the deflators, since the latter would imply that revisions to nominal and real variables are dissimilar.

A word on a limitation of this analysis is in order. As outlined previously, there are two main types of revisions: informative and uninformative revisions. Our data does not allow us to disentangle these two different classes of revisions and therefore, the revision statistics reported here, do not only reflect the arrival of more comprehensive information, but also changes in the underlying methodology.

Cross-country comparison

In order to put the results for Malta into perspective, we compare them with those for other countries. Table 3 reports revision statistics for real GDP growth of a sample of OECD countries.[15] Data on the mean absolute revision show that while revisions to initial estimates of overall real GDP growth in other countries tend to be smaller in size than in Malta, these revisions are generally still relatively large. For example, the revision, in absolute terms, between the first estimate and that published a year later reaches 0.63 percentage point in Japan. Turning to the mean revision, the data suggest that initial overall GDP growth rates are biased upwards in most countries. Indeed, in only three of the twelve countries in the sample are these figures revised downwards, on average, in the data release published a year later. However, this positive bias is less pronounced than is the case for Malta. Figures for the standard

[14] In our analysis, we do not include changes in inventories and acquisitions less disposals of valuables. This component is largely composed of the statistical discrepancy, which makes it highly volatile. Consequently, revision statistics for this variable are of little use.

[15] These revision statistics were compiled using the OECD's Revisions Analysis Dataset, to our knowledge the most comprehensive cross-country database of macroeconomic data revisions. The data we report here are discussed in Zwijnenburg et al. (2014) and Zwijnenburg (2015).

Table 3
REVISION STATISTICS FOR REAL GDP GROWTH DATA OF A SAMPLE OF OECD COUNTRIES

Percentage points

	Mean Absolute Revision		Mean Revision		Standard Deviation of Revisions	
	1 year later	3 years later	1 year later	3 years later	1 year later	3 years later
Australia	0.36	0.57	0.12	0.35	0.46	0.60
Belgium	0.29	0.48	0.03	0.11	0.37	0.59
Canada	0.22	0.44	0.07	0.26	0.28	0.52
France	0.29	0.53	0.03	0.15	0.34	0.61
Germany	0.23	0.47	0.07	-0.03	0.31	0.59
Italy	0.20	0.39	-0.02	0.11	0.26	0.47
Japan	0.63	0.93	-0.07	0.29	0.78	1.12
Netherlands	0.32	0.60	0.12	0.44	0.37	0.57
Portugal	0.27	0.53	0.01	0.34	0.39	0.57
Spain	0.19	0.43	0.03	0.26	0.24	0.50
United Kingdom	0.25	0.58	0.07	0.15	0.32	0.91
United States	0.32	0.68	-0.03	-0.33	0.44	0.79
Average	0.30	0.55	0.04	0.18	0.38	0.65

Sources: OECD; author's calculations.

deviation reveal that first estimates of growth in overall real GDP are relatively volatile in many countries, although less so than in Malta. As is the case for Malta, the size, bias and volatility of revisions in other countries tend to increase with the horizon. In many cases, the revision statistics for the three year horizon are greater than those for the one year horizon.

The OECD's revisions database shows that the main expenditure components of GDP generally witness revisions that are larger in terms of size, bias and volatility than the revisions to their aggregate counterpart, in line with the result for Malta. Similarly, revisions to private consumption and government consumption tend to be smaller in magnitude, less biased and less volatile than revisions to investment, exports and imports.[16]

"The stylised facts relating to the revisions to Maltese GDP data are very similar to those reported for other countries. However, in the case of Malta, revisions are generally larger in terms of size, bias, as well as volatility"

In summary, the stylised facts relating to the revisions to Maltese GDP data are very similar to those reported for other countries. There is, however, an important difference: in the case of Malta, revisions are generally larger in terms of size, bias, as well as volatility. Although all effort should be made to improve the reliability of Maltese GDP data since this would enhance their usefulness, relatively large revisions to Maltese GDP data in comparison with those in other countries, can be justified on at least two grounds. First, over the time period considered – 2002Q1 to 2018Q1 – Malta experienced robust economic growth of 3.6 per cent per annum, on average, in real terms, or 6.1 per cent in nominal terms.[17] Higher rates of growth are bound to give rise to larger revisions. To circumvent this issue and improve cross-country comparability, one can consider the revision statistics relative to GDP growth but we leave this to future research. Second, due to the small size of the Maltese economy, the volume of activity is low compared to that in other countries. Consequently, revisions to individual transactions will influence overall revisions in a more potent manner.

[16] The stylised facts we report for Malta are also in line with those for other economies, besides those mentioned here, such as the euro area and Ireland, amongst others, as discussed in Giannone et al. (2010) and Bermingham (2006), respectively.
[17] According to the 2018Q1 vintage.

Conclusion

A number of policy implications can be drawn from the results. Here we will limit ourselves to two of them. First, the stylised facts documented here can significantly enhance users' interpretation of GDP releases. Policymakers, researchers, forecasters and analysts should, for example, bear in mind that initial GDP data are likely to be subject to considerable revisions, which are likely to be on the upside. Taking this information into account will allow them to have a more complete understanding of what the true state of the economy is likely to be. Second, these revision statistics can be used by the NSO to improve the reliability of GDP data. Incorporating this information by, for instance, publishing first GDP estimates that are higher than preliminary data suggest, should make National Accounts data subject to lower revisions.

Going forward, there are several avenues of further research that can be pursued. First, this study can be extended in a number of ways, for instance by splitting the sample to examine whether the properties of revisions have changed over time and by using a more extensive range of revision indicators that shed light on whether revisions are correlated with the business cycle, across quarters and across components. Second, the real-time database can be used in other applications, such as to study whether empirical macroeconomic results for Malta are sensitive to the data vintage used, to evaluate past policy actions and to evaluate forecasts. To promote such research, the real-time database will be updated on a regular basis and possibly extended to include additional variables.

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