

Assessing the efficiency of South Africa's preliminary quarterly GDP announcements

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Abstract

Gross domestic product (GDP) as a measure of economic activity and performance influences economic decisions and policy. However, due to the need for timely data, users often base their decisions and policy on preliminary estimates that are later revised as more comprehensive information becomes available. It is therefore crucial that the preliminary GDP announcements can be relied on, by ensuring that all available information at a particular time is being used in the most efficient way to compile estimates.

The study focuses on South Africa's initial preliminary announcements of the seasonally adjusted and annualised GDP estimates at constant prices. An analysis of the statistical properties of the final revisions to the initial estimates, as well as using an Ordinary Least Squares estimation technique to examine the relationship between the initial estimates and final revised data; suggests that the quarterly initial preliminary announcements for GDP, GDE, final consumption expenditure by households, GNI and disposable income of households for the period 1999 to 2013 are not efficient. This implies that they contain measurement errors that could be eliminated in order to become a better estimate of the final and true value. It is recommended that the statistical agents producing South Africa's national accounts aggregates improve the quality of the initially announced estimates focusing on the statistical compilation processes, i.e. data sources and methodologies.

Keywords: GDP, preliminary estimates, data revisions.

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1. Introduction

Gross domestic product (GDP) influences economic decisions and policy by governments, business and financial communities. However, due to the need for timely data, users often base their decisions and policy on preliminary initial estimates. The preliminary estimates are subsequently revised as more comprehensive information becomes available. It is therefore crucial that the initial estimates can be relied on as efficient. According to Mckenzie, Tosetto and Fixler (2008), efficiency, in this case, means ensuring that all available information at a particular time is being used in the most efficient way to compile an estimate. Mckenzie *et al.* (2008), Aruoba (2008), Garratt and Vahey (2006), Faust, Rogers and Wright (2005), and Baghestani (2004) suggest that having efficiently derived preliminary estimates will ensure that revisions to initially published estimates: are due solely to the incorporation of new information rather than the correction of systematic measurement errors in the compilation process of the initial estimates; are unpredictable using the information set at the time of the initial announcement; and that the initial preliminary estimate is an unbiased measure of the final estimate.

Revisions are defined as any change in the value of an estimate initially published by a statistical agency (Carson, Khawaja and Morrison, 2004). All initially published estimates of GDP and its components are subject to revisions.

The study analyses revisions to South Africa's national accounts aggregates; namely, Gross Domestic Product (GDP), Gross Domestic Expenditure (GDE), Final Consumption Expenditure by Households, Final Consumption Expenditure by General Government, Gross Fixed Capital Formation (GFCF), Exports of goods and services, Imports of goods and services, Gross National Income (GNI), and Domestic Income of Households.

This paper is structured as follows. Section 2 discusses revisions to initially announced estimates. Section 3 highlights the aims of the study, the data used, and illustrates the research approach. Section 4 presents and interprets the results of the study. Section 5 concludes the paper and provides recommendations.

2. Revisions to preliminary estimates

Revisions are a normal feature of any statistical compilation process that estimates values for variables whose source data gradually improves over time, where the definition of the variable is subject to change, or where methodological changes occur (Ahmad, Bournot and Koechlin 2007: 6). According to Carson *et al.* (2004: 5-8), Sleeman (2005: 32-3) and Sim, de Catsro and Pascua (2009: 3-4) revisions may arise from the:

- incorporation of more comprehensive data, and/or re-estimation of the seasonal factors for seasonally-adjusted series. These are routine revisions which occur in the weeks or months shortly after the initial announcement. For example, when imputed values are being replaced by actual values or seasonal factors are being updated following later observations.
- reconciliation of quarterly and annual measures. These constitute annual revisions for example when monthly, and/or quarterly data are modified with more accurately based annual data.
- rebasing and re-weighting of the constant price series or introduction of definitional or methodological changes. These are major revisions also referred to as comprehensive, or benchmark revisions. For example, when there are major changes in statistical methods and/or changes in concepts, definitions, and classifications.

To formalise the discussion, we express the revisions function as follows:

$$r_t^f = y_t^f - y_t^{t+1}$$

Where:

y_t^{t+1} = is the initial announcement of a variable that was realized at time t

y_t^f = is the final or true value of the same variable

r_t^f = is the final or total revision

From a statistical point of view, Aruoba (2005: 2-3) states that, the final or total revision is expected to satisfy three properties in order to be considered 'well-behaved'.

1. The mean of the revision is expected to be zero. This would imply that the initial announcement by the statistical agency is an unbiased estimate of the final or true value.
2. The variance of the revision is expected to be small compared to the variance of the final or true value.

3. The revisions are expected to be unpredictable given the information set at the time of the initial announcement. When the revision is predictable, the initially announced figures are not an optimal measure.

Christoffersen, Ghysels and Swamson (2001: 4) indicates that it is possible that the final or true value for many economic series will never be available. This is because benchmark and definitional changes are ongoing and may continue into the indefinite future. In practice the final or true value is defined as those (revised) figures available at some future point in time, which are no longer subject to revision due to the addition of new information.

2.1 Informative and uninformative revisions

The different categories of revisions to initially published estimates may be classified as either informative or uninformative revisions. Informative revisions carry informational content by reflecting the incorporation of new information which was not previously available to the statistical agency (Aruoba 2005: 8). Examples of informative revisions are the routine revisions that occur when imputed values are being replaced by actual values or seasonal factors being updated following later observations, and/or annual revisions when monthly or quarterly data are modified with more accurately based annual data. Whereas uninformative revisions are those revisions that are a result of changes in the definition of the variable, or statistical changes such as the change of base year or reweighting (Aruoba 2005: 8). Examples of uninformative revisions are the benchmark or comprehensive revisions when there are major changes in statistical methods and/or changes in concepts, definitions, and classifications.

2.2 Revisions: News or Noise

The informational content carried by informative revisions is further characterised as either news or noise. Revisions are news when they bring new information which becomes available for the compilation of the later estimates. According to McKenzie *et al.* (2008: 2) the incorporation of new information from the ongoing flow of source data is important given that the general goal of the sequence of estimates is to approach some true value. This is also an important issue for users of the data as they would expect that revisions are adding information to aid in their decision making processes, rather than providing random changes in previously published estimates. Under the news characterisation the revision is correlated with the final value but uncorrelated with the data available when the earlier estimate is made (McKenzie *et al.* 2008: 1 and Aruoba 2008: 327). Revisions are noise when they are a result of the correction of earlier errors. McKenzie *et al.* (2008: 2) state that when a revision to a variable contains noise it means that all or

part of the revision does not contain any new information, rather the change in the estimate is due to systematic measurement errors that could arise from several factors such as biased estimates due to estimation based on non-representative samples, use of non-optimal imputation methodologies for imputing missing data. Under the noise characterization the revision is uncorrelated with the final value but correlated with the data available when the earlier estimate is made (Mckenzie *et al.* 2008: 1 and Aruoba 2008: 327).

3. The study

The main objective of the study is to assess whether South Africa's preliminary quarterly GDP announcements can be relied on as efficient. The specific objectives are to:

1. analyse the statistical properties of the final or total revisions to the preliminary estimates (we consider whether the mean of the final revisions is zero)
2. establish whether the final revisions are characterised by news as this will give an indication of whether the preliminary estimates are efficient.

3.1 Data

At the time of the study Statistics South Africa (Stats SA) was responsible for compiling the production side of the national accounts, while the South African Reserve Bank (SARB) was responsible for compiling the expenditure side of national accounts, as well as the income and savings and the balance of payments. Stats SA and the SARB cooperate closely to revise the national accounts estimates. The data used in this study is sourced from published copies of quarterly GDP releases by Stats SA and the SARB Quarterly Bulletin. Stats SA makes the initial GDP announcement for a quarter about 50 to 60 days after the end of that quarter. The SARB publishes expenditure components in the SARB Quarterly Bulletin a few weeks later, about 70 to 80 days after the end of the relevant quarter.

This study focuses on seasonally adjusted and annualised (Q\Q) growth rates at constant prices for the following national accounts aggregates:

- Gross domestic product (GDP)
- Gross domestic expenditure (GDE)
- Final consumption expenditure by households
- Final consumption expenditure by general government
- Gross fixed capital formation (GFCF)

Exports of goods and services
 Imports of goods and services
 Gross national income (GNI)
 Disposable income of households

This study uses time series data and covers the period 1999Q1 to 2013Q4, as such there are 60 quarterly observations. The data used in this study was gathered as follows:

- to derive the initial announcement for each variable the study took the initially announced estimate for the relevant quarter;
- to derive the final value for each variable the study looked at the periods after which there were no more revisions except for benchmark and rebasing revisions. Therefore, the later final estimate used in the study includes as many revisions as possible, but avoids the inclusion of benchmark and rebasing revisions; and
- to derive the total revisions for each variable the study subtracts from the later final estimate the initially announced estimate for the relevant quarter.

3.2 Approach

The descriptive statistics is derived from the following statistical indices:

Mean absolute revision

$$MAR = \frac{1}{n} \sum_{t=1}^n |y_t^f - y_t^{t+1}| = \frac{1}{n} \sum_{t=1}^n |r_t|$$

Where:

y_t^{t+1} = is the initial announcement of a variable that was realised at time t

y_t^f = is the final value of the same variable

r_t = is the total revision

n = is the number of estimates over time.

Mean revision

$$MR = \frac{1}{n} \sum_{t=1}^n (y_t^f - y_t^{t+1}) = \frac{1}{n} \sum_{t=1}^n (r_t)$$

Where:

y_t^{t+1} = is the initial announcement of a variable that was realised at time t

y_t^f = is the final value of the same variable

r_t = is the total revision

n = is the number of estimates over time.

In order to test the statistical significance of the mean revision, a t-test that the mean total revision is insignificantly different from zero is performed by the study. The t-stat is given in the following equation:

$$t = \frac{\bar{r} - \mu_x}{\sqrt{\frac{\sigma_x^2}{n}}}$$

Where:

\bar{r} = is mean total revision at a particular stage;

σ_x^2 = is variance of the mean total revisions at a particular stage;

n = number of observations.

It is standard practice to use a t-test adjusted for the existence of a serial correlation between quarters. In order to take into account serial correlation, the study used a heteroscedasticity and autocorrelation consistent (HAC) standard deviation of the mean total revisions. As suggested by McKenzie and Gamba (n.d), the standard deviation is calculated as the square root of:

$$\sigma_x^2 = \frac{1}{n(n-1)} \left\{ \sum_{t=1}^n \hat{\varepsilon}_t^2 + \frac{3}{4} \sum_{t=2}^n \hat{\varepsilon}_t \hat{\varepsilon}_{t-1} + \frac{2}{3} \sum_{t=3}^n \hat{\varepsilon}_t \hat{\varepsilon}_{t-2} \right\}$$

With: $\hat{\varepsilon}_t = r_t - \bar{r}$.

The notation of the null hypothesis is as follows:

H_0 : Mean total revision is equal to zero

H_1 : Mean total revision is not equal to zero

If the null hypothesis is rejected it is concluded that the initial announcements are biased estimates of the final value. If the null hypothesis cannot be rejected it is concluded that the initial announcements are not biased estimates of the final value. The level of significance that the study has chosen for the statistical test is the value of $\alpha = 0.05$.

Other statistics included in the summary statistics tables are:

Min revision: value of the lowest total revision

Max revision: value of the highest total revision

For information about the nature of the revisions to initial GDP estimates, and thus the efficiency of the estimation processes, the news hypotheses are tested using a regression estimation method. The regression method used in the study has been previously adopted by Richardson (2003), Palis *et al.* (2004), Faust *et al.* (2005), Sleeman (2005) and Garratt and Vahey (2006). The functional form of the regression technique, also referred to as the Mincer-Zarnowitz forecast efficiency technique, is as follows:

$$\text{Total Revision}_t = \beta_0 + \beta_1 \text{Initial announcement}_t + \varepsilon$$

Where:

Total Revision_t: is the difference between the later final estimate and initially announced estimate.

β_0 : is the constant

β_1 (Initial announcemet)_t: initial announcement denotes the initial announced estimate.

ε : is the error term

The study employed the above regression technique to test whether the total revisions are characterised by news this would be indicative that the estimates are compiled efficiently. Under the news characterisation, it is expected that the two parameters β_0 and β_1 be jointly insignificant from zero. The following hypothesis is therefore tested.

$$H_0: \beta_0 = \beta_1 = 0$$

$$H_1: \beta_0 \neq \beta_1 \neq 0$$

In order to test the joint significance of the two parameters the study performed Wald tests. If the null hypothesis is rejected it is concluded that the total revisions are not characterised by news. If the null hypothesis cannot be rejected it is concluded that total revisions are characterised by news. The level of significance that the study has chosen for the statistical test is the value of $\alpha = 0.05$.

4. Results

Table 1. Descriptive statistics

Variable	N	Mean absolute	Mean	Min	Max	t-stat	st.dev
Gross Domestic Product	60	0.64	0.50	-0.8	6.1	3.4874 (0.0009)	0.1419
Gross Domestic Expenditure	60	1.55	0.39	-5.9	5.9	1.8689 (0.0668)	0.2069
Final expenditure consumption by households	60	0.67	0.49	-1.9	3.9	3.1801 (0.0024)	0.1546
Final expenditure consumption by general government	60	1.09	0.40	-5.1	9.9	0.9588 (0.3416)	0.4137
Gross Fixed Capital Formation	60	2.75	-0.12	-7.5	10.1	-0.2213 (0.8256)	0.5572
Exports of goods and services	60	5.40	0.73	-23.6	34.6	0.7681 (0.4455)	0.9460
Imports of goods and services	60	3.66	-0.27	-20.9	18.6	-0.4443 (0.6585)	0.6115
Gross National Income	60	1.27	0.46	-3.3	5.5	2.4206 (0.0186)	0.1887
Disposable income of households	60	0.74	0.50	-1.9	4.1	3.4114 (0.0012)	0.1471

Table 1 presents the results of the descriptive statistics of the total revisions for the period 1999Q1 to 2013Q4. The mean absolute total revisions over the period are large for GNI, exports and imports of goods and services. The mean total revisions indicate that on average over the period initially announced estimates for GDP, GDE, final consumption expenditure by households and government, exports of goods and services, GNI and disposable income of households have been underestimated. For GFCF and imports of goods and services initially announced estimates have been overestimated. The range of the total revisions is large for exports and imports of goods and services, and is relatively small for GDP, final consumption expenditure by households, GNI and disposable income of households. To report on the probability that the mean total revision is equal to zero over the period the t-stat of the mean total revisions is used. The figures in brackets below the estimated t-stat provide the probability that mean total revision is insignificantly different from zero. The results indicate that the mean total revisions for GDE, final consumption expenditure by general government, GFCF and exports and imports of goods and

services are insignificantly different from zero. The mean total revision for GDP, final consumption expenditure by households, GNI and disposable income of households are significantly different from zero. The last column reports the standard deviation of the total revisions which measures the spread of total revisions around their mean.

Table 2. Regression estimation

Variable	Sample of quarters	β_0	β_1	Probability ($\beta_0 = \beta_1 = 0$)
Gross Domestic Product	1999Q1-2013Q4	0.556659 (0.281875)	-0.024387 (0.069687)	0.0024
Gross Domestic Expenditure	1999Q1-2013Q4	0.731912 (0.24543)	-0.104991 (0.053321)	0.0156
Final consumption expenditure by households	1999Q1-2013Q4	0.570438 (0.279862)	-0.023906 (0.061839)	0.0098
Final consumption expenditure by general government	1999Q1-2013Q4	1.095227 (0.786457)	-0.184967 (0.120664)	0.288
Gross Fixed Capital Formation	1999Q1-2013Q4	-0.48309 (0.793362)	0.061514 (0.091617)	0.7871
Exports of goods and services	1999Q1-2013Q4	1.341153 (1.066696)	-0.136958 (0.078279)	0.22
Imports of goods and services	1999Q1-2013Q4	0.239167 (0.553224)	-0.069628 (0.029144)	0.0636
Gross National Income	1999Q1-2013Q4	0.514836 (0.211353)	-0.019272 (0.047148)	0.0403
Disposable income of households	1999Q1-2013Q4	0.637878 (0.292267)	-0.041381 (0.067440)	0.0058

Table 2 presents the results of the regression estimation for the period 1999Q1 to 2013Q4. The results indicate that the null hypothesis that the parameters β_0 and β_1 are jointly insignificant from zero cannot be rejected for final consumption expenditure by general government, GFCF, exports and imports of goods and services. The null hypothesis is rejected for GDP, GDE, final consumption expenditure by households, GNI and disposable income of households.

4.1 Interpretation of the results

The results of the study are interpreted as follows. For the period 1999Q1 to 2013Q4, initial announcements for GDE, final consumption expenditure by general government, GFCF, and exports and imports of goods and services are not biased estimates of the final or true value. Initial announcements for GDP, final consumption expenditure by households, GNI and disposable income of households are biased estimates of the final or true value. Over the period revisions are large for GNI, exports and imports of goods and services. For the same period, 1999Q1 to 2013Q4, total revisions to initially announced estimates for final consumption expenditure for general government, GFCF, exports and imports of goods and services are characterised by news. Total revisions to initially announced estimates for GDP, GDE, and final consumption expenditure by households, GNI and disposable income of households are not characterised by news.

5. Conclusion

It can be concluded that little confidence should be attributed to interpretations of the initially announced estimates for GDP, GDE, final consumption expenditure by households, GNI and disposable income by households. Evidence was found in the study that suggests that the initial announcements are biased and inefficient. This implies that the initial announcements contain measurement errors that could be eliminated in order to become a better forecast of the final and true value. For short-term analysis the users of GDP data are encouraged to focus on different measures.

It is recommended that the statistical agents producing South Africa's national accounts aggregates improve the quality of the initially announced estimates focusing on the statistical compilation processes, i.e. data sources and methodologies. The statistical agency is encouraged to look at improving the sample size and reporting systems to improve response rates. They are also encouraged to look at the representation and coverage of data sources. As well as to improve imputation methods for missing data. Furthermore, the statistical agency is also encouraged to conduct periodic revisions studies and make these available to the users.

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