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Accuracy assessment of the FPB medium-term outlooks
An update

September 2017

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Accuracy assessment of the FPB medium-term outlooks

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Abstract - This working paper provides an update of a study from 2007 (WP 8-07) in which the accuracy of the medium-term outlooks for the Belgian economy is assessed. These outlooks have been published by the Federal Planning Bureau since the beginning of the 1980s. The study is expanded with nine additional editions of the Economic Outlook covering a mixture of pre-crisis, crisis and post-crisis periods. It examines the statistical properties of the projection errors of the key macroeconomic aggregates and investigates their possible causes.

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Executive summary

Although the Federal Planning Bureau has been publishing medium-term outlooks for the Belgian economy since the beginning of the 1980s, the first accuracy assessment was released only in 2007. As such, medium-term projections lend themselves less to traditional post-mortem analyses than short-term forecasts that are published, for example, in the economic budget. The overall coherence of the projection and the quality of the analysis offered to policy makers and to the public in general in terms of diagnosis, are probably the main elements by which the usefulness of the projection can be gauged. However, scrutinising past projection errors could provide users with a broad idea of the precision of the projections and could help identify possible methodological weaknesses. Moreover, since the Act of 21 December 1994 creating the National Accounts Institute (NAI) was amended by the Act of 28 February 2014, a preliminary version of the Economic Outlook is released each year in March under the responsibility of the NAI. This same amended law states that an evaluation of the economic forecasts and projections must be carried out every three years and submitted to a scientific committee. The result of that evaluation shall be made public and taken into account appropriately in upcoming macroeconomic forecasts. This analysis, however, focuses on the final version of the Economic Outlook, which is published under the sole responsibility of the FPB, seeing as we do not yet have the hindsight needed to carry out a retrospective study for the March edition.

The present working paper provides an update of WP 8-07 by expanding the sample with nine additional editions of the Economic Outlook covering a mixture of pre-crisis (2006-2007), crisis (2008-2009) and post-crisis (2010-2015) periods. On the one hand, the analysis of the statistical properties of the projection errors shows that including these additional periods lowers the absolute size of the projection error on private consumption, domestic price deflators, the labour force and employment. On the other hand, the absolute projection error increases for exports, imports, productivity and, to a lesser extent, for GDP. Expanding the sample also significantly increases the optimistic bias on these four variables.

By analysing the causes behind these errors, the crucial role played by external assumptions – in particular the evolution of world trade, international prices and exchange rates – is confirmed. The absolute size of the error and the mean error on export projections are almost halved when correcting for errors made on potential export markets. However, the statistically significant bias for exports does not disappear because the losses in market shares recorded until the end of the 2000s were systematically and substantially underestimated. Employment growth corrected for external growth errors was on average significantly underestimated, while uncorrected errors were on average virtually zero. The bias in labour productivity growth is somewhat lower after the correction but remains highly significant. Overall, after correcting for the errors in world trade growth, the absolute size of the error on GDP growth is lowered by almost 60% and large errors are eliminated. However, an optimistic bias of around a quarter of a percentage point persists. Correcting inflation projections for errors made on import prices reduces the mean absolute error on the deflator of private consumption growth by about a third.

Until the 2007 edition of the Economic Outlook, labour force growth was systematically underestimated. These errors on the labour force can be decomposed into the respective contributions of the working-age population and the participation rate. Until the middle of the sample, the largest part of the under-estimation is explained by negative errors on the participation rate. Afterwards, the underestimation is entirely caused by the errors on the working-age population. In the latest editions, these errors approach zero and the overestimation of the labour force growth is almost entirely explained by the positive errors on the participation rate.

Budgetary prospects are made under the 'no-policy-change' rule. Accordingly, the aim of the outlook is not to provide the best possible budgetary forecasts anticipating policy decisions, but rather to provide a benchmark scenario against which the fiscal objectives of the government can be assessed. The difference between projected and observed changes in the primary balance corrected for surprises in external growth gives an indication of the discrepancy between the fiscal policy stance assumed in the outlook and the outcome. During most of the 1990s, the no-policy-change scenario implied a more expansive fiscal policy than the one observed, while the opposite holds true for the next decade. The strong tightening of fiscal policy in the years following the global financial crisis was not fully integrated in the no-policy-change scenario.

Although we are not yet able to evaluate the Economic Outlooks published after 2010 due to the lack of hard data, we can already make some qualitative assessments of those editions. The 2011 and 2012 editions were too optimistic regarding GDP growth, too pessimistic as regards the evolution of export market shares and counted on a relatively strong rebound of productivity growth after the collapse during the financial crisis, which did not materialise. For the most recent releases, no definite statement can be made except that they contain by far the lowest average GDP growth rates projected over the whole sample. Moreover, they persist in the view that export market shares should decrease, albeit at a slower pace than previously projected, and foresee annual productivity growth below 1%.

1. Introduction

Although the Federal Planning Bureau has been publishing medium-term outlooks for the Belgian economy since the beginning of the 1980s, the first accuracy assessment was released only in 2007.[1] One difficulty of this type of evaluation is that outcomes based on hard data are only available after a long delay. Another difficulty relates to the fact that the prime objective of these medium-term projections is to provide – by extending underlying trends – a no-policy-change scenario pointing to possible future constraints and imbalances. This scenario may never materialise if policy adjustments are made.

As such, it lends itself less to traditional post-mortem analyses than short-term forecasts published, for example in the economic budget, which are regularly assessed.[2] The overall coherence of the projection and the quality of the analysis offered to policy makers and to the public in general in terms of diagnosis, are probably the main elements by which the usefulness of the projection can be gauged. However, in the 2007 working paper we argued that scrutinising past projection errors could provide users with a broad idea of the precision of the projections and could help identify possible methodological weaknesses. Moreover, since the Act of 21 December 1994 creating the National Accounts Institute (NAI) was amended by the Act of 28 February 2014, a preliminary version of the Economic Outlook, used as the macroeconomic framework for the Belgian stability programme, is released each year in March under the responsibility of the NAI. This same amended law states that an evaluation of the economic forecasts and projections must be carried out every three years and submitted to a scientific committee composed partly of members external to the NAI. The result of that evaluation shall be made public and taken into account appropriately in upcoming macroeconomic forecasts. This analysis, however, focuses temporarily on the final version of the Economic Outlook, which is published under the sole responsibility of the FPB, seeing as we do not yet have the hindsight needed to carry out a retrospective study for the March edition of the medium-term projections.

Predicting the evolution of the business cycle in the short run is not an easy task, but producing medium-term projections is even more challenging. As post-mortem evaluations regularly point out, short-term forecasting performances are weak around turning points[3]. When we consider this in the light of our five-years-ahead projection, forecasting the GDP trend correctly would have meant anticipating, for example, the 2008-2009 recession from 2004 onwards. As long as they have not materialised, shocks are usually not incorporated into the baseline scenario, but they are only presented qualitatively in the accompanying text in terms of positive and negative risks.

The paper is organised as follows. In Section 2, we discuss the methodology adopted and comment upon the comparison between projected growth rates and outcomes for a selected number of macroeconomic variables. The main statistical properties of the projection errors for these variables are presented in Section 3. The possible causes behind these projection errors are examined in the following section. Based upon the main conclusions of the previous sections, the final part then makes a qualitative assessment of the most recent editions of the Economic Outlook.

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[1]   See LEBRUN (2007).
[2]   See DOBBELAERE and HERTVELDT (2004), BOGAERT *et al.* (2006) or DOBBELAERE and LEBRUN (2012).
[3]   See, for instance LOUNGANI and RODRIGUEZ (2008).

2. Comparing projected growth rates and outcomes

2.1. The methodology adopted

The Economic Outlook has been released each year in spring since the mid-1990s. With the setup of the European Semester in 2012, a preliminary version is now produced each year in March. This version is used as the macroeconomic framework for the Belgian Stability Programme.[4] Prior to 1996, a first version was published in February-March and an updated version in July. The spring releases (and before 1996 the July issues) have been selected for this study, starting with the Outlook of July 1986 (covering the period 1987-1990) and ending with the May 2010 release (covering the period 2011-2015). Subsequent editions cannot be fully evaluated yet due to the lack of hard data. Until the 1997 release, the projection period covered four years beyond the current year; since 1998 an extra year is added. To analyse the projection errors, we use the annual average growth rate over the projection period.[5] This measure, which ignores the errors on a year-by-year basis, is very much in line with the objective of the outlook, i.e. to provide the best possible estimate of the medium-term trend without foreseeing with precision cyclical fluctuations. It is also for that reason that we do not include the estimates for the current year as these short-term forecasts are produced with a different methodology using a quarterly model supplemented by business-cycle-related information.[6]

A traditional problem faced when measuring forecasting errors is the choice of the data vintage to be defined as the outcome. Indeed, most macroeconomic data – notably national accounts – are regularly revised when additional information becomes available or when methodological changes are introduced. As these factors can hardly be anticipated, we choose to compare the projected growth rate for year *t* with its realisation available in the release of the year *t*+2. For instance, we define the outcome for 1998 by the realisation available in the spring 2000 edition. This choice is based on the calendar of the national accounts as that data vintage entails the first complete release of the national accounts for 1998 published in autumn 1999. The time series constructed in that way is then used to compute, based on a moving average, the annual average growth rates considered as realisations.

In the following pages, we analyse the same variables as in WP 8-07, namely real GDP and its endogenous components by expenditure[7], deflators for private consumption and GDP and finally labour force, employment and productivity. Variables related to fiscal policy and projected under the 'no-policy-change' rule will be discussed briefly in Section 4.5. Issues linked to potential growth and output gap estimates will not be addressed here but interested readers can refer to LEBRUN (2015, 2016).

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[4]   Prior to 2012, the spring outlook was updated in October to serve as the macroeconomic framework for the Stability Programme.
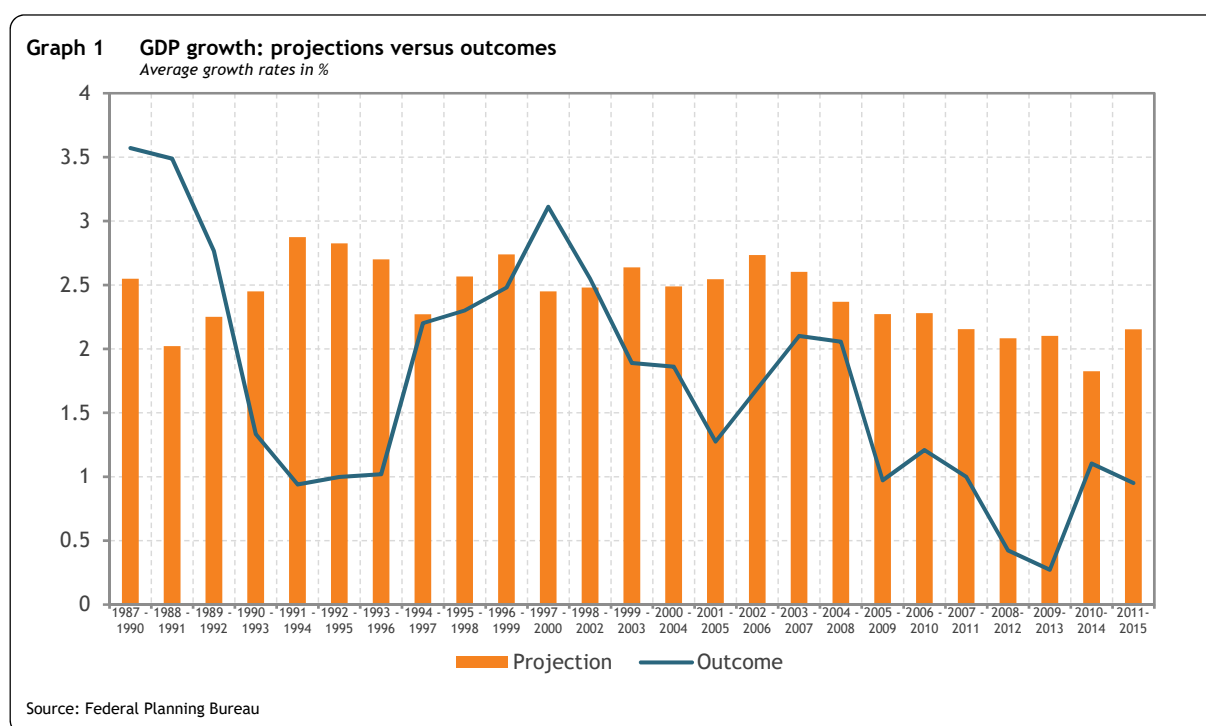
[5]   See Annex 1 for the mathematical formula.

[6]   See DOBBELAERE *et al.* (2003).

[7]   We exclude here projections for public consumption and public investment, which are produced independently of other variables using a no-policy-change methodology.

2.2. Real GDP and components by expenditure

As shown in Graph 1 below, the volatility of GDP growth rates, although smoothed by the four- or five-year average, is not well captured by the projections. Average projected growth rates oscillate between 1.8% and 2.9%, while the outcome varies between 0.3% and 3.6%. The upswing in the late eighties, following a period of low economic growth during the first half of that decade, was clearly underestimated, while high growth figures recorded during the period 1987-1990 generated hopes of sustained higher growth, which did not materialise. The period following the 1993 recession was characterised by more cautious projections which were more in line with the outcomes, whereas the downturn following the burst of the dot-com bubble at the beginning of the years 2000 was missed. Projection errors decreased somewhat during the following releases but of course increased dramatically once the year 2009 appeared in the sample, even with projections at their lowest over the last twenty years. Although a sharp correction in the US housing market and in the subprime mortgage market was signalled as a major risk as from 2006, it was never taken on board in the baseline projection before the global financial crisis truly erupted. The same phenomenon holds true for the ensuing sovereign-debt crisis that followed shortly after. A major lesson that can be drawn from this historical analysis is that – since the growth spurt of the late eighties – most shocks have been negative, meaning that the balance of risks around the baseline projection was in fact most of the time strongly on the downside. This is the main explanation behind the clear overestimation of GDP trend growth since the early 1990s.

Graph 1   GDP growth: projections versus outcomes
Average growth rates in %

Source: Federal Planning Bureau

Projections for private consumption growth (Graph 2) clearly show a more cyclical pattern than projections for GDP, while the cycles in outcomes exhibit a more similar pattern. The upswing in the late 1980s and the subsequent downturn were clearly missed as the top of the cycle in 2000. Although consumption growth projections have been almost systematically reduced since the release covering the 2002-2006 period, the observed decreasing trend has been even more pronounced. Over the whole sample, annual private consumption growth was overestimated on average by 0.4 percentage points.

Graph 2   **Private consumption growth: projections versus outcomes**
Average growth rates in %

Source: Federal Planning Bureau
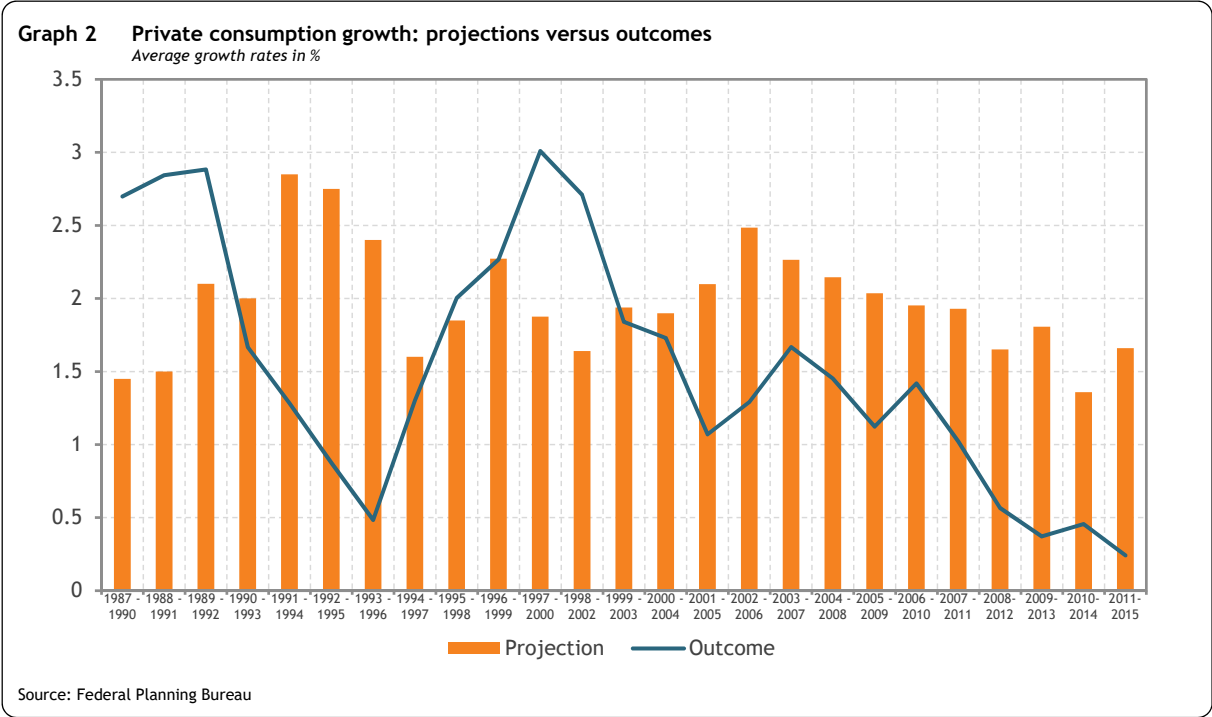
One of the explanations behind the limited cyclicality in GDP growth projections as compared to outcomes can be found in Graph 3. Indeed, concerning business investment, neither the surge during the 1987-1993 period nor the slowdown following the burst of the dot-com bubble were captured. The latest cycle in our sample is apprehended slightly better, although a large error for the period 2009-2013 persists. Average projected growth rates vary between 2.2% and 5.3% whereas outcomes fluctuate between -2.2% and 11.7%. Over the entire period, annual business investment growth was overestimated on average by 1.1 percentage points. If the first two outlooks are left out of the sample, the overestimation rises to 1.7 percentage points.

Just as for business investment, the boom in housing investment during the late 1980s came as a complete surprise, but the subsequent slowdown and the modest growth during the second half of the 1990s were captured reasonably well. The following short boom and the severe downturn caused by the global financial crisis were both missed. Over the whole sample, annual housing investment growth was underestimated by 0.4 percentage points, but if the first three projections are skipped, the result shifts to an overestimation by 0.7 percentage points.

Graph 3   Business and housing investment growth: projections versus outcomes
Average growth rates in %
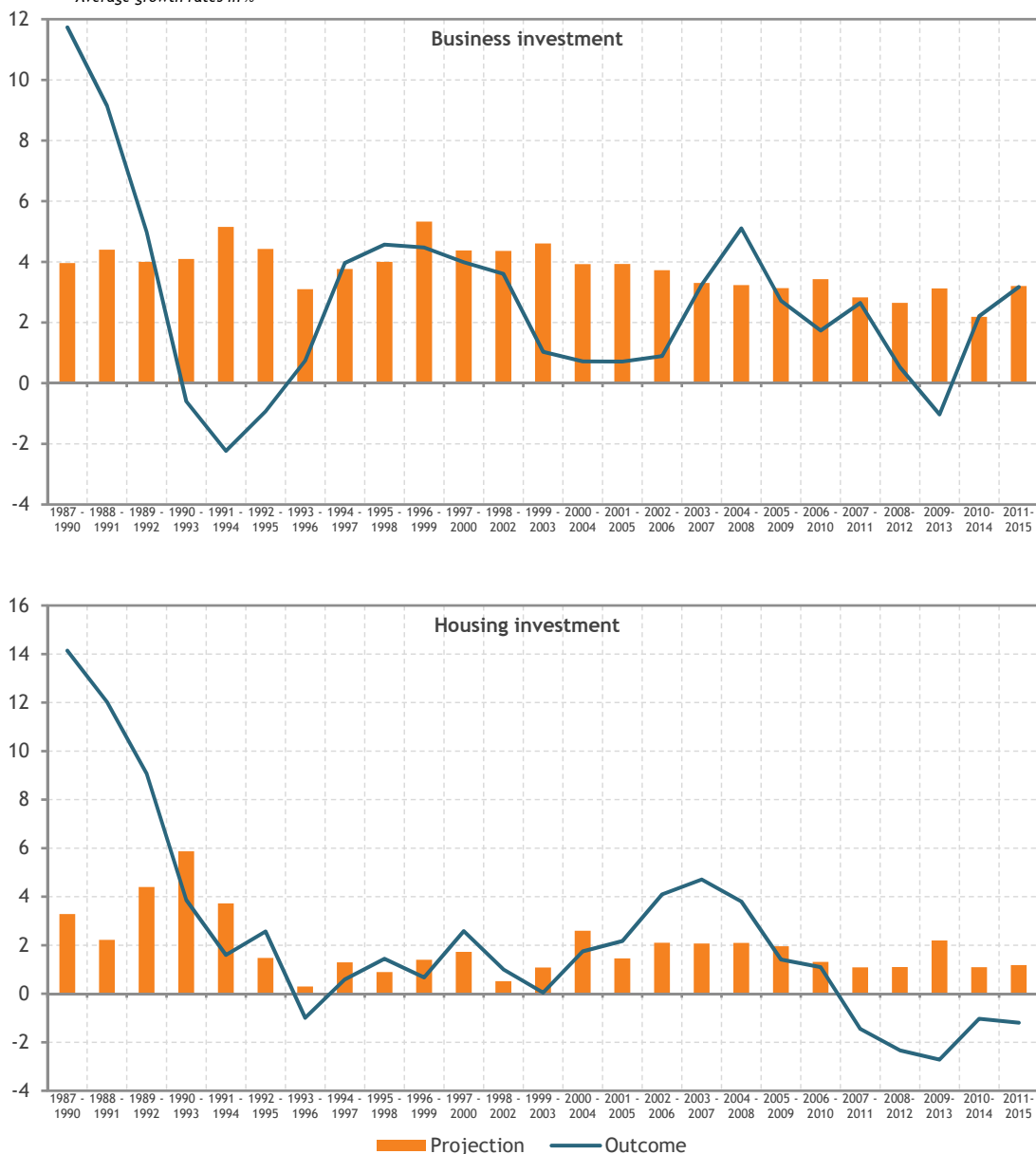
Source: Federal Planning Bureau

As can be seen in Graph 4, export growth projections are remarkably stable if the beginning and end of the sample are excluded. Conversely, the outcome shows a strong cyclical pattern. Underestimation of export growth only occurs in 5 out of 25 economic outlooks. Obviously, errors are very large for the projection periods in which the year 2009 is included, but even during the boom years preceding the outbreak of the global financial crisis, export growth was significantly overestimated. On average, exports have been projected to increase by 5.4% annually, while actual average growth rates reached only 3.6%.

Import growth projections are clearly linked to final demand growth projections. In the lower panel of Graph 4, we added a curve representing import growth projections corrected for growth errors on final

demand components based on the average import content of each component. This approximate correction generates import growth projections which are much closer to the outcomes for all periods, except for the first three outlooks and the last outlook. The average corrected projection error is close to zero if these outliers are excluded from the sample.

Graph 4   Export and import growth: projections versus outcomes
Average growth rates in %

Source: Federal Planning Bureau

2.3. Prices

In this subsection, we consider two domestic prices, namely the private consumption and the GDP deflator. As presented in Graph 5, the growth rate of the private consumption deflator was markedly underestimated at the beginning of the sample, while it was systematically overestimated in the 1990s. From the turn of the century until the outburst of the global financial crisis, inflation turned out to be

higher than expected. For the latest editions, projections turned out to be more accurate. Over the whole sample, the average underestimation is less than 0.2 percentage points, but if the first three editions are excluded from the sample, positive and negative errors cancel each other out.

As shown in the lower panel, GDP deflator growth rates were also noticeably underestimated during the first three economic outlooks under review and then overestimated during most of the 1990s. For the subsequent periods, projections and outcomes are substantially closer to each other, with the error never exceeding 0.4 percentage points. The average error is very close to zero over the whole sample.

Graph 5   Private consumption and GDP deflator: projections versus outcomes
Average growth rates in %
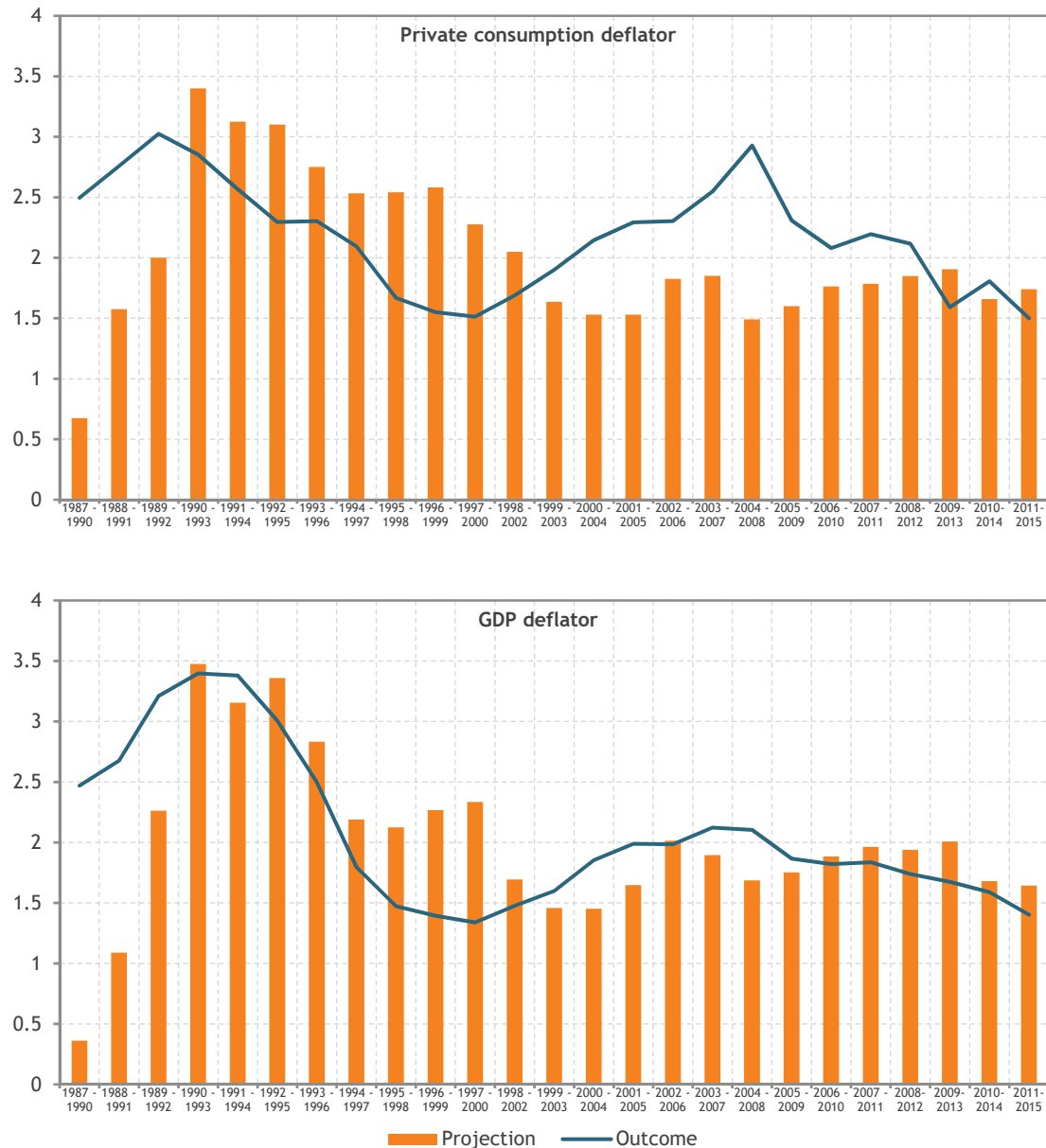
Source: Federal Planning Bureau

2.4. Labour force, employment and productivity

In this final subsection, we compare projections with outcomes for labour force, employment and productivity growth.

The labour force is an exogenous variable from the perspective of the macroeconometric model that is used[8], but labour force projections are nonetheless an endogenous component of the Economic Outlook as they result from demographic projections and assumptions made on labour participation rates by gender and age group. Graph 6 reveals that – until the 2007 edition of the outlook – labour force growth was systematically underestimated. Errors were, however, significantly reduced with the start of the new millennium. For the last three releases under review, labour force growth projections were strongly increased while the outcome shows, on the contrary, a clear declining trend. Over the whole sample, recorded average annual growth rates reached 0.7%, while the labour force was projected to increase by 0.4% per year.

Graph 6   Labour force growth: projections versus outcomes
Average growth rates in %

Source: Federal Planning Bureau
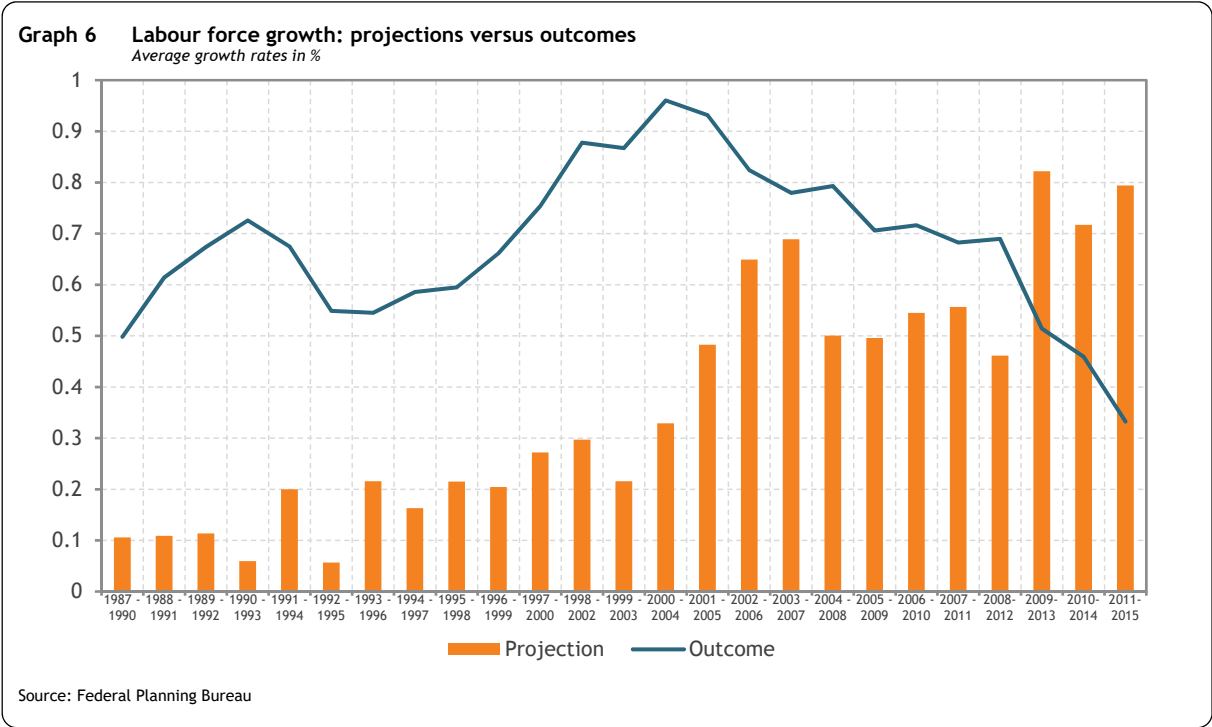
Graph 7 shows that employment growth projections were – in line with GDP growth projections – too prudent at the end of the 1980s, while subsequent outlooks during the early 1990s were clearly too optimistic. The upswing that followed was captured to a certain extent. From the 1999 to the 2007 release, employment growth was on average projected rather accurately. Two of the last three editions were clearly too sanguine. On average over the whole sample, employment growth was projected without error, while GDP growth was – as previously seen – largely overestimated.

As a result, labour productivity growth per worker was on average overestimated. This becomes obvious when looking at the lower panel of Graph 7: projected productivity growth exceeds the outcome in

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8   Since 1988, the Economic Outlook is produced using the macroeconometric HERMES model (see BASSILIÈRE *et al.*, 2013), while previously the MARIBEL model was used.

23 out of 25 cases. Clearly, the decreasing trend in productivity growth observed since the end of the 1990s and further exacerbated by the financial crisis, was captured insufficiently in the successive projections. On average, productivity growth was overestimated by 0.7 percentage points annually.

Graph 7   Employment and productivity growth: projections versus outcomes
Average growth rates in %

Source: Federal Planning Bureau

3. Statistical properties of the projection errors

After a graphical inspection of projections and outcomes, we now turn to some standard statistics summarising the properties of the projection errors. The mathematical formulas that are used to calculate these summary statistics can be found in Annex 1.

The mean error (ME) indicates by how much the projected growth rates were on average overestimated (positive sign) or underestimated (negative sign).[9] A desirable property of forecasts is unbiasedness, meaning that the mean error should be close to zero. To test this property statistically, forecast errors are regressed on a constant and its *t*-statistic is computed. However, a mean says nothing about the overall size of the error. A small mean could indicate that all the errors were small but also that large negative and positive errors offset each other. The mean absolute error (MAE) and the root mean square error (RMSE) do not suffer from this ambiguity. Compared with the MAE, the RMSE gives more weight to the largest errors. A drawback of the above-mentioned statistics is that they depend upon the volatility of the series in question which means that one cannot readily compare them across variables. A way to normalise them is to divide the MAE by the mean absolute deviation of the series and the RMSE by the standard deviation of the series.

Another way to evaluate the accuracy of the forecasts is to compare them with naïve forecasts[10] using the Theil coefficient. A value below unity indicates that the projection outperforms the naïve alternative. Forecast errors should also be serially uncorrelated, otherwise past forecast errors could be used to improve the forecast made in year *t*. However, while this property applies to short-term forecasting, for medium-term projections it is impossible in practice to use past errors because they only become available with a long delay.[11]

The first column in Table 1 indicates – as we already noticed in the previous chapter – that, except for housing investment, the growth rates of all GDP components were on average overestimated. Yet the last column shows that this optimistic bias is statistically significant at 5% level only for exports, imports and GDP. Inflation, as measured by private consumption and GDP deflators, was slightly underestimated over the whole sample but without statistically significant bias. The same findings hold true for employment growth. Finally, the evolution of the labour force and labour productivity were undeniably under- and overestimated respectively.

As can be seen from the second column, the absolute size of the errors is clearly larger for investment and exports than for consumption, while absolute errors on price deflators are more limited. Note that the size of the absolute error on GDP is lower than for first round forecasts of the economic budget[12] since over- and underestimates compensate each other somewhat over the four- or five-year projection period. In the case of the labour force, the mean absolute error is only slightly larger than the mean error because the average growth rate was underestimated in all but three projections. A similar conclusion

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[9]   The projection error is defined here as the projected growth rate minus the outcome.
[10]   By naïve forecasts we refer here to univariate techniques using lagged values of the series to construct future values of the same series.
[11]   For example, the full outcome for the spring 2016 outlook will be available only in autumn 2022.
[12]   See DOBBELAERE and LEBRUN, *op. cit*.

holds true for labour productivity growth. The RMSE statistic in the third column reflects the preceding column, except that the large errors made on business and housing investment growth at the beginning of the sample are more penalised.

Table 1   Key descriptive statistics for errors on projected four- or five-year average growth rates (1987-2015)

	ME	MAE	RMSE	RMSE/σ	Theil	No bias
Private consumption	0.45	0.91	1.05	0.82	0.81	0.12
Business investment	1.08	2.38	3.26	0.60	0.56	0.20
Housing investment	-0.42	2.41	3.57	0.57	0.54	0.68
Exports of goods and services	1.79	2.21	2.64	0.70	1.14	0.00**
Imports of goods and services	1.52	2.09	2.54	0.68	1.00	0.01**
Gross domestic product	0.67	0.97	1.12	0.72	0.76	0.01**
Private consumption deflator	-0.15	0.66	0.77	0.79	0.64	0.51
GDP deflator	-0.06	0.46	0.67	0.82	0.52	0.76
Labour force	-0.31	0.39	0.42	1.53	1.74	0.00**
Employment	-0.04	0.51	0.65	0.82	0.67	0.83
Labour productivity	0.70	0.75	0.87	0.73	1.08	0.00**

Notes: Projection error = projection - outcome; ME is the mean error; MAE is the mean absolute error; RMSE/σ is the root mean square error divided by the standard deviation of the variable; Theil reports the RMSE of a given projection relative to the RMSE of a naïve alternative given by the average growth of the four or five previous years; No bias gives *p*-value of the *t*-statistic (with standard error robust to autocorrelation) for the hypothesis H_0: ME = 0 obtained by regressing the projection error on a constant; * and ** indicate a rejection of H_0 at a significance level of respectively 10% and 5%.

The fourth column computes the size of the error, corrected for the volatility of the series as it is likely that larger absolute errors are made on more volatile series. Allowing for this correction, the size of the error appears to be comparable among all variables except for the labour force. The next column compares the projections errors with those obtained using a naïve method that takes the four or five-year average growth rate recorded the year before the projection was made. The Theil statistics indicate that the projections are more accurate except for exports, imports, the labour force and labour productivity. This finding constitutes a deterioration compared to the results presented in WP 8-07, where only the labour force growth recorded a Theil statistic above unity.[13]

Not surprisingly, autocorrelation cannot be rejected for any of the variables (results not shown). As mentioned previously, for medium-term projections, unlike short-term forecasting, outcomes and consequently errors are only computable after a long delay, which explains the inertia in the latter.

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[13]   Obviously, the poor result obtained for imports is clearly related to the export projections.

4. Analysing projection errors

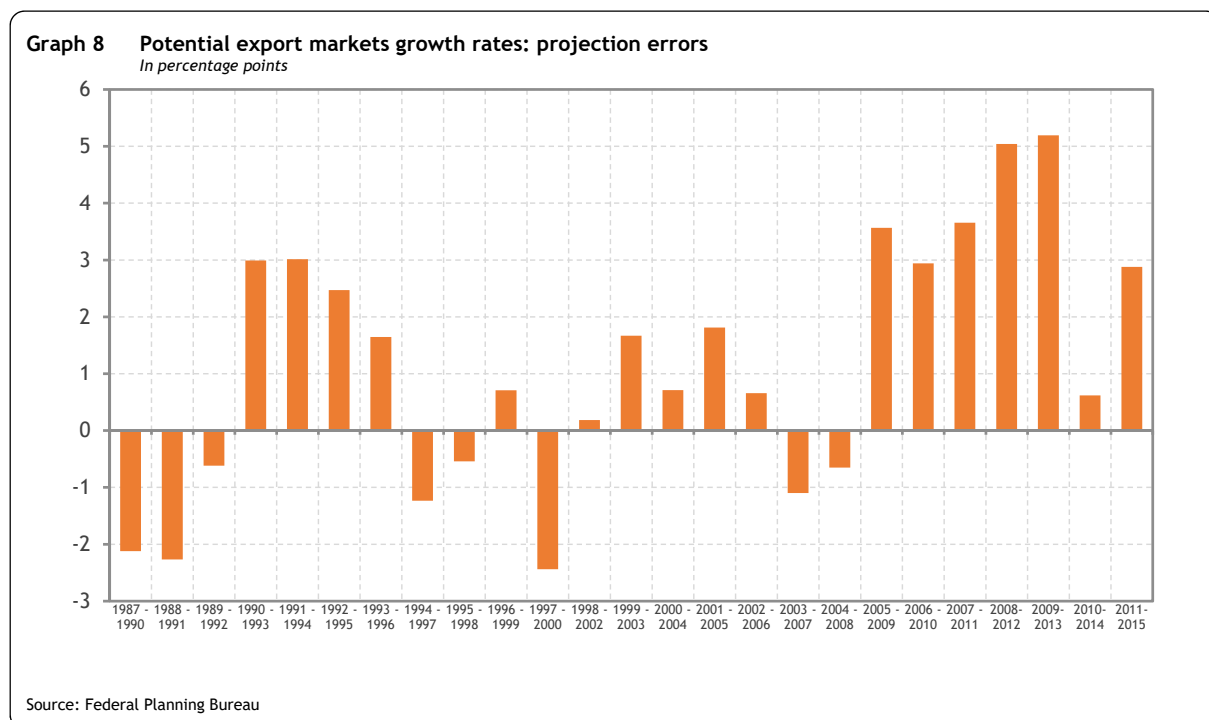## 4.1. Possible causes behind projection errors

In the previous sections, we compared projected average growth rates with outcomes, and through a number of summary statistics examined the main characteristics of the projection errors. In this section, we will analyse some of the possible causes behind these errors.

As already described in WP 8-07, projection errors can originate from four kinds of sources. Firstly, errors can be due to the uncertainty surrounding the most recent data. This factor is certainly crucial for short-term forecasts for which starting points and carryover effects are essential, but it is less critical for projections with a longer horizon. Secondly, errors can originate from the model itself. Econometric models contain stochastic coefficients and error terms which are shrouded in uncertainty. Coefficients may also change over time. The model may be misspecified, which means that the functional forms of the equations or the simultaneous dynamics of the whole system do not adequately describe the functioning of the economy. Thirdly, errors can be ascribed to mistakes on the exogenous variables. Exogenous variables are variables for which the future path is defined outside the core model used to produce the forecasts. The future values for these variables are themselves simply assumed, constructed with specific methods or forecasted by other institutions. Typical exogenous variables for the economic outlook are those related to the international environment, demography and fiscal policy. A last source of error is related to the so-called 'add-factors' reflecting expert's opinion and amending the spontaneous solution of the model. This last aspect is certainly important for short-term forecasting but these add-factors are used in a more parsimonious way in medium-term projections which essentially reflect the unconstrained outcome of the model.

As mentioned above, errors on medium-term projections can essentially be attributed to two factors, namely to the exogenous assumptions and to the model itself. Ideally, to disentangle the contribution of each of these factors, each projection should be rerun using the historical model but replacing the original set of exogenous variables by their outcome, as defined in Section 2. In a model the size of HERMES, containing hundreds of exogenous variables, and which is continuously adapted and updated, this would represent an immense task. Here, we will make use of a simplified methodology, correcting projections for the main macroeconomic variables described in the previous sections for errors on some key exogenous assumptions using regression coefficients.
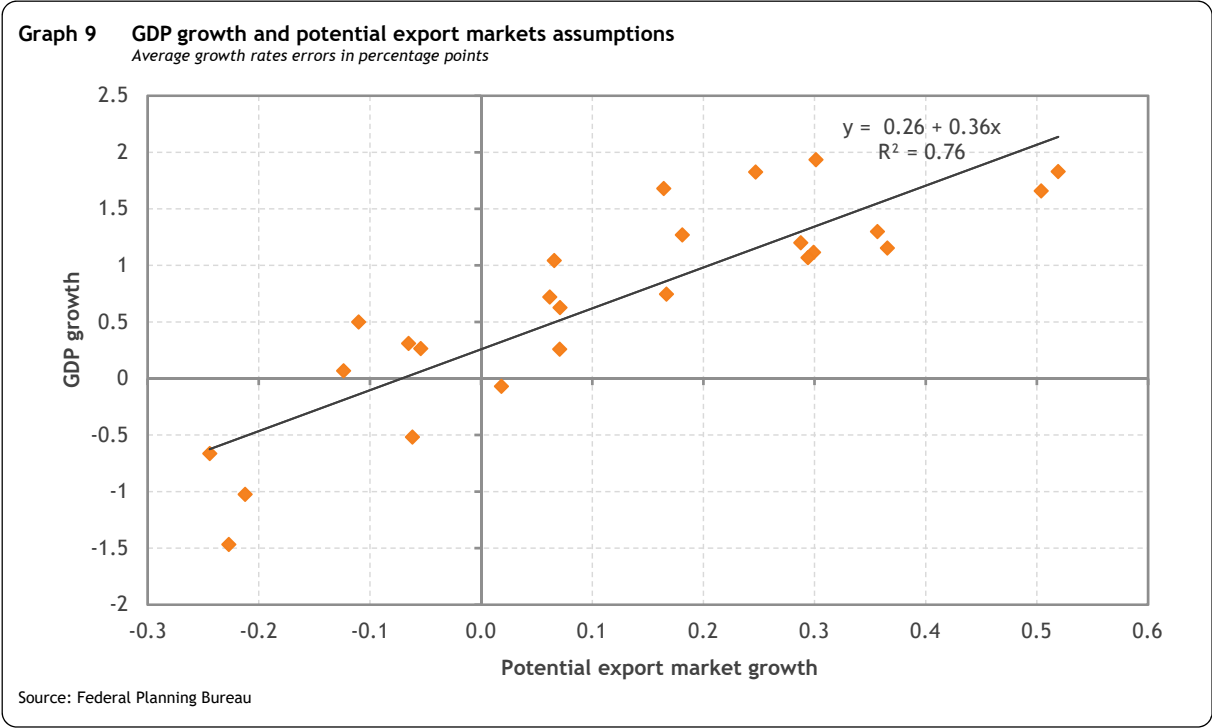
4.2. International trade

The development of potential export markets is the crucial exogenous variable for projecting export growth and hence – for a small, open economy like Belgium – a key determinant of economic growth. The export market hypothesis is typically based on weighted[14] import growth projections of Belgium's trading partners produced by international organisations (European Commission, OECD and IMF). As can be seen in Graph 8 below, foreign export market growth was on average only slightly overestimated when ending the sample with the 2003 edition (covering the period 2004-2008), but excessively optimistic once 2009, i.e. the year of the Great Recession, is included in the period averages.

Graph 8   Potential export markets growth rates: projection errors
In percentage points

Source: Federal Planning Bureau

The positive slope of the regression line in Graph 9 shows the clear relationship between the errors on foreign export markets and on Belgian GDP growth. According to the regression results, about 76% of the variance of the errors on the latter is explained by errors on potential export market growth. The estimated coefficient indicates that for each percentage point error on export market growth, GDP growth projection will deviate by 0.36 percentage points from its outcome.[15]

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[14]   Reflecting the geographical orientation of Belgian exports.
[15]   Note that the constant of the regression is positive and significant, meaning that correcting for errors on export markets will not eliminate the bias completely, as we shall see later in the analysis.

Graph 9   GDP growth and potential export markets assumptions
Average growth rates errors in percentage points

$y = 0.26 + 0.36x$
$R^2 = 0.76$

Source: Federal Planning Bureau

It is important to stress that the equation presented here is a reduced form estimate which may capture not only the international trade surprises but also the impact of other exogenous variables which are correlated with world trade, such as oil prices, asset prices or interest rates. It may also include the effects of fiscal policy if the latter is pro-cyclical. However, as shown in Table 2 below, the impact on GDP growth of a shock on world trade – which is exclusively based on a technical simulation with the HERMES model – is comparable.[16] The same observation applies to imports, employment and productivity, while the elasticity based on the projection errors is higher for private consumption, business investment and much higher for housing investment[17]. Only exports exhibit a lower reduced-form elasticity.

Table 2   Comparison between elasticities based on regression result and on a model simulation

	Regression result	Model simulation
Private consumption	0.31 (R2 = 0.51)	0.16
Business investment	0.92 (R2 = 0.41)	0.60
Housing investment	1.21 (R2 = 0.54)	0.04
Exports of goods and services	0.73 (R2 = 0.65)	0.93
Imports of goods and services	0.81 (R2 = 0.74)	0.81
Gross domestic product	0.36 (R2 = 0.76)	0.37
Employment	0.19 (R2 = 0.40)	0.22
Labour productivity	0.17 (R2 = 0.51)	0.17

Notes: The column labelled "Regression result" gives the impact of a one percentage point error on export market growth obtained by regressing the average growth error of the variable considered on a constant and on the average export market growth error; the column labelled "Model simulation" indicates the average impact over four years of a one percent increase in export markets based on a technical simulation with the HERMES model (see BOSSIER and VANHOREBEEK, 2000).

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[16]   Obviously different model versions may generate slightly different elasticities. In this analysis, we choose to retain the model version of the year 2000, which roughly corresponds to the middle of our sample.

[17]   Note that when the first three outlooks are excluded from the sample, the regression coefficient turns out to be twice as small, casting some doubts on the robustness of the estimated relationship between the errors of the two variables.

For the results presented in Table 3 below, we corrected projections on GDP growth and components using the elasticities based on the regression results. The first three columns give the ratio of the mean error, the mean absolute error and the mean square error between 'corrected' and 'uncorrected' projection errors respectively. These statistics indicate that the mean error on private consumption growth has been reduced by 80%, while the size of the error has been reduced by around 35% or even 60% if large errors are penalised more. The average error on business investment is now virtually zero and the absolute size of the error is reduced by 20% (50% if large errors are given more weight).
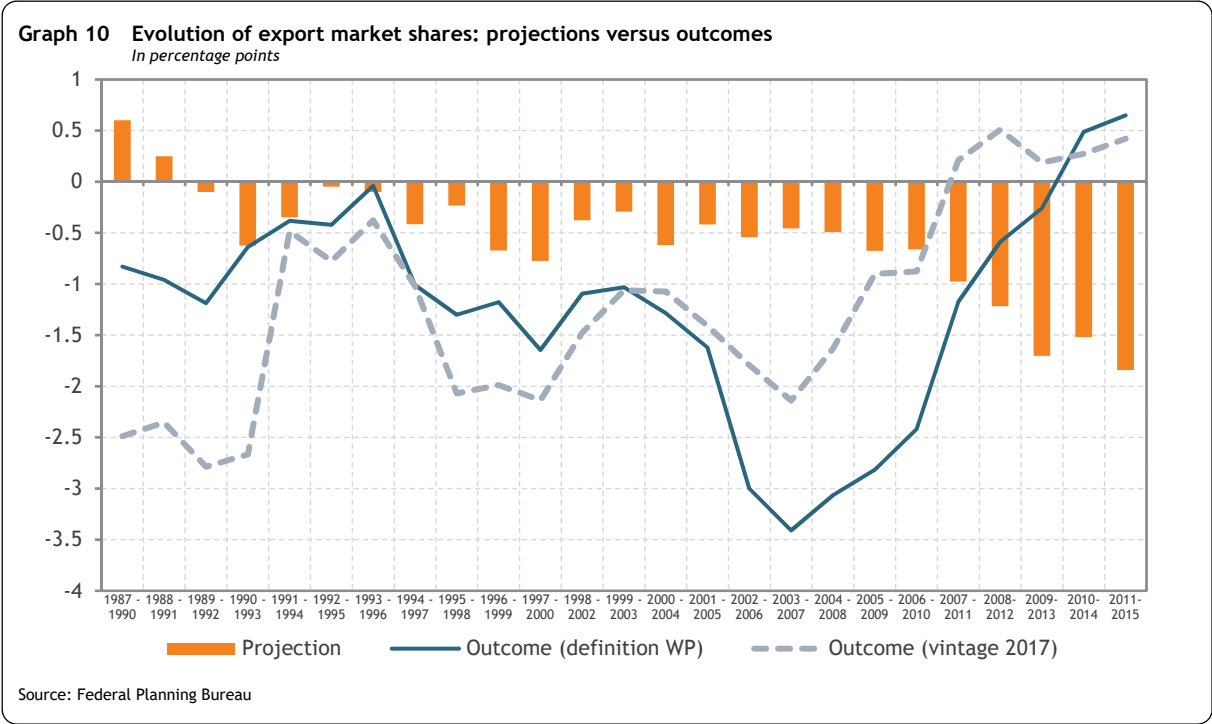
Correcting housing investment growth based on the regression coefficient strongly increases the mean error, while only marginally reducing the mean absolute error. This tends to confirm – as pointed out by the HERMES model simulations – that housing investment has its own cycle that is only weakly related to the evolution of international trade. The average projection error is almost halved for exports, but the bias remains significant. The mean absolute error is lowered by 45%, while the mean square error is reduced by 70%, which means that the largest errors are removed by the correction. For imports, the bias and the absolute size of the errors are reduced even more. For GDP as a whole, the average error and the mean absolute error are lowered by 60%. Again, large errors are eliminated as the value of the mean square error indicates.

Table 3   Key descriptive statistics for projections errors corrected for export market assumptions (1987-2015)

	ME ratio	MAE ratio	MSE ratio	No bias
Private consumption	0.20	0.64	0.41	0.65
Business investment	0.02	0.81	0.52	0.97
Housing investment	4.29	0.94	0.71	0.01**
Exports of goods and services	0.53	0.56	0.32	0.01**
Imports of goods and services	0.38	0.43	0.21	0.07*
Gross domestic product	0.38	0.41	0.21	0.06*
Employment	6.51	0.92	0.76	0.09*
Labour productivity	0.72	0.77	0.51	0.00**

Notes: ME ratio is computed as the mean error of the "corrected" projection errors divided by the mean error of the "uncorrected" projection errors; identical definition for the mean absolute error (MAE) and the mean square error (MSE); No bias: see notes Table 1.

As mentioned before, the statistically significant bias for exports does not disappear when corrected for export market errors. Export growth projections are now overestimated in all cases except the last three editions under review. As shown in Graph 10, the losses in market shares – computed as the difference between growth of exports and of potential export markets – were undoubtedly underestimated until the 2005 release (covering the period 2006-2010). Based on these past performances, export market share losses were increased in subsequent editions, while the outcome turned out to be much more positive, even recording gains at the end of the sample. However, to illustrate the importance of revisions of the data over time and consequently the difficulty to monitor in real time the evolution of market shares, we also present the outcomes based on the 2017 vintage of the database. While the losses in export market shares are confirmed for most of the sample, they are considerably smaller for the years 2000 and gains already appear from the period 2007-2011 onwards.

Graph 10 Evolution of export market shares: projections versus outcomes
In percentage points

Source: Federal Planning Bureau

For employment, the ME ratio in Table 3 indicates that, while uncorrected errors were on average virtually zero (see Table 1), employment growth corrected for external growth errors was on average significantly underestimated. The absolute size of the errors would have been only slightly smaller, but at least larger errors are reduced. The optimistic bias in labour productivity growth is somewhat lower with the correction, but it remains highly significant. The mean square error, as for all other variables, diminishes notably more than the mean absolute error. As shown in Graph 11, while errors on productivity and employment cancel each other out in the more recent period, for the releases of the Economic Outlook from 1990 to 1994 (covering the period 1991-1998) and again for the editions from 1999 to 2003 (covering the period 2000-2008), the positive errors on productivity growth dominate. Overall, after correcting for the optimistic bias in world trade, GDP growth still exhibits a mean error of around a quarter of a percentage point.

Graph 11   Decomposition of GDP growth projection errors corrected for export market assumptions
In percentage points

Source: Federal Planning Bureau

Legend: Employment (corrected) — Productivity (corrected) — GDP (corrected)
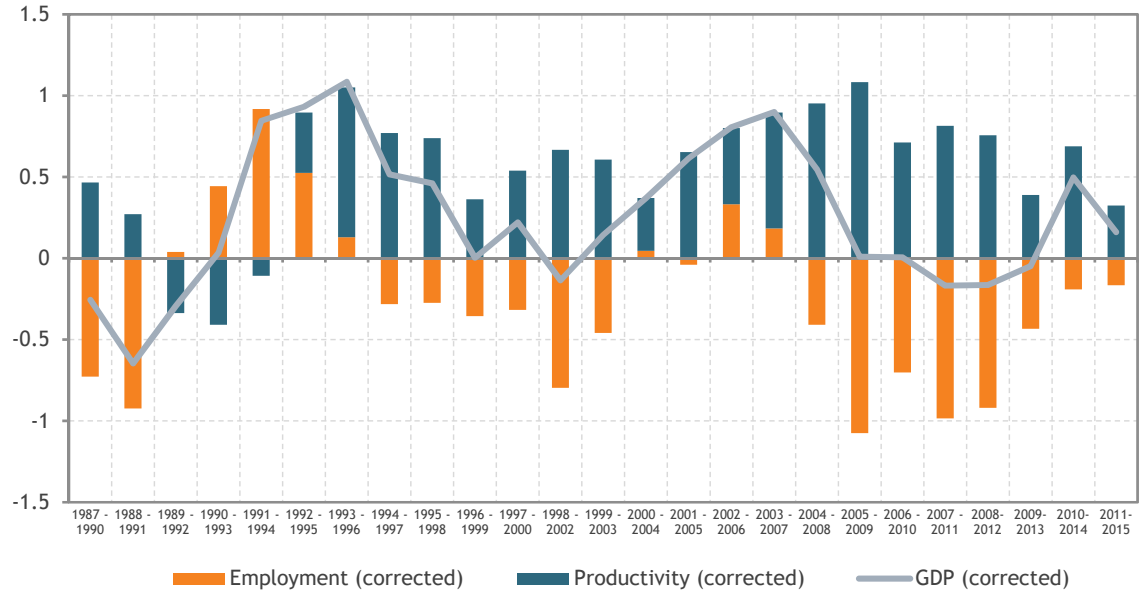
4.3. Import prices

In this subsection, we examine the impact of import prices projection errors on consumer prices. Although import prices are endogenous in the HERMES model, they are largely determined by international prices (among which oil prices) and exchange rates.[18] As shown in Graph 12, import price growth was strongly overestimated till the mid-1990s. This can be partly explained by the (unforeseen) appreciation of the effective exchange rate of the BEF between 1986 and 1995. Thereafter, the errors are smaller but predominantly negative.

Graph 12   Import prices growth rates: Projection errors
*In percentage points*

Source: Federal Planning Bureau
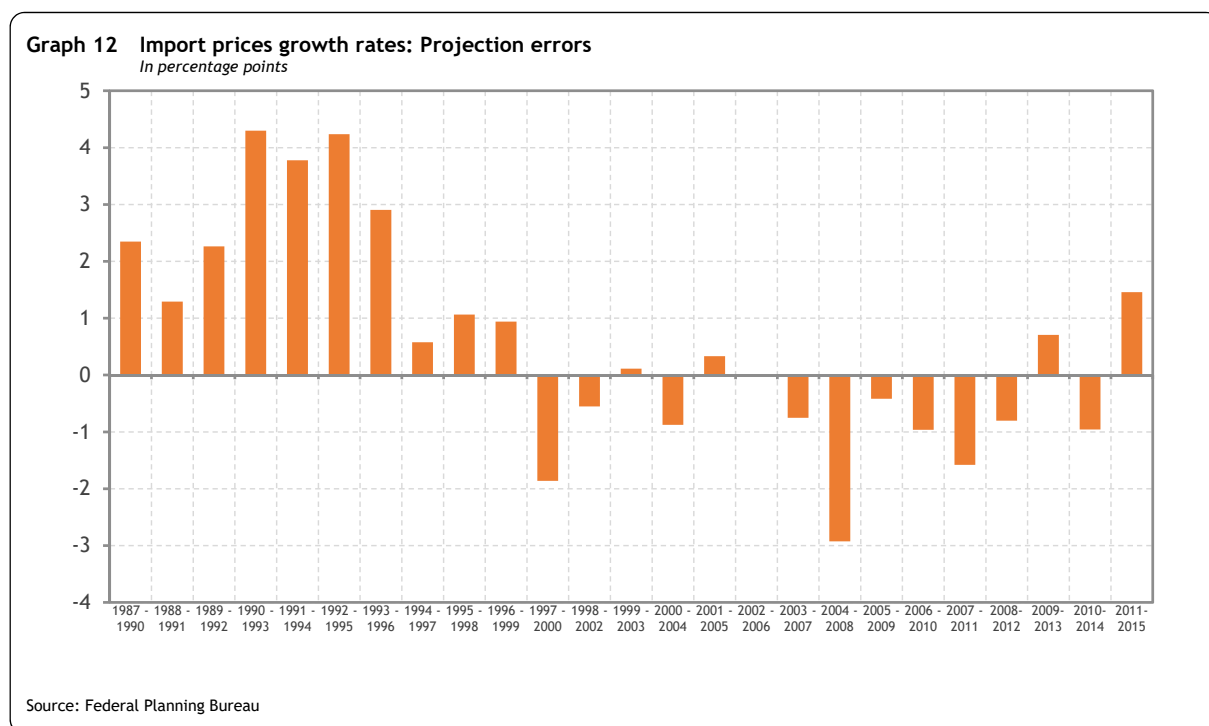
The results in Graph 13 show that the regression coefficient of import price projection errors is positive and significantly different from zero, but only when the three first releases of the Economic Outlook are excluded.[19] However, the correlation is less strong than in the case of errors on GDP and export market growth, which of course is explained by the fact that domestic costs and mark-ups also play an important role in determining the consumer price evolution. Using the same type of methodology as in the previous subsection to correct inflation projections for errors in import prices reveals that inflation projections would have remained unbiased, but that the mean absolute error and the mean square error would have been reduced by 30% and 40% respectively.

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[18]   A pricing to the market strategy by the importers would nevertheless entail some influence of domestic prices on import prices, see BASSILIÈRE *et al.* (2013).

[19]   This does not come as a surprise as in the releases from 1986 to 1988, errors on consumer price and import price growth are large but with opposite signs.

Graph 13   Import and consumer prices growth: projection errors (1990-2015)
Average growth rates errors in percentage points

$$y = -0.07 + 0.21x$$
$$R^2 = 0.39$$
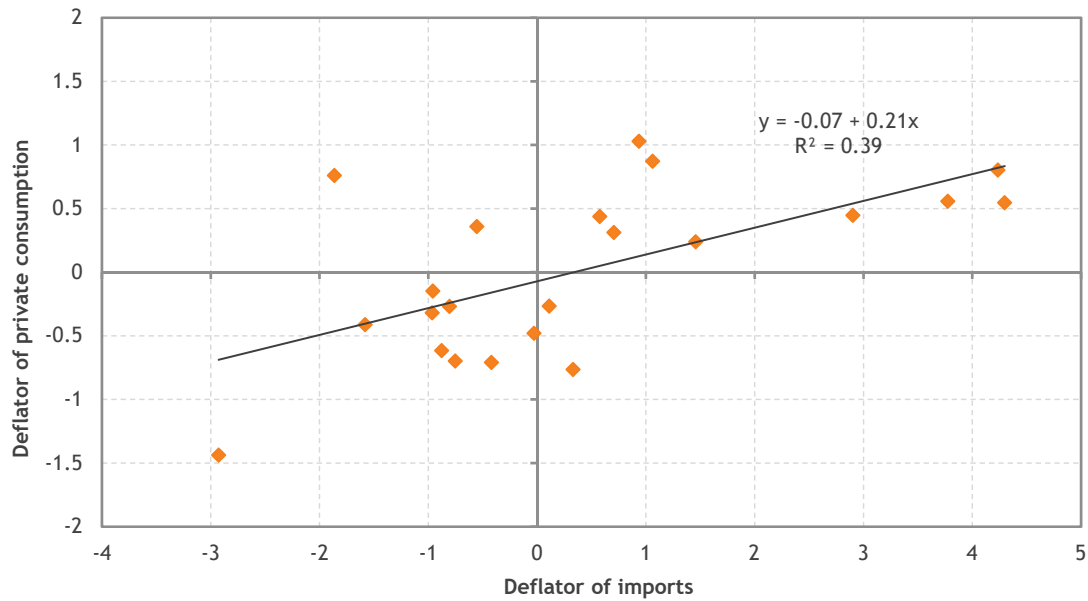
Source: Federal Planning Bureau

4.4. Demographic and participation rate projections

As revealed by the analysis in Section 2, labour force growth has been underestimated except for the last three releases of the Economic Outlook under review. Although this series is an exogenous variable for the HERMES model, its future path is in fact the combination of separate projections for the population and participation rate by age and gender.

Graph 14 shows – since the 1993 edition[20] – the respective contribution of errors on the working-age population and the participation rate to the labour force growth projection errors. Until the 2000 release, the errors on the participation rate are negative and explain the largest part of the underestimation of the labour force growth. Afterwards, the errors on the participation rate become positive and the underestimation is entirely caused by the errors on the working-age population. In the latest editions, these errors become close to zero and the overestimation of the labour force growth is almost entirely explained by the positive errors on the participation rate.

[20]   Demographic projections prior to 1993 were not updated annually.

Graph 14   Decomposition of labour force growth projection errors
In percentage points
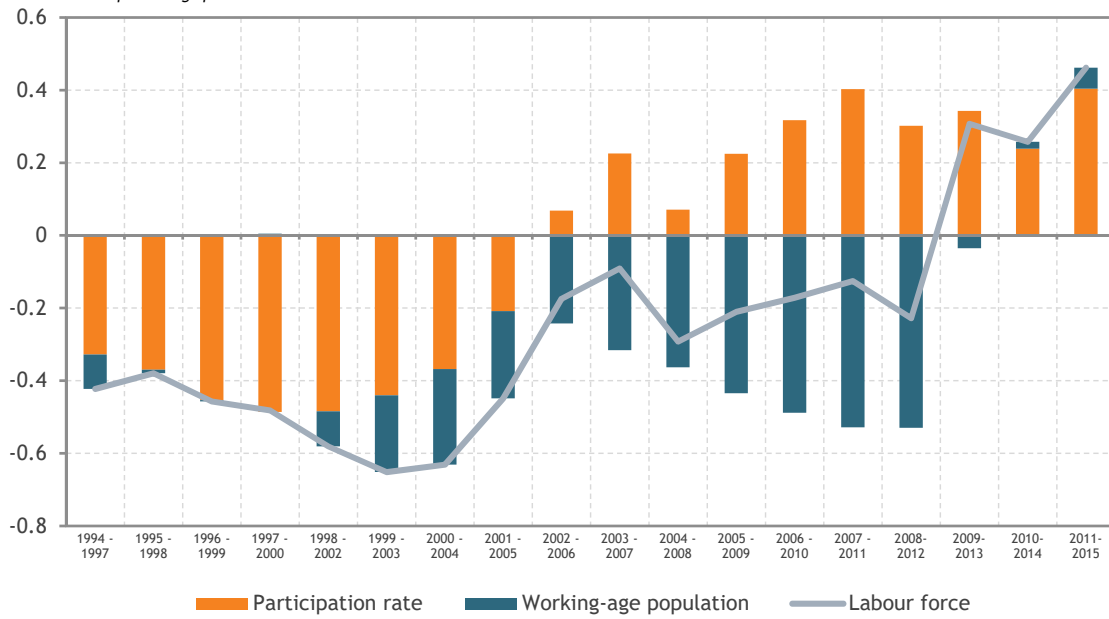
Source: Federal Planning Bureau

The underestimation of the working-age population largely reflects, except for the first four releases, projection errors made on the overall population. As can be seen in Graph 15, it took about a decade to adapt the population projections to the new reality of growth rates that were much higher than the ones prevailing during the 1990s.

Graph 15   Population growth: projections versus outcomes
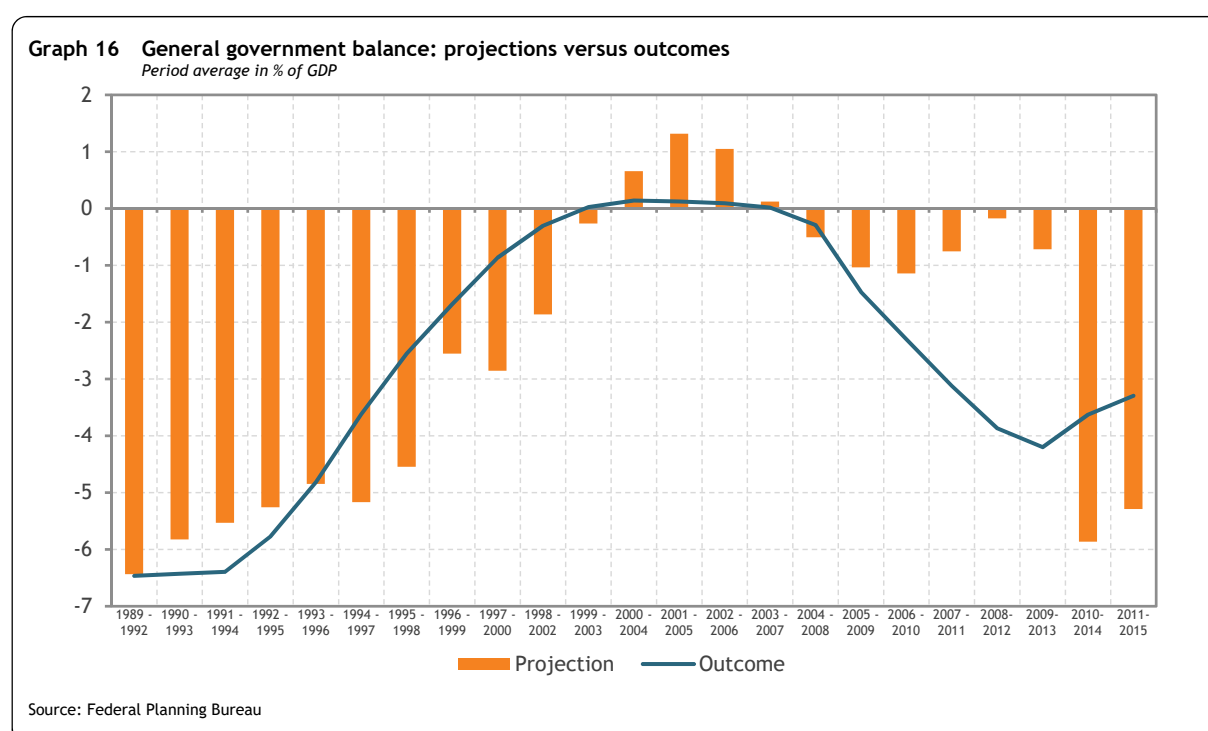*Average growth rates in %*
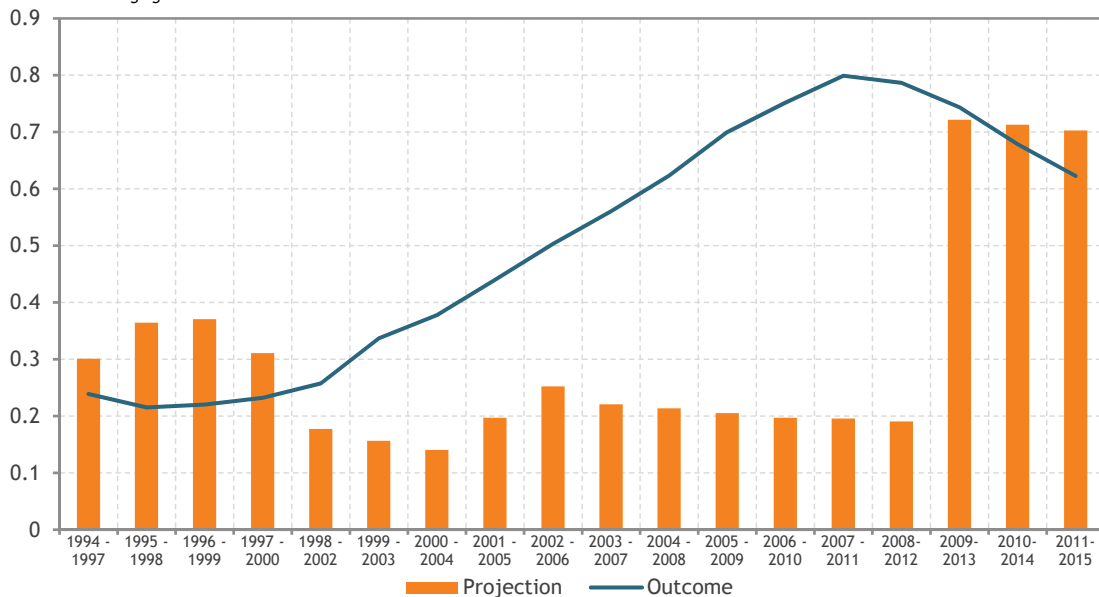
Source: Federal Planning Bureau

4.5. Fiscal policy

As mentioned previously, budgetary prospects are provided under the 'no-policy-change' rule. Accordingly, the aim of the exercise is not to provide the most accurate budgetary forecasts anticipating policy decisions, but rather to provide a benchmark scenario against which the fiscal objectives of the government can be assessed, including those contained in the stability programmes. The reasons underpinning the discrepancies between projected and observed budgetary values are thus fourfold: (i) errors on macroeconomic and financial variables, (ii) changes in fiscal policy including one-off measures, (iii) errors related to model misspecifications and (iv) changes in accounting concepts.[21]
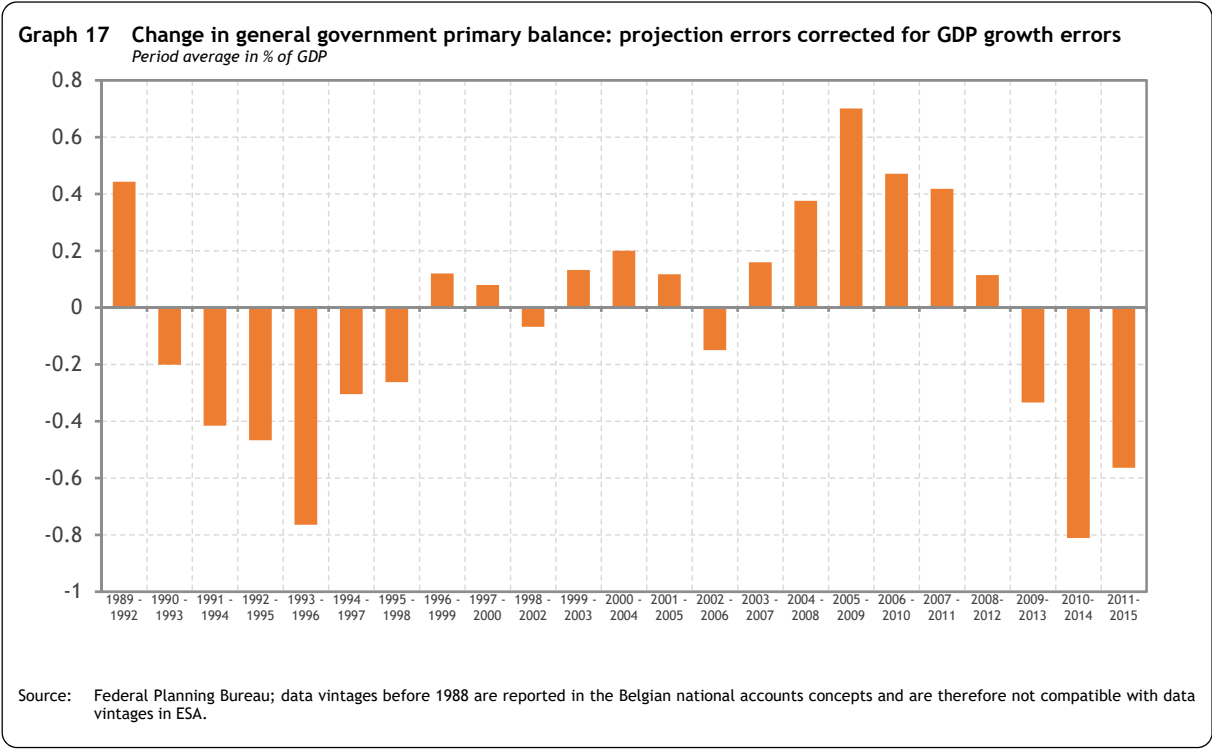
In Graph 16, we present projections and outcomes for the general government balance (in % of GDP of its own data set) using the same methodology as in the previous sections.[22] The underestimation of the deficit at the beginning of the sample can partly be attributed to overly optimistic growth projections. From the year 1993 onwards, the better than expected improvement in the fiscal stance is due to new measures taken, especially on the revenue side, to comply with the Maastricht criteria and subsequently to converge to the close-to-balanced target of the Stability and Growth Pact. From there on, budgetary surpluses were projected that never materialised due to lower than expected economic growth, a tax reform and increases in a number of expenditure items. The unforeseen sharp increase in the deficit once the year 2009 is included in the period average is of course related to the Great Recession and its aftermath. For the period 2010-2015, the smaller than projected deficit is explained by the restrictive fiscal policy that was adopted shortly after the end of the recession.

Graph 16   General government balance: projections versus outcomes
Period average in % of GDP

Source: Federal Planning Bureau

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[21]   See LEBRUN (2009) for a discussion.
[22]   Note, however, that the sample only starts with the data vintage 1988, because earlier vintages are reported in the Belgian national accounts concepts and are therefore not compatible with data vintages in ESA.

In the same spirit as the previously used correction method, we can here adjust the projections of the change in primary balance for economic growth errors using a semi-elasticity obtained with the HERMES model supposing an external growth shock. While the value of the semi-elasticity[23] depends on the type of shock, an important part of GDP growth errors – as mentioned earlier – is precisely due to external growth surprises. In Graph 17, the difference between projected and observed changes in the primary balance corrected for economic growth errors gives an indication of the discrepancy between the fiscal policy stance assumed in the outlook and the outcome. During most of the 1990s, the no-policy-change scenario implied a more expansive fiscal policy than the one observed, while the opposite holds true for the next decade. The strong tightening of fiscal policy in the years following the financial crisis is also visible.

Graph 17   Change in general government primary balance: projection errors corrected for GDP growth errors
Period average in % of GDP

Source: Federal Planning Bureau; data vintages before 1988 are reported in the Belgian national accounts concepts and are therefore not compatible with data vintages in ESA.
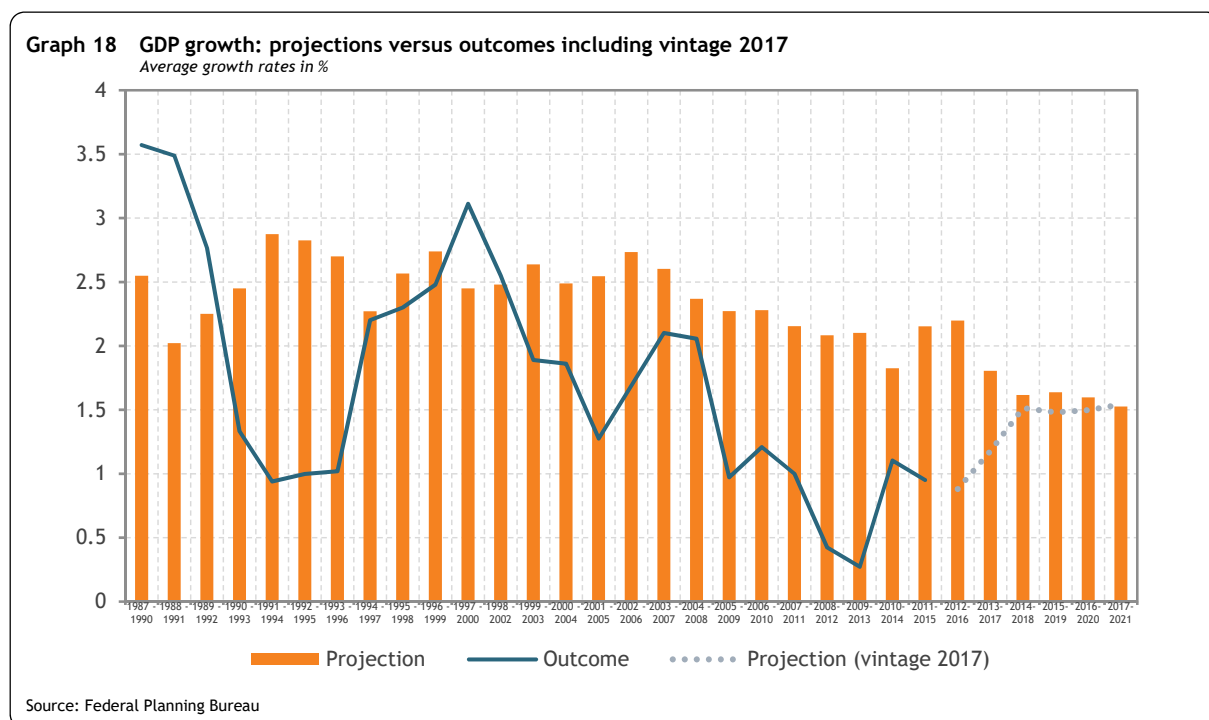
While the impact on public finances of errors on economic growth can be measured approximately as explained above, the impact of the no-policy-change rule on the errors on macroeconomic variables is far less obvious to estimate and would require, for instance the use of the unexpected change in the structural fiscal balance (see Fioramanti *et al.*, 2016), which is not readily available in our historical databases.

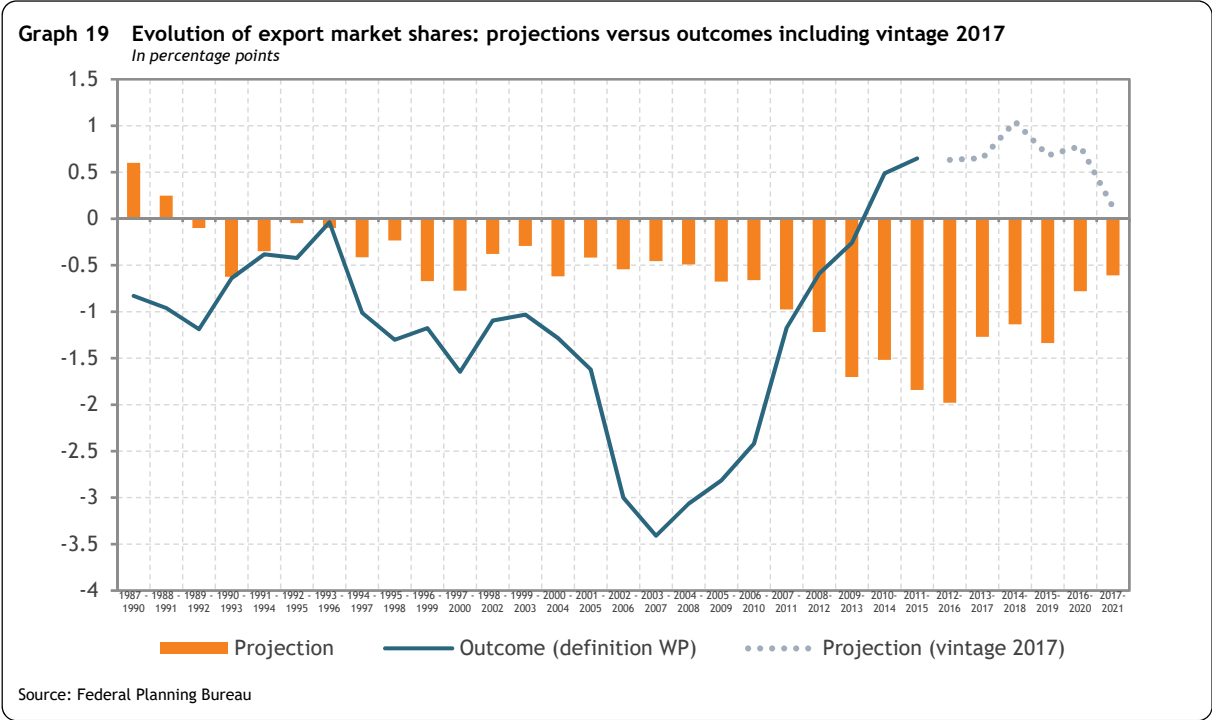[23]   An average value of 0.4 has been retained here.

5. Looking ahead

As mentioned in the introduction, an accuracy assessment serves two purposes: evaluating the uncertainty surrounding the projection and identifying possible methodological weaknesses. In Working Paper 8-07 we emphasised the need to better understand the reasons behind the increase in export market share losses and the factors determining the labour productivity trend. We also described the methodological developments introduced or planned to improve participation rate and population projections.

Although we are not yet able to fully evaluate the Economic Outlooks published after 2010 due to the lack of hard data, we can already compare the projections of the more recent releases with the 2017 vintage, which contains some statistical information until the year 2016. For example, based on Graph 18 below, we can already confirm that the 2011 edition of the Economic Outlook (covering 2012-2016) was largely too optimistic regarding GDP growth. The same assertion holds true for the 2012 edition. The negative impact on growth of the sovereign debt crisis in the euro zone was clearly underestimated in the baseline scenario, while the no-policy-change assumption probably also explains part of the overestimation in a context of restrictive budgetary policy. With respect to the latest editions, no definite statement can be made except that they contain by far the lowest average growth rates projected over the whole sample and that they are confirmed by the 2017 release. It remains to be seen whether this was prudent enough or, on the contrary, still too bright.

Graph 18 GDP growth: projections versus outcomes including vintage 2017
Average growth rates in %

Source: Federal Planning Bureau

Another important issue that has been put forward in the previous section concerns the evolution of export market shares. According to the data available, the evolution of export market shares should remain positive on average for the period 2012-2016 and most likely also for the period 2013-2017. Clearly, the 2011 and 2012 releases continued to be too pessimistic in the wake of the previous four editions. More recent outlooks continue to consider that export market shares should decrease, although at a slower pace than previously projected while in the 2017 release small gains are expected to persist.

Forecasting the evolution of market shares is a complex undertaking. Firstly, as we saw in the previous section, outcomes can be revised substantially. Secondly, part of the developments in Belgian market shares is not explained by internal factors but by international trade phenomena like the specific dynamics of emerging economies, in particular China.

Graph 19 Evolution of export market shares: projections versus outcomes including vintage 2017
In percentage points

Source: Federal Planning Bureau

With regard to productivity growth, it can be said that – while initial projections implied a relatively strong rebound following the collapse during the financial crisis – it became progressively clear that productivity gains would not return to their pre-crisis levels. The most recent outlooks now foresee annual productivity growth below 1%, which can be partly explained by labour market policies restraining labour cost increases. But average projected productivity growth is even lower in the 2017 edition (around 0.5%).

Graph 20   Productivity growth: projections versus outcomes including vintage 2017
Average growth rates in %
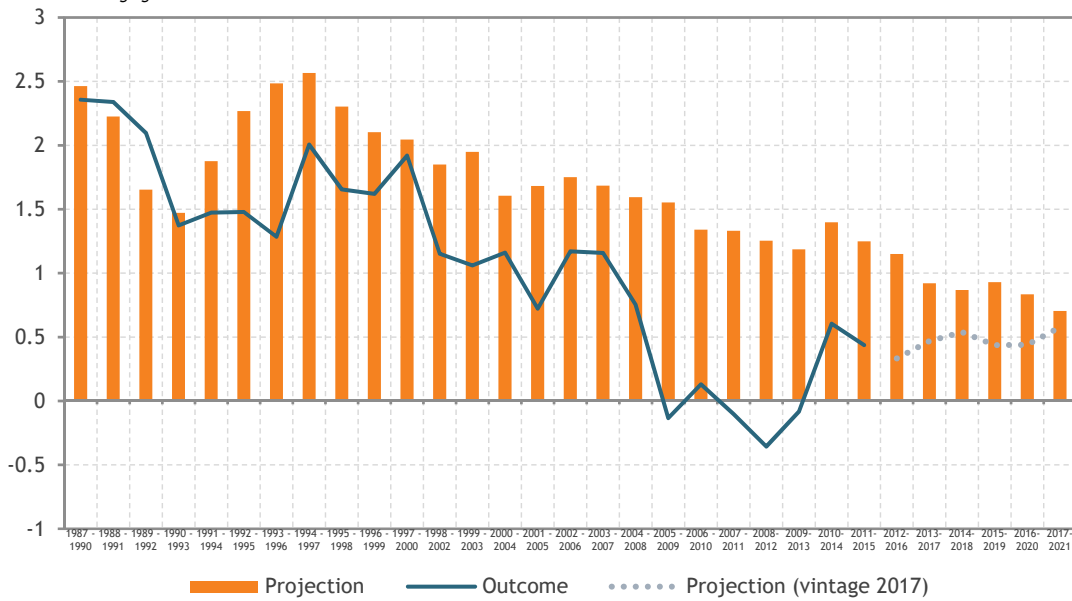
Source: Federal Planning Bureau

As we saw in the previous section, the overestimation of the labour force growth in the latest editions under review was almost exclusively attributable to errors regarding the participation rate. Based on the 2017 vintage, errors remained positive for the 2011 and 2012 releases, although they were spread somewhat more equally between errors on the working-age population and the participation rate (breakdown in errors not shown in Graph 21 below). More recent releases cannot be assessed yet, but growth rates are projected to slow down due to a strong decrease in the contribution of the working-age population.

Graph 21   Labour force growth: projections versus outcomes including vintage 2017
Average growth rates in %

Source: Federal Planning Bureau

6. References

BASSILIÈRE, D., BAUDEWYNS, D., BOSSIER, F., BRACKE, I., LEBRUN, I., STOCKMAN, P. and WILLEMÉ, P. (2013), *A new version of the HERMES model - HERMES III*, Working Paper 13-13, Brussels, Federal Planning Bureau.

BOGAERT, H., DOBBELAERE, L., HERTVELDT, B. and LEBRUN, I. (2006), *Fiscal councils, independent forecasts and the budgetary process: lessons from the Belgian case*, Working Paper 4-06, Brussels, Federal Planning Bureau.

BOSSIER, F. and VANHOREBEEK, F. (2000), *Simulations with the HERMES II model for Belgium*, Working Paper 11-00, Brussels, Federal Planning Bureau.

FEDERAL PLANNING BUREAU (issues from 1986 to 2016), *Perspectives économiques – Economische vooruitzichten*, Brussels.

DOBBELAERE, L., HESPEL, E., HERTVELDT, B. and LEBRUN, I. (2003), *Tout savoir sur la confection du budget économique*, Working Paper 17-03, Brussels, Federal Planning Bureau.

DOBBELAERE, L. and HERTVELDT, B. (2004), *10 jaar Economische Begroting: Een terugblik op de kwaliteit van de vooruitzichten*, Working Paper 13-04, Brussels, Federal Planning Bureau.

DOBBELAERE, L. and LEBRUN, I. (2012), *Track record of the FPB's short-term forecasts. An update*, Working Paper 3-12, Brussels, Federal Planning Bureau.

FIORAMANTI, M., GONZÁLEZ CABANILLAS, L., ROELSTRAETE, B. and FERRANDIS VALLTERRA, S. (2016), *European Commission's Forecasts Accuracy Revisited: Statistical Properties and Possible Causes of Forecast Errors*, Discussion Paper 27, Brussels, European Commission.

LEBRUN, I. (2007), *An accuracy assessment of FPB's medium-term projection*s, Working Paper 8-07, Brussels, Federal Planning Bureau.

LEBRUN, I. (2009), *Fiscal councils, independent forecasts and the budgetary process: lessons from the Belgian case*, In AYUSO-I-CASAL, J., DEROOSE, S., FLORES, E. and MOULIN, L. (eds.), Policy Instruments for Sound Fiscal Policies - Fiscal Rules and Institutions, London, Palgrave Macmillan, pp. 320-345.

LEBRUN, I. (2015), *Potential output growth in Belgium since the crisis - Lower and more uncertain*, Working Paper 4-15, Brussels, Federal Planning Bureau.

LEBRUN, I. (2016), *Croissance potentielle et output gap : une analyse rétrospective des estimations réalisées par le BFP et la CE*, Rapport, Bruxelles, Bureau fédéral du Plan.

LOUNGANI, P. and RODRIGUEZ, J. (2008), *Economic Forecasts: Too smooth by far*?, World Economics, vol. 9, nr. 2, pp. 1-12.

Annex 1. Summary statistics

The average growth rate over the projection period for a variable Y is computed as:

$$Y_{t+1,t+n} = \left(\sqrt[n]{\frac{Y_{t+n}}{Y_{t+1}}} - 1 \right) * 100$$

With t = 'year of release of the projection' and n=4 until the 1997 release, n=5 afterwards

The standard deviation of the annual growth rate of variable Y is a measure of its volatility:

$$STD = \sqrt{\frac{1}{N} \sum_{t=1}^{N} \left(grt(Y_t) - \overline{grt}(Y) \right)^2}$$

The projection error E is defined as the projection F minus the outcome X:

$$E_{t+1,t+n} = F_{t+1,t+n} - X_{t+1,t+n}$$

The mean error measures the bias of the projection:

$$ME = \frac{1}{N} \sum_{t=1}^{N} E_{t+1,t+n}$$

The mean absolute error provides a measure of the size of the error:

$$MAE = \frac{1}{N} \sum_{t=1}^{N} \left| E_{t+1,t+n} \right|$$

The root mean square error also provides a measure of the size of the error but gives more weight to the largest errors:

$$RMSE = \sqrt{\frac{1}{N} \sum_{t=1}^{N} E_{t+1,t+n}^2}$$

The corrected RMSE ensures comparability between series with different volatilities:

$$RMSE / \sigma = \frac{RMSE}{STD}$$

The Theil coefficient compares the RMSE of the projection with the RMSE of an alternative projection method:

$$THEIL = \frac{RMSE}{RMSE_{alt}}$$