

Lessons from OECD forecasts during and after the financial crisis

by

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This paper assesses the OECD's projections for GDP growth and inflation during the global financial crisis and recovery, focusing on lessons that can be learned. Growth was repeatedly overestimated in the projections, which failed to anticipate the extent of the slowdown and later the weak pace of the recovery. Similar errors were made by many other forecasters. At the same time, inflation was stronger than expected on average. Analysis of the growth errors shows that the OECD projections in the crisis years were larger in countries with more international trade openness and greater presence of foreign banks. In the recovery, there is little evidence that an underestimate of the impact of fiscal consolidation contributed significantly to forecast errors. Instead, the repeated conditioning assumption that the euro area crisis would stabilise or ease played an important role, with growth weaker than projected in European countries where bond spreads were higher than had been assumed. But placing these errors in a historical context illustrates that the errors were not without precedent: similar-sized errors were made in the first oil price shock of the 1970s. In response to the challenges encountered in forecasting in recent years and the lessons learnt, the OECD and other international organisations have sought to improve their forecasting techniques and procedures, to improve their ability to monitor near-term developments and to better account for international linkages and financial market developments.

JEL classification: E17, E27, E32, E37, E62, E66, F47, G01

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1. Introduction and summary

This paper assesses the performance of OECD projections for GDP growth over the period 2007-12 and places these in the context of the errors made in earlier years and by other international organisations. The focus is on the lessons that can be learned from projection errors and their cross-country differences and the resulting changes to forecasting models and procedures that have occurred since the start of the financial crisis, both inside the OECD and in other international organisations.

Forecasting the timing, depth and ramifications of the global financial crisis proved exceptionally difficult. Particular challenges included the identification of imbalances and unsustainabilities entering the crisis, the timing of their unwinding and the likely impact on real activity. These challenges were compounded by the unusually high speed and depth of cross-country interconnections between real and financial developments, the increased variability of economic growth compared with the pre-crisis period, the lack of timely data on many important financial factors and the limited understanding of macro-financial linkages. All these came on top of the well documented difficulties normally experienced when forecasting around major turning points in activity.

On average across the OECD and the BRIICS economies, calendar year GDP growth was overestimated across 2007-12, with the largest errors occurring in the projections for the vulnerable euro area economies. The largest errors were made at the height of the financial crisis in 2009 but there were also growth disappointments during the recovery. The OECD was not alone in finding this period particularly challenging. The profile and magnitude of the errors in the GDP growth projections of other international organisations and consensus forecasts are strikingly similar.

Although recent projection errors were large, they were not unprecedented: the first oil-price shock in the early 1970s also proved to be an equally difficult period for forecasters. Over a longer perspective of forty years, the OECD projections for G7 countries have generally been efficient and informative. Allowing for variations in growth volatility over time, the projection errors over 2007-12 are of a broadly similar magnitude to those in the pre-crisis years.

A number of economic characteristics are associated with the projection errors during this period. Growth was typically weaker than expected and errors higher in countries that are more open to external developments and exposed to shocks from other economies. For example, international trade openness and the presence of foreign banks in the economy are strongly associated with larger errors during the downturn period. This suggests that the projections may have failed to fully reflect the higher exposure of these economies to interconnected negative global shocks. In the recovery, growth was weaker than expected in countries in which banks had low pre-crisis capital ratios and in countries in which non-performing loans had risen strongly. Moreover, growth in countries with more regulated product and labour markets has generally proved more difficult to forecast. In part this

may reflect insufficient attention being paid to the extent to which tighter regulations have delayed the necessary reallocation across sectors in the recovery phase.

Based on the OECD forecasts, stronger projected fiscal consolidation has been associated with growth disappointments, but only in some years and only if Greece is included in the sample used. The repeated assumption that the euro crisis would dissipate over time, and that sovereign bond yield differentials would narrow, appears to have been a more important source of error. This underlines the conditional nature of OECD projections, which are not intended to be forecasts, but also raises questions about the conditioning assumptions chosen.

In response to the crisis, the OECD and other international organisations have been reviewing and changing their forecast procedures and practices. A key change has been to increase the centralisation of the early stages of the forecast round. This ensures that global economic developments and cross-country spillover effects are reflected consistently in the projections for individual economies. Monitoring and statistical modelling of near-term developments has also been enhanced, with the OECD's indicator models for near-term GDP and global trade growth proving to be a useful source of guidance. Anecdotal evidence from contacts with businesses has also become more important. In addition, there is now a stronger focus on financial market developments, with financial market indicators increasingly being integrated into projection processes and macroeconomic models. Communication efforts have also been enhanced to characterise the shape of the risk distribution around the baseline projection, including forecast ranges and the use of fan charts. Greater use is also being made of quantitative scenario analyses to illustrate the implications of key risks.

The structure of this paper is as follows. Section 2 briefly reviews forecasting and risk assessment practices before the onset of the financial crisis and then discusses the properties of the errors made for the 2007-12 period. (The focus is on the period of the crisis and the years that immediately followed because this paper is based on a project covering those years (Pain, et al., 2014); 2013 is not reported in the paper but revisions to the initial projections were generally comparatively small.) Section 3 assesses whether OECD projection errors in the 2007-12 period, or the downturn and recovery sub-periods, are systematically linked to pre-crisis conditions, structural conditions, and policy assumptions. Section 4 places the recent errors in a longer-run context to better understand whether they are unusual errors from an unusual period. A discussion of the nature of the projections follows. The final part of the paper takes stock of recent changes in forecasting procedures and practices in the OECD and other international organisations to address the identified weaknesses with earlier forecasting practices, drawing on a series of interviews undertaken in 2013. Information on the data set used and the statistical procedures undertaken is summarised in Box 1.

2. Forecasting before and during the crisis

2.1. Forecasting and risk assessment practices before the onset of the financial crisis

The pre-crisis period was one of relative economic stability. OECD projections in this period appeared to perform relatively well (Vogel, 2007), with only limited revisions to GDP growth projections typically observed as the forecast horizon narrowed, even for 2007 (Figure 1).¹ However, changes in the global economy and financial system in the early to mid-2000s contributed to the subsequent difficulties of forecasting once the crisis began.

Box 1. Data and definitions

Data

The results in this document make use of data sets for projections made by the OECD for OECD countries and six non-member countries (the BRIICS: Brazil, Russia, India, Indonesia, China and South Africa), with the main focus on OECD countries. Annual calendar year GDP growth data for 2007-12 are used for all countries except India, where annual growth over the fiscal year (to April) is used. Three different sets of projections are considered:

- May *Economic Outlook* projections for calendar year GDP growth and inflation in the same year.
- May *Economic Outlook* projections for calendar year GDP growth and inflation in the following year.
- November *Economic Outlook* projections for calendar year GDP growth and inflation in the following year.

The projection error is defined as the outturn less the projection. The outturn data for GDP growth in any given year are taken from the May *Economic Outlook* in the year immediately after. An issue for all evaluations of forecasting performance is the appropriate vintage of data to use, since the initial outturn estimates may not be especially reliable, particularly at times of rapid change in the economy (Shrestha and Marini, 2013). But use of the latest vintages of data can result in the calculated forecast errors being misleading, since they can also contain changes to national accounting procedures and concepts that were not known about at the time of the projection. This paper follows standard practice in using early realisations of the outcome.

To enable longer-run comparisons, OECD growth projections for the G7 countries from 1971 are also used. For some countries, these include GNP growth projections, rather than GDP growth, over the first part of the sample period.

Use is also made of a short-run and longer-run dataset of other forecasters' projections for GDP growth in the G7 countries. The short dataset, covering 2007-12, includes projections published by the IMF, European Commission and Consensus Economics, where the latter is the average of private-sector economists' forecasts for each country. The longer-run dataset for the G7 countries, covering 1991-2012, also includes consensus forecasts from 1991 onwards.

Key metrics

The paper uses three key measures of the size of the errors:

- The **average error** for each country, which is the average projection error (defined as above) over a given period. The means for various country groups are based on unweighted averages across countries and time.
- The **average absolute error**, defined as the average of the *absolute value* of individual country errors over the time period shown. For country groups, this is calculated as the unweighted average of absolute errors across countries and time. For greater comparability across countries and time, the average absolute error is also scaled by the corresponding average absolute growth rates. The ratio of country groups is calculated as the unweighted average ratio across countries.
- The **root mean squared error (RMSE)**, which is calculated by squaring individual country errors, then averaging these over the time period shown and taking the square root of the result. For country groups, this is the square root of the average of country squared errors, where the average is calculated across countries and time. To improve comparability, the RMSE is also scaled by the average volatility of growth (i.e. standard deviations) for a country or time period. The ratio of country groups is calculated as the unweighted average across countries.

Box 1. **Data and definitions** (cont.)**Forecast evaluation tests**

- **Unbiasedness:** tested by a pooled regression of country projection errors on a constant. Unbiasedness requires that $\alpha = 0$ in:

$$Error_{it} = \alpha + \varepsilon_{it} \quad [1]$$

- **Information content:** tested by a pooled regression. Informative projections have positive β in:

$$Outcome_{it} = \alpha + \beta Projection_{it} + \varepsilon_{it} \quad [2]$$

Information content is also tested relative to two alternative forecasts: a naïve forecast of the previous year's growth rate; and the consensus forecasts.

- **Efficiency:** this can be measured in several ways, with different degrees of strength. A basic requirement is simply that the RMSE is smaller at each forecast horizon. A slightly stronger definition is that the error should not be predictable and the projections should be informative – “weak efficiency” – which requires that both $\alpha = 0$ and $\beta = 1$ in the second regression above. A third, stronger form of efficiency is that projections embody all information available to the forecasters at the time, in which case the projection errors should be uncorrelated with informative data series. Another strong test of efficiency requires that revisions to a specific forecast be small and unpredictable from one forecasting round to the next, and uncorrelated with the previous revision.
- **Directional accuracy:** this measures whether the projections were qualitatively accurate, in the sense of accurately projecting rising or declining growth rates in the forecast period.

This period was one of increasing globalisation and integration of real and financial activity, raising the potential for cross-border and cross-market transmission of economic and financial shocks. Foreign-owned banks became more important in domestic banking markets and in many economies bank funding relied increasingly on international markets. Financial leverage and risk-taking expanded rapidly in a low interest rate environment, reflected in strong asset price and credit growth. External imbalances also built up to what were widely viewed as unsustainable levels.

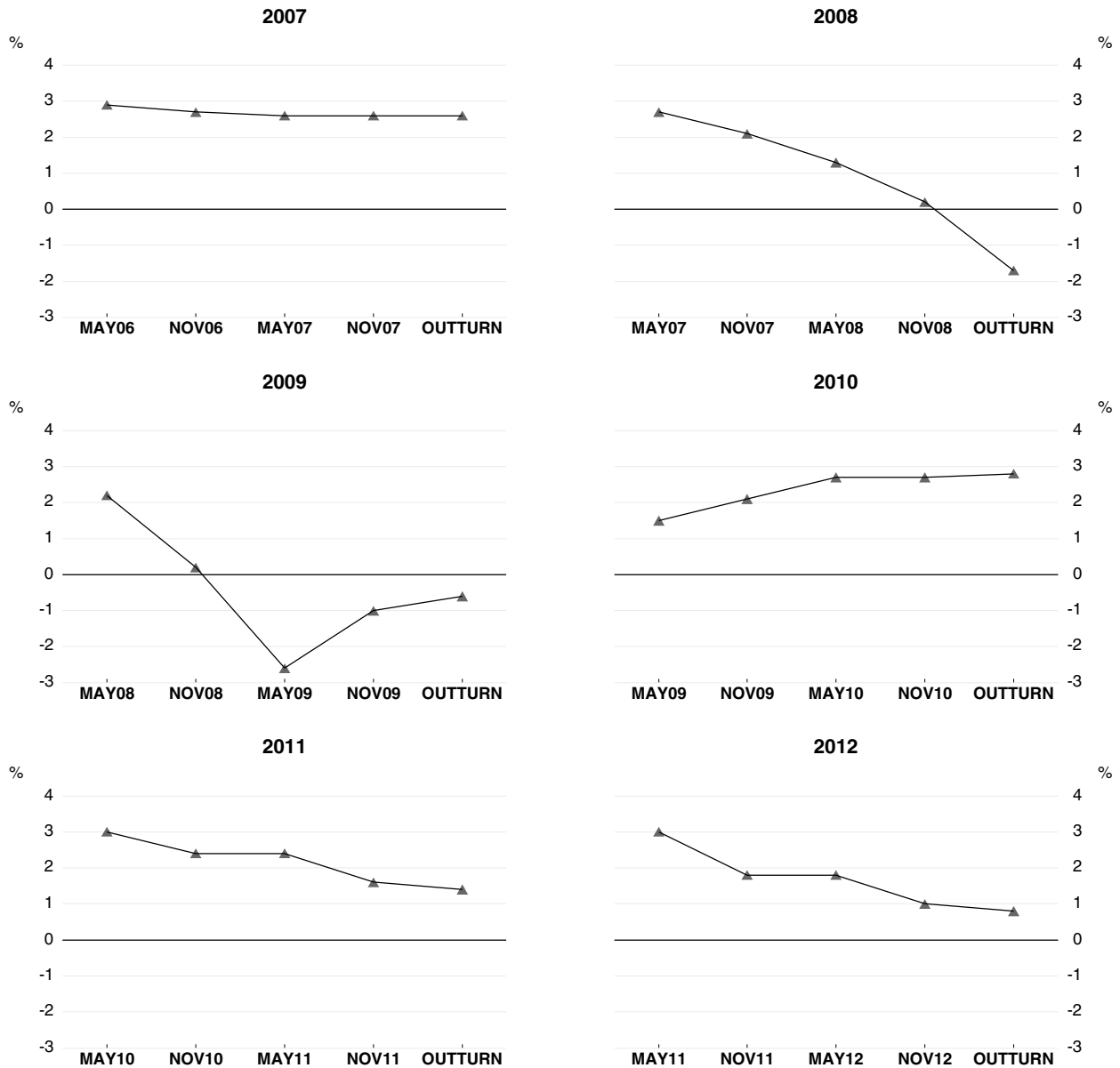
Limited weight was given to the possible impact of excessive risk-taking in the projections made before the crisis, not least because the extent of risk-taking was often hidden in off-balance-sheet activities or masked by derivative positions. That said, frequent risk analysis was done of the extent of over-valuation of housing markets and the activity implications stemming from developments such as the run-up and subsequent correction in US house prices.² However, only a handful of financial variables were integrated fully into the forecast process and the background models used; typically, account was taken only of policy interest rate and asset price effects on activity.³ Certain structural policy settings, notably less stringent product and labour market regulations, were believed to enhance the resilience of economies by improving the flexibility to bounce back relatively quickly from downturns, conditional on the assumption that financial markets and the monetary transmission mechanism functioned in a normal manner (Duval et al., 2007; Duval and Vogel, 2008). In this context, increases in financial depth were seen as being beneficial to both long-term growth and cyclical resilience.

2.2. Forecast performance during the financial crisis and its aftermath: GDP growth

As the crisis intensified, it spread across countries rapidly, in a manner well beyond that suggested by the linkages built into standard forecasting and simulation models (Bini Smaghi, 2010). Global trade collapsed in late 2008 and the early part of 2009, and

Figure 1. **The evolution of year-on-year projections for OECD GDP growth**

Q4-on-Q4 percentage change in GDP at each forecast date shown



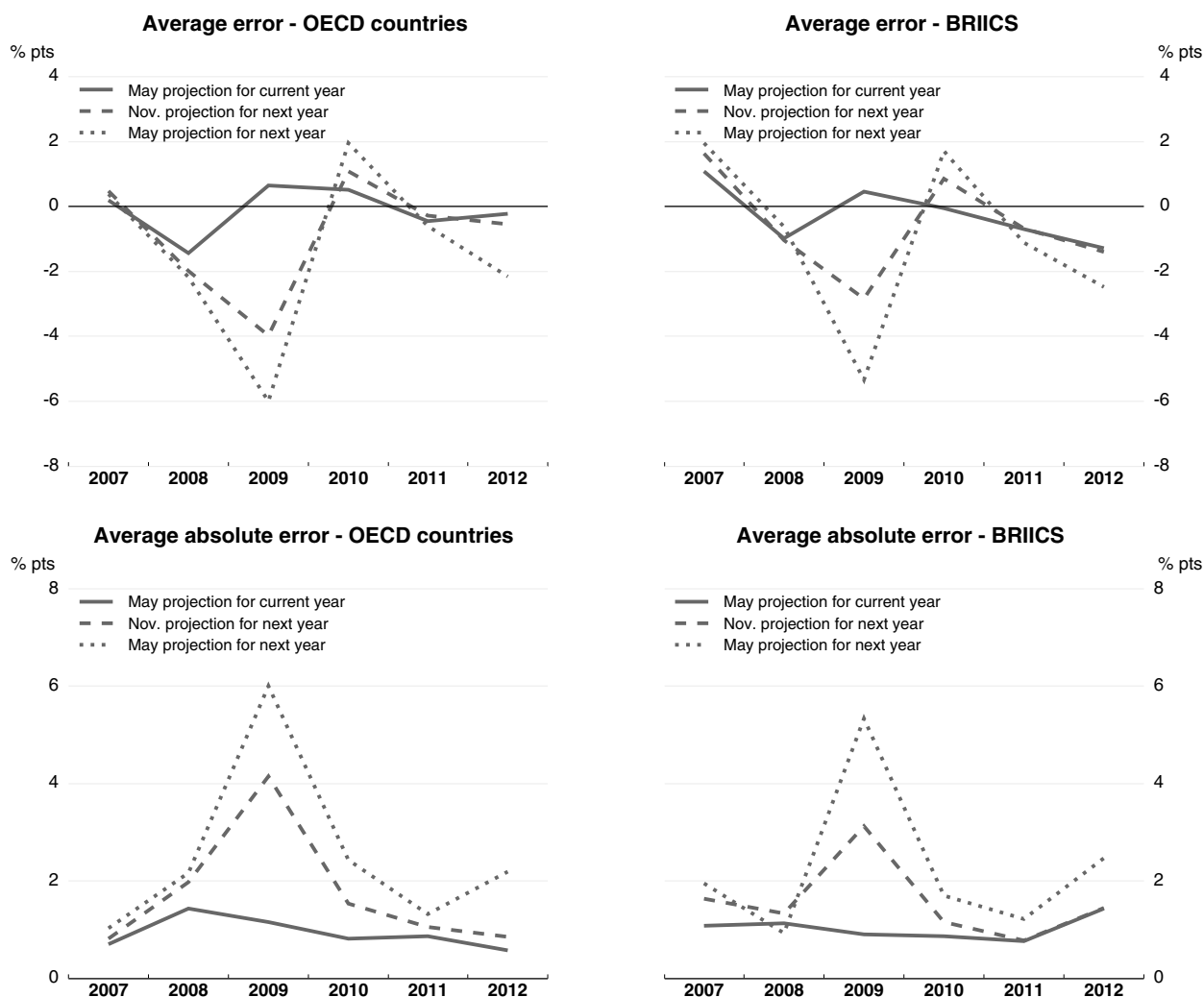
Note: Outturn is defined as the published figure at May the following year.

Source: OECD Economic Outlook Databases.

private sector sentiment fell sharply worldwide. The cumulative errors in the May 2008 projections for GDP growth in 2008 and 2009 were large. Forecasts were revised down consistently and very rapidly when the sub-prime crisis erupted and Lehman Brothers subsequently failed, with growth outturns in 2009 nonetheless still proving substantially weaker than had been projected (Figure 2).⁴ The onset of the euro area crisis in 2010, with the re-pricing of sovereign debt and banking sector risks, subsequently contributed to a further period of growth disappointments, particularly in Europe.

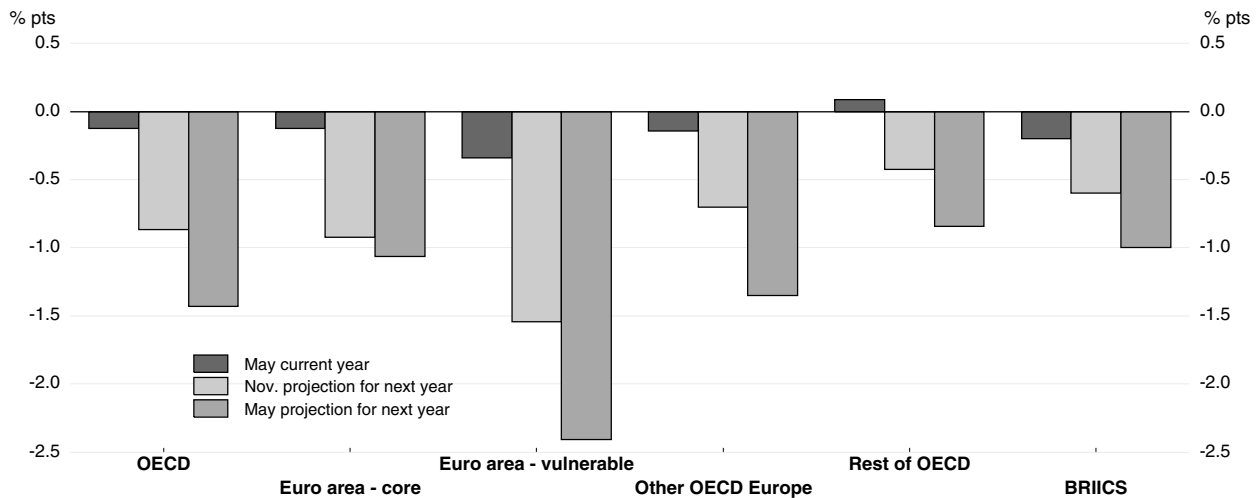
Thus, on average across countries, calendar year GDP growth was overestimated across 2007-12.⁵ As might be expected, given the larger information set available at the time of the forecast, the errors in (current year) projections of current year growth are smaller than in (current year) projections of GDP growth for the year ahead. On average, growth was overestimated in both the OECD and BRIICS economies, though the errors in the latter were slightly smaller than in the OECD economies (Figure 3). The largest errors were made in the vulnerable euro area economies. The large errors from the year-ahead projections for some countries during the crisis gives the distribution of the errors a negative skew; the dispersion of these errors was largest in 2009 and 2010 (Figure 4). The errors from the current year projections are more symmetric overall and the range is much narrower, even in 2009.

Figure 2. **Errors in calendar year GDP growth projections in recent years**



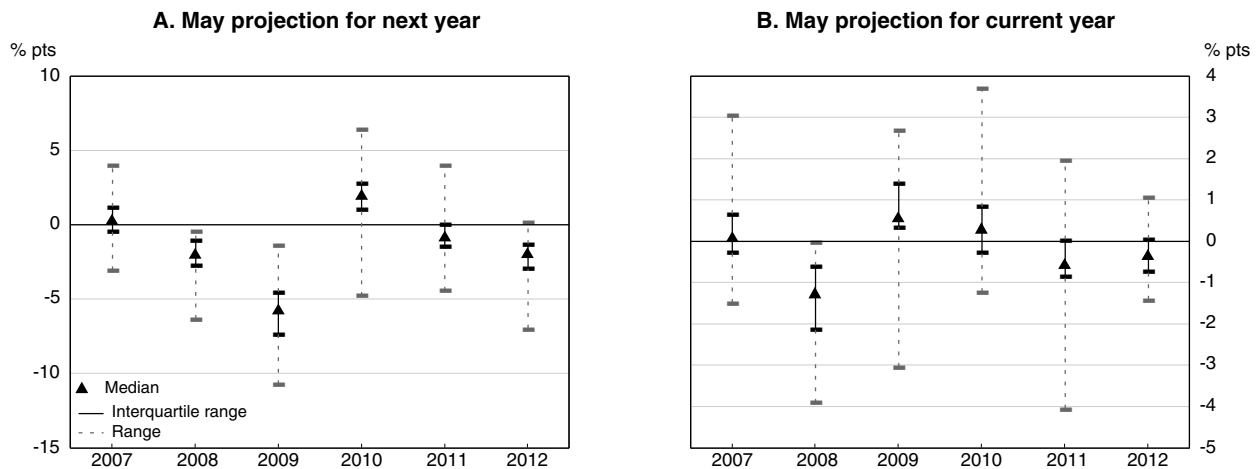
Note: An unweighted average of projection errors across countries is shown. See Box 1 for a description of the calculation of errors and the different projections considered. Errors are calculated as actual growth less projected growth at each forecast horizon, where actual growth is the published outcome as at May the following year. A negative (positive) average error indicates over(under)-prediction. There is only partial coverage for Chile, Estonia, Indonesia, Israel, Slovenia and South Africa.
 Source: OECD Economic Outlook Databases; and OECD calculations.

Figure 3. Average errors of calendar year GDP growth projections by country group
2007-12, percentage points



Note: See Box 1 for a description of the calculation of errors and the different projections considered. Errors are calculated as actual growth less projected growth at each forecast horizon, where actual growth is the published outcome as at May the following year. A negative (positive) average error indicates over(under)-prediction. There is only partial coverage for Chile, Estonia, Indonesia, Israel, Slovenia and South Africa. Countries included in the “euro area – vulnerable” group are Greece, Ireland, Italy, Portugal and Spain.
Source: OECD Economic Outlook Databases; and OECD calculations.

Figure 4. Dispersion of calendar GDP growth projections for OECD countries



Note: See Box 1 for a description of the calculation of errors and the different projections considered. Errors are calculated as actual growth less projected growth at each forecast horizon, where actual growth is the published outcome as at May the following year. A negative (positive) average error indicates over(under)-prediction. Countries with partial coverage are excluded (Chile, Estonia, Israel and Slovenia).
Source: OECD Economic Outlook Databases; and OECD calculations.

The differences in forecasting performance across countries narrow if the projection errors are adjusted for the considerable cross-country differences during this period in average GDP growth rates and the volatility of GDP growth. On average, in the May current-year projections, the RMSE for OECD countries is a little under one-half of the volatility of GDP growth over 2007-12, whereas for the projections of growth a year ahead it is around the same magnitude as GDP growth volatility (Appendix A). For the non-OECD countries, the adjusted measure of accuracy is similar to the OECD countries. A necessary but not

sufficient requirement for forecast efficiency is that accuracy should improve as the forecast horizon shortens. This is the case for the average error, average absolute error and RMSE for almost all countries (Appendix A).

Statistical tests of the properties of the OECD country growth projections are summarised in Pain et al. (2014), though the results need to be viewed with some caution, given the small sample size available. The main findings include:

- The projections for OECD countries are found to be biased during this period, particularly the projections for the following year.
- The projections in this period were informative, in the sense that they contain statistically-significant information correlated with the outturns. However, various tests of weak efficiency for the OECD countries are not passed at any of the horizons (other than the requirement that the projections become more accurate as the forecast horizon narrows).
- Stronger tests of efficiency are also rejected. The forecasts through the sample period were downwardly revised, by 0.6 percentage points on average in November and then 0.7 percentage points the following May when the year was underway. There is a significant positive relationship between successive revisions, which is consistent with smoothing.⁶
- The May projections for GDP growth in the same year and the following year contain additional statistically-significant information over a naïve forecast that uses only the previous year's growth rate.
- Similar results are found for other sets of forecasts, with forecast-encompassing tests suggesting that consensus forecasts do not contain additional information over the OECD projections at any horizon.⁷

Another way of judging the usefulness of the projections is by their ability to get the “story” right – or directional accuracy. In the sample period 2007-12, there were 56 instances of a year-on-year rise in GDP growth in an OECD country (growth in year t was higher than growth in year $t-1$) and 116 instances of declines.⁸ The projections correctly anticipated around 90% of the growth pick-ups, both in the same year and the year ahead. But declines were more difficult: around 90% of declines were correctly projected in the same year, but the performance of the projections made in May for growth in the following calendar year was no better than a coin toss. This feature of OECD projections was also reported in an earlier assessment for the pre-crisis period (Vogel, 2007) and is also present in the 40-year dataset discussed later (see Table 5 in Section 4).

3. Factors correlated with the growth forecast errors

3.1. Factors correlated with errors over the whole period and during the downturn

This section highlights some of the individual variables correlated with the growth projection errors over the whole period and during the downturn phase (forecasts made in May 2008 for 2008-09) and the subsequent recovery (forecasts made in May 2010 for 2010-11 and May 2011 for 2011-12). Pair-wise correlations between the country forecast errors, four broad sets of pre-crisis factors and four indicators of contemporaneous economic developments are set out in Table 1.⁹ Given the small sample size and the potential collinearity of country characteristics, some caution is warranted in interpreting these results. Nonetheless, some of the reported associations suggest potential sources of error in the projections that could be investigated in more detail in the future.¹⁰

Table 1. **Correlation between growth projection errors and pre-crisis conditions**

| | Full period: 2007-12 | | Sub-periods | | |
|--|--|--------|--|------------------------|------------------------|
| | Average error | RMSE | Cumulative error over two years shown (at publication date indicated) | | |
| | From projections at May for the next year | | 2008-09 (May-08 EO) | 2010-11 (May-10 EO) | 2011-12 (May-11 EO) |
| Openness | | | | | |
| Trade openness | -0.3* | 0.4** | -0.4** | 0.0 | -0.3 |
| Financial openness [^] | 0.3 | -0.3 | 0.4* | 0.0 | 0.0 |
| Foreign banks' assets | -0.3* | 0.5*** | -0.5*** | 0.1 | 0.0 |
| Economy-wide regulations | | | | | |
| Product market regulation | -0.1 | 0.3* | -0.2 | 0.2 | -0.2 |
| Employment protection legislation | -0.1 | 0.4* | -0.4* | 0.3 | -0.2 |
| Financial structure | | | | | |
| Stock market capitalisation | 0.2 | -0.3 | 0.3* | -0.1 | 0.0 |
| Regulatory capital | 0.1 | 0.4** | -0.3* | 0.5*** | 0.3 |
| Financial services [^] | 0.1 | -0.3 | 0.3 | -0.3* | 0.3 |
| Pre-crisis imbalances | | | | | |
| House price growth (2000-07) | -0.2 | -0.1 | 0.1 | -0.2 | -0.1 |
| Private-sector credit growth (2000-07) | -0.2 | 0.0 | 0.0 | -0.2 | -0.1 |
| Current account balance | 0.3* | -0.1 | 0.0 | 0.2 | 0.0 |
| Contemporaneous developments | | | | | |
| Equity prices | 0.3 | 0.0 | 0.0 | 0.7*** | 0.8*** |
| Non-performing loans | -0.7*** | 0.3* | -0.3 | -0.5*** | -0.5*** |
| Business confidence (manufacturing) | 0.1 | 0.0 | 0.2 | 0.4* | 0.2 |
| Consumer confidence | 0.3* | -0.1 | 0.0 | 0.6*** | 0.4** |

Note: Errors are calculated as actual growth less projected growth at each forecast horizon, where actual growth is the published outturn as at May the following year. A negative (positive) error indicates over(under)-prediction. Negative correlations for average errors indicate more negative growth surprises are correlated with more positive changes in the other variable. *, **, *** denote significance at the 10%, 5%, or 1% level, respectively. ^ denotes variables with extreme values that have been omitted because they change the nature of the relationship. The first three columns exclude countries with partial coverage: Chile, Estonia, Israel and Slovenia. Contemporaneous developments are the change over the relevant period being considered.

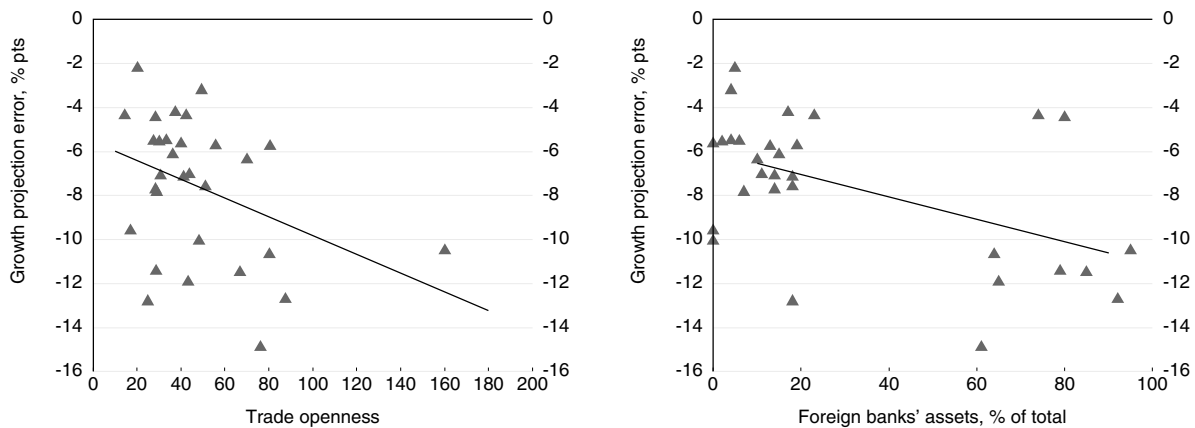
Sources: IMF, Financial Soundness Indicators, OECD Economic Outlook Databases; OECD Going for Growth (2012); OECD House Price Database; OECD Structural Analysis Database; World Bank Global Financial Development Database; World Bank World Development Indicators; and OECD calculations.

First, growth was weaker than expected and projection errors higher in countries that are more open to external developments and exposed to shocks from other economies. Factors such as openness to international trade and the share of total national banking assets held by foreign-owned banks are found to be significantly negatively correlated with forecast errors over the period as a whole and particularly so during the downturn (Figure 5). This suggests that the projections may have failed to fully reflect the increasing globalisation of real and financial activity prior to the crisis, which had raised the potential for cross-border and cross-market transmission of economic and financial shocks. In particular during the crisis, there was a tendency for foreign-owned banks – an increasingly important presence in domestic banking markets in the pre-crisis period – to cut credit extensions or reduce new lending in their host economies in order to meet lower risk targets imposed by their parent banks.¹¹

Second, larger forecast errors over 2007-12 have occurred in countries with more stringent pre-crisis labour and product market regulations (Figure 6). This finding is difficult to interpret, but may in part reflect the weight given to pre-crisis empirical

evidence that tight regulations could help to cushion economic shocks (Duval et al., 2007), and insufficient attention being paid to the extent to which tighter regulations could delay necessary reallocations across sectors in the recovery phase. A third possibility is that it reflects a correlation between restrictive regulation and the pre-crisis build-up of imbalances, although indicators such as pre-crisis house price and credit growth are not found to be strongly correlated with the forecast errors.¹²

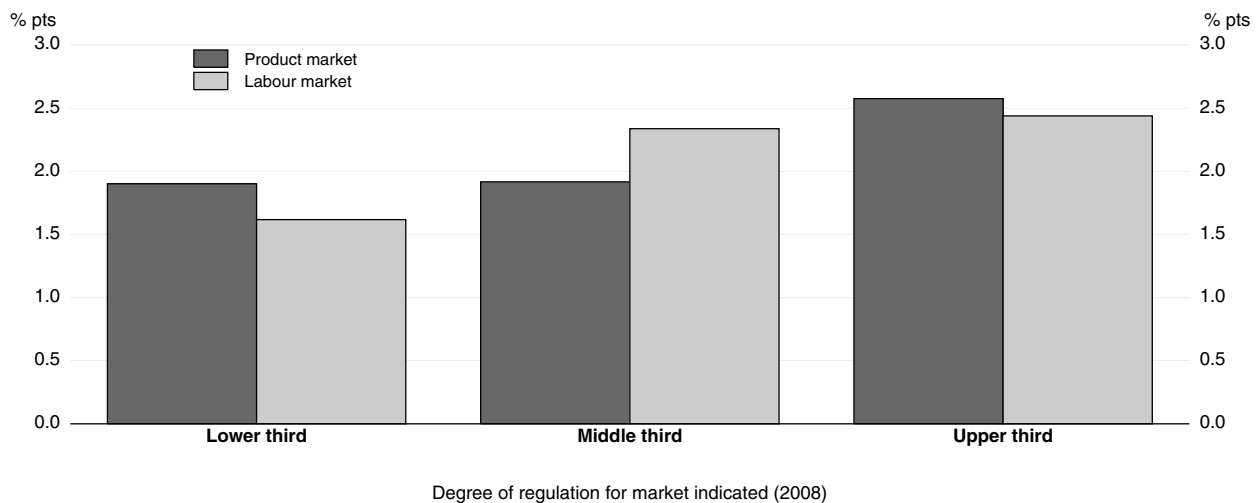
Figure 5. Relationship between growth projection errors for 2008-09 and other characteristics
Cumulative errors for 2008-09 calendar year projections made at May 2008



Note: See Box 1 for a description of the calculation of errors and the different projections considered. Errors are calculated as actual growth less forecast growth at each forecast horizon, where actual growth is the published outturn as at May the following year. A negative (positive) error indicates over(under)-prediction. Countries with partial coverage for the period are excluded (Chile, Estonia, Israel and Slovenia).

Source: OECD Economic Outlook Databases; World Bank Global Financial Development Database; and OECD calculations.

Figure 6. Relationship between accuracy of growth projections and regulation
Average RMSE of growth projections for 2007-12 made at November a year earlier



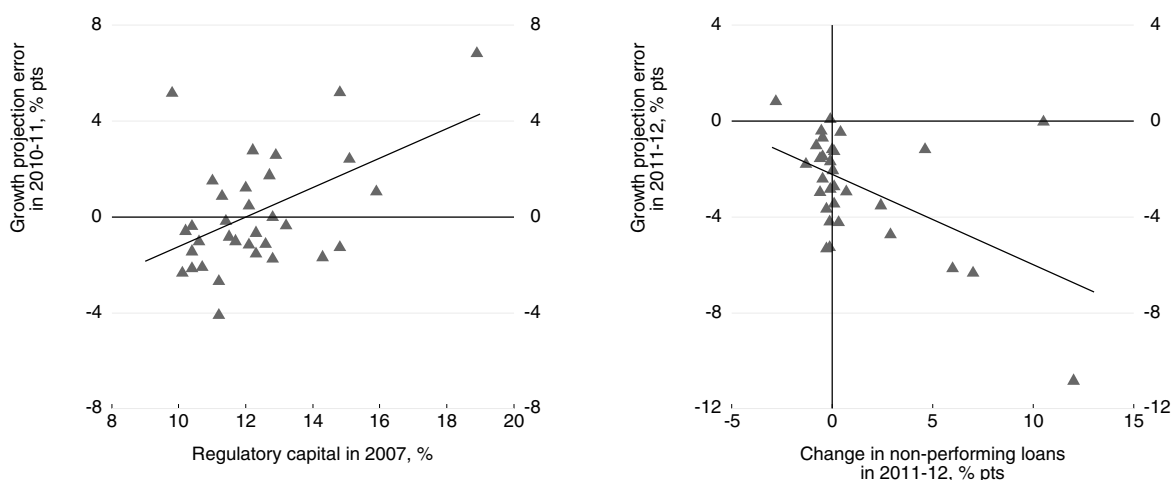
Note: See Box 1 for a description of the calculation of errors and the different projections considered. Countries with partial coverage for the period are excluded (Chile, Estonia, Israel and Slovenia).

Source: OECD, *Going for Growth* (2012); OECD Economic Outlook Databases; and OECD calculations.

Third, growth was weaker than expected in the recovery in countries in which banks had a low ratio of regulatory capital to risk-weighted assets in 2007 (Figure 7, left panel). This may suggest that insufficient account was taken of the post-crisis deleveraging undertaken by weakly capitalised banks. Although, over the period as a whole, sizeable projection errors (i.e. large RMSEs) have been made in countries in which banks have comparatively high levels of regulatory capital, this primarily reflects the higher underlying growth volatility of these economies in this period.¹³

Finally, during the post-crisis recovery period there are strong correlations between projection errors and changes in equity prices, private sector confidence and non-performing loans in the banking sector (Figure 7, right panel). This again suggests that the projections may have underestimated the negative impacts of impaired banking systems and weak confidence.¹⁴

Figure 7. **Relationship between errors in growth projections in the recovery and the financial sector**



Note: See Box 1 for a description of the calculation of errors and the different projections considered. Errors are calculated as actual growth less projected growth at each forecast horizon, where actual growth is the published outcome as at May the following year. A negative (positive) error indicates over(under)-prediction.

Source: IMF, *Financial Soundness Indicators*; OECD *Economic Outlook Databases*; World Bank *Global Financial Development Database*; and OECD calculations.

Perhaps surprisingly, indicators of pre-crisis vulnerabilities such as house price increases and private credit growth are not generally associated with negative growth surprises since the crisis began.¹⁵ A possible explanation might be that these vulnerabilities have been generally well understood and incorporated successfully into forecast judgements. However, larger downside surprises on average have occurred in countries with a pre-crisis current account deficit.

Changes in the OECD composite leading indicators (CLIs) ahead of May 2008 were negatively correlated with the errors in the growth projections made at that time, with the CLIs continuing to improve in some countries even at the point at which GDP was past its peak (see Appendix 7 in Pain et al., 2014). This suggests that the usual relationship between many high-frequency variables – including activity, labour market and survey data – broke down during this period.

3.2. Fiscal consolidation, bond spreads and growth disappointments in 2010-11 and 2011-12

In 2010-11 and 2011-12, the pick-up in the pace of the global recovery projected in the May 2010 and May 2011 *Economic Outlook* ultimately failed to materialise. As mentioned above, one factor behind this may have been an underestimate of the impact of impaired banking systems and bank deleveraging during these years (Figure 7). But these years also saw the deepening of the euro area crisis and the onset of widespread fiscal consolidation, providing other possible explanations for the projection errors. IMF studies point to a negative relationship between the errors in its Spring 2010 *World Economic Outlook* projections for GDP growth over 2010-11 and projected fiscal consolidation during this period (IMF, 2012; Blanchard and Leigh, 2013). An implication drawn from this is that fiscal multipliers were underestimated considerably, thereby contributing to an overestimate of growth prospects.¹⁶

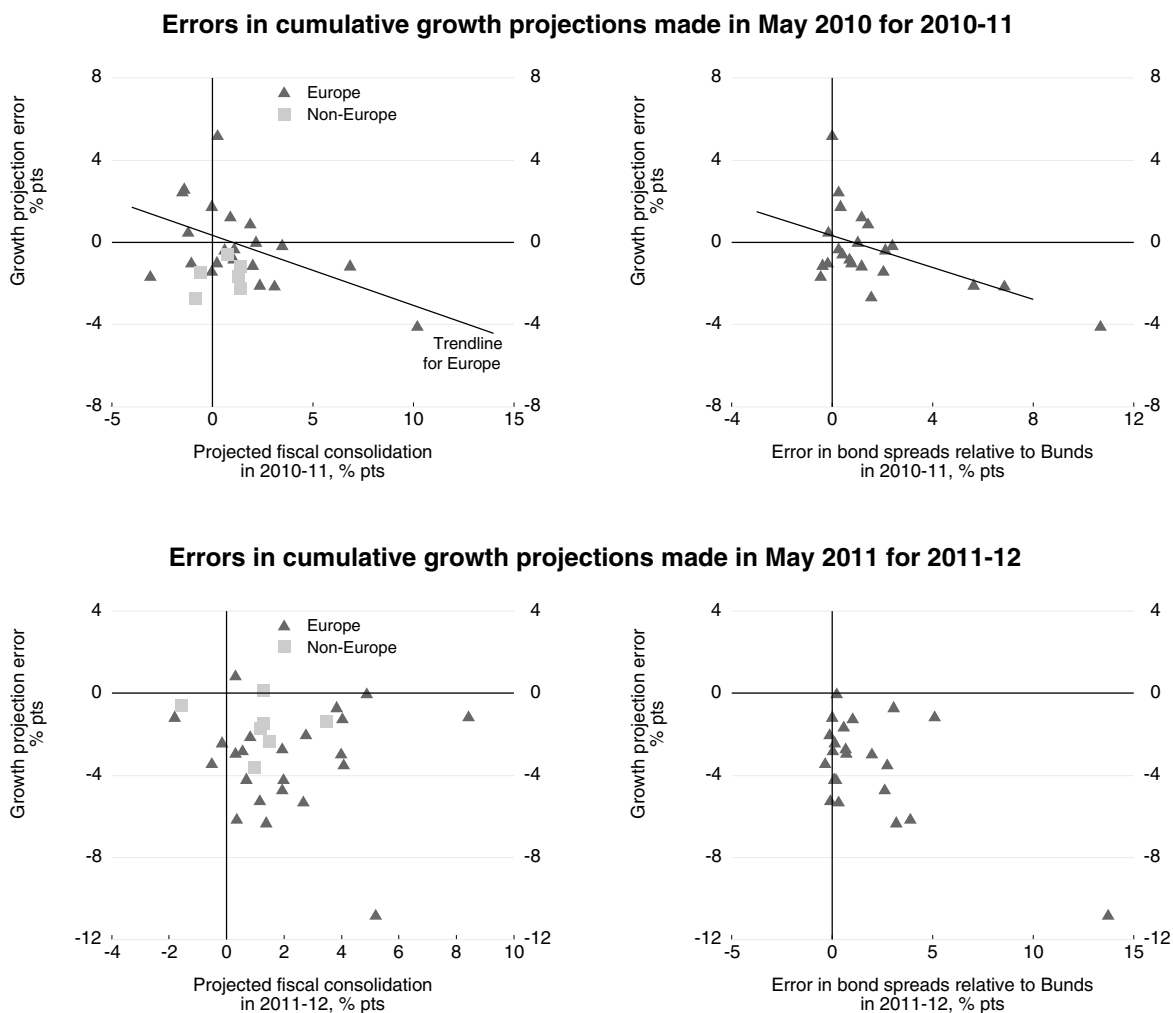
The OECD projections published in the *Economic Outlook* in May 2010 for cumulative GDP growth during 2010-11 offer only partial support for this hypothesis. Projected fiscal consolidation is indeed negatively correlated with the growth forecast errors in 2010-11 (Figure 8, upper left panel). But this relationship stems from the downside growth surprises in the European economies, and in particular, Greece; without Greece, the relationship remains negative but no longer statistically significant. Outside Europe, the relationship is harder to discern. The projections from May 2011 for cumulative growth 2011-12 are not related to fiscal consolidation (as was the case in the *World Economic Outlook* forecasts). To the extent that the earlier relationship reflects an initial underestimation of the multiplier effects of fiscal consolidation, the lack of relationship in the projections made one year later suggests that forecasters revised their judgement as the impact of consolidation in an environment with limited monetary policy space became clearer.

A second possibility is that the correlation between fiscal consolidation and growth forecast errors in 2010-11 could rise from an underestimate of the amount of fiscal consolidation, rather than from an underestimate of the fiscal multiplier. On average, in the European economies, cumulative fiscal consolidation in 2010-11 was 0.8% of GDP greater than projected in the May 2010 *Economic Outlook*.¹⁷ The actual level of fiscal consolidation is also negatively correlated with the growth forecast errors in 2010-11, but this relationship is again found to be dependent on the inclusion of Greece in the sample considered.

A further aspect of the published OECD projections in these years was that they were based on a “muddling through” assumption, with the euro area crisis assumed to diminish slowly and government bond spreads between other European countries and Germany assumed to narrow over the projection period. In fact, spreads widened in many countries over the projection period. There is a clear correlation between the errors in the assumptions about bond spreads and the growth forecast errors in 2010-11 (Figure 8, upper right panel), with growth weaker than projected in countries whose bond spreads relative to Germany were higher than had been assumed. This negative correlation is robust to the exclusion of Greece.

Because bond spreads are clearly endogenous to growth outcomes and the possibility of further fiscal consolidation, it is difficult to identify conclusively whether incorrect assumptions about fiscal multipliers or bond spreads are more important. However, econometric evidence suggests that the errors in the bond spread assumptions appear to

Figure 8. Relationship between errors in growth projections in the recovery and economic developments



Note: See Box 1 for a description of the calculation of errors and the different projections considered. Errors are calculated as actual growth less forecast growth at each forecast horizon, where actual growth is the published outturn as at May the following year. A negative (positive) error indicates over(under)-prediction. The trendline for the error in bond spreads to Bunds excludes Greece. Trendlines are not shown where the relationship is not statistically significant at the 10% level.

Source: *Economic Outlook Databases*; and OECD calculations.

be a more robust explanation of forecast errors than the possible underestimation of fiscal multipliers or the underestimation of the amount of fiscal consolidation. Considered together, there is no longer any significant relationship between the forecast errors and projected fiscal consolidation, but the errors in bond spreads remain negatively, and in most cases significantly, related to the forecast errors for 2010-11 (Table 2). A similar result is reported in European Commission (2012). Repeating the exercise for 2011-12 reinforces the finding that projected fiscal consolidation is not significantly related to the errors. The relationship with bond spreads is not robust and varies according to the estimation techniques used and whether Greece is included in the sample.

These findings raise questions about the appropriateness of the forecast assumptions made during the recovery, particularly the prevailing assumption that the euro area crisis would ease over the projection period. This issue is discussed further below. Other factors also contributed to the projection errors over 2010-12, including the underestimation of the impact of impaired banking systems and bank deleveraging (Figure 7).

Table 2. Explaining the errors in the 2010-11 growth projections

Dependent variable: Cumulative error in the GDP growth projections made in May 2010 for 2010-11

| Country sample | Europe | | | | Europe excl. Greece | | | |
|--|---------------------|--------------------|--------------------|---------------------|---------------------|------------------|-------------------|--------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Estimation method | TSLS | OLS | TSLS | OLS | TSLS | OLS | TSLS | OLS |
| Error in bond spreads (to Bunds) | -0.43*** (0.087) | | -0.47** (0.210) | -0.36*** (0.126) | -0.44** (0.181) | | -0.49* (0.243) | -0.36** (0.135) |
| Projected fiscal consolidation | | -0.31** (0.136) | 0.02 (0.207) | -0.05 (0.155) | | -0.19 (0.168) | 0.01 (0.213) | -0.05 (0.193) |
| Constant | 0.52 (0.484) | 0.22 (0.488) | 0.54 (0.508) | 0.47 (0.482) | 0.52 (0.563) | 0.16 (0.499) | 0.57 (0.599) | 0.46 (0.553) |
| Obs | 21 | 21 | 21 | 21 | 20 | 20 | 20 | 20 |
| R-squared | 0.34 | 0.22 | 0.34 | 0.34 | 0.17 | 0.05 | 0.16 | 0.17 |
| F-statistic of excluded instruments from first stage | 61.0 | - | 21.7 | - | 16.1 | - | 12.9 | - |

Note: The sample is restricted to those countries with values for both variables. Robust standard errors are reported in parenthesis. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Source: OECD calculations.

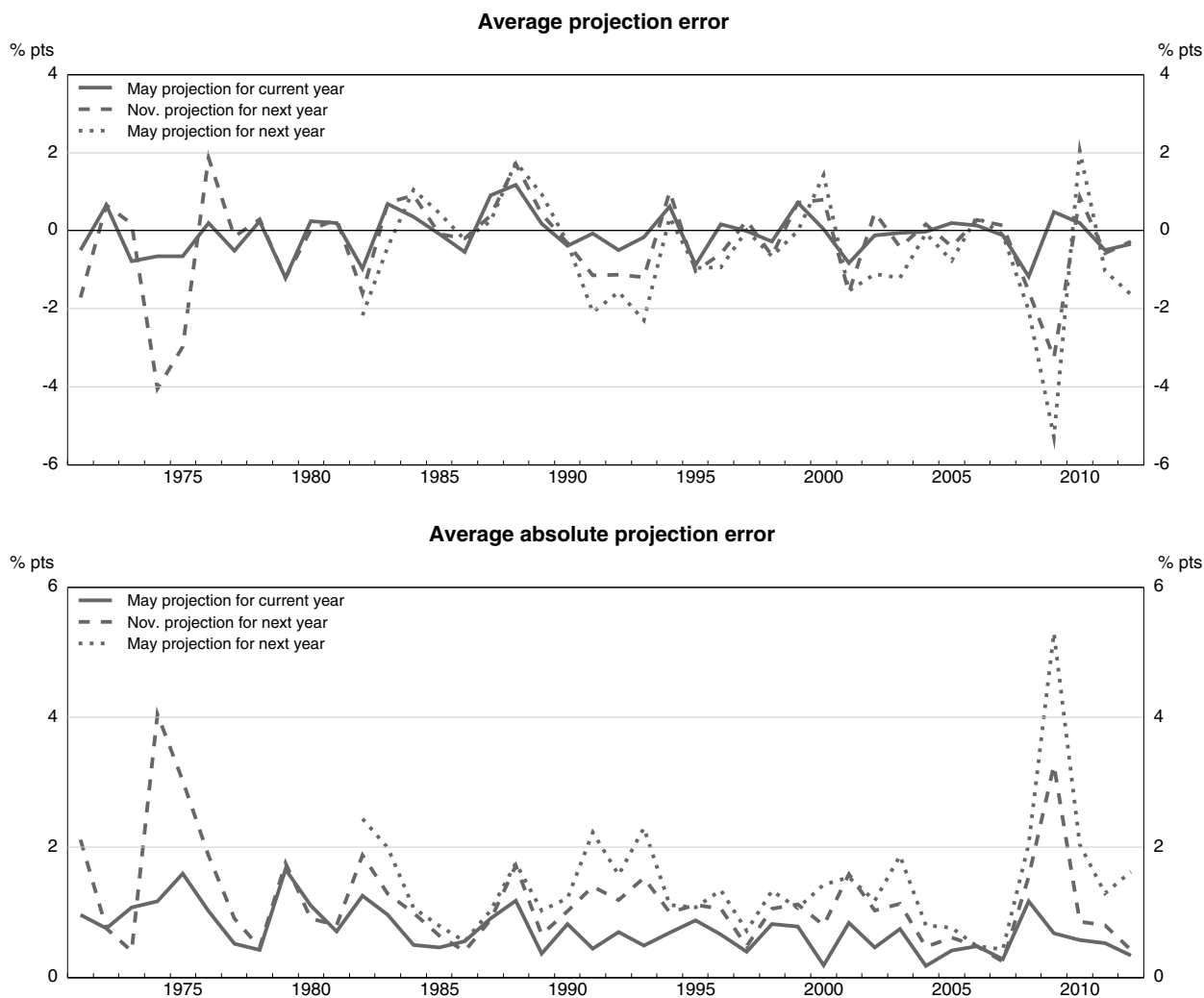
4. A broader perspective on the size of recent growth projection errors

4.1. A longer-term perspective: OECD forecasts over 1971-2012

Examining the characteristics of the OECD growth projections for the G7 countries – for which there are data from 1971 – helps to place the characteristics of recent forecast errors in context, and allows an assessment of whether they are markedly different from past experience. Key findings include:

- The errors made during the crisis are large, but not unprecedented. Errors of a magnitude comparable with those in 2009 occurred in the early 1970s, following the first oil crisis (Figure 9).¹⁸
- The average absolute projection error in the G7 economies declined from the late 1970s to the mid-2000s. In part, this reflects the moderation in the volatility of output growth. At shorter horizons the decline might also reflect improved data availability, especially regarding near-term developments, and improvements in forecasting procedures.
- In many cases, weak efficiency of the projections for G7 countries over four decades cannot be rejected (Table 3).¹⁹ The near-term forecasts perform best; fewer of the May projections for growth in the next year are weakly efficient, although the sample is shorter.
- Overall, the near-term projections for G7 countries have been unbiased. The average error in the May projections for growth in the same year is close to zero (or not statistically different from zero) for each country. In contrast, the November and May projections for growth the following calendar year have, on average, been overly optimistic, although in many cases the bias is not statistically significant. In the May projections for GDP growth in the following year, the extent of over-prediction

Figure 9. **Errors in GDP growth forecasts for G7 countries over the long run**



Note: In each year the error is an unweighted average across countries. See Box 1 for a description of the calculation of errors and the different projections considered. Errors are calculated as actual growth less forecast growth at each forecast horizon, where actual growth is the published outturn as at May the following year. A negative (positive) average error indicates over(under)-prediction. May projections for GDP growth in the following year are available only from 1982.

Source: OECD, *Economic Outlook* publications and databases; and OECD calculations.

over 2007-12 was markedly worse than the average over the preceding 25 years (from when data are available).²⁰

- On average across the G7 countries, the RMSEs over 2007-12 are higher than over the previous 15-year period of relative stability and low inflation, from 1991-2006 (Table 4, left panel). However, this difference disappears if the RMSEs are standardised by the volatility of GDP growth in the different samples. This is true also over a longer period from 1971 onwards; indeed the errors made during the period from 2007-12 are smaller than those made in the decade after 1971, reflecting the difficulties in forecasting the impact of the oil price shocks, as well as the exceptionally high volatility in GDP growth since the start of the financial crisis.

Table 3. The long-run GDP growth forecasts are weakly efficient
p-values from tests of forecast efficiency

| | May projection for current year | November projection for following year | May projection for following year |
|----------------|---------------------------------|--|-----------------------------------|
| | 1971-2012 | 1971-2012 | 1982-2012 |
| Canada | 0.342 | 0.349 | 0.000 |
| France | 0.104 | 0.064 | 0.002 |
| Germany | 0.113 | 0.381 | 0.020 |
| Italy | 0.376 | 0.161 | 0.008 |
| Japan | 0.036 | 0.057 | 0.390 |
| United Kingdom | 0.687 | 0.373 | 0.427 |
| United States | 0.264 | 0.893 | 0.878 |

Note: Based on joint tests of whether in country-level regressions of the outcome on the projection and a constant, the coefficient for the projections is one and the constant is zero, with shading indicating significance at the 10% level. Newey-West standard errors are used. May projections are only available from 1982.

Source: OECD calculations.

Table 4. RMSE of calendar year GDP growth projections over the longer run

Unweighted average of G7 countries

| | Percentage points of GDP | | | Ratio to standard deviation of growth | | |
|-----------|---------------------------------|-----------------------------------|------------------------------|---------------------------------------|-----------------------------------|------------------------------|
| | May projection for current year | November projection for next year | May projection for next year | May projection for current year | November projection for next year | May projection for next year |
| 1971-2012 | 1.0 | 1.7 | n.a. | 0.4 | 0.7 | n.a. |
| 1971-1981 | 1.3 | 2.2 | n.a. | 0.5 | 0.8 | n.a. |
| 1982-1990 | 1.0 | 1.3 | 1.7 | 0.6 | 0.8 | 1.0 |
| 1991-2006 | 0.7 | 1.3 | 1.6 | 0.5 | 0.9 | 1.2 |
| 2007-2012 | 0.7 | 1.6 | 2.7 | 0.3 | 0.6 | 1.1 |

Note: Errors are calculated as actual growth less projected growth at each forecast horizon, where actual growth is the published outcome as at May the following year. May projections for the following year are only available from 1982.

Source: OECD Economic Outlook publications and databases; and OECD calculations.

The general tendency to overestimate growth in the year ahead, on average, is common to many forecasters (Abreu, 2011). Two reasons appear to be a common failing to predict downturns and to predict their size: directional accuracy is asymmetric, with a much lower share of decelerations and recessions predicted a year in advance; and errors are larger in recessions. These difficulties have been found across forecasters, across countries and over longer periods of time (Zarnowitz, 1991; Loungani, 2001; Abreu, 2011; González Cabanillas and Terzi, 2012).

In contrast, the directional accuracy of the long sample of G7 growth projections does not appear very different from that of the broader sample of countries over 2007-12 reported earlier (Table 5). There is a high degree of accuracy in projecting growth pick-ups, but little success predicting declines in growth (especially in the year ahead, with the success rate approximately as good as a coin toss). A similar finding is reported by Vogel (2007), using data for 1991-2006.

Table 5. **Directional accuracy of May growth projections**

| | Increases in growth | Decreases in growth |
|--------------------------------------|---------------------|---------------------|
| OECD countries: 2007-12 | | |
| Number in period | 56 | 116 |
| % correct: Projections for same year | 86 | 88 |
| % correct: Projections for next year | 91 | 46 |
| G7 countries: 1982-2006 | | |
| Number in period | 82 | 78 |
| % correct: Projections for same year | 79 | 83 |
| % correct: Projections for next year | 74 | 45 |

Note: The threshold for increase or decrease is a change in growth exceeding 0.1 percentage points (from rounded data).

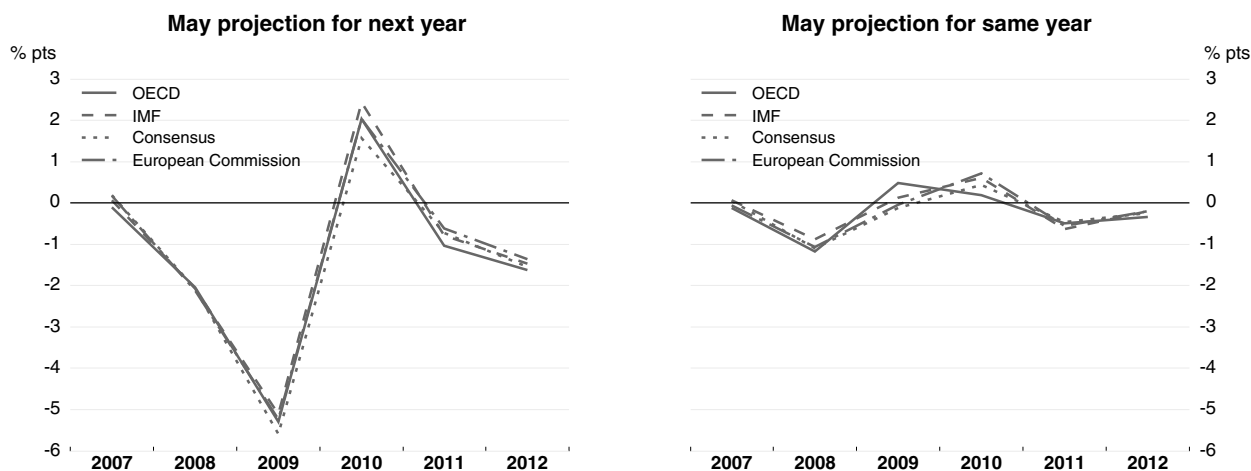
Source: OECD, *Economic Outlook* publications, databases and calculations.

4.2. Comparisons with other forecasters

Overall, the size and profile of the OECD projection errors are very similar to the errors in the projections made by other international organisations, such as the IMF and the European Commission (González Cabanillas and Terzi, 2012), and also the errors that are implied by consensus forecasts (Ahir and Loungani, 2014) (Figure 10). All of these overestimated growth considerably in 2009 and were then surprised by the extent of the initial bounce-back in 2010 and the subsequent weakness of the recovery. On average, all forecasters over-predicted growth during the period 2007-12. No set of projections clearly outperformed the others during this period; for instance, the RMSEs of the calendar year growth projections made in May the same year were almost identical across forecasters for each of the G7 economies, possibly reflecting a collective “groupthink” underlying the projections and their assumptions.

A comparison of the OECD growth projections and consensus forecasts for G7 countries over a longer period reveals similar patterns (Pain et al., 2014), with little significant difference

Figure 10. **Comparison of average projection errors for growth in G7 countries**



Note: An unweighted average of projection errors across countries is shown. See Box 1 for a description of the calculation of errors and the different projections considered. Errors are calculated as actual growth less forecast growth at each forecast horizon, where actual growth is the published outcome as at May the following year. A negative (positive) average error indicates over(under)-prediction. European Commission and IMF projections are released in April.

Source: Consensus Economics; European Commission European Economic Forecast publications; IMF *World Economic Outlook Databases*; OECD *Economic Outlook Databases*; and OECD calculations.

in the overall accuracy of the OECD and consensus forecasts over the past two decades. Forecast-encompassing tests (Fair and Shiller, 1990) suggest that the OECD May current-year projections and November year-ahead projections encompass the consensus forecasts (i.e. contain all the relevant information found in the consensus forecasts). However, neither of the separate May projections for growth in the following year encompasses the other. This is the case for both the pre-crisis period and also over 2007-2012.

4.3. The nature of the projections

The OECD forecasts are conditional projections rather than pure forecasts. The projections are consistent with the advice given about monetary policy settings and rest on explicit and implicit assumptions, such as fiscal policy changes and whether the euro area crisis will be successfully contained. Some potentially endogenous factors, such as commodity prices and nominal exchange rates, are also switched off over the projection period.²¹ This raises a number of difficult issues.

One issue is that the projections, and especially the accompanying commentary, sometimes point to unsustainable developments and the need for policy changes. If these are built into the projections, but the advice is not followed (or vice versa), an error in the projections will likely occur. It is not clear how or whether this type of error can be controlled for in the projection process.

A related issue, as noted above, is that the projections made during the euro area crisis placed a lot of weight on the assumption that the euro area crisis would be contained and subsequently ease, with accompanying declines in sovereign bond spreads and improvements in confidence. Yet it is not clear what else could have been assumed in projections for a period of over two years made public by an inter-governmental organisation. One possible answer – and the route chosen by the OECD at the time – is to make extensive use of scenario analyses to quantify possible adverse outcomes if key assumptions did not hold.

A third issue relates to the interpretation of the forecasts since the onset of the crisis. Given the skewed distribution of possible projections, depending on the assumptions chosen, and the emergence of fat negative tail risks, the nature of the published projections has changed. Whereas previously they were best seen as mean projections, more recently they have become modal forecasts, i.e. reflecting the most likely outcome. This has, however, resulted in a communications problem, as many users of the projections still view them as mean projections with a balanced distribution of risks.

5. Recent changes in forecasting techniques and procedures and the unfinished agenda

The challenges encountered in forecasting in recent years have led to changes in forecasting techniques and procedures in the OECD and in other international organisations, some of them still in progress. Key developments are outlined below, drawing on OECD experience and consultations with experts from the IMF, World Bank, European Commission and European Central Bank.²²

5.1. Increases in the centralisation or “top-down” component of the forecast process

Reflecting the common errors made in all country forecasts in recent years, and the extent to which these have been associated with stronger than expected global financial,

trade and sentiment interconnections, increasing weight has been placed on central strategic guidance at an early stage of the forecast process, at the OECD and elsewhere.

- One aspect has been early identification of key global developments and risks and their likely quantitative implications for global activity and global trade. This ensures a consistent view amongst country specialists of forces acting on the forecasts and outlook for the major economies.
- Initial early guidance in the form of top-down centralised projections is now provided at the OECD and elsewhere, to help ensure that projections for individual countries are based on a common general storyline. These projections draw together the key points from standalone analyses such as indicator models and assessments of financial market developments.

5.2. Enhanced monitoring of near-term activity developments

Although it took time for the full effects of the sub-prime and Lehman Brothers collapse to start to appear in published activity data, they were reflected swiftly in high-frequency tendency surveys. Developments such as the generalised collapse of confidence during the Great Recession and more recently when the euro area crisis intensified have also pointed to the potential usefulness of early survey-based signals. This has been reflected in a number of ongoing developments:

- The longstanding use of statistical composite leading indicators by the OECD has been augmented by the use of empirical “nowcasting” models, exploiting high-frequency information to gain an early picture of key activity developments (Box 2). Examples used by the OECD in forming projections for the *Economic Outlook* include the suite of quarterly GDP growth models for G7 economies introduced a decade ago (Sédillot and Pain, 2003), and the more recently-developed suite of indicator models for global trade (Guichard and Rusticelli, 2011). The OECD growth indicator models during the crisis provided a very useful real-time signal of a significant slowdown and then major contraction. Elsewhere, the indicator model approach is being extended by using high-frequency information to model private sector expenditure. Assessments are also being undertaken of possible non-linearities in the relationship between indicator variables and growth outcomes at times of extreme stress.
- Greater use has also been made of the anecdotal information gathered from outside business contacts. At times of fast-moving financial developments these may provide an early signal of changes in factors such as credit conditions, and thus near-term activity developments. One example given in the interviews was an early signal about the impact of a freezing of trade credits at the height of the crisis.
- Increasing attempts have been made, though not yet in the OECD, to utilise high-frequency information on real-time activity developments provided by internet-based indicators (“big data”). Internet-based search measures, based on Google Trends, have been used to identify early signals about specific housing and labour market developments (Hellerstein and Middeldorp, 2012; McLaren and Shanbhogue, 2011), as well as policy uncertainty (Baker et al., 2012). Recent studies have also sought to use real-time financial transactions data (such as the volume of SWIFT banking transactions, or data on credit card transactions) as an early indicator of GDP growth and trends in global trade finance (Gill et al., 2012).²³ The usefulness of such indicators when combined with other longstanding indicator variables has yet to be explored.

Box 2. Indicator models, composite leading indicators and OECD projections

Two models available to OECD forecasters are the short-term indicator models, which are used to predict GDP growth for two quarters, and the OECD Composite Leading Indicators (CLIs), which are designed to predict turning points in growth relative to trend. As explained below, both tools are designed to extract information about growth from high frequency and timely data sources. By responding reasonably rapidly, the reliance on the indicator models likely reduced overall forecast errors. But it does seem that better use of the information in the CLIs could have reduced the forecast errors in the November projections for growth in the following year (but not the other horizons).

Although both tools combine recent data to produce signals about economic growth, they are different by construction.

- The short-term indicator models (Sédillot and Pain, 2003 and Mourougane, 2006) are regression-based models that efficiently combine available monthly and quarterly data to predict current quarter and quarter-ahead GDP growth for the G7 countries and the euro area. The input data include “hard” data, such as industrial production and retail sales, and “soft” data, such as business and consumer sentiment. Because the dependent variable is GDP growth, the process of producing a forecast is straightforward. Other work has shown the main gain from the indicator approach is for current-quarter forecasts, where estimated indicator models appear to outperform autoregressive time series models, both in terms of size of error and directional accuracy.
- The OECD CLIs are long-running series produced for all OECD countries and some non-OECD countries. For each country, 5-10 series are used that best predict turning points in the business cycle. The CLI is typically available with a two-month lag. Because the results are primarily qualitative, it is possible that the information contained in these series is not used optimally in the forecasting round.

The performance of the indicator models in the crisis

The OECD growth indicator models during the crisis provided a very useful real-time signal of a significant slowdown and then major contraction (see figure below). Nonetheless, large errors were recorded in the fourth quarter 2008 and early 2009 and even when the third quarter 2008 was underway, the contraction in growth was not foreseen. But both the downturn and bounce-back were highlighted relatively quickly. Overall, the indicator models were useful in compiling the projections at that time and likely reduced the size of the overall errors made.

The real-time performance of the indicator models during the crisis can also be assessed relative to that in the pre-crisis period and the simulated out-of-sample performance when the models were first developed. The root mean squared errors (RMSE) for the G7 countries are shown below (see table). There are slight differences in the timing and information sets for each forecast, but in almost all cases one to two months of hard indicator data and two to three months of survey data were available for each economy. Four main points emerge from the 2007-12 period:

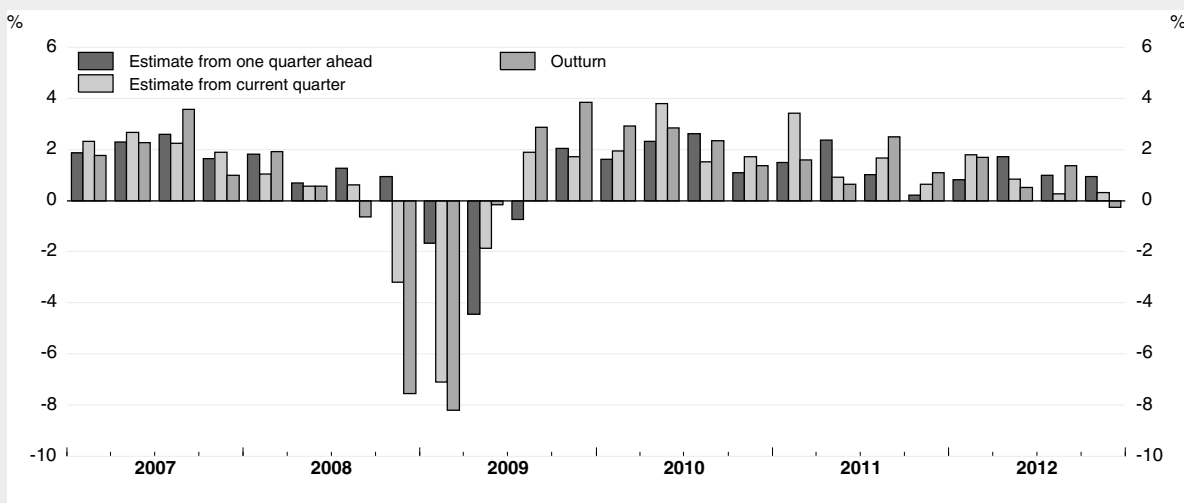
- The current quarter real-time forecast errors are comparable with those before the crisis (Sédillot and Pain, 2005), both in terms of the cross-country pattern of the errors and the size of the errors. A notable exception is the United Kingdom, where the real-time errors since 2007 have been more than double those in the pre-crisis period. The errors were also larger in Japan. But overall, the data suggest that the current quarter models have remained a useful guide to current economic activity.
- The real-time forecast errors in the quarter-ahead forecasts were generally larger than might have been expected based on those from the pre-crisis period and the initial out-of-sample exercise, particularly in Japan, Germany and the United Kingdom. However, the cross-country differences in the magnitude of the errors are broadly comparable with the pre-crisis period. The generally-higher real-time errors over 2007-12 appear to be largely due to the relatively greater volatility of growth outcomes in the recent period: when the RMSEs are scaled by the standard deviation of growth outcomes, the errors over 2007-12 are all smaller, except for the United Kingdom.

Box 2. Indicator models, composite leading indicators and OECD projections (cont.)

- In all economies the real-time errors for the one-quarter ahead forecasts have been greater than those for the current quarter forecasts. The difference between the two is smallest for France.
- The published forecasts appear to have incorporated the information from the indicator model. The current quarter errors from the published projections are positively and significantly correlated with those from the indicator model. And there is only a statistically significant relationship (at the 10% level) between the errors from the published current quarter forecasts and the current quarter indicator model projections if 2008Q4 is included.

OECD indicator model estimates and G7 GDP growth

Annualised quarter-on-quarter percentage changes, 2007Q1-2012Q4



Note: Outturn is defined as the published figure at the following *Economic Outlook*. The indicator model estimates shown are real-time estimates, typically from the last month of the quarter. Data are weighted using nominal GDP at PPP rates in 2010. Source: OECD Economic Outlook Databases; and OECD calculations.

The current quarter indicator model has performed well in recent years

RMSE of annualised quarter-on-quarter GDP growth projections, percentage points

| | Current quarter | | | One-quarter ahead | | |
|----------------|-----------------|---------------|---------------|-------------------|---------------|---------------|
| | Simulated RMSE | Actual RMSE | | Simulated RMSE | Actual RMSE | |
| | 1998Q1-2002Q4 | 2003Q1-2005Q1 | 2007Q1-2012Q4 | 1998Q1-2002Q4 | 2003Q1-2005Q1 | 2007Q1-2012Q4 |
| United States | 1.6 | 1.4 | 1.5 | 2.1 | 1.7 | 2.3 |
| Japan | 2.3 | 2.3 | 4.3 | 2.5 | 2.8 | 5.9 |
| Germany | 1.7 | 1.3 | 1.9 | 2.2 | 1.5 | 4.2 |
| France | 1.0 | 1.0 | 1.4 | 1.6 | 1.2 | 2.0 |
| Italy | 1.0 | 1.8 | 2.0 | 1.6 | 2.1 | 3.3 |
| United Kingdom | 1.0 | 0.5 | 2.0 | 1.0 | 0.9 | 2.7 |
| Canada | 0.8 | - | 2.0 | 1.8 | - | 2.7 |

Note: The simulated RMSEs and actual out-of-sample RMSEs for 2003Q1-2005Q1 are derived from Sédillot and Pain (2005, Table 4). The simulated RMSEs for Canada are derived from Mourougane (2006, Table 3) based on the availability of one month of GDP data. The outturn data for 2003-05 are the first available outturn estimate of GDP growth; the outturn data for 2007-12 are the first available published outturn data reported in following issues of the *OECD Economic Outlook*.

Source: Sédillot and Pain (2005); Mourougane (2006); and OECD calculations.

Box 2. Indicator models, composite leading indicators and OECD projections (cont.)**The usefulness of the OECD composite leading indicators since the crisis began**

A simple way of assessing whether the real-time CLIs contained information that might have helped to reduce the real-time projection errors is to regress the errors in GDP growth projections on the change in the CLIs that would have been available to forecasters at the time. One-month, 3-month, 6-month and 12-month changes up to the projection date in the CLIs for the G7 countries were considered for the period 2007-12 (see Appendix 7 of Pain et al., 2014).

Some caution is, of course needed in interpreting the results, but the following points emerge from this exercise:

- It does not appear that there was some information in the CLIs that could have been used to reduce the projection errors made in May 2008 as the downturn got underway.
- However, in the early stages of the recovery, at a time of considerable uncertainty, the errors in the November 2009 and May 2010 growth projections are found to be positively associated with the changes in the CLIs at the time of the forecast.

5.3. Enhanced monitoring of financial market developments and greater integration into the forecast process

Increasing attention is now paid to financial market developments in the construction of the projections and in empirical analysis.

- As the financial crisis progressed, the OECD Secretariat developed new financial conditions indices (FCIs) for the United States, Japan, the euro area and the United Kingdom (Guichard and Turner, 2008; Guichard et al., 2009). These weight together a wide range of financial variables that have a well-established link with GDP growth 12 to 18 months later.²⁴ The FCIs have been used extensively in the forecasting rounds since 2008-09 and as a guide to possible GDP effects in scenario analyses.
- A limitation of the aggregate FCIs is that they do not pick up all recent financial market developments, notably financial fragmentation in the euro area. Thus some organisations have also sought to directly incorporate country-specific information on bank lending rates and lending conditions in the set of variables being projected.
- In the OECD and elsewhere, discussions with internal financial market specialists and/or outside experts have been strengthened. In the OECD there are regular contacts between the Economics Department and the Directorate for Financial and Enterprise Affairs. Elsewhere, developments include the establishment of new divisions/units covering financial market developments and macro-financial linkages and considering key risks.
- Work is underway in some institutions on the difficult tasks of augmenting existing macroeconomic models with more detailed relationships of banking sector behaviour and strengthening linkages to reflect global financial interconnectedness. The macroeconomic models available at the time of the crisis typically ignored the banking system and failed to account for the possibility of bank capital shortages and credit rationing having an impact on macroeconomic developments. However, incorporating the financial sector into macroeconomic models is proving to be a major challenge.

5.4. Enhanced focus on risk assessments and global spillovers

Reflecting the uncertainty about the basic assumptions underlying the projections and the speed and depth of cross-country spillovers since the crisis began, there is now an enhanced focus on risk assessments and global spillovers in all international organisations:

- Greater information is now being provided about the distribution of risks around the central projections. At the OECD, while not providing a numerical risk distribution, the risk profile for the *Economic Outlook* projections has typically been characterised qualitatively as being balanced or skewed or bimodal and the projections themselves characterised as being modal rather than average projections.²⁵ Other international forecasting organisations have presented their assessed numerical risk distribution in the form of a fan chart or in the form of forecast ranges for key variables.
- Greater use is being made of quantitative scenario analyses to illustrate alternative outcomes and their global implications. Two notable examples in the OECD are the scenario used to illustrate a severe downside outcome arising from adverse euro area developments in the latter half of 2011 and the scenario illustrating the impact of the US debt ceiling becoming binding in the November 2013 *Economic Outlook*. The first of these scenarios made use of new forecasting tools, such as the financial conditions indices and models linking uncertainty and confidence with final expenditure, as well as a standard macroeconomic model, to calibrate the potential near-term activity impact of deteriorating financial conditions and a collapse in confidence brought about by a further worsening of the euro area crisis. The second used a global macroeconomic model to illustrate the extent to which a low-probability, but high-impact event would quickly spread to other countries.

Notes

1. The main analysis in this paper is based on calendar year growth rates. Figure 1 uses Q4/Q4 growth rates to illustrate the sudden deterioration in the financial crisis in the last quarter of 2008 and the impact this had on forecasts at the time.
2. See for example: OECD (2005, 2006), van den Noord (2006), Dieter et al. (2009) and Shigehara and Atkinson (2012).
3. Empirical analysis and macro-model simulations of an increasingly globalised financial system did, however, highlight the resulting potential for shocks in one economy to spill over to others to an ever greater extent (Hervé et al., 2007).
4. With the projection errors in each year tending to be in the same direction for almost all countries, the average absolute error across countries in Figure 2 is similar in magnitude to the average errors.
5. The projection errors are derived by subtracting the forecast from the outcome, so that an overestimate of growth results in a negative projection error.
6. This suggests the forecasts are not consistent with full information rational expectations.
7. This is based on the tests of the errors for G7 countries in Appendix 3 of Pain et al. (2014).
8. Changes in growth of less than 0.1 percentage points (from rounded data) are excluded.
9. The set of explanatory variables here is related to that in other studies that seek to explain cross-country differences in growth outcomes during the crisis, including Rose and Spiegel (2010), Cecchetti et al. (2011) and Berkmen et al. (2012). This paper focuses on a smaller set of countries (OECD member countries) and projection errors during the recovery as well as the downturn, and also considers some contemporaneous developments.
10. Multivariate regressions would better allow causal relationships to be established but are difficult in this small sample. Some preliminary results using the RMSEs of the country growth forecasts are presented in Table A.5.4 of Pain et al. (2014), although caveats still apply. The key finding is that for the November year-ahead projection errors, product market regulation remains correlated with accuracy after controlling for openness, with both variables significant at the 10% level.

11. The evidence points to the enhanced exposure of host economies to source economy shocks during the downturn outweighing the potential for foreign-owned banks, with access to internal capital resources, to help shield host economies from domestic shocks, which would limit negative growth surprises. A related finding is reported by Cetorelli and Goldberg (2012). Claessens and van Horen (2012) also show that foreign banks reduced their domestic credit more sharply than domestic banks during the crisis.
12. Related measures of business and labour market regulation produced by the World Bank and the Fraser Institute were found to have similar relationships (not shown here).
13. The negative relationship early in the crisis is more difficult to interpret since other studies have shown that countries with higher capital ratios outperformed those with lower ratios during that time (Cecchetti et al., 2011). One difference here is the focus on errors, rather than outcomes. Another is the use of regulatory capital (rather than total capital) to risk-weighted assets.
14. It is possible that the correlations could also reflect a reverse causal link, with weaker growth outcomes leading to more impaired loans and deteriorating confidence. However, qualitatively similar results are obtained if confidence changes available at the time of the forecasts are used instead.
15. Cecchetti et al. (2011) find that lower pre-crisis levels of private-sector credit to GDP and lower rates of growth in private-sector credit from 2005-07 were associated with better growth outcomes in the downturn (across a broader sample of countries). In contrast, there is evidence of a positive, but not significant, relationship between the errors in the OECD growth projections and pre-crisis level of private-sector bank credit.
16. The IMF studies focus primarily on European countries, although the main findings remain even if the sample is broadened to other advanced economies.
17. Actual fiscal consolidation was, however, strongly positively correlated with projected fiscal consolidation.
18. The average error and average absolute error of projections made in November 1973 for growth in 1974 were both larger than any projection error from the November year-ahead forecasts during the financial crisis.
19. Based on empirical estimates of equations 1 and 2 from Box 1.
20. The difference between the errors from the same-year May projections for growth in recent years compared with before the crisis is smaller in magnitude but is still statistically significant for three countries (France, Italy and the United Kingdom).
21. In 2008 and 2009, commodity prices were assumed to be fixed in the projections. In fact, they acted as an important automatic stabiliser for global activity, falling sharply as the crisis intensified and rebounding as the recovery began. If these developments had been incorporated in the OECD projections, then it is possible that the underestimation of the depth of the recession in 2008-09 and the extent of the bounce-back in 2009-10 would have been larger.
22. As part of the consultation it was agreed that individual comments and remarks would not be attributable to any individual institution. Additional relevant information is taken from Kenny and Morgan (2011) and González Cabanillas and Terzi (2012).
23. One example of the usefulness of such indicators was provided by the early signal of the extent of supply disruption in Japan following the earthquake and tsunami in March 2011. As noted in the May 2011 OECD *Economic Outlook*, an indicator of product availability compiled by the Billion Prices Project at MIT showed a fall of around 15% in online product availability in March.
24. The variables used include changes in credit availability, corporate bond spreads, short- and long-term interest rates, exchange rates and household wealth-income ratios.
25. Attempts have also been made to provide an indication of the uncertainty associated with the projections from the growth indicator models (Laurent and Kozluk, 2012; Rusticelli, 2012).

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APPENDIX A

Summary of projection errors

This appendix summarises the errors in the GDP growth projections for each country and for groups of countries. As in the main text, the key statistics are:

- The average error, which is positive or negative, depending on whether growth was under- or over-predicted on average during the period. This statistic is also a measure of bias.
- The average absolute error and root mean squared error (RMSE), which are indicators of accuracy. They can be scaled to facilitate comparisons across countries or time – to do this the average absolute error is scaled by average absolute growth during the same period and the RMSE is scaled by the volatility of growth in that period (the standard deviation).

Errors in annual GDP growth projections

In the 2007-2012 period, the average errors in the projections for GDP growth in the following year were negative for almost all countries – i.e. growth was weaker than projected. In contrast, the errors in the May projections for growth in the same year were, on average, close to zero, and negative in less than half of the OECD economies (see Table A.1). There is a wide range of outcomes around these means. The largest over-predictions of growth amongst those countries where projections were made throughout 2007-2012 were in Greece and Ireland amongst the OECD economies and in Russia for the BRIICS.

The average errors mask offsetting positive and negative errors in the projections. As a result, the average absolute errors or RMSEs (Tables A.2 and A.3) are larger than the average errors. Average absolute errors are typically around 1 percentage point for the May current year projections, but rise as the forecast horizon is lengthened to over 2 percentage points for most countries. The RMSEs present a similar picture. By both metrics, OECD countries outside of Europe had lower errors in the projections made for growth in the year ahead.

Scaling these measures growth outcomes provides a more standardised basis with which to compare accuracy across countries. When scaled by absolute GDP growth outcomes, the average absolute error in the current year projections is around 20-30% of the typical absolute growth rate of GDP (Table A.2, column 4). In contrast, for the average OECD economy, the average absolute error in the May projections for growth in the following year is approximately the same size as the absolute growth rate (Table A.2, column 6). On the basis of the RMSEs relative to the volatility of growth, the projections for the OECD countries were typically as accurate as those for the BRIICS (Table A.3, columns 4 to 6). Projection errors are, on average, around one-half of the volatility of GDP growth in the May current year projections, but broadly equal to the standard deviation of growth in the May projections for growth in the following year.

Table A.1. **Average errors of GDP growth projections for 2007-12**
Percentage points

| | May projection for current year | November projection for next year | May projection for next year |
|---|---------------------------------|-----------------------------------|------------------------------|
| OECD countries | | | |
| Australia | 0.2 | -0.3 | -0.5 |
| Austria | 0.2 | -0.1 | -0.5 |
| Belgium | 0.0 | -0.4 | -0.9 |
| Canada | -0.4 | -0.5 | -1.2 |
| Chile ¹ | 0.5 | 0.7 | 0.5 |
| Czech Republic | -0.3 | -1.8 | -2.4 |
| Denmark | -0.8 | -1.5 | -1.8 |
| Estonia ¹ | 1.4 | -1.0 | 1.8 |
| Finland | -0.8 | -1.4 | -1.8 |
| France | -0.4 | -0.6 | -1.2 |
| Germany | 0.1 | -0.2 | -0.6 |
| Greece | -1.2 | -2.6 | -3.7 |
| Hungary | -0.6 | -1.4 | -3.0 |
| Iceland | 0.3 | 0.7 | -1.2 |
| Ireland | -0.3 | -1.9 | -3.5 |
| Israel ¹ | 0.7 | 0.5 | 1.2 |
| Italy | -0.5 | -1.5 | -2.1 |
| Japan | 0.0 | -1.3 | -1.5 |
| Korea | -0.2 | -0.9 | -1.4 |
| Luxembourg | -0.8 | -1.5 | -2.4 |
| Mexico | 0.1 | -0.9 | -1.6 |
| Netherlands | 0.1 | -0.7 | -1.2 |
| New Zealand | 0.4 | -0.2 | -1.0 |
| Norway | -0.2 | -0.7 | -0.5 |
| Poland | 0.2 | 0.1 | 0.0 |
| Portugal | 0.2 | -0.8 | -1.4 |
| Slovak Republic | 0.1 | -0.8 | -1.6 |
| Slovenia ¹ | -1.2 | -4.1 | -2.3 |
| Spain | 0.1 | -0.9 | -1.3 |
| Sweden | 0.0 | -1.0 | -1.3 |
| Switzerland | 0.3 | 0.1 | -0.2 |
| Turkey | 0.0 | -0.7 | -1.5 |
| United Kingdom | -0.4 | -1.0 | -1.7 |
| United States | -0.2 | -0.4 | -1.0 |
| <i>OECD aggregate projection</i> | <i>-0.1</i> | <i>-0.7</i> | <i>-1.2</i> |
| Non-OECD countries | | | |
| Brazil | -0.1 | -0.4 | -0.9 |
| China | 0.1 | -0.1 | -0.6 |
| India | -0.7 | -0.7 | -0.9 |
| Indonesia ¹ | 0.4 | 0.1 | -0.2 |
| Russia | -0.8 | -1.7 | -2.3 |
| South Africa ¹ | -0.7 | -0.7 | -1.8 |
| Country group averages² | | | |
| OECD | -0.1 | -0.9 | -1.4 |
| Euro area | -0.2 | -1.1 | -1.5 |
| Euro area: Core | -0.1 | -0.9 | -1.1 |
| Euro area: Vulnerable | -0.3 | -1.5 | -2.4 |
| Other OECD Europe | -0.1 | -0.7 | -1.4 |
| OECD outside Europe | 0.1 | -0.4 | -0.8 |
| BRIICS | -0.2 | -0.6 | -1.0 |

Note: Errors are calculated as actual growth less projected growth at each forecast horizon, where actual growth is the published outturn as at May the following year. A negative (positive) average error indicates over(under)-prediction. All projections are calendar year except India, which is fiscal year. "OECD aggregate projection" refers to the published projection for the OECD area.

1. Projections only available for part of the period 2007-12.

2. Countries included in the "euro area: vulnerable group" are Greece, Ireland, Italy, Portugal and Spain.

Source: OECD, *Economic Outlook Databases*; and OECD calculations.

Table A.2. **Average absolute errors of GDP growth projections for 2007-12**

| | Average absolute error (percentage points) | | | Ratio of average absolute error to average absolute growth | | |
|----------------------------------|--|-----------------------------------|------------------------------|--|-----------------------------------|------------------------------|
| | May projection for current year | November projection for next year | May projection for next year | May projection for current year | November projection for next year | May projection for next year |
| OECD countries | | | | | | |
| Australia | 0.8 | 0.8 | 1.1 | 0.3 | 0.3 | 0.4 |
| Austria | 0.4 | 1.2 | 1.9 | 0.2 | 0.5 | 0.8 |
| Belgium | 0.7 | 1.1 | 1.9 | 0.4 | 0.6 | 1.0 |
| Canada | 0.4 | 0.9 | 2.0 | 0.2 | 0.4 | 0.9 |
| Chile | 0.9 | 0.9 | 0.5 | 0.2 | 0.2 | 0.1 |
| Czech Republic | 0.7 | 2.4 | 3.3 | 0.2 | 0.8 | 1.1 |
| Denmark | 1.1 | 1.8 | 2.4 | 0.6 | 0.9 | 1.3 |
| Estonia | 1.5 | 5.1 | 2.7 | 0.2 | 0.7 | 0.6 |
| Finland | 1.6 | 2.8 | 3.2 | 0.5 | 0.9 | 1.0 |
| France | 0.6 | 0.7 | 1.6 | 0.4 | 0.5 | 1.2 |
| Germany | 0.8 | 1.4 | 2.4 | 0.3 | 0.5 | 0.9 |
| Greece | 1.2 | 2.7 | 3.8 | 0.3 | 0.6 | 0.9 |
| Hungary | 0.8 | 2.1 | 4.0 | 0.4 | 1.0 | 2.0 |
| Iceland | 1.2 | 1.7 | 2.3 | 0.4 | 0.5 | 0.7 |
| Ireland | 1.5 | 2.3 | 3.7 | 0.6 | 0.9 | 1.4 |
| Israel | 1.0 | 1.2 | 2.2 | 0.3 | 0.4 | 0.5 |
| Italy | 0.7 | 1.5 | 2.4 | 0.3 | 0.8 | 1.3 |
| Japan | 0.9 | 2.0 | 2.6 | 0.4 | 0.8 | 1.1 |
| Korea | 1.3 | 1.7 | 2.3 | 0.4 | 0.5 | 0.7 |
| Luxembourg | 1.3 | 2.0 | 3.8 | 0.5 | 0.8 | 1.6 |
| Mexico | 0.8 | 2.2 | 2.6 | 0.2 | 0.5 | 0.6 |
| Netherlands | 0.6 | 1.2 | 2.2 | 0.3 | 0.5 | 1.0 |
| New Zealand | 1.4 | 1.4 | 2.1 | 0.7 | 0.7 | 1.0 |
| Norway | 0.6 | 1.1 | 1.0 | 0.3 | 0.5 | 0.5 |
| Poland | 0.9 | 1.0 | 1.9 | 0.2 | 0.2 | 0.5 |
| Portugal | 0.7 | 1.1 | 2.1 | 0.4 | 0.6 | 1.2 |
| Slovak Republic | 0.7 | 2.4 | 3.3 | 0.1 | 0.5 | 0.6 |
| Slovenia | 1.2 | 4.1 | 2.7 | 0.4 | 1.4 | 2.2 |
| Spain | 0.3 | 1.1 | 1.8 | 0.1 | 0.6 | 1.0 |
| Sweden | 1.5 | 2.3 | 3.2 | 0.5 | 0.7 | 1.0 |
| Switzerland | 0.7 | 0.8 | 1.6 | 0.4 | 0.4 | 0.8 |
| Turkey | 1.7 | 3.5 | 5.0 | 0.3 | 0.7 | 1.0 |
| United Kingdom | 0.5 | 1.1 | 2.1 | 0.3 | 0.6 | 1.2 |
| United States | 0.3 | 0.6 | 1.7 | 0.1 | 0.3 | 0.8 |
| <i>OECD aggregate projection</i> | <i>0.4</i> | <i>1.0</i> | <i>1.9</i> | <i>0.2</i> | <i>0.5</i> | <i>0.9</i> |
| Non-OECD countries | | | | | | |
| Brazil | 1.1 | 2.0 | 2.7 | 0.3 | 0.6 | 0.7 |
| China | 0.8 | 0.9 | 1.2 | 0.1 | 0.1 | 0.1 |
| India | 1.4 | 1.9 | 2.2 | 0.2 | 0.3 | 0.3 |
| Indonesia | 0.4 | 0.5 | 1.3 | 0.1 | 0.1 | 0.2 |
| Russia | 1.3 | 2.5 | 3.2 | 0.2 | 0.4 | 0.6 |
| South Africa | 0.7 | 0.8 | 1.8 | 0.2 | 0.3 | 0.6 |
| Country group averages | | | | | | |
| OECD | 0.9 | 1.7 | 2.5 | 0.3 | 0.6 | 1.0 |
| Euro area | 0.9 | 1.8 | 2.4 | 0.3 | 0.6 | 1.1 |
| Euro area: Core | 0.8 | 1.9 | 2.3 | 0.3 | 0.6 | 1.0 |
| Euro area: Vulnerable | 0.9 | 1.8 | 2.8 | 0.3 | 0.7 | 1.1 |
| Other OECD Europe | 1.0 | 1.8 | 2.7 | 0.4 | 0.7 | 1.0 |
| OECD outside Europe | 0.8 | 1.2 | 1.7 | 0.3 | 0.5 | 0.8 |
| BRIICS | 1.0 | 1.6 | 2.3 | 0.2 | 0.3 | 0.4 |

Note: Errors are calculated as actual growth less projected growth at each forecast horizon, where actual growth is the published outturn as at May the following year. All projections are calendar year except India, which is fiscal year. Projections are only available for part of the period 2007-12 for Chile, Estonia, Israel, Slovenia, Indonesia and South Africa; these are excluded from country group averages of the ratio of average absolute error to average absolute growth. Countries included in the "euro area: vulnerable" group are Greece, Ireland, Italy, Portugal and Spain.

Source: OECD, *Economic Outlook Databases*; and OECD calculations.

Table A.3. **RMSE of GDP growth projections for 2007-12**

| | RMSE (percentage points) | | | Ratio of RMSE to standard deviation of growth outcomes | | |
|----------------------------------|---------------------------------|-----------------------------------|------------------------------|--|-----------------------------------|------------------------------|
| | May projection for current year | November projection for next year | May projection for next year | May projection for current year | November projection for next year | May projection for next year |
| OECD countries | | | | | | |
| Australia | 0.9 | 0.9 | 1.2 | 0.9 | 0.9 | 1.1 |
| Austria | 0.5 | 1.5 | 2.4 | 0.2 | 0.6 | 1.0 |
| Belgium | 0.7 | 1.4 | 2.5 | 0.3 | 0.7 | 1.1 |
| Canada | 0.5 | 1.3 | 2.5 | 0.2 | 0.6 | 1.1 |
| Chile | 0.9 | 1.1 | 0.5 | 2.3 | 2.6 | 1.6 |
| Czech Republic | 0.9 | 3.1 | 4.3 | 0.2 | 0.9 | 1.2 |
| Denmark | 1.3 | 2.3 | 2.9 | 0.5 | 0.9 | 1.1 |
| Estonia | 1.8 | 6.7 | 2.9 | 0.2 | 0.7 | 1.1 |
| Finland | 1.8 | 3.8 | 4.5 | 0.4 | 0.9 | 1.0 |
| France | 0.7 | 1.0 | 2.0 | 0.4 | 0.6 | 1.2 |
| Germany | 0.9 | 2.0 | 3.0 | 0.3 | 0.6 | 1.0 |
| Greece | 1.8 | 3.1 | 4.5 | 0.4 | 0.7 | 1.0 |
| Hungary | 0.9 | 2.6 | 4.7 | 0.3 | 0.9 | 1.6 |
| Iceland | 1.5 | 1.9 | 3.0 | 0.4 | 0.5 | 0.7 |
| Ireland | 2.0 | 3.1 | 5.1 | 0.5 | 0.8 | 1.4 |
| Israel | 1.4 | 1.4 | 2.7 | 0.8 | 0.8 | 3.2 |
| Italy | 0.8 | 2.1 | 3.2 | 0.3 | 0.8 | 1.3 |
| Japan | 1.3 | 2.6 | 3.4 | 0.4 | 0.8 | 1.1 |
| Korea | 1.5 | 1.9 | 2.7 | 0.7 | 0.9 | 1.3 |
| Luxembourg | 1.8 | 2.8 | 4.5 | 0.6 | 1.0 | 1.5 |
| Mexico | 1.0 | 3.2 | 4.3 | 0.2 | 0.7 | 1.0 |
| Netherlands | 0.7 | 1.7 | 2.9 | 0.2 | 0.6 | 1.1 |
| New Zealand | 1.7 | 1.8 | 2.2 | 0.8 | 0.9 | 1.1 |
| Norway | 0.7 | 1.4 | 1.5 | 0.4 | 0.8 | 0.8 |
| Poland | 1.1 | 1.0 | 2.2 | 0.6 | 0.6 | 1.2 |
| Portugal | 1.0 | 1.4 | 2.5 | 0.5 | 0.7 | 1.2 |
| Slovak Republic | 0.9 | 3.8 | 4.8 | 0.2 | 0.8 | 1.0 |
| Slovenia | 1.5 | 5.4 | 3.2 | 0.4 | 1.3 | 1.8 |
| Spain | 0.3 | 1.4 | 2.4 | 0.1 | 0.6 | 1.0 |
| Sweden | 2.0 | 2.9 | 4.0 | 0.5 | 0.8 | 1.1 |
| Switzerland | 0.8 | 1.0 | 1.8 | 0.5 | 0.6 | 1.2 |
| Turkey | 1.8 | 4.1 | 5.6 | 0.3 | 0.8 | 1.1 |
| United Kingdom | 0.6 | 1.7 | 2.9 | 0.2 | 0.6 | 1.1 |
| United States | 0.4 | 0.8 | 1.9 | 0.2 | 0.4 | 1.0 |
| <i>OECD aggregate projection</i> | <i>0.5</i> | <i>1.4</i> | <i>2.5</i> | <i>0.2</i> | <i>0.6</i> | <i>1.1</i> |
| Non-OECD countries | | | | | | |
| Brazil | 1.3 | 2.2 | 3.0 | 0.4 | 0.7 | 1.0 |
| China | 0.9 | 1.1 | 1.4 | 0.6 | 0.7 | 1.0 |
| India | 1.8 | 2.1 | 2.5 | 0.9 | 1.0 | 1.2 |
| Indonesia | 0.6 | 0.6 | 1.5 | 0.7 | 0.7 | 7.2 |
| Russia | 1.4 | 4.3 | 6.0 | 0.2 | 0.8 | 1.1 |
| South Africa | 0.7 | 0.9 | 1.8 | 2.3 | 3.1 | 4.4 |
| Country group averages | | | | | | |
| OECD | 1.2 | 2.6 | 3.4 | 0.4 | 0.7 | 1.1 |
| Euro area | 1.2 | 2.9 | 3.4 | 0.4 | 0.7 | 1.1 |
| Euro area: Core | 1.2 | 3.1 | 3.3 | 0.3 | 0.7 | 1.1 |
| Euro area: Vulnerable | 1.3 | 2.4 | 3.7 | 0.4 | 0.7 | 1.1 |
| Other OECD Europe | 1.2 | 2.4 | 3.5 | 0.4 | 0.7 | 1.1 |
| OECD outside Europe | 1.1 | 1.8 | 2.5 | 0.5 | 0.7 | 1.1 |
| BRIICS | 1.2 | 2.4 | 3.6 | 0.5 | 0.8 | 1.1 |

Note: Errors are calculated as actual growth less projected growth at each forecast horizon, where actual growth is the published outturn as at May the following year. All projections are calendar year except India, which is fiscal year. Projections are only available for part of the period 2007-12 for Chile, Estonia, Israel, Slovenia, Indonesia and South Africa; these are excluded from country group averages of the ratio of the RMSE to the standard error of growth. Countries included in the "euro area: vulnerable" group are Greece, Ireland, Italy, Portugal and Spain.

Source: OECD, *Economic Outlook Databases*; and OECD calculations.