Harald Stieber

Exogenous determinants of Austrian economic growth
# Contents

Abstract 5  
Acknowledgements 6  
Zusammenfassung und Kernaussagen 7  
Summary and key messages 8  
1. Introduction 9  
2. Description of the data and the model used 10  
3. Baseline scenario 12  
4. Positive and negative risk analysis 16  
  4.1. Inflation Scenarios 17  
  Box 1. Oil price shocks and recycling of petrodollars 18  
  4.2. Terms of trade shocks 20  
  4.3. Demand shocks 23  
  4.4. Monetary shocks 25  
5. Outlook: Sensitivity analysis in the next update 27  
6. Conclusions 28  
References 29  
The Author 30  
Literatures 31
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Abstract:

A small macroeconometric model of the Austrian economy is simulated over the medium term until the year 2015. On the basis of these simulations we have built a medium term scenario of the Austrian economy that incorporates the short term WIFO economic forecast for the years 2005 and 2006 (WIFO 2005) and the information about the government budget for these years (BMF 2005). The medium term scenario then serves as a baseline for an extensive sensitivity analysis. We report the results from simulations of a simple demand shock, a monetary shock, and of two different shocks to the terms of trade. We also report some econometric evidence on the increased role of recycling of oil revenues in the light of the strong increase in price for crude oil in the years 2004 and 2005.

JEL-Classification: E62, E47
Keywords: macroeconometric modelling, economic shocks, sensitivity analysis, recycling
Acknowledgements

This paper benefited substantially from criticism and comments from several colleagues, such as Alfred Katterl and Niki Fink (both BMF), as well as David Hauner (IMF). All remaining errors are my own.
Zusammenfassung und Kernaussagen


Die Kernaussagen dieser Analyse lauten:

- Ein standardisierter temporärer negativer Schock entweder des Wachstums der Exportmärkte oder der Terms of Trade resultiert in zirka 1 Prozentpunkt niedrigerem Wachstum im Jahr des Schocks.

- Terms of Trade Schocks haben eine höhere Wahrscheinlichkeit stark auszufallen, wenn sie auf Preisentwicklungen in Österreichs Exportmärkten zurückgehen, die Standardabweichung solcher Schocks ist um 60-70% größer als jene der Importpreise.

- Die direkten negativen Zinsrisiken sind vernachlässigbar gering und dürften darüber hinaus in vielen Fällen durch positive Terms of Trade Entwicklungen überkompensiert werden.

- Positive direkte Zinsrisiken sind vorhanden, sie sind jedoch klein im Vergleich zu den Risiken, die mit dem Wachstum der Exportmärkte verknüpft sind.

- Die beiden letzteren Ergebnisse könnten eine gewisse Erklärung dafür geben, warum sich Mitgliedstaaten mit kleinen offenen Volkswirtschaften als die owner des Stabilitäts- und Wachstumspaktes erwiesen haben, viel mehr als es für die großen Staaten der Fall war, und warum das voraussichtlich so bleiben wird.

- Ökonometrische Analysen weisen darauf hin, dass ein höheres Ausmaß an Recycling der zusätzlichen Einkünfte aus dem Verkauf von Öl die negativen Wachstumseffekte des aktuellen Erdölpreishochs abgedeert haben könnte.
Summary and key messages

According to the opinion on the content and format of stability and convergence programmes, Member States are requested to include an analysis in their stability and convergence programmes that quantifies various risks for the envisaged growth performance and budgetary outcomes over the programme horizon. This main results of this analysis were reported in chapter 4 of the November 2005 update of the Austrian Stability Programme for the period 2005-2008. The analysis, which is explained in this paper in more detail, exemplifies the high degree of dependence of the Austrian economy on demand and price developments in other economies.

Key messages coming out of the analysis:

- A standardised temporary negative shock to either growth of export markets or terms of trade lowers economic growth in the year of the shock by roughly 1 percentage point.
- Terms of trade shocks are more likely to be large when they originate from price developments in Austrian exports markets; the standard deviation of these shocks is 60-70% bigger than the standard deviation of import prices.
- Direct negative interest rate risks are negligible and should in many cases be more than compensated by positive terms of trade developments.
- Positive direct interest rate risks exist, but they are small compared to risks connected to growth of export markets.
- The latter two results go some way in explaining why small open economy member states owned the Stability and Growth Pact so far more than large member states, and why they are likely to continue to do so.
- We find some econometric evidence that a higher degree of recycling could have helped to cushion the negative effects on growth of the recent hike in oil prices.
1. Introduction

A small macroeconometric model of the Austrian economy is simulated over the medium term until the year 2015. On the basis of these simulations we have build a medium term scenario of the Austrian economy that incorporates the short term WIFO economic forecast for the years 2005 and 2006 (WIFO 2005) and the information about the government budget for these years (BMF 2005). The medium term scenario then serves as a baseline for an extensive sensitivity analysis.

The analysis highlight the high degree of dependence of the Austrian economy on demand and price developments in other economies. Furthermore, it has to be stressed, that this degree of dependence constitutes a lower bound of what we esteem to be the actual degree of dependence over the time horizon of the present update of the Austrian Stability Programme for the period 2005 to 2008, since it is derived from parameters of a model, that has been estimated with data from 1976 to 2004\(^1\). During this period the integration of the Austrian economy increased in terms of openness (figure 1), in geographic terms (opening up of the Eastern European economies), and, last but not least in terms of fiscal integration (first Stability and Growth Pact from 1997 on, reformed SGP from 2005). On the other hand, compared to these types of integration, monetary integration has known little variation, due to the quasi monetary union with Germany starting in 1981 (Hochreiter and Winckler 1995).

\[\text{OPENNESS}\]

Openness is calculated as the sum of exports and imports as a share of GDP in %
Source: BMF (2005), Stieber (2006)

Figure 1

\(^1\) In order to assess the robustness of the estimated relationship, we also used linked data series going back as far as 1960. More on this is reported in Stieber (2006).
2. Description of the data and the model used

In the 30 years between 1977 and 2006\(^2\) the Austrian economy exhibits an average growth of 2.3% (this is both the mean and the median value of the real GDP series). This and other descriptive statistics are summed up in table 1. Whenever possible, data were taken from the Austrian national accounts as compiled by Statistics Austria (2005).\(^3\)

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>endogenous variables:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP growth</td>
<td>2.2</td>
<td>2.7</td>
<td>2.1</td>
<td>2.3</td>
</tr>
<tr>
<td>Private consumption</td>
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<td>2.7</td>
<td>1.5</td>
<td>2.2</td>
</tr>
<tr>
<td>Government consumption</td>
<td>2.1</td>
<td>2.2</td>
<td>1.2</td>
<td>1.9</td>
</tr>
<tr>
<td>Investment</td>
<td>1.1</td>
<td>3.6</td>
<td>1.8</td>
<td>2.2</td>
</tr>
<tr>
<td>Exports</td>
<td>4.4</td>
<td>4.9</td>
<td>6.6</td>
<td>5.4</td>
</tr>
<tr>
<td>Imports</td>
<td>3.1</td>
<td>5.3</td>
<td>5.3</td>
<td>4.6</td>
</tr>
<tr>
<td>Inflation</td>
<td>4.5</td>
<td>2.7</td>
<td>1.6</td>
<td>2.9</td>
</tr>
<tr>
<td>Deflator exports</td>
<td>3.5</td>
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<td>0.8</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>exogenous variables:</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price level in export markets</td>
<td>2.5</td>
<td>-0.1</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Growth of relevant export markets</td>
<td>3.8</td>
<td>5.8</td>
<td>7.8</td>
<td>5.8</td>
</tr>
<tr>
<td>Real interest rates (long term, in %)</td>
<td>3.9</td>
<td>4.8</td>
<td>3.4</td>
<td>4.0</td>
</tr>
<tr>
<td>Price level imports</td>
<td>4.1</td>
<td>1.1</td>
<td>0.8</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Source: Stieber (2006)

Table 1

Comparing the 3 decades in the estimation sample from a macroeconomic perspective,\(^4\) one fact stands out: Only in the last decade the average growth of the deflator of Austrian exports was lower than the average change in the price level in Austria’s export markets (table 1). It is at this point that Austrian exports "take off", whereas import growth remains roughly the same. This is covering up the fact that export driven imports increased while internal demand and investment related imports decreased. Of course, this is one part of a larger story which comes under the heading of European economic integration. But still, depending on its ability to compete, an economy may win or lose from increased economic integration in the short to medium run, and the more so the slower its price system adjusts to the new situation. Thus,

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\(^2\) Throughout the paper we include the most recent short term economic forecast of the Austrian Institute of Economic Research (WIFO) for the years 2005 and 2006 (WIFO 2005).

\(^3\) Statistics Austria publishes nominal figures \(p^*x\) and an index of the respective volume series \(l_i\). From this deflators \(p\) are recovered. During the estimation and testing of the model we also used series from the OECD Economic Outlook Analytical Database, from DG Ecfin’s AMECO database. One of the robustness checks included estimating the model with data over various time span, going back as far as 1960. The results were encouraging.

\(^4\) Bearing in mind that the Austrian economy is very dependent on exogenous supply and demand conditions, as well as exogenous price and interest rate developments.
during the last decade, Austria could translate an increased price competitiveness into higher growth contributions from net exports. A second stylized fact is the slow down of both private and government consumption growth. A crucial question at this point is how investment demand will react to these developments. It is an open (and hence empirical) question if expectations about future internal demand or expectations about future exports growth weigh more in the decision making of firms where to invest in production capacity.\(^5\)

The version of the model that was used to compile the medium term macroeconomic scenario in the current update of the Austrian stability programme contains 75 equations, the model uses annual data. There are 12 estimated stochastic dynamic behavioural equations governing the 'mechanics' of the model. In general, the behavioural equations were first estimated separately by OLS over various time horizons to identify breaks in the series. In a second step, they were estimated as a system using the SUR estimator.\(^6\) As is typical for this type of model (Hofer and Kunst 2005, p. 87), most of the equations are identities.\(^7\) The identities close the model in such a way that all transmission channels of interest are properly functioning.

The use of dummies was kept to an absolute minimum. The only dummy variable that we esteied as absolutely necessary is taking up a structural break in the series of the deflator of public consumption. Here, in the year 1997 several public undertakings were classified outside the public sector which led to an abrupt fall in the public consumption deflator.\(^8\) Since the model has an equation for both the deflator and nominal public consumption, the dummy comes in twice. From a purely statistical point of view, other data points would qualify for the introduction of a dummy variable as well. In the series of real investment growth, the second oil price shock produces significant outliers in the series. Also, the fall in investment in 2002 is from a statistical point of view an outlier. However, neither of these extraordinary changes in investment activity changes the structure of the model in a lasting way (i.e. from a structural point of view, they are not only purely transitory but also non-distortionary), so we did not include them in the final version of the model used for this sensitivity analysis exercise.\(^9\)

Finally, the role of the real interest rate warrants some remarks. Prior versions of the model used a real interest rate that was computed as the nominal interest rate (being a period's average rate of return on 10 year government bond) minus the GDP deflator. Since the only place where real interest rates enter the model is the investment growth equation, we switched to the investment deflator for the computation of real rates to better capture the opportunity

\(^5\) On this question, see the excellent discussion in Acocella (2005), p. 56-57.

\(^6\) The SUR estimator seems appropriate here due to the heteroscedasticity of some of the system equations' error terms. The SUR system estimator produces and subsequently uses a whole set of stochastic information in an iterated optimization exercise. This involves repeatedly estimating the system parameters using non-linear least squares. An alternative method would have been 3SLS. An example, how this type of stochastic information can be put to use, can be found in Neck and Stieber (2004).

\(^7\) In terms of size, the model is comparable to IHS's yearly forecast model LIMA and therefore is, as Hofer and Kunst (2004) note, "a comparatively small macroeconometric model".

\(^8\) Discussions with colleagues at the Austrian Institute of Economic Research, the Austrian National Bank, and the Vienna University of Economics and Business Administration confirmed this necessity.

\(^9\) A more detailed analysis of the model properties, estimated coefficients and comparison to other models in general and models of the Austrian economy in particular will be given in a forthcoming paper (Stieber 2006).
cost aspect of giving up a certain real return on investment in government debt for the uncertain real return on investment in entrepreneurial activity.\(^\text{10}\)

### 3. Baseline scenario

The baseline scenario (table 2) is computed in the following way: for the years 2005 and 2006, the short term economic forecast of the Austrian Institute of Economic Research (WIFO) is taken (i.e. all the behavioural equations are made exogenous). Public revenues and expenditures are plugged in as exogenous parameters as well. In the short run, this procedure makes good sense, since a lot of information such as the public budget, that is stochastic from the model’s point of view, is available already (i.e., has lost at least some of its stochastic character) and therefore should be used. From 2007 on, short term information on price developments, on growth of trade and on interest rates becomes very scarce already, hence, from this point on, the stochastic view of the model is more sensible.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP, value, in billions of €</td>
<td>237.0</td>
<td>245.32</td>
<td>254.29</td>
<td>264.42</td>
<td>274.83</td>
</tr>
<tr>
<td>GDP, volume, change in %</td>
<td>2.4</td>
<td>1.68</td>
<td>1.79</td>
<td>2.37</td>
<td>2.48</td>
</tr>
<tr>
<td>Gov. balance % of GDP</td>
<td>-1.0</td>
<td>-1.87</td>
<td>-1.69</td>
<td>-0.78</td>
<td>0.00</td>
</tr>
<tr>
<td>Gov. balance in billions of €</td>
<td>-2.3</td>
<td>-4.59</td>
<td>-4.30</td>
<td>-2.07</td>
<td>0.00</td>
</tr>
<tr>
<td>Debt in billions of €</td>
<td>150.8</td>
<td>155.60</td>
<td>160.40</td>
<td>162.97</td>
<td>163.47</td>
</tr>
<tr>
<td>Debt in % of GDP</td>
<td>63.6</td>
<td>63.43</td>
<td>63.08</td>
<td>61.63</td>
<td>59.48</td>
</tr>
</tbody>
</table>

Source: Statistics Austria, Federal Ministry of Finance

Table 2

There is one exception to this rule: on the side of public households, there is, in principle, the possibility to commit oneself to fiscal targets in a credible manner, since the government has the instruments to achieve such goals. In the present model, the commitments, as they are embodied in the current update of the Austrian Stability Programme (BMF 2005) and the Austrian Stability Pact, are respected in the baseline scenario. The instruments of the policy maker are public revenues and public expenditures. We relate state and local governments revenues and expenditures by fixed ratios to the federal measures. In the computation of the baseline scenario and for the rest of the sensitivity analysis, the instruments are “turned off” in order to assess the growth performance after a shock net of any possible discretionary policy

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\(^\text{10}\) More specifically, in the case of strong terms of trade shocks via the price of imports, real interest rates deflated with the GDP deflator may overstate the effect on the cost of financing investment. The estimated short run import price elasticity of the investment deflator is 0.2 whereas import prices enter the GDP deflator with their GDP share, which is close to 50%.
reactions. Again, this is a standard approach in sensitivity analysis.

For the time period of the stability programme’s macroeconomic scenario, two sets of exogenous variables are relevant. One set stems from WIFO’s economic forecast for the years 2005 and 2006, the other stems from the BMF’s model-based forecast for the years 2007 and 2008. Table 3 gives an overview of the combined set of exogenous variables.

<table>
<thead>
<tr>
<th>Exogenous factors</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interest rates</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>euro area: short-term</td>
<td>2.1</td>
<td>1.8</td>
<td>2.0</td>
<td>2.2</td>
</tr>
<tr>
<td>euro area: long-term</td>
<td>3.4</td>
<td>3.6</td>
<td>3.8</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>Exchange rates</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USD / €</td>
<td>1.25</td>
<td>1.21</td>
<td>1.22</td>
<td>1.22</td>
</tr>
<tr>
<td>Nominal effective exchange rate</td>
<td>-0.6</td>
<td>-0.3</td>
<td>0.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Real effective exchange rate</td>
<td>-0.4</td>
<td>-0.1</td>
<td>0.5</td>
<td>-0.2</td>
</tr>
<tr>
<td><strong>GDP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OECD, total (World for 2007 and 2008)</td>
<td>2.4</td>
<td>2.4</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>USA</td>
<td>3.3</td>
<td>3.3</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Japan</td>
<td>2.2</td>
<td>2.3</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>EU-25</td>
<td>1.5</td>
<td>1.6</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td><strong>World trade</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Austrian export markets</td>
<td>4.5</td>
<td>4.8</td>
<td>6.0</td>
<td>6.0</td>
</tr>
<tr>
<td>World trade, volumes (excluding EU for 2007 and 2008)</td>
<td>6.7</td>
<td>7.0</td>
<td>8.4</td>
<td>8.4</td>
</tr>
<tr>
<td>Import prices</td>
<td>1.2</td>
<td>2.7</td>
<td>1.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Price level in Austrian export markets</td>
<td>2.0</td>
<td>1.5</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Commodity prices</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil prices, USD per barrel</td>
<td>58.0</td>
<td>62.0</td>
<td>60.0</td>
<td>60.0</td>
</tr>
</tbody>
</table>

Table 3

Purely exogenous variables are forecast until 2015. The price variables are forecast using time series methods. First, we model the series as a combination autoregressive and moving average processes. Contrary to the case of the fully specified structural system described above, in this non-structural modelling exercise the correct identification of period dummies is crucial in order to arrive at sensible parameter estimates for the following forecast. Three clear cases for the use of period dummies are identified: the first and the second oil price shocks in the import price series, and the sharp appreciation of the Deutschmark against a range of currencies after in 1986. Accordingly, the price level of imports is forecast with a ARMA(1,1) process, the price level in Austrian export markets with a ARMA(1,3) process. Nominal long term interest rates are forecast with a no policy change assumption (rates are kept at 4% after 2008; as a consequence, real interest rates converge to a value of somewhat below 3% in the medium to long run).

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11 In addition to that, for the sensitivity analysis we have to roll back the model onto the years 2005 and 2006, where we had plugged in the WIFO forecast for the compilation of the baseline scenario. Thus, during sensitivity analysis, where we are only interested in the model’s departures from the baseline scenario, the model is run over the period of 2005 to 2015, whereas for the macroeconomic forecast that is used in the current update of the Austrian Stability Programme, the model is only used to compute a solution for the years 2007 and 2008.
The growth of relevant export markets is set to a cautious plausible long run value (in our case we have set this growth rate to 4% from 2009 onwards)\(^{12}\).

![Graphs showing economic indicators](image)

**Figure 2**

For the sensitivity analysis carried out in the context of the stability programme’s compilation, only these four most influential exogenous variables were shocked. We thus consider one demand shock (via exports), one monetary shock (via long term nominal interest rates), and two terms of trade shocks (via import prices, and via the price level in export markets). While the first two shocks are standard in the literature (see various articles in OeNB 2005), the terms of trade shocks are more unusual but may become more common again in the light of the recent hike in energy prices and the related question of recycling of petrodollars (see Box 1).

Figure 2 shows the time series (historical data plus forecast) of these four exogenous variables: the long term nominal interest rate, the growth of relevant export markets, the price level of imports, and the price level in export markets.

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\(^{12}\) From a historical perspective, this is a very low figure. It can be interpreted in the sense, that the expected value of the export ratio in the year 2015 is equivalent to the export ratio of the year 2008 which is seen at 55% of GDP (BMF 2005).
Using these forecasts of the exogenous variables, the solution of the model thus constitutes a dynamic stochastic forecast. This forecast is used as the baseline solution. In the sensitivity analysis various shocks (permanent and transitory) are imposed and the model is solved again. The results of these tests are presented until 2015 in order to assess the longer run properties of the model.

The alternative scenarios 2005-2008

<table>
<thead>
<tr>
<th>Scenario 1 - Permanent oil price shock and low growth of world economy</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP, value, in billions of €</td>
<td>237.0</td>
<td>246.20</td>
<td>255.40</td>
<td>265.30</td>
<td>274.90</td>
</tr>
<tr>
<td>GDP, volume, change in %</td>
<td>2.4</td>
<td>1.74</td>
<td>1.21</td>
<td>1.95</td>
<td>2.06</td>
</tr>
<tr>
<td>Growth differential</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gov. balance % of GDP</td>
<td>-1.0</td>
<td>-1.90</td>
<td>-1.90</td>
<td>-1.14</td>
<td>-0.64</td>
</tr>
<tr>
<td>Gov. balance in billions of €</td>
<td>-4.60</td>
<td>-5.00</td>
<td>-3.00</td>
<td>-1.80</td>
<td></td>
</tr>
<tr>
<td>Debt in billions of €</td>
<td>150.8</td>
<td>155.61</td>
<td>161.08</td>
<td>164.61</td>
<td>166.87</td>
</tr>
<tr>
<td>Debt in % of GDP</td>
<td>63.6</td>
<td>63.22</td>
<td>63.06</td>
<td>62.06</td>
<td>60.69</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario 2 - Low growth of world economy, low interest rates</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP, value, in billions of €</td>
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<td>244.80</td>
<td>252.80</td>
<td>261.90</td>
<td>271.10</td>
</tr>
<tr>
<td>GDP, volume, change in %</td>
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<td>1.41</td>
<td>2.00</td>
<td>2.12</td>
</tr>
<tr>
<td>Growth differential</td>
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<td>-0.40</td>
<td>-0.37</td>
<td>-0.36</td>
<td></td>
</tr>
<tr>
<td>Gov. balance % of GDP</td>
<td>-1.0</td>
<td>-2.00</td>
<td>-2.00</td>
<td>-1.15</td>
<td>-0.62</td>
</tr>
<tr>
<td>Gov. balance in billions of €</td>
<td>-4.90</td>
<td>-5.00</td>
<td>-3.00</td>
<td>-1.70</td>
<td></td>
</tr>
<tr>
<td>Debt in billions of €</td>
<td>150.8</td>
<td>155.90</td>
<td>161.40</td>
<td>164.92</td>
<td>167.10</td>
</tr>
<tr>
<td>Debt in % of GDP</td>
<td>63.6</td>
<td>63.68</td>
<td>63.85</td>
<td>62.98</td>
<td>61.63</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario 3 - High growth of world economy, high interest rates</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP, value, in billions of €</td>
<td>237.0</td>
<td>245.80</td>
<td>255.80</td>
<td>267.00</td>
<td>278.70</td>
</tr>
<tr>
<td>GDP, volume, change in %</td>
<td>2.4</td>
<td>1.89</td>
<td>2.18</td>
<td>2.74</td>
<td>2.84</td>
</tr>
<tr>
<td>Growth differential</td>
<td>0.20</td>
<td>0.40</td>
<td>0.38</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>Gov. balance % of GDP</td>
<td>-1.0</td>
<td>-1.80</td>
<td>-1.40</td>
<td>-0.24</td>
<td>0.63</td>
</tr>
<tr>
<td>Gov. balance in billions of €</td>
<td>-4.40</td>
<td>-3.60</td>
<td>-0.60</td>
<td>1.80</td>
<td></td>
</tr>
<tr>
<td>Debt in billions of €</td>
<td>150.8</td>
<td>155.44</td>
<td>159.57</td>
<td>160.72</td>
<td>159.46</td>
</tr>
<tr>
<td>Debt in % of GDP</td>
<td>63.6</td>
<td>63.23</td>
<td>62.38</td>
<td>60.19</td>
<td>57.22</td>
</tr>
</tbody>
</table>

Source: BMF (2005)

Table 4

In the current update of the Austrian stability programme, we have combined several shocks into three different scenarios:

- Scenario 1 in table 4 is thus a combination of two terms of trade shocks (one negative, one positive) and a demand shock. These shocks are described individually in figures 4, 6, and 9 in section 4.
- Scenario 2 in table 4 is one of low growth and low interest rates, combining the scenarios displayed in figure 9 and figure 13.
- Scenario 3 in table 4 is the corresponding positive case of high growth and high interest rates.
rates, combining the two shocks in figure 11 and figure 14 in section 4.

In all the scenarios, general government net lending was linked to the growth performance via the budgetary balance growth elasticity of 0.47 (Girouard and André 2005).\(^{13}\)

Reminder: The sensitivity analysis is carried out under a no-policy-change assumption. There are no discretionary fiscal policy reactions, e.g. in the case of a negative shock; however, automatic stabilizers are fully working.

4. Positive and negative risk analysis

According to the opinion on the content and format of stability and convergence programmes\(^{14}\) Member States are requested to include an analysis in their stability and convergence programmes that quantifies various risks for the envisaged growth performance and budgetary outcomes over the medium run. As to the economic parameters that should be shocked, the code mentions explicitly the interest rate and more generally any economic parameter that differs significantly from the common external assumptions that underlie the European Commission’s economic forecast exercise. In the present analysis, both cases apply since at the time the simulations were carried out, common external assumptions were not available yet.\(^{15}\)

In the following, we present the model's responses to 4 different types of shocks \((A, B, C, \text{ and } D)\). \(A\) and \(B\) are terms of trade shocks, \(C\) is a typical demand shock, and \(D\) is a monetary (policy) shock.

With the exception of the monetary shock, where nominal interest rates are simply higher or lower for the whole simulation period, we distinguish between a permanent (suffix p) and a transitory shock (suffix t). The permanent shock is modelled as a permanent change of the exogenous variable by 1 percentage point in the case of the growth rates, and a change by 100 basis points in the case of the interest rates. The transitory shocks are modelled as one standard deviation innovations in the variables in the year 2005.\(^{16}\)

With the exception of price shocks via higher import prices, we also report both the negative

\(^{13}\) The short run growth elasticity of the public revenue side of the general government in our model is 0.427. This confirms the growth elasticity of public revenues of 0.43 calculated by the OECD. For the expenditure side, the OECD calculates a growth elasticity of -0.04 (‘reversed sign’ convention!). Since we have only point elasticities for this elasticity, we have used the OECD figure.

\(^{14}\) The reformed Code of Conduct, which contains the technical details for the compilation of stability programmes under the new SGP, was endorsed by the Council of the European Union in its composition of ministers of the economy and finance (Ecofin) on 10 October 2005 (Council of the European Union 2005).

\(^{15}\) The relevant European Commission’s economic forecast (European Commission 2005), that provided a benchmark scenario for economic developments in member states until 2007 based on the common external assumptions, was only available by mid-November 2005, whereas the sensitivity analysis documented in this paper was carried out beginning of October 2005.

\(^{16}\) This is a common and straightforward way of standardizing the probability of different shocks.
(upper ‘-’) and the positive (upper ‘+’) shocks in order to discover eventual asymmetries. As a matter of fact, asymmetries arise in the case of monetary shocks, whereas shocks to demand and terms of trade are almost symmetric.

4.1. Inflation Scenarios

Scenario $A_p^-$: negative permanent price shock (higher inflation)

This scenario could materialize in the case of a prolonged transmission of higher oil prices onto other prices in the economy, e.g. via indexation of wages, fees, social transfers, etc. In the first year, the price shock is dampened by the partial adjustment mechanism. From the second year on, growth is a quarter of a percentage point lower than in the baseline scenario.\footnote{This type of shock is added mainly for illustrative purposes. In reality it is not very realistic to assume that economic agents permanently cannot find ways to substitute away from those goods and services that caused the increase in prices, i.e. that were most severely affected by the original price shock. However, to generate these substitution effects a much more disaggregated model would have to be used.}
Scenario $A_t^{-}$: negative transitory price shock (higher inflation)

Shock: transitory increase in the price level of imports

This scenario could be interpreted as a temporary oil price shock with no second round effects. Growth is almost 0.6 percentage points lower in the year of the shock and still some 0.15 percentage points lower in the year after the shock. The cumulated output loss therefore is roughly 0.75 percentage points in the year after the shock, which approximately corresponds to a real GDP in 2006 that is 2bn € (in 2005 prices) lower than in the baseline scenario. Both scenarios taken together, $A_p^{-}$ and $A_t^{-}$, depending on the size and the existence of second round effects, typically encompass various cases of an oil price shock. Box 1 makes a short digression on the empirical relevance of recycling in the case of the Austrian economy.

Box 1. Oil price shocks and recycling of petrodollars

The resilience of the Austrian economy vis-à-vis oil price shocks has been increasing since the first two oil shocks due to a more efficient use of energy and a wider choice of substitutes for oil. In addition to that, the recycling of petrodollars in terms of increased exports to oil-producing countries has become more important as well.

This is clearly documented by regression analysis results reported in table 5 below. We use quarterly data on Austrian exports to oil producing countries from the IMF Directions of Trade database and quarterly data on the price of oil from the third quarter of 1980 until the second quarter of 2005, thus providing us with 100 observations. The dependent variable, exports, is denominated in billions of U.S. dollars, the main explanatory variable, the price of crude oil, is denominated in U.S. dollars per barrel.

In order to take into account the potential endogeneity problem due to reverse causality (oil prices may be high due to high demand which again is reflected by buoyant exports), the equation was estimated using two step least squares with the second lag of oil prices serving as instrument.
Box 1 contd.

As a matter of fact, the estimation results indicate that simple OLS estimation could severely underestimate the coefficient on oil in the first half of the sample by as much as 40%, whereas in the second half of the sample this problem seems less present. This further corroborates the effect of an increase in recycling, since it indicates that in the second half of the sample the overall position in business cycle (in terms of growth of world trade) has become less relevant for Austrian exports to oil producing countries, whereas the price of oil has become more relevant at the same time.

We then include the real effective exchange rate (reer) in order to control for shifts in exports due to changes in the terms of trade. As can be seen from the regression results, the real effective exchange rate variable is highly significant in all three reported estimated equations. In the estimations, the real effective exchange rate picks up effects that otherwise would be taken up by a constant and a time specific dummy. This indicates that both the price level and shocks to the price level of Austrian exports in terms of oil matter. Some time specific dummies are still statistically significant, but after the inclusion of the real effective exchange rate they do not alter the basic story, so they were dropped. We also tested for linear and non-linear time trends in the data which gave similar results as in the case of time specific dummies.

The preferred specification is reported in table 5. The dependent variable is quarterly Austrian exports to oil producing countries, the explanatory variable is the price of crude oil (Composite of Dubai, Brent & West Texas, Average, USD; regressions using the OPEC basket price gave almost exactly the same results) of the preceding quarter.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>oil(-1)</td>
<td>0.0060</td>
<td>(3.39)**</td>
<td>0.0036</td>
</tr>
<tr>
<td>reer</td>
<td>0.0014</td>
<td>(4.16)**</td>
<td>0.0018</td>
</tr>
<tr>
<td>R^2 adj.</td>
<td>0.55</td>
<td></td>
<td>0.43</td>
</tr>
<tr>
<td>DW</td>
<td>2.26</td>
<td></td>
<td>2.16</td>
</tr>
<tr>
<td>observations</td>
<td>100</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

t-statistics in parentheses, *, **, *** denotes significance at the 10, 5, and 1%-level.
Coefficients on AR(1)-terms are not reported, but available upon request.

Table 5

Thus, we only look at a direct, bilateral version of recycling. In principle, growth of Austrian exports could also take the form of increased exports of intermediary goods that will feed into increased exports of other countries to oil producing regions. However, econometrically, these indirect effects are difficult to disentangle from myriads of other effects driving overall exports. We therefore restricted ourselves to this narrow version of recycling. It is fair to say that the estimated effects can be thought of as a lower bound to what can be expected to be the true overall effect of recycling.
Box 1 contd.
The first column reports estimation results using the whole sample of observations from 1980 until 2005. As is common practice, in order to analyse the change of estimated coefficients over time, we split the sample into half. The second column reports estimations results for the first half of the sample, and the third column displays the results for the second half of the sample. Estimation results reported in table 5 show that the estimated coefficient is significant in all three estimation samples, missing the 1%-significance level in the first half of the sample by a very narrow margin. Even so, the coefficient is clearly more significant in the second half of the sample. Estimations of the specification across various sub-samples point to the coefficient continuously increasing over time.

The estimated coefficient on the price of oil in the second half of the sample is more than twice the size of the coefficient in the first half. In the first half of the sample, an increase in the oil price by 1 U.S. dollar induces an increase in Austrian exports to oil producing countries worth some 3.6m U.S. dollars (corresponding to an increase of exports by roughly 1.5%). In the second half of the split sample, the same increase induces Austrian exports into the region worth some 8.9m U.S. dollars (corresponding to an increase of exports by approximately 3%). Thus, the response of exports to an increase is twice as big in the second half of the sample.

Using the estimated coefficient for the second half of the sample, one can calculate the estimated oil recycling in the years 2004 and 2005. Thus, Austrian exports to oil producing countries rose by 400 to 450m US dollars in the year 2004 and by some 460 to 520m US dollars during the year 2005 due to recycling of increased oil revenues.

4.2. Terms of trade shocks

Scenario $B^p$: positive permanent terms of trade shock

Shock: permanently higher price level in export markets

Source: author’s calculations

Figure 5
This can be thought of as permanently more favourable terms of trade development. The overall growth effect is some 0.2 percentage points of GDP on a permanent basis (in a rough decomposition, there is a positive contribution to growth from exports of some 0.25 percentage points and a negative contribution to growth from imports of some 0.05 percentage points; the effects stemming from other parts of the system, while being numerous, are much smaller). In the years after the shock, the growth effect becomes smaller as higher internal demand leads to a pick up in imports. Later on, the positive growth effects start to strengthen again and continue a moderate rise until the end of the simulation period.

Scenario $B^+_t$: positive temporary terms of trade shock

A temporary positive terms of trade shock has a slightly smaller effect in the first year than the permanent terms of trade shock in $B^+_p$ taking into account the different sizes of the shocks. In the second year, the growth effect turns negative. This shock can also be thought of as a transitory demand shock in Austrian export markets (such as the German re-unification). By 2010, the level shift in real GDP due to the positive shock is completed and the long run effect on the growth rate is zero.
Scenario $B_p^-$: negative permanent terms of trade shock

Shock: permanently lower price level in export markets

This is the corresponding negative scenario to $B_p^+$.

Scenario $B_t^-$: negative transitory terms of trade shock

Shock: transitory decrease of price level in export markets

This is the negative risk case of $B_t^+$. Interestingly, it is not fully symmetric with respect to $B_t^+$, the growth effect of the negative shock has a somewhat bigger amplitude. We will explore this potential asymmetry further in future sensitivity analysis, especially to find out if it becomes more accentuated in refined versions of the underlying model.
4.3. Demand shocks

Scenario $C_p^-$: negative permanent demand shock

There are many possible scenarios that could lead to lower growth in what is today Austria’s export markets. The shock comes in two steps, with some 40% of the shock materializing in the first year (remember that effect are displayed as changes in growth rates!). In years 3 to 6, lower imports help to cushion the shock. The effects after that are again not very realistic due to the unchanged trade structure (which in a realistic assumption in the short run, less so in the medium run and not at all in the long run).

Scenario $C_t^-$: negative temporary demand shock

Source: author’s calculations

Figure 9

Source: author’s calculations

Figure 10
This scenario encompasses amongst other things the case of an international (temporary) slowdown in the world economy, as it was the case in 2001.

Scenario $C_p^+$: positive permanent demand shock

![Figure 11](source)

Source: author’s calculations

Symmetric positive risk scenario to $C_p^-$.

Scenario $C_t^+$: positive transitory demand shock

![Figure 12](source)

Source: author’s calculations

Symmetric positive risk scenario to $C_t^-$. 

24
4.4. Monetary shocks

Scenario $D^-$: negative monetary shock

Here we simulate an isolated move of long term interest rates to a higher level. The effect of such a move in the real world could be smaller or larger depending on the circumstances that led to the hike in interest rates. In the case of higher (Eurozone) inflation due to higher growth, the negative effects on Austria would be more than compensated by the higher price level in and the higher growth of relevant export markets (competitiveness channel).\textsuperscript{18} This relative advantage of small open economies has also been illustrated by recent model simulations carried with the European Commission’s QUEST model (Roeger 2005).

Higher interest rates as such do not constitute an important risk for the Austrian economy. Only if they come in combination with subdued growth (but this risk is taken care of in other scenarios). An interesting case, where the net effect on growth is ambiguous ex ante, is the scenario, where the ECB raises interest rates substantially after an oil shock, causing a slowdown in growth especially in the large economies of the euro area. In this case one has to weigh positive net effects for Austrian terms of trade during the oil price shock against the negative effects from slower growth of export markets.

Here, an interesting constellation of interests arises: the small open economies, well cushioned against the adverse price effects, have at least a short run interest in the big economies running counter-cyclical policies to keep the shock to export market growth to an unavoidable minimum. This is one of the reasons, why small open member states were the owners of the old SGP and are likely to be the new ones as well.

\textsuperscript{18} Indirect effects could be substantial: they are taken up in the analysis of a export-related demand shock, but in the version of the model used here cannot be disentangled from other factors affecting demand.
Scenario $D^+$: positive monetary shock

The same caveats as in the case of the higher interest rates scenario apply. However, the high and the low interest rate scenario are clearly not symmetric. This corroborates the story just told in the paragraph above. In the case of lower interest rates, the above mentioned terms of trade effects do not materialize, therefore the positive growth effects from lower interest rates are substantially bigger than the respective negative growth effect from higher interest rates.\footnote{Again, indirect effects of lower levels of interest rates that translate into higher growth of Austrian export markets can be expected to be substantially more important.} By 2010, the positive growth effect is close to 0.06 percentage points in the case of lower interest rates, whereas the negative growth effect is only close to 0.04 percentage points in the case of higher interest rates.

Again, this could help to explain the hypothesis that in general small member states with open economies such as the Austrian one are more interested in anti-cyclical budgetary policies (in the big member states) than in structural (labour market) reforms leading to a potential interest rate premium (Hoeller et al. 2005).
5. Outlook: Sensitivity analysis in the next update

The biggest drawback in the current analysis stems from the fact, that potential output is exogenous. DG Ecfin has provided Member States with a set of data and programme routines that allow to make potential output endogenous. Potential output is computed according to the agreed production function method (Denis et al. 2002).

**Structural reforms**

The need for making the effects of structural reforms on potential growth more explicit has increased due to the new status that has been attributed to structural reforms in the reformed SGP. If structural reforms enhance the growth potential of an economy (e.g., by increasing the actual labour input for a given production function), those budgetary costs, that arise from the implementation of such reforms can be taken into account when a temporary deviation from the medium term objective of a member state is assessed.

For the sensitivity analysis, structural reforms raise a slightly different issue. Those structural reforms which are viable for consideration under the new SGP, by definition, change potential output.

As mentioned already, some of these reform may come in the form of shocks to the labour supply (which at potential is equivalent to actual labour input) and/or to the NAIRU. However, at this moment it is not clear how results from this type of sensitivity analysis will be linked to technical aspects of the SGP, such as minimum benchmarks or temporary deviations from a member states medium term objective.
6. Conclusions

Altogether, the results of the sensitivity analysis reflect the high degree of dependence of the Austrian economy on demand and price developments in other economies. Direct negative interest rate risks not only appear to be small, in many plausible macroeconomic scenarios, they are likely to be more than compensated by favourable terms of trade developments.20

The simulated demand shocks show roughly the same impact than shocks to the terms of trade.

The cushioning against unfavourable terms of trade developments due to an increase in the price of oil has become much stronger since the beginning of the 90ies, the positive effect that can be attributed to recycling is estimated to be twice as big as it has been during the 80ies.

In the context of multilateral surveillance of economic policies in the European Union in general and the ownership of the Stability and Growth Pact in particular, the sensitivity analysis results reported in this paper explain to some extent, why Austria (or any other small, open economy of the Eurozone) has a fundamental economic interest in the conduct of anti-cyclical (budgetary) policies in the EMU’s large member states.21

20 However, indirect effects could be substantial: they are taken up in the analysis of a export-related demand shock. It is not possible to disentangle them from other factors affecting demand in the present analysis, a fact which points out a necessary extension of the model.

21 Of course, we do not assume that this is the most relevant part of the explanation, political economy considerations are surely more important, so there is a big caveat here. However, it is also difficult as well to prove the contrary (that economic incentives are irrelevant), since we simply do not know much about the way purely economic incentives influence political agendas.
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