Estonia’s potential growth revisited

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Abstract

There have been several data revisions to output statistics in Estonia during the past six years as methodologies have been harmonised. These changes are significant enough to require corrections to the earlier understanding of Estonia’s potential economic growth rate. In this paper the latest data vintage from 2009 is used to estimate Estonia’s potential output growth and output gap. The production function approach that has been used shows that the gap varies quite extensively, ranging from −8% in 1999 to +8% in 2007, while the average potential growth rate in 1997–2009 was around 6%. The macro model simulations expect the potential growth rate to fall in the future. The fall in the marginal productivity of production inputs makes growth slow to about 4–5% in the next five years, if there are no additional shocks to the economy.

Keywords: potential output, potential growth, output gap, production function
JEL classification: E32, F43

1. Introduction

Estonia’s actual output data have been revised several times by the national statistical office in the past few years in order to harmonise its methodology with that of Eurostat, the major revisions taking place in 2006, 2007 and 2008. Alongside other methodological changes, the greatest change took place in September 2008 when the statistical office adopted chain linking. The last six revisions have changed both the level and growth of the output. In some instances, the spread between the latest available growth rate and those of previous data releases reach as much as 4pp. GDP measurements for 2005 taken in 2006 are about 8% lower than the latest available official data for the same period. Vintages after 2006 show smaller deviations, but the spreads still remain quite sizeable (see Appendix 1). These differences are large enough to permit the assumption that the underlying potential growth rate has also changed, and therefore potential output and the output gap also have to be revised.

Apart from difficulties stemming from the revisions, extracting the cycle from Estonia’s actual output data is also problematic because the period covered by the series is so short. At the present moment the data cover only one full cycle, meaning there are wide error bands when the cyclical position of the economy is determined. The absence of any longer cyclical pattern in the data precludes any very precise estimation of the initial gap value, or of the latest. The problem is more acute when statistical de-trending methods are used, because many

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of them tend to fit the smoothed series to the actually observed data at both ends of the series. This is the so-called end-point or end-of-sample problem which relates to statistical filters that become one-sided at both ends of the sample: Guay and St-Amant (1997) show that the widely used Hodrick-Prescott filter is one of these. Multivariate methods somewhat dampen the methodological shortcoming but do not eliminate it completely. The method which is least sensitive to a problem of this sort is a structural approach, for example a production function as employed in this paper. The production function method, on the other hand, is open to other types of problems and shortcomings often related to data availability issues, as discussed in this paper.

The paper does not aim to give “the most accurate estimate” of potential output, as this cannot in any case be tested because potential output is unobserved. Rather, it explains potential output by means of the chosen framework. The approach makes use of three production inputs, capital, labour and technology, the dynamics of which allow potential growth to be decomposed retrospectively and also give pointers for future periods. In some respects the qualitative information on potential growth arising from the analysis is even more important than the numerical calculations, especially as regards the forecast. The kind of knowledge obtained here is intended to answer the questions whether potential growth will bounce back to its historical mean after the current slowdown is over, what the necessary conditions for that to happen are, and why it might not be possible.

The paper is organised as follows: in Section 2 a production function approach is used to give the latest estimates of potential output and of the output gap. Section 3 provides forecasts of potential growth and of the output gap, based on macro-model simulations. These are discussed in the context of the neoclassical growth concept. The last section, Section 4, draws the most relevant conclusions on the topic.

2. Measuring potential output and the output gap

Potential output in Estonia is evaluated using the core part of the Eesti Pank macro-economic model EMMA. In the model, potential output is given by the production function, which stands for the aggregate supply of monopolistically competing companies, each seeking to maximise profit given the state of the economy. Selection of the particular approach is dictated by the wish to forecast future potential GDP in addition to evaluating its historical levels. The benefit of using the production function within the fully-fledged macro model is that the forecast would be consistent with a large number of macroeconomic indicators which directly or indirectly affect the sources of potential growth. In EMMA, potential output, \( Y^* \), is given by the neoclassical Cobb-Douglas production function with Harrod-neutral (labour augmenting) technological progress and constant returns to scale:

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Y_t^* = K_t^\alpha (L_t^* A_t)^{1-\alpha}
\]

(1)

where \( K \) is the outstanding stock of physical production capital, \( L^* \) stands for full employment, \( A \) is the level of production technology and \( \alpha \), denotes the income share of capital.

\[1\] See Kattai (2005) for a general overview of the model.
Production function is a key part of the macro model and therefore all the necessary data also originate from the macro model’s database. However, none of the listed input series are directly observed. Hence their construction is discussed in the latter part of the paper.

No official data are available on physical production capital. In this case ESA’95 suggests a PIM (Perpetual Inventory Method) cumulation method to retrieve the missing series (Goerzig, 2007). The accumulation process is given by $K_t = (1 - \delta)K_{t-1} + I_t$, where $I$ is real investment and $\delta$ is the depreciation rate. $I$ includes only corporate and government investment as $K$ stands for non-residential production capital.

The size of capital stock and its growth rate are determined by the initial value chosen for capital stock, $K_0$, and $\delta$. Changes in either value have a major effect on the calculated series at the beginning of the sample but become less significant in a longer time horizon. The starting value for $K$ in 1996q1 is chosen so that it roughly matches the real value of the assets of companies as published by the national statistical office (Statistics Estonia, 2009). According to the statistical office, companies held about 67 billion kroons of assets at the beginning of 1996, which gives a real value of about 75 billion kroons. This is the value at which the PIM calculation is initiated, with the capital to output ratio equalling a little more than 100%.

Initial capital estimates for individual countries are often derived from corporate accounting but this has some significant drawbacks. Pula (2003) stresses that (a) accounting data may differ from real economic conditions because they are affected by tax regulations; (b) they are evaluated at historical prices, meaning there is no uniform price base; and (c) in transition economies the turbulent flow of assets may not have been reflected in book values. For these reasons this paper treats the aggregate asset value as a rough indication or approximation, but not as a perfect point estimate.

The depreciation rate, $\delta$, is set at 0.05 per year. This rate is well within the plausible range used in the literature. Bergheim (2008) reviews a number of studies and summarises that most of them use a depreciation rate of between 0.05 and 0.07. He also proves in an experiment that switching from $\delta = 0.06$ to $\delta = 0.05$ causes no major change in the paths of capital stock. The calculated capital stock depreciating 5% annually gives 9% of GDP in 1996–2009 on average for the consumption of non-residential capital.

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2 See OECD (2001) for a detailed overview of the method.

3 The alternative method would be calculating capital services (recommended by Biatour et al. (2007)) but the approach is too complex for incorporating in the macro model. Although capital services are generally regarded as more suitable for growth accounting, the approach suffers from almost no empirical evidence on how assets lose their efficiency. Typically ad hoc assumptions of geometric and/or hyperbolic profiles are used. Capital stock that is used in this paper resembles a special case of the efficiency profile. It assumes that all assets keep their full productive efficiency until they disintegrate (OECD, 2009). Although this definitely holds true for certain assets (buildings and structures for example), other assets tend to gradually lose their efficiency over time (computers, machinery and equipment). Therefore the possible weakness of the constructed capital series is that it may overestimate the actual contribution of production input.

4 Real asset values are obtained by deflating assets with the investment deflator, which is considered to be the most appropriate price index in this case.
The absence of official data makes it impossible to evaluate whether calculated capital stock is close to the “true” data. One way to test the reliability of the synthetic series is to compare it with data from other countries. A country with a similar economic background and development would make the best comparison. An article by Pula (2003) offers a good benchmark in this respect, showing estimates of Hungarian capital stock. Like the present paper, Pula measures non-residential capital rather than the overall stock in the economy. He finds that the non-residential capital to output ratio in Hungary was 150% in 1999, which is just a little higher than the measured ratio for Estonia (see panel b in Figure 1). Given that capital deepening is positively correlated with the level of economic advancement, a small gap between Estonian and Hungarian capital to output ratios in 1999 can be explained by Hungary’s slightly higher income level. However, this indicates that data derived on capital stock lie in a reasonable range in order to produce plausible results from measuring potential output.
Three peaks in investment occurred during the past 14 years that affected the potential growth rate: in 1998, 2003 and 2007. The first peak was caused by increased export revenues, which were used to enlarge production capacity, and also by high FDI inflows. The occurrence of the Asian and Russian crises shortly after this peak changed the investment climate and the investment to output ratio fell back to its earlier level, but that short period of intense investment was enough to raise the capital to output ratio by about one third, from 105% to 135% of GDP. In 2003, a positive shock to investment was triggered by accession to the EU, but worked through the expectations channel as the shock took place a year before Estonia actually joined the EU. The 2007 peak in investment was generated by loosening of the credit supply, which made it easier for companies to gain access to external financing.

It may be noticed that the turning point in capital growth appears about three quarters after the turning point in the investment to output ratio. This is caused purely by the additive process of capital accumulation. It could be argued whether capital stock should contain any cyclical pattern at all, because it is automatically carried over to the calculation of potential growth, which is often supposed to be acyclical. In this paper it is assumed that new investment increases production capacity and therefore affects potential growth regardless of the level of volatility in capital growth. There are modelling techniques that would dampen fluctuations in capital growth, assuming no real rigidities in investment, such as the Time to Build concept (Kydland and Prescott, 1982) which distributes current investments over time on the grounds that it takes some time to put new equipment into operation. This is a realistic assumption but growth in investment has been four times more volatile than growth in aggregate output in Estonia, making swings in capital growth too large to be smoothed out anyway.

Labour input is expressed in equation 1 by its natural level. Full employment, \( L^* \), equals \((1 - \dot{u}^*)N\), where \( u^* \) is the natural rate of unemployment (NAIRU or Non Accelerating Inflation Rate of Unemployment) and \( N \) is the amount of labour available in the economy. The natural rate of unemployment is given for full time equivalent employment. This paper considers work-time adjusted employment to be a more precise and consistent measure of labour input than actual employment expressed as the number of people employed. As Figure 2 shows, actual employment has been growing faster than its full time equivalent, a process that can be attributed to the increased role of part-time workers. Both measures were practically equal in 1996 but have been diverging ever since. Accordingly, the number of people employed in 2009 fell only to the levels of 2005, but full time equivalent employment reached its historical lowest point. Similarly, headline unemployment has been more volatile, falling to only 4% in 2007 even though the full working-time adjusted unemployment rate was around 9% at the time.

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5 Hungary is similar to Estonia in many aspects, starting from the initial platform for the employ transmission process after the collapse of the Soviet Union. Smith (2003) writes that capital stock inherited from communist times had to be modernized and rebuilt to satisfy more sophisticated demand of western countries. Both Hungary and Estonia were very successful in attracting foreign (direct) investment, which was used to finance current account deficits but also helped technology transfer. In 1997 both countries were recognized by the European Commission as satisfying the economic and political criteria established at the Copenhagen Summit. Latvia and Lithuania—geographically the closest countries to Estonia - complied with the criteria two years later.

6 NAIRU is estimated by a state-space modelling technique. The approach is inspired by the “triangle” model of inflation developed by Gordon (1997).
Figure 2 shows that NAIRU has followed the dynamics of the unemployment rate but stayed below it for most of the time. As well as illuminating the prevailing inflationary pressures in the economy, it also implies that the “potential” labour input of employment at the NAIRU level has, on average, been lower than actual employment.

Figure 2. Labour market indicators

![Graph showing labour market indicators](image)

In the calculation of potential output it has been assumed that Estonia shares the same production technology as more developed countries, or, for ease of interpretation, with the EU-15, and that there are no restrictions on access to production technologies used worldwide. Developed countries are assumed to have reached their steady states and therefore, as neoclassical growth theory predicts, the output growth of these countries equals the speed of their technological progress. This suggests that the level of technology advances by about 2% annually in the EU-15 on average, as this is the group’s average economic growth.7

The constant 2% rate of technological progress for Estonia can easily be a target for criticism because it may be undervalued, at least for the beginning of the sample.8 It can be argued that the production technology inherited from the planned-economy era was outdated and the initial level of technology was low. Technological catch-up probably caused the speed of progress to exceed that in advanced countries, but that hypothesis remains unexplored in this paper. The possibly higher speed of progress is indirectly characterised by faster capital

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7 See Figure 8 in Appendix 2, which plots the EU-27 countries’ average growth rates, the EU-15 being concentrated at the bottom-right corner of the graph.

8 Time variance of technological progress may in any case be overstated in the literature. For example Basu and Kimball (1997) undermine RBC models by finding only little evidence on cyclical productivity but witnessing strong cyclical movements in utilization rates.
accumulation in the same period, as it is realistic to assume that new investments are at least partially made to replace older and technologically less advanced physical production capital. If this is so, then higher capital growth also translates into faster technological advancement.

The level of technology is determined by the following accumulation process: $A_t = (1 + g)A_{t-1}$, or equivalently: $A_t = A_0 e^{gt}$ for subsequent calculational convenience, where $g = 0.02$ annually. The initial level of technology, $A_0$, is determined by the principle that average potential output and average actual output must be equal in the long run (and in the sample): $m\{K_t^\alpha (L_t^\frac{1}{1-\alpha} A_0 e^{gt})^{1-\alpha}\} = m\{Y_t\}$, from which:

$$A_0 = m\left\{\left[\frac{Y_t}{K_t^\alpha (L_t^\frac{1}{1-\alpha} A_0 e^{gt})^{1-\alpha}}\right]^{1-\alpha}\right\}$$

where $m\{\}$ denotes mean value. Equation 2 may however return a biased value for $A_0$ because the period under observation is short and contains quite large shock impulses (the Asian and Russian crises, EU accession, and the credit boom and contraction, as described above) which may have caused the mean value of actual output to differ from the mean value of potential output. As there is no reliable way to test this, it is best to treat the means as equal.

**Figure 3. Potential growth rate and contributions**

Potential output is calculated using equation 1, in which the income share of capital, $\alpha$, equals 0.4. Panel a in Figure 3 plots the factor contributions to potential growth. The greatest source of growth has been capital accumulation, which has averaged 5%. Figure 3 also reveals that despite the high investment to output ratio (see panel a in Figure 1) capital accumulation is
trending downwards. The neoclassical growth model used here explains this by the continuously falling marginal productivity of the capital input, which is an expected scenario as a country develops towards a steady state.

The contribution of technological progress is constant and equals 1.2%. Labour input has contributed negatively on average, which is caused by the ageing of the population coupled with a negative natural increase rate and net emigration. Although the labour contribution has been slightly negative but close to zero on average, it has been a significant source of variation in potential growth. This is especially noticeable around 2006 when the available labour supply jumped by more than 4% (see also panel a in Figure 2). Mean potential growth has been around 6% with at least two higher growth periods culminating in 2003 and in 2006/2007, the second of these periods being mostly generated by a peak in the labour supply (see panel b in Figure 3). Earlier acceleration was mainly due to the higher level of investment, but was also supported by favourable labour market conditions.

**Figure 4.** Comparison of the output gap with unemployment and inflation

The output gap varied quite dramatically in 1997–2009, from lows of –8% in 1999 and –10% in 2009\(^9\) up to a peak of +8% in 2007. The downturn which began in 1998 with the Russian crisis was followed by a quick recovery, and the large negative gap had eroded away by 2002/2003 (see panel a in Figure 4). 2002–2003 was the most balanced growth period of the

\(^9\) This is the latest period of estimates. Given the previous dynamics of the output gap and the current state of the economy, the present downturn will result in a deeper negative output gap than did that of 1999. This issue is discussed in more detail later in the paper.
last decade, with actual output equalling potential, in terms of both levels and growth rates. There were no major shocks to economic growth in these years as the impacts of the Asian and Russian crises had been overcome and the boost from EU accession was still yet about to come. Furthermore, in these years the unemployment rate was fairly close to its natural level (see panel b in Figure 2). In 2004 accession to the EU and subsequent loosening of the credit market created a sizeable 8% positive output gap through the real estate and investment booms.

Figure 4 shows that the extracted gap series is highly correlated with other cyclical indicators. Correlation with unemployment is 0.94 or 0.64 depending on whether the actual or full time equivalent rate is considered.

The actual unemployment rate follows the gap somewhat better at the end of the sample, which reflects tensions in the labour market generated by the boom. A sharp increase in wages, especially in the construction sector, attracted people to accept part-time jobs, not only in construction, which widened the spread between actual and full time equivalent unemployment numbers.

Co-movement with prices accords with the Phillips curve ideology. The correlation of the gap with wage inflation is 0.72 and with CPI inflation is 0.31. The lower correlation with CPI inflation can be explained by two major reasons: wages react first to the cycle and then via increased production costs they finally pass through to consumer prices (demand-side effects are relatively weaker); and inflation is also influenced by foreign price impulses and administrative factors, loosening somewhat the tight relation with the cycle.

3. Projection of potential growth and the output gap

The macro-econometric model of the Estonian economy, EMMA (Kattai, 2005), is used to produce a forecast of potential output and the output gap. The equations for potential output are those described earlier in this paper. The forecast starts from the third quarter of 2009 and runs up to the end of 2020. Simulations are run without any add-factors or adjustments from outside the sample. The state sector is set to follow the most conservative rule, that its expenditures must equal its earned revenues. This means that the state sector is not able to smooth the cycle in the simulations. The results are in no way a part of the official forecast of Eesti Pank but only represent the outcome of an independent simulation exercise related to the macro model’s long-term properties.

Panel a in Figure 5 shows that after recovery from the down-phase, potential growth stays between 4 and 5% during the next five years, until 2015. Before elaborating this outcome in detail, the long-term properties of the whole model should be discussed. In the model long-term growth is determined by the aggregate supply of companies. All companies share the same production function defined in equation 1, and they set the level of production by choosing inputs that would maximise their profits. Companies are operating in an economy that is catching-up, and they face falling marginal productivity of capital. This explains the relatively higher growth of capital stock (and potential output) when the capital to output ratio is low. In the long term, the capital to output ratio is expected to reach its optimal level,
after which the mature economy will grow at the rate of technological progress. Until that point is reached, a steady decrease in potential growth can be witnessed. If the economy is hit by neither shocks nor structural shifts, the underlying theoretical framework would project a very smooth downward trending potential growth rate over the course of capital deepening. The grey shaded line in Figure 5 illustrates the likely outcome in that case (the line is purely theoretical not computational).

**Figure 5.** Forecasts of potential growth rate, factor contributions and output gap

Any departure from the purely theoretical grey line may, and indeed should, be related to a specific shock or to a structural or institutional change in the economy. It has already been shown that around 2002–2003 the gap was close to zero and that actual growth equalled its potential (see Figure 4) and the shaded line crosses the calculated potential growth at this period. In the preceding period the shaded line is above calculated potential growth, meaning that if access to credit had been as easy as it was after 2005, then companies would have invested more because of the higher marginal productivity of capital, and capital stock would have grown faster, boosting potential growth. A structural shift occurred in 2005 when the liberalisation of the credit market eased external financing. Combined with a contemporaneous increase in the labour supply, this resulted in a peak in potential growth in 2006–2007. This probably would not have occurred, or at least not so sharply, if the financing conditions had been the same over the whole period.

Extracting the shock impulses from the calculated potential growth series for 1997–2009 would generate a trend-line similar to the grey line that is predicted by the theory. Therefore a fall in potential growth in the next few years cannot be treated as a step downwards but as a transition to an underlying shock-free trend growth. The fall in potential growth around 2010
is caused by a cut in investments as bank loans became less accessible than they used to be. The additive process of capital accumulation shifts the cycle in the growth of capital stock forwards by about three quarters compared to the cycle in investments. Consequently the low point in investing activity shows up in the capital stock three quarters of a year later, while a recovery in investment takes the same time to affect capital stock and thereby potential growth. The latest crisis episode has been more severe than was the slowdown in 1999, as potential growth sinks to –2.5% in 2010.

The figure of 4–5% growth is obtained under a believably optimistic assumption of zero growth in the labour supply. If the upward shift in the labour supply in 2006 (see panel a in Figure 2) was not structural but cycle-generated, then it should be followed by a decline and the contribution of labour input should become negative.

Another assumption that has an impact is the constant rate of technological progress. In this case a conservative point of view is taken, which foresees no technological breakthrough. If such a breakthrough were to happen, it would add extra growth to potential output, but exploring this lies beyond the scope of the present paper.

The period starting from 2015 describes how the economy will probably evolve in the longer perspective. In this case the outcome is no longer driven by inertia from earlier shocks, as the impact of the shocks has vanished and new shocks have not been added, but by the macro-model’s theoretical underpinnings, producing a 3–4% growth rate. Now the concept of convergence prevails, closing the gap between the per capita income levels of Estonia and the EU. In 2008 the relative income in Estonia was 67.4% of that in the EU-27 in purchasing power parity terms (PPP), which is a great improvement from the lowly 45% of 2000 (Eurostat, 2009). Given the simple relationship between EU-27 countries’ average growth rates and relative per capita income levels, the fitted trend would predict Estonian output growth around 4% annually for the next ten years (see Figure 8 in Appendix 2). This roughly equals the outcome of the model solution. 3–5% growth rate is well below the historical average, but still remains higher than in the EU-27, and is sufficient to close the gap in the per capita income level over time. According to the theory, the growth rate is supposed to decline smoothly until real convergence is achieved, after which Estonia will share the same steady growth rate with the EU; there is no kink in growth when income levels have converged.

The forecast for the output gap shows a rapid response to the high values seen earlier, and it drops to about –17% by 2010 (see panel b in Figure 5). The downswing is greater than the preceding upswing, indicating the vulnerability of the economy. On the other hand, predicted recovery from the lowest point is quite rapid. 2010 marks the bottom of the cycle, after which growth starts to pick up. Investments will start to grow again and build up capital stock, supporting potential growth. Exit from the trough will generate a slight positive gap because of inertia in several variables.

Crisis episodes are often related to a fall in the level of potential GDP, which may be permanent or temporary depending on the sources of growth of the country (see for example Reinhart and Rogoff (2009), Haugh et al. (2009)). The European Commission (2009) assumes that the cumulative fall in the EU-8 as a result of the global crisis will average 5.9%. The macro model is used to run another simulation which mimics this fall to assess the consequences
for later potential growth in comparison to the previous exercise. In order to test the scenario, the levels of technology and capital stock are negatively shocked during 2008q1–2009q2. The decline in both can be justified because investments made in the boom phase were tilted towards specific sectors, such as construction and real estate, and the capital stock generated and the technology brought in do not necessarily match the new demand structure. The beginning of the adjustment period coincides with the turning point for economic growth, and the adjusted period overlaps most of the substantial drop in output. The drop in production capital and technology is hypothetical and is specific to the current scenario analysis, as the event itself remains unquantifiable at the present time and can only be witnessed ex post.

Figure 6 depicts the outcome of the simulation. Panel a demonstrates the negative growth of capital and technology inputs and consequently of potential output. In level terms it translates into a fall during the predetermined 1.5 years of 5.9%. From 2010, after forced adjustment, the model predicts comparable potential growth to the scenario without the sudden drop in production capital and technology, as growth stays between 4 and 5% in the following five years and between 3 and 4% after that. Since there is no post shock acceleration in growth, GDP stays permanently lower than it was in the first simulation.

Due to the fall in potential GDP, the gap does not reach the same negative levels that it did in the previous case. The lowest point is approximately –10% in 2010, although this is still greater than in 1999. The speed of recovery, the time it takes the gap to return to zero, is independent of whether the underlying GDP trend shifts or not. The economy adjusts in the same time frame but to different levels.

Figure 6. Forecasts (shaded area) of potential growth, factor contributions and the output gap with a permanent shift in the level of potential output.
Detecting a downward shift in potential GDP is possible only ex post, so for now it can only be considered as a hypothetical scenario. Whether this scenario materialises or not, the model simulations prove that in terms of growth the economy is expected to return to its pattern of long-term growth. Unless an acceleration occurs in technological advancement, potential growth settles to a more modest rate of around 4 – 5% initially, that is in the next five years, then decreases steadily afterwards as the economy matures. Rather than being sudden or unexpected, as it may seem in comparison to the earlier credit-accelerated growth, a fall in the growth rate from its high historical values actually follows the rules of growth theory, suggesting that as income levels increase, economic growth steadily slows down.

4. Conclusions

Understanding of what Estonia’s potential growth rate is has changed during recent years because of frequent revisions of output statistics. Estimating unobserved potential GDP is made more difficult because the time series is so short, covering only the last 12–13 years, depending on the variables. Although relatively short, however, this time span is rich in shock episodes. At the beginning of the span domestic output was heavily affected by the Asian and Russian crises, then EU accession soon after opened new growth channels and boosted growth, which was later reinforced by the credit boom, which ended after unfavourable shocks from the global crisis. These events form one full cycle, within which potential GDP has to be detected.

Using the latest data vintage available, the production function approach returns 6% average potential growth for the period 1997–2009, although there are quite sizeable peaks. These are generated by the shocks listed earlier and by structural changes such as shifts in the labour supply for example. These factors have also made the gap fluctuate quite widely from –8% in 1999 to +8% in 2007.

The model-based forecast shows that sources of high growth have vanished and unless an unforeseen technological breakthrough happens, potential growth will settle on a more stable but considerably lower path. This finding is, of course, conditional on the method chosen, in this case the production function approach, which predicts falling marginal returns on production inputs and therefore steadily slowing potential growth. This happens until the economy matures and reaches its steady state.

The predicted potential growth rate lies between 4 and 5% in the next five years and between 3 and 4% in the years after that. These rates are realistic if there are no major shocks, negative or positive, which could bend potential growth downwards or upwards. In any case, the present paper does not aim to provide the most precise prediction of potential output growth but uses numerical model simulations to consider that the sources of rapid growth have already been used up to a large extent over the course of economic development, and average growth in the future will remain lower than the historical average. The productivity of one additional unit of a production input, like an investment in fixed capital or technology, is lower than before, making trend growth slow down. The actual measured growth rate may depart from trend growth depending on cyclical movements.
Recent data show that the ongoing downturn is more severe than that of 1999. Model simulations, however, predict quite a quick recovery from the lowest point, at which the output gap reaches –17 or –10% depending on whether the capital generated in the boom times matches the new demand structure or not. In the first case the negative output gap is more pronounced but the economy adjusts back to its previous GDP level, but this does not happen in the second case when accumulated production capacity cannot be fully used to meet the new demand structure. In this second case the negative gap is smaller but at the cost of a fall in the level of potential, and actual GDP. It can only be verified ex post whether the former or latter holds, once there are enough data on the adjustment of the economy.

References

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Appendix 1. Output revisions

Figure 7. Output statistics and their revisions by successive vintages: data available in 2006 (Init), revised in 2006 (R’06), first revision in 2007 (R’07(a)), second revision in 2007 (R’07(b)), first revision in 2008 (R’08(a)), second revision in 2008 (R’08(b)), last available vintage (R’09)

(a) Revised output series, seasonally adjusted (billion kroons)

(b) Revised output growth series (%)

(c) Deviations of earlier vintages of GDP level data from the latest release (%)  

(d) Deviations of earlier vintages of GDP growth data from the latest release (pp.)