German Economic Team

UZBEKISTAN

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The potential output estimation for Uzbekistan

by Marius Clemens and Julian Milek

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Content

1 Introduction

The potential output and its related output gap are the key indicators to determine the cyclical stance of the economy. Furthermore, it has become the essential instrument to evaluate structural reforms in economies around the globe. The potential output is an indicator for the aggregate production capacity at which the economy utilizes all available factors sustainably and without creating additional inflationary pressure. In pure statistical terms it is the (cyclically adjusted) trend output. The output gap, measured as difference between actual and potential output, is an indicator for the degree of economic boom or slack.

If for example the output gap becomes negative – actual output is below the potential – not all factors are utilized in order to produce the demanded quantities. Therefore, firms can reduce working hours or start to fire employees, which finally can cause wage and price reductions. Such a recessionary situation has important implications for **fiscal policy**: Many economies have automatic stabilisers, as i.e. income taxes, which lead to high fiscal budgets when the economy is in a boom. In an ideal world those surpluses are saved during booms and are then used to finance fiscal stimuli in a recessionary state. The potential output and output gap calculation has, therefore, become highly politically relevant, because it determines not only the state at which fiscal policy is allowed to additionally stimulate the economy but also to determine the structural budget position.

Estimating the output gap is a difficult task, since the potential output is not directly observable. But its high political relevance makes it crucial to form the calculation as transparent as possible. While in economic research it is always desirable to find the best estimation methodology no matter how complex it is, in applied economic research and economic policy there are some trade-offs to be considered in forming the most transparent and comparable methodology.

First, there is a **trade-off between complexity and applicability**. For example, some cutting-edge techniques, i.e. large structural econometric models or DSGE models have advantages in terms of forecast predictability or in considering and explaining the channels through which the business cycle is affected. However, it is everything but easily applicable and it takes years to train people to become experts. It would be better to use an approach that comes to similar results, but is easily applicable and could be recomputed transparently.

Second, the **comparability between countries** and former estimations is important to gain credibility, especially with indicators of high political interests. Although new methodological extensions would not change the results remarkably, also slight differences that come just through changes in the methodology have to be subtracted when comparing the cyclical position in two subsequent periods.

The production function (PF) methodology has the advantage that it is a simplistic approach but is able to consider the structure of the economy. It is better applicable than more scientific methods and it is easier to calculate different scenarios for i.e. structural reforms. This, makes it easier for economic policy to draw different scenarios based on expected future trend changes. Another relative advantage of PF function approach is its comparability with output gap estimations from other countries. Not only the EU commission but also the IMF, OECD and other institutions use the production function approach in order to compare the business cycle and fiscal surveillance of their member with a comparable and transparent measure. Once this tool is well established, the variety of measures could be enhanced in order to focus more on specific business cycle issues or economic concepts, as the price-output or unemployment-wage relationship.

This technical note applies the production function approach to estimate the potential output and the output gap for Uzbekistan. It extends the standard production function approach of the EU commission by capital stock gap and sectoral differences in order to take into account the specific transition situation of Uzbekistan.

2 The Production Function Methodology

2.1 General approach

The European Commission, the IMF and the OECD estimate potential output via a production function approach, where potential GDP is defined as a function of potential labor volume, capital stock and trend total factor productivity. A major advantage of the production function approach is the implied economic intuition combined with well proven statistical methodology, however it requires assumptions on the functional form of the production technology, returns to scale, filtering methods and the representative utilization of production factors. The overall production function methodology presented in this chapter is based on Harvik et al. (2014), which is the methodology of the European Commission.[1] We deviate from the EU Commission Methodology due to lack of data availability: First, we use HP Filters instead of Kalman Filter, because relevant variables, such as sentiment indicators are not available. Second, we do not estimate an Unobserved Component Model because due to structural breaks it is not possible to estimate a stable Phillips Curve relationship. Third, there are no official data for working hours, therefore, we do not consider potential labor volume (LP) but potential employment (PE).

In a first step, the model starts with an actual representation of the observed supply side economy. GDP (Y) is represented by a combination of factor inputs – labor (L) and the capital stock (K), corrected for the degree of excess capacity (U_L, U_K) and adjusted for the level of efficiency (E_L, E_K). Production is commonly described using the Cobb-Douglas specification of the production function. This simplifies estimation and exposition considerably. Thus, GDP is given by:

(1) $Y = (U_L * L * E_L)^{\alpha} (U_K * K * E_K)^{1-\alpha} = L^{\alpha}K^{1-\alpha} * TFP,$

where α is labor's contribution to output growth defined as the share of wages in the total value added in the economy, which is assumed to be constant over time. Total factor productivity (TFP) measures productivity growth independent from capital and labor, such as technology improvements and is set equal to:

(2) $TFP = (E_L^{\alpha} * E_K^{1-\alpha}) * (U_L^{\alpha} * U_K^{1-\alpha}),$

which summarizes both the degree of utilization of factor inputs as well as their technological level. Factor inputs are measured in physical units. Capital depends on past capital stock, investments, and depreciation rate, which is assumed to remain constant over the projection period. Furthermore, it is assumed that there are no cycles for capital stock: any increase in investment enters directly in the production function and increases potential output. Labor is defined in terms of employed persons,

[1] See Harvik (2014): *The Production Function Methodology for Calculating Potential Growth Rates & Output Gaps*, Directorate General Economic and Monetary Affairs, European Commission, European Economy - Economic Papers, 535

and is calculated as a product of population projections, participation rates and the structural unemployment.

Various assumptions enter this specification of the production function. The most important ones are the assumption of constant returns to scale and a factor price elasticity which is equal to one. The main advantage of these assumptions is simplicity. However, these assumptions seem broadly consistent with empirical evidence at the macro level.

In a second step, trend and potential variables were computed via filtering methodologies. The functional form of the potential output stays equal to the actual output and can be represented as follows:

(3) $YPOT = (PE * E_L^T)^{\alpha} (K * E_K^T)^{1-\alpha} = LP^{\alpha} K^{1-\alpha} * TTFP$,

where the full utilization of factor inputs is normalized to one. The maximum potential output contribution of capital is given by the full utilization of the existing capital stock in an economy, so there is no reason to smooth this series in the production function approach. Labor input is defined in terms of hours and is classified into four subcomponents. First, the future working-age population path is used from the deterministic population projection. In addition, migration can be forecasted separately. Second, the trend labor force is obtained by detrending (using an HP Filter) the aggregate participation rate. Third, the trend unemployment is calculated by detrending (using an HP Filter) the aggregate unemployment rate. The production function approach calculates potential output with a "normal" level of efficiency of factor inputs, with this trend efficiency being measured as detrended Solow residuum.

In the medium-term production function framework the production function depends on six exogenous trend variables that have to be estimated:

1. **Trend Total Factor Productivity (TTFP):** The TFP trend is estimated from the Solow residual by an HP filter.
2. **Structural Unemployment Rate (SUR):** The trend specification chosen for unemployment is estimated by using a HP filter.
3. **Population of Working Age:** Population, 15-74 years old
4. **Participation Rate Changes:** The implied total participation rate is calculated as log difference from working-age population and labor force up to the end of the short-term forecasting period.
5. **Investment to (potential) GDP Ratio:** The investment to potential GDP series is used as an exogenous variable, while investment itself is made endogenous

The model with time index *t* can be summarized as follows:

<u>Exogenous Variables</u>

- POPW - (Population of Working Age)
- PARTS - (Smoothed Participation Rate)
- SUR - (Structural Unemployment)
- IYPOT - (Investment to Potential GDP Ratio)
- SRK - (~~Kalman~~ Filtered Solow Residual)

<u>Endogenous Variables</u>

- PE - (Potential Employment)

- I - (Investment)
- K - (Capital Stock)
- YPOT - (Potential Output)

1. Potential Employment

$PE_t = (POPW_t * PARTS_t * (1 - SUR_t)$

2. Investment and Capital

$I_t = IYPOT_t * YPOT_t$

$K_t = I_t + (1 - dep) * K_{t-1}$

3. Potential Output

$YPOT_t = PE_t^{\alpha} K_t^{1-\alpha} SRK_t$

4. Output Gap

$YGAP_t = (Y_t/YPOT_t$ -1)

2.2 Specific Issues for Uzbekistan

Note that the EU commission implements country-specific differences not in the model structure but rather in the estimated coefficients, parameters, filtering options. For Uzbekistan we also estimate the structural parameters of the model and make different assumptions in order to capture the transition process. Furthermore, in order to assess whether the existing sector strategies and the already defined sectoral goals are consistent with each other, the production function approach is extended via a sectoral approach. For each sector, a production function is estimated based on employment, capital accumulation, and TFP using the same procedure to calculate the potential value for each factor. Therefore, we need specific data about the sectoral input factors.

As in the general case, potential output in sector *i* is assumed to be generated from a Cobb-Douglas production function:

$YPOT_{i,t}$= $PE_{i,t}^{\alpha_i} K_{i,t}^{1-\alpha_i} * TFP_{i,t}$

with sector-specific α_i and where $YPOT_{i,t}$ is period-*t* potential output in sector *i*, $PE_{i,t}$ is potential employment in sector *i* for period *t*, $K_{i,t}$ is the level of the capital stock in sector *i* at time *t*, and $TFP_{i,t}$ is period-t technological progress for sector i.

In contrast to the general approach, the potential level of employment, $PE_{i,t}$ can now not be disaggregated because of a lack of data availability. Instead, we use HP filter methodology to the sectoral employment data in order to estimate the potential labor volume.

3 Estimating the Potential Output in Uzbekistan

In a first step we estimate the potential output with the standard EU methodology without sectoral differences in employment and capital in the time period between 2008 and 2020.[2] In order estimate a consistent medium-term projection our approach heavily relies on the integration of the relevant short-term forecast. However, we neither could use official forecast data nor apply an appropriate short-term forecast model, e.g. macroeconometric model, that considers economic theory and agents behavior. Instead, we estimate the short-term development of key variables with simple pure statistical approaches, e.g. autoregressive processes. The main focus of the paper is to generate and discuss a methodology to calculate the potential output to Uzbekistan. However, it is not time consuming to provide a consistent medium-term projection, because only well-estimated short-term forecast data have to be included in the estimation process. Keeping this in mind the results in the projection period after 2020 have to be interpreted with caution.

In general we find that potential output during the whole time period between 2008 and 2020 grew by 7 percent annually. However, the speed has reduced, between 2015 and 2020 the average potential output growth rate was 5.7 percent. The projected growth rate will reduce slightly between 2021-2025 (See Table 1).

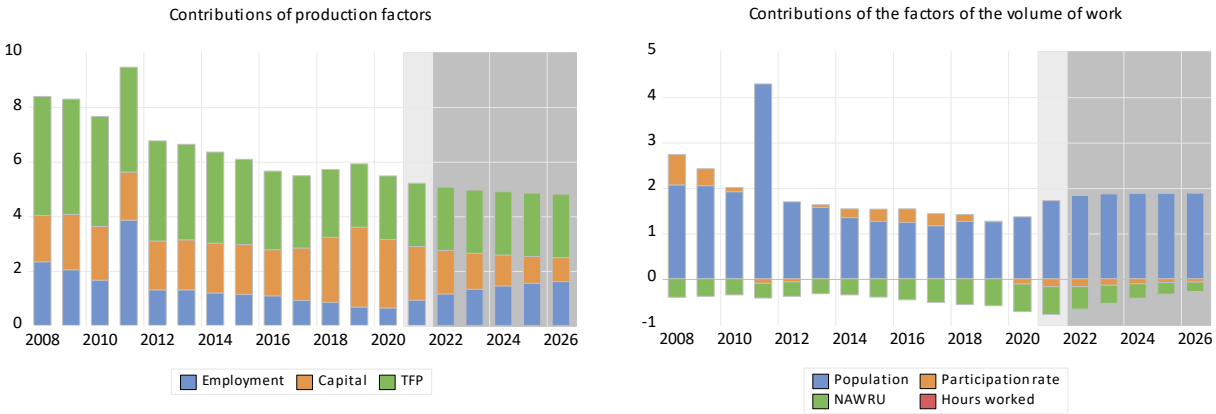
Table 1: Potential Output and its components, 2015-2020 and 2021-2025

	2015 - 2020 (actually)		2015 - 2020 (potentially)		2021 - 2025 (potentially)	
Output	4.6		5.7		5.1	
Capital stock	11	2.2	12	2.4	7.2	1.4
Solow-Residuum	2.2	2.2	2.5	2.5	2.3	2.3
Employment	0.3	0.2	1	0.8	1.6	1.3
Working-age population	1.6		1.6		2.3	
Participation rate	0.1		0.2		-0.2	
NAWRU	-1.2		-0.7		-0.5	
For information:						
Labor productivity	4.3		4.7		3.4	

The main reason for high potential output growth in the past 10 years was the strongly growing capital stock and TFP growth. In contrast the contribution of potential employment was not as high, although population growth was strong. However, this potential labor force will not be utilized: especially structural unemployment but also a the slow job market participation have led to a overall potential employment growth of 1 percent. In the future, if maybe capital stock will not increase at such high rates as in the past, it becomes more relevant for economic policy to reform labor markets.

[2] Although our data set comprises data from 1990 to 2020, we decided to use a shorter time periods, because there is a structural break in the unemployment series in 2007 which is related to the statistical methodology to calculate the unemployment rate. The production elasticity of the production functions between 2008 and 2020 is estimated α=0.8 with the aggregate variables. Robustness checks with sectoral production functions confirm this result. Across sectors the production elasticity varies between 0.75 and 0.93.

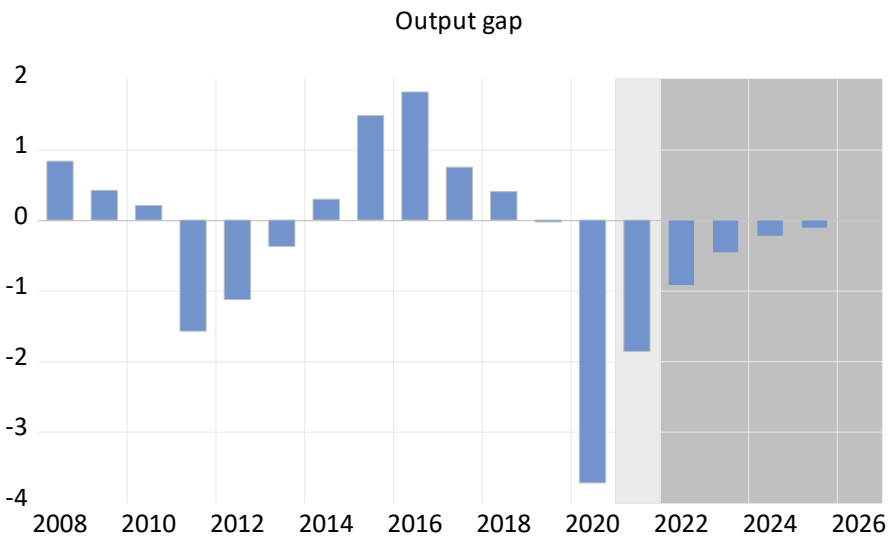
Figure 1: Contributions of production factors, 2008-2026



This pattern becomes even clearer if we analyze annual contributions of production factors. In Figure 1 (LHS) we can see that the growth contribution of capital diminishes over time while it increases for labor volume, mainly due to stronger population growth. However, it will not compensate the lower capital growth, mainly because job market participation and structural unemployment may reduce potential growth in the future (RHS).

Lastly, we can calculate the output gap, that is the percentage deviation of actual to the potential output (See Figure 2).

Figure 2: Output gap, 2008-2026



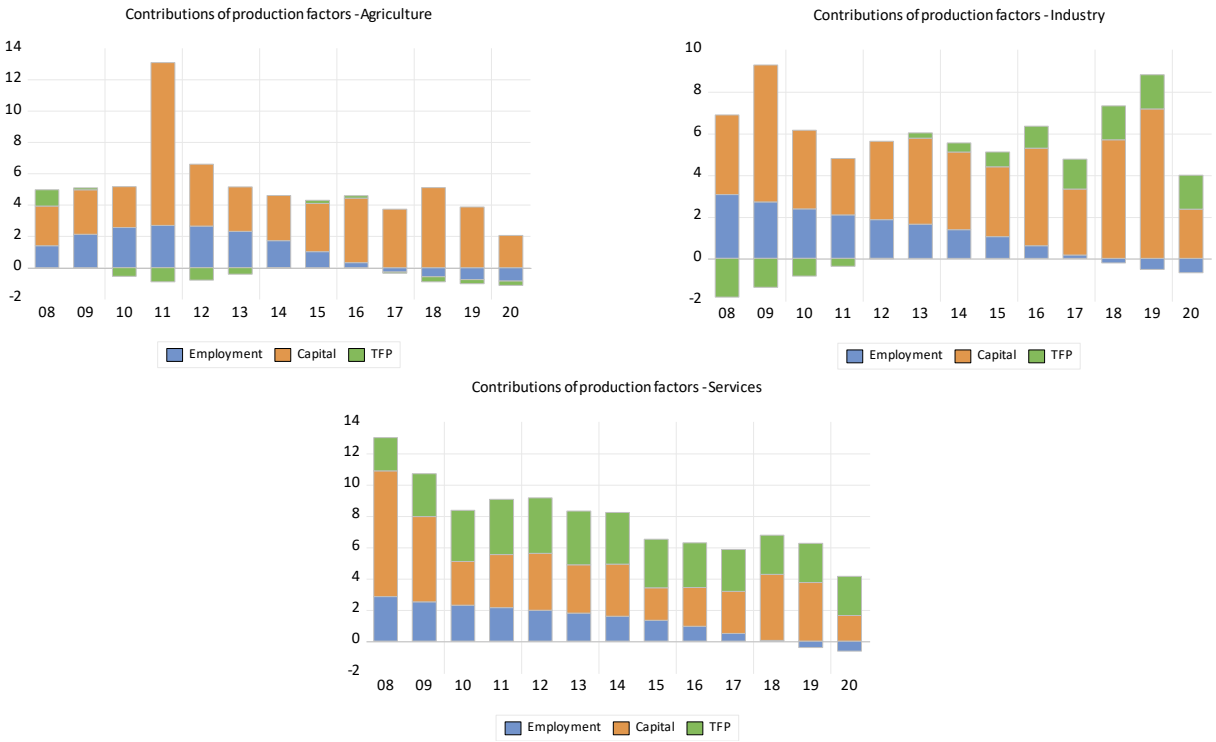
It can be seen that the COVID-19 pandemic has led to a recession in 2020 with large unused capacities: The Uzbek production was close to 4 percent below its potential production. Considering the very basic underlaying short-term forecast model, we would estimate that even in this and the next year capacities were still underutilized.

4 Considering sectoral shifts

In the next step we consider sectoral employment and capital in the potential output methodology. As mentioned before, on a sectoral level we can not disentangle potential employment into population,

structural participation and structural unemployment due to missing data. Additionally, as in the general potential output calculation the projection of future growth rates is based on a simplistic short-term forecast an not on official data or an macroeconomic forecast model. Therefore, we concentrate on the description of the past development.

Figure 3: Potential output by sector, 2008-2020



In Figure 3 we show the contributions of potential employment, capital and the total factor productivity by sectors. Three aspects are noteworthy: First, if we desist from the Corona Crisis in 2020 potential growth in the industrial sector growth rates were even higher than in 2008. In the agricultural and the service sector potential growth has reduced. Second, the higher potential growth in the industry sector is due to the stronger capital growth in production. In the other sectors capital input remains stable over time. Furthermore, since 2014 total factor productivity in the industry, e.g. due to regulations or deregulations, or technological advances in the production process, contributes positively to growth. In the agricultural sector it does not contribute at all. In the service sector TFP increases growth, but with stable contributions, such that does not change growth rates over time. Third, in all sectors the contribution of employment diminishes. From the aggregate model, we know that especially the structural unemployment increases and dampens potential output. Thus, we expect this as the main driver of low employment growth in all sectors, while counteracting developments from population growth or job market participation can not considered in this sectoral view.[3]

[3] The potential employment of sectors do not sum up to the potential employment from the aggregate model, because in the aggregate model we disentangle the specific factors. Therefore, it is possible to detect structural changes in subcomponents of potential employment, such as population growth, participation changes or changes of the structural unemployment. In the sector model, employment is not disentangled, therefore, the employment trend is mainly driven by the unemployment development.

5 Summary and implication

We estimated the potential output based on a production function approach closely related to the EU methodology. We find that between 2015 and 2020 the average potential output growth rate was 5.7 percent. The main reason for this growth was the strongly growing capital stock and TFP growth, whereas potential employment accounted only for a small contribution. However, in the future projection the growth contribution of capital may diminish over time while it could increase for labor volume, mainly due to stronger population growth. The output gap, i.e. the percentage deviation of actual to the potential output was close to 4 percent in 2020 due to COVID-19. Even in the aftermath of the crisis, it is estimated that in 2021 and 2022 capacities will still be underutilized. Therefore, reviving structural reforms after the COVID-19 shock remains essential to boost productivity and put the economy on a sustainable growth path.

In addition, the potential output and its contributions in different sectors were analyzed. It was shown that potential growth in the agricultural and the service sector has been reduced over time. The higher potential growth in the industry sector is due to stronger capital growth in production, whereas in the other sectors capital input remains stable over time. TFP contributes positively to growth in the industry and the service sector, while in the agricultural sector it does not contribute at all. Moreover, similarly to the aggregate view in all sectors the contribution of employment diminishes, mainly due to the increase in the structural unemployment that dampens potential output. Thus, it should be focused on education and training (e.g. government programs or employer-led apprenticeships), as well as investment grants for firms to tackle structural employment in the future.