Trends in GDP Growth and its Driving Factors

Teodora Borota Milicevic

Bilaga 1 till Långtidsutredningen 2023

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Förord

Långtidsutredningen 2023 har utarbetats av ett fristående projektgrupp inom Finansdepartementets enhet för ekonomisk politik och fördelning. Inom ramen för utredningen har ett antal specialstudier tagits fram, vilka publiceras som fristående bilagor. Av huvudbetänkandet framgår hur bilagornas analyser och slutsatser använts i utredningens arbete.

Denna bilaga har utarbetats av Teodora Borota Milicevic, universitetslektor vid Uppsala universitet. De åsikter om uttrycks i denna bilaga är författarens egna.

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Summary

The last four decades have seen weaker economic performance in many advanced economies, with Gross Domestic Product (GDP) growth rates following a downward path since the late 1990s. The growth rates have reached levels up to 1.5 percentage points lower than in the 1980s. In Sweden, on the other hand, the growth rate was strong in the late 1990s and early 2000s but has also deteriorated and returned to slightly lower levels compared to the early 1980s. Economic analysis of this long-run trend has focused on the sources of weaker growth performance, including structural components of GDP, permanent supply-side shocks, and changes in the economic environment. In this practice, economists use the concept of potential GDP (potential output) as a measure of an economy's production capacity, indicating its ability to sustain a level of output given the available resources, technology, and efficiency. It is a supply-side concept of central concern in economic policy, used to assess the long-term development of public finances and recommend structural policies. Over shorter horizons, an economy is exposed to various transitory supply and demand shocks, causing cyclical variation in actual output and inflation. In this context, temporary oscillations in the actual GDP highlight the interest in the actual-to-potential GDP gap and the goals and means of stabilization policies. Consistent estimates of the GDP gap provide feedback to policy actions and allow for shorter-run fiscal surveillance.

This report explores the potential GDP's medium- and long-term development in Sweden and comparable countries. The trend in potential output is analyzed through the lenses of its two main components, the trend in hours worked and labor productivity, where the latter is driven by the changes in capital per unit of labor input, human capital, and total factor productivity.

In many advanced economies, the trend in the prospective working-age population (15-74) and its fraction of the overall population has been declining recently due to demographic changes such as a slowing in population growth and ageing. Higher employment rates and better labor force participation only partially offset this effect. Due in part to high fertility and immigration, Sweden has not faced unfavorable demographic trends. Despite this, the high labor force participation and labor force growth are nevertheless accompanied by high equilibrium unemployment, which serves as a barrier to the contribution of prospective employment and, consequently, hours worked to potential output growth. Overall, the growth in hours worked has been relatively stable, shifting the focus to labor productivity as the potential source of observed developments in potential output.

The primary factor influencing long-term economic wellbeing is labor productivity, which has the ability to offset adverse changes in other structural factors. A significant slowdown in its growth over the recent decades has been the most notable aspect of economic trends. Except for brief intervals of higher performance, such as those in the US and Sweden in the late 1990s and early 2000s, this decline has affected all advanced countries. The changes in two components of labor productivity—capital per labor unit and total factor productivity (TFP)—stand out. In Sweden, the slump in capital formation and deepening (growth in capital stock per unit of labor input) started in the 2000s, with the contribution of capital deepening to output growth remaining low and stable a decade later. Strong recovery in the aftermath of the Great Recession (2007-2010) still showed a lower capital deepening rate compared to the end of the 80s and the 90s decades. The decline is largely driven by the deterioration in information and communication (ICT) capital intensity growth, falling from the very high rates experienced before the 2000s. However, a significant component of capital, namely the knowledge-based or intangible capital (KBC), including innovative property and competencies, software, and computerized information, has now proved to have a substantial impact on labor productivity growth. In many advanced economies, the pace of intangible capital accumulation has accelerated and outgrown tangible investment. Sweden experienced substantial contribution of intangible capital deepening to labor productivity growth since the

mid-'90s, with somewhat weaker developments during the Great recession. The Covid-19 pandemic has affected the latest trends favorably, as rising investment in intangible and ICT capital is associated with the push for digitalization, which may have longer-lasting effects on labor productivity growth in the future.

Total factor productivity (TFP), as the ratio of an economy's output to its total inputs, has been the key contributor to labor productivity and total output growth since World War II. The decline in TFP growth, on average, has been widespread across the developed world. Some research suggests that the decline is due to diminishing productivity benefits of new technologies, while others suggest failures of innovation policies and weak investment. Swedish experience resembled those of the US and UK, with the strongest growth occurring in the ICT sector. The financial crisis and Great Recession had further negative implications on TFP growth, with a strong initial contraction but also the recovery after 2010. Covid-19 has brought similar developments, but again the rebound in productivity and TFP growth measures after the pandemic was quick, supported by digital technologies, e-commerce, and teleworking.

Looking ahead, forecasting potential output and growth in the near and long run is challenging due to the prolonged economic implications of the Covid-19 pandemic, the war in Ukraine, disruptions in energy supplies, and longer-term issues like climate change, demographic developments, natural disasters, health crises, and geopolitical dynamics. The OECD forecasts predict that global potential output growth will slow further in the advanced economies up to 2060 to reach 1-1.5 percent, with European economies experiencing relative stagnation. The EU Commission forecasts for EU countries project rates of 1.2 percent up to 2030, slightly increasing in the 2030s and 2040s and stabilizing afterward. Demographic trends are expected to be the main growth-reducing component. Again, Sweden is expected to share the general potential employment trend of the other advanced economies, although at a lag and at higher levels. On a positive note, the Covid-19 pandemic has led to faster labor market adjustment, and short-time and distance work, reducing separation rates and resulting in an expected fall in the equilibrium unemployment rate by early 2030s according to NIER analyses. Nevertheless, in most advanced economies future labor productivity growth is singled out as the main driver of

potential positive developments. Labor productivity growth is projected to rise from less than 1 to 1.5 percent by 2030 and remain stable throughout the period. TFP growth, labeled as the sole source of potential output growth in the EU Commission forecasts, will be recovering but only up to 1-1.2 percent for selected countries (including Sweden where the negative productivity gap is projected to close by 2026). At the same time, there are large uncertainties on future global TFP growth, and the role of superstar multinational firms in TFP growth and diffusion of frontier technologies will be crucial. Sweden is well equipped to expect stable or positive developments in TFP growth due to high rates of investment in non-tangible assets and the rising intensity of digitalization. However, potential risks for poor performance include rising industry concentration, skill shortages, and worker-to-job mismatches. Moreover, the composition of sectoral output in the total potential GDP may have significant consequences for growth rates, with public and health sectors experiencing lower productivity growth rates compared to the business sector.

Finally, a crucial policy issue - climate change mitigation and greening of the economy – is in the focus of many debates. To achieve net carbon neutrality by 2050, world economies must implement large and rapid policy interventions, including greenhouse gas (GHG) emission taxes, emission trading systems, government regulation of emissions, and investment in low-carbon technologies. The IMF World Outlook 2020 reports moderate costs for optimal policy packages, which are expected to have a net positive effect on global growth in the initial years, supporting the recovery from the Covid-19 pandemic. GDP growth is then expected to slow down gradually, and the estimated GDP costs of transition are within the range of 1-6 percent of GDP by 2050. After 2050 and until 2100, the estimates on both the benefits of avoided damage and GDP level and growth gains are substantial. Furthermore, climate mitigation policy and investment can generate significant returns to the support of technological innovation, often neglected in policy scenario evaluations. Carbon taxes and green R&D subsidies affect technological innovation and produce long-term growth benefits. However, the positive effects come only after a certain lag. Additionally, green technology spillovers may bring

about negative pressures on potential GDP growth due to the reallocation of investments to climate adaptation purposes.

Sammanfattning

Under de senaste fyra decennierna har många avancerade ekonomier haft svaga ekonomiska resultat, där bruttonationalproduktens (BNP) tillväxttakt följer en nedåtgående trend sedan slutet av 1990-talet. Tillväxttakten har legat på nivåer upp till 1,5 procentenheter lägre än på 1980-talet. I Sverige var tillväxttakten däremot stark i slutet av 1990-talet och början av 2000-talet men har därefter försämrats och återgått till något lägre nivåer jämfört med början av 1980-talet. Ekonomisk analys av den långsiktiga trenden har fokuserat på orsakerna till svagare tillväxt, genom att bland annat se till strukturella komponenter i BNP, permanenta utbudschocker och förändringar i den ekonomiska miljön. När utvecklingen av dessa variabler analyseras använder ekonomer begreppet potentiell BNP (potentiell produktion) som ett mått på ekonomins produktionskapacitet, vilket indikerar dess förmåga att upprätthålla en produktionsnivå baserat på tillgängliga resurser, teknik och effektivitet. Detta är ett koncept på utbudssidan som är av centralt intresse i den ekonomiska politiken och som används för att bedöma den långsiktiga utvecklingen av de offentliga finanserna och rekommendera strukturpolitik. Under kortare tidsperioder utsätts en ekonomi för olika tillfälliga utbuds- och efterfrågechocker, vilket orsakar cykliska variationer i faktisk produktion och inflation. Detta leder till ett intresse för skillnaden mellan verklig och potentiell BNP (BNP-gapet) samt målen och medlen för stabiliseringspolitiken. Konsekventa uppskattningar av BNP-gapet ger återkoppling till politiska åtgärder och möjliggör kortare budgetövervakning.

I denna bilaga undersöks den potentiella utvecklingen av BNP på medellång och lång sikt för Sverige och andra jämförbara länder. Trenden i potentiell produktion analyseras genom dess två huvudkomponenter, trenden i arbetade timmar och arbetsproduktivitet,

där den senare drivs av förändringarna i kapital per enhet arbete, humankapital och total faktor produktivitet (TFP).

I många avancerade ekonomier har trenden i den framtida arbetsåldern (15–74) och dess andel av den totala befolkningen nyligen minskat på grund av demografiska förändringar såsom en långsammare befolkningstillväxt och en åldrande befolkning. Högre sysselsättningsgrader och bättre arbetskraftsdeltagande kompenserar endast delvis för denna effekt. Sverige har dock inte stött på negativa demografiska trender vilket delvis är på grund av den höga fertiliteten och invandringen. Trots detta åtföljs arbetskraftens höga deltagande och tillväxt av en hög jämviktsarbetslöshet vilket begränsar arbetskraftens och antalet arbetade timmars bidrag till potentiell BNP. Tillväxten av antalet potentiella arbetade timmarna har varit ganska stabil under de senaste åren, vilket har riktat uppmärksamhet mot arbetsproduktivitet som den potentiella orsaken till den observerade utvecklingen av framtida produktion.

Den primära faktorn som påverkar det långsiktiga ekonomiska välbefinnandet är arbetsproduktiviteten, vilken har förmågan att kompensera för negativa förändringar i andra strukturella faktorer. En betydande nedgång i dess tillväxt under de senaste decennierna har varit den mest anmärkningsvärda faktorn bakom den ekonomiska utvecklingen. Med undantag för korta intervaller med högre resultat, som i USA och Sverige i slutet av 1990-talet och början av 2000-talet, har denna nedgång drabbat alla utvecklade ekonomier. Förändringar i två komponenter av arbetsproduktivitet – kapital per enhet arbete och total faktorproduktivitet (TFP) – sticker ut. I Sverige började nedgången i kapitalbildning och fördjupning (tillväxt i kapitalbeståndet per enhet arbete) på 2000-talet, och tillväxtbidraget från kapitalfördjupningen förblev sedan låg och stabil under ett decennium. Den starka återhämtningen efter finanskrisen (2007–2010) visade fortfarande en lägre kapitalfördjupning jämfört med slutet av 80-talet och 90-talet. Nedgången beror till stor del på den försämrade tillväxten av informations- och kommunikations (IKT) kapital intensiteten, som föll från de mycket höga siffror som upplevdes före 2000-talet. Men en betydande del av kapitalet, nämligen kunskapsbaserat eller immateriellt kapital (knowledge-based capital – KBC), inklusive innovativ egendom och kompetens, programvara och digitaliserad information, har nu visat sig ha en väsentlig inverkan på tillväxten av arbetskraftens produktivitet. I

många avancerade ekonomier har ackumuleringen av immateriellt kapital accelererat och överstigit materiella investeringar. Sverige har sedan mitten av 90-talet upplevt ett signifikant bidrag från det immateriella kapitalets fördjupning till arbetsproduktivitetstillväxten, med något svagare utveckling under finanskrisen (2007–2010). Covid-19-pandemin har påverkat de senaste trenderna positivt, eftersom ökade investeringar i immateriella och IKT-kapital är förknippade med ökad digitalisering, vilket kan ha långvariga effekter på arbetsproduktivitetstillväxten i framtiden.

Total faktorproduktivitet (TFP), förhållandet mellan ekonomins produktion och dess totala insatser, har varit den viktigaste bidragande faktorn till arbetsproduktivitet och total produktionstillväxt sedan andra världskriget. TFP-tillväxten har i genomsnitt minskat i hela den utvecklade världen. Vissa undersökningar tyder på att nedgången beror på minskande produktivitetsfördelar från ny teknik, medan andra antyder på misslyckanden i innovationspolitiken och svaga investeringar. Den svenska utvecklingen har liknat den i USA och Storbritannien, där IKT-sektorn har haft den starkaste tillväxten. Finanskrisen hade ytterligare negativa konsekvenser för TFP-tillväxten, med en kraftig inledande minskning men därefter också en stark återhämtningen efter 2010. Covid-19 har medfört liknande utveckling, men återhämtningen i produktivitet och TFP tillväxtåtgärder efter pandemin var snabb, delvis tack vare digital teknik, e-handel och distansarbete.

Framtida prognoser om potentiell produktion och tillväxt på kort och lång sikt är utmanande på grund av de långvariga ekonomiska konsekvenserna av Covid-19-pandemin, kriget i Ukraina och störningar i energiförsörjningen samt även långsiktiga frågor som klimatförändringar, demografiska utvecklingar, naturkatastrofer, hälsokriser och geopolitisk dynamik. OECD:s prognoser förutspår att den globala potentiella tillväxten av produktionen kommer att bromsa in ytterligare i de avancerade ekonomierna fram till 2060 och nå en nivå på 1–1,5 procent, de europeiska ekonomier väntas uppleva relativ stagnation. EU-kommissionen förutspår att EU-länderna når projektnivåer på 1,2 procent fram till 2030, därefter öka något under 2030-talet och 2040-talen för att sedan stabiliseras. De demografiska trenderna förväntas vara den huvudsakliga komponenten för minskningen i tillväxt. Återigen förväntas Sverige dela den allmänna potentiella sysselsättningsutvecklingen med andra avancerade eko-

nomier, om än något senare och på något högre nivåer. En positiv effekt som Covid-19-pandemin lett till är snabbare anpassning på arbetsmarknaden och en ökning av korttids- och distansarbete, vilket i sin tur minskar separationsgraden samt resulterar i en förväntad minskning av jämviktsarbetslösheten i början av 2030-talet enligt Konjunkturinstitutets analyser. I de flesta avancerade länder är tillväxten av framtida arbetsproduktivitet den primära drivkraften bakom en potentiellt positiv utveckling. Arbetsproduktivitetstillväxten beräknas stiga från mindre än 1 procent till 1,5 procent år 2030 och sedan förbli stabil under hela perioden. TFP-tillväxten, som anges som den enda källan till potentiell tillväxt i EU-kommissionens prognoser, väntas återhämta sig men bara upp till 1–1,2 procent för utvalda länder (inklusive Sverige där det negativa produktivitetsgapet beräknas försvinna till 2026). Samtidigt finns det stora osäkerheter om den framtida globala tillväxten av TFP, och superstar multinationella företag kommer att spela en avgörande roll i global TFP-tillväxt och spridning av teknologi. Sverige är väl rustat och kan förvänta sig en stabil eller positiv utveckling av TFP-tillväxten på grund av de höga investeringarna i immateriella tillgångar och den ökade digitaliseringen. Potentiella risker för dålig prestation är exempelvis ökad branschkoncentration, kompetensbrist och kompetensglapp. Dessutom kan sammansättningen av olika sektorers produktion i total potentiell BNP ha betydande konsekvenser för tillväxttakten, exempelvis eftersom offentliga och hälso- och sjukvårdssektorer upplever lägre produktivitetsökningshastigheter jämfört med näringslivet.

Slutligen är en avgörande politisk fråga – begränsning av klimatförändringarna och greening of the economy - i fokus för många debatter. För att uppnå netto koldioxidneutralitet till 2050 måste världsekonomierna genomföra stora och snabba politiska åtgärder, inklusive växthusgasutsläppsskatter, system för handel med utsläpp, regeringsreglering av utsläpp och investeringar i koldioxidsnåla tekniker. IMF World Outlook 2020 rapporterar måttliga kostnader för optimala policypaket, som förväntas ha en nettopositiv effekt på den globala BNP-tillväxten under de första åren, vilket stöder återhämtningen från Covid-19 pandemin. BNP-tillväxten förväntas sedan gradvis sakta ner, och de uppskattade kostnaderna av övergången ligger inom intervallet 1–6 procent av BNP år 2050. Efter 2050 och fram till 2100 förväntas fördelarna vara betydande genom att skador

förhindras samtidigt som BNP-nivån och BNP-tillväxten ökar. Dessutom kan klimatpolitik och investeringar i syfte att minska klimatförändringarna generera betydande avkastning genom dess stöd för teknisk innovation, vilket är något som ofta försummas i utvärderingar av politiska scenarion. Två exempel på detta är koldioxidskatter och gröna FoU-stöd som påverkar teknisk innovation och ger långsiktiga tillväxtfördelar, de positiva effekterna kommer dock först efter en viss fördröjning. Trots detta, kan investeringar i grön teknik även medföra negativa påtryckningar på den potentiella BNP-tillväxten på grund av en omfördelning av investeringar till fördel för klimatanpassning.

1 Introduction

Potential output or potential gross domestic product (GDP) is a measure of the production capacity of an economy, a level of output that the economy can sustain given its available resources, implemented technology and the full efficiency at which those can be combined. As such, it is one of the central concerns of economic policy. Over a longer term, potential GDP, particularly in its per capita level, presents the main measure of (material) welfare level of a society, correlating positively to almost all measures of its living standards. Furthermore, potential GDP is the main reference for assessing the trend (long-term) development of public finances, and finally, it is the basis for the stabilization policy.

This report discusses the medium-term and long-term development of potential GDP, the driving forces behind these developments and the future prospects in Sweden and comparable countries.

Section 2 presents the actual GDP developments since the 1980s in several advanced economies and in Sweden, analyses the main contributing factors of growth, focusing on the GDP growth slowdown observed across the economies. Understanding GDP growth as a supply-side process driven by the hours worked and labor productivity growth, with latter including contributions from capital per unit of labor input, human capital and total factor productivity, each of these factors are addressed in turn in sections 2.2.1-2.2.2. In Section 3, the report turns to potential GDP including its definition, measurement and developments since the 1980s. While the analysis of potential labor productivity in the medium and long run corresponds to that presented in Section 2.2 where the actual labor productivity is discussed, the analysis of potential hours worked is different. This potential output component depends on the estimates of equilibrium unemployment, which often differs

from the actual unemployment. Section 3.3.1 presents the definition and development of potential hours worked in the selected advanced economies. Moving forward, Section 4 presents the forecasts on future potential GDP and its growth, relying on the OECD, The EU Commission and the NIER analyses. Section 5 provides a final discussion on the key findings of the report and points to several important factors and policy challenges for the future. In particular, climate policy issues, globalization trends and the potential output measurement challenges are addressed.

2 Gross Domestic Product (GDP) growth since the 1980s

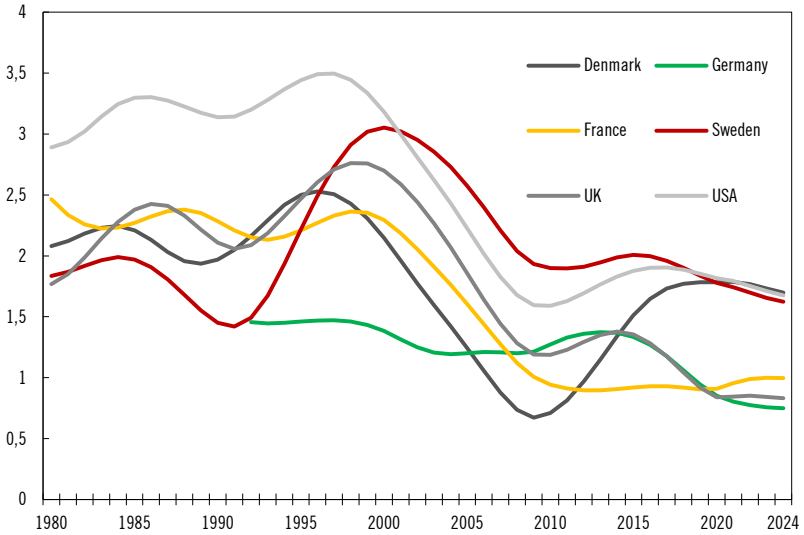
2.1 GDP growth slowdown

Following the post-World War II decades of relatively high output (GDP) growth, the last four decades have brought weaker performance in many advanced economies. Figure 2.1 presents the evolution of the trend GDP growth rates in selected advanced economies.[1] Stagnating in the 1980s and somewhat stronger in the 1990s (in some economies), the GDP growth rates across presented economies have followed a downward path in the last two decades. They have reached the levels that are up to 1.5 percentage points lower compared to the growth rates in the '80s, with a notable exception of Sweden which has returned to only slightly lower rates after a period of strong performance in the end of '90s and beginning of 2000s. In Sweden as well, the GDP growth has been slowing down in the recent two decades.[2]

These developments have long been in the focus of the economic analysis, searching for the sources of the weaker growth performance among the structural components of GDP, permanent and longer-lasting supply-side shocks to the economy and the changes in economic environment. All of these factors have the ability to affect the long-run, trend performance in GDP level and growth rates that have been observed in the data.

[1] The selected group of analyzed countries include advanced EU economies, France and Germany, Denmark as a Scandinavian economy, UK and the USA.
[2] Growth slowdown is even more significant if the latest decade's observed rates are compared to the decades prior to 80's which points to a longer-lasting nature of the phenomenon.

Figure 2.1 Trend GDP growth since 1980 (in percentage), selected countries



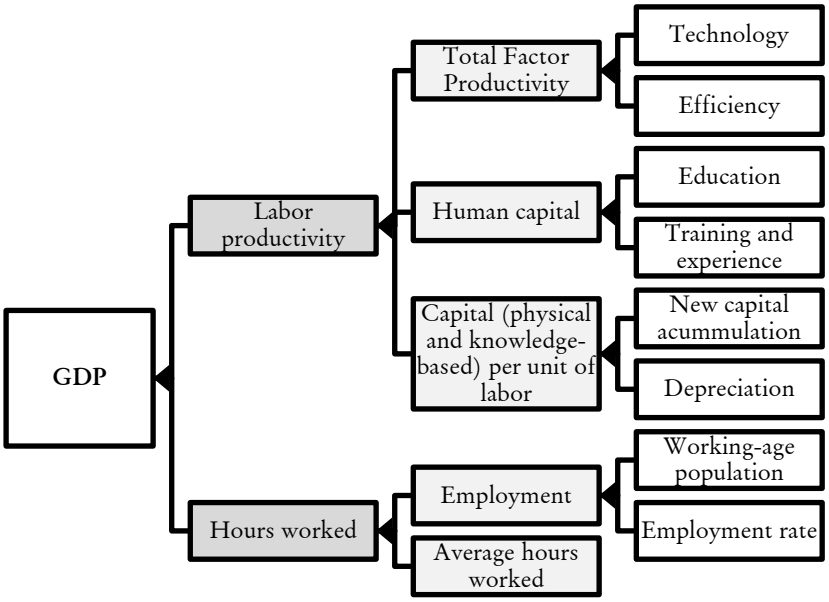
Note: The presented trend is calculated by applying the Hodrick-Prescott (HP) filtering on the actual data series.
Source: OECD Economic Outlook Database (112) and own calculations.

2.2 Reasons for the decline

Relying on the definition of the trend output growth as a purely supply-side driven process, one can focus on the notion of the production function in order to analyze GDP growth. Total GDP of an economy is produced by labor providing the input of hours worked, with a certain level of labor productivity defined as the output per hour worked. Then, as an identity, GDP growth is the sum of the growth in hours worked and the labor productivity growth. The latter component consists of the growth rates of all the factors that contribute to the growth of output produced per hour, weighted by their respective contributions that are given by the parameters of the production function. As showed in Figure 2.2, these factors include capital per unit of labor input used in the production, quality of labor (the human capital) and total factor productivity (TFP) that is determined by the level of technology applied and the efficiency at which the factors of production are utilized (See Appendix B for output growth decomposition).

Sections 2.2.1–2.2.2 present each of these growth components and discusses their historical developments across the selected group of countries and Sweden.

Figure 2.2 Illustration of GDP Components

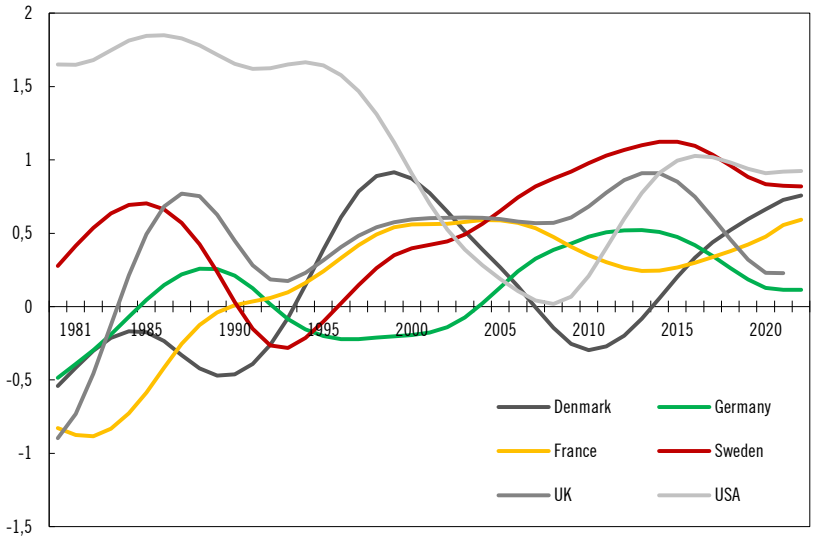


2.2.1 Hours worked

Recent demographic developments with a marked slowdown in population growth (and population ageing affecting the share of dependent population and GDP per capita) have had a significant draw on the hours worked growth in many advanced countries (e.g. US and France) These changes have been compensated to a larger or smaller degree by stronger participation in the labor force and higher employment rates across countries. In some other economies, such as Sweden and Denmark, the negative demographic changes have not been experienced, partly due to strong fertility and immigration. Overall, with a notable exception of the US, the growth in hours worked have been relatively stable, or even remarkably stronger as in Sweden, in the analyzed period (see Figure 2.3), which shifts the

focus on labor productivity as the potential source of the observed GDP developments.

Figure 2.3 Trend growth in total hours worked (in percentage)



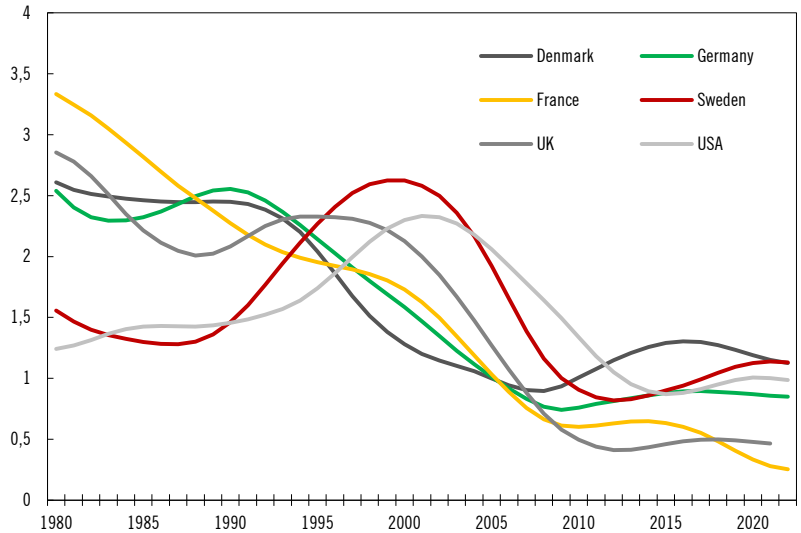
Note: The presented trend is calculated by applying the Hodrick-Prescott (HP) filtering on the actual data series.
Source: OECD Economic Outlook Database (112) and own calculations.

2.2.2 Labor productivity

GDP per hour worked is the main driver of the long run development in economic welfare of population, with the capacity to compensate for the negative developments of other structural factors that lie largely outside the scope of economic policy, such as demographics. The most striking feature of economic developments in the past four decades (and longer) has been a significant downturn in the trend labor productivity growth. As shown in Figure 2.4, this slump has been experienced across all advanced economies, only with the exception of limited periods of stronger performance such as those in the US and Sweden in the end of '90s and beginning of 2000s. In this period, the Swedish economy caught up with the US, overpassing other advanced European economies, and in the two subsequent decades the developments in Swedish growth mimic the general trends. There is still an ongoing discussion in the economic

literature and debates on the potential reasons for the "productivity slump", among other the nature and implementation process of the new (ICT) technologies. Up until the Great Recession, the trend in productivity was expected to recover as the new digital economy finally transformed the ways businesses operate and use their inputs. This development was awaited as productivity growth is typically expected to play the largest role in output growth over the projections and beyond.[3]

Figure 2.4 Trend growth in labor productivity (in percentage)

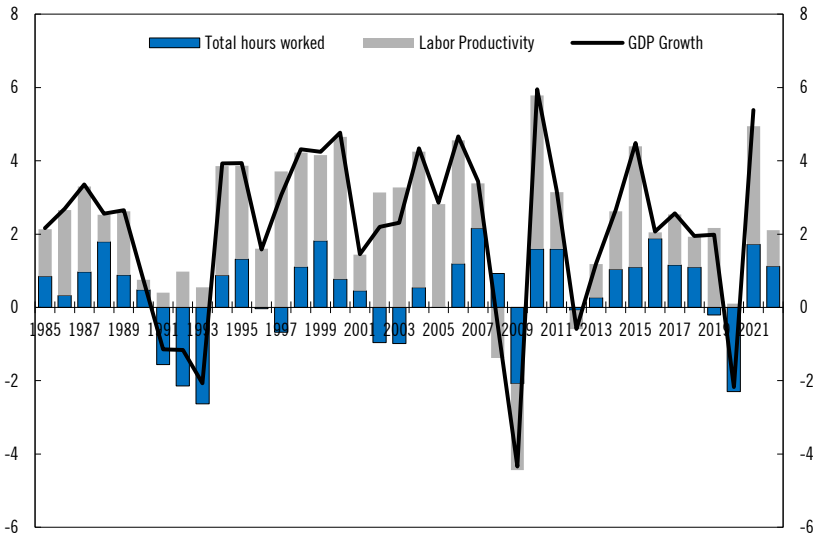


Note: The presented trend is calculated by applying the Hodrick-Prescott (HP) filtering on the actual data series.
Source: OECD Economic Outlook Database (112) and own calculations.

As the most important driver of the developments in the trend GDP level and growth rate, labor productivity is also the biggest contributor to the actual GDP level and growth as well as to their developments over time. (see Figure 2.5).

[3] There is, however, an ongoing debate about exactly how much one can expect productivity growth to rise (Schembri 2018).

Figure 2.5 Decomposition of GDP growth rate in Sweden, hours worked growth and labor productivity growth (in percentage)



Source: OECD Economic Outlook Database (112).

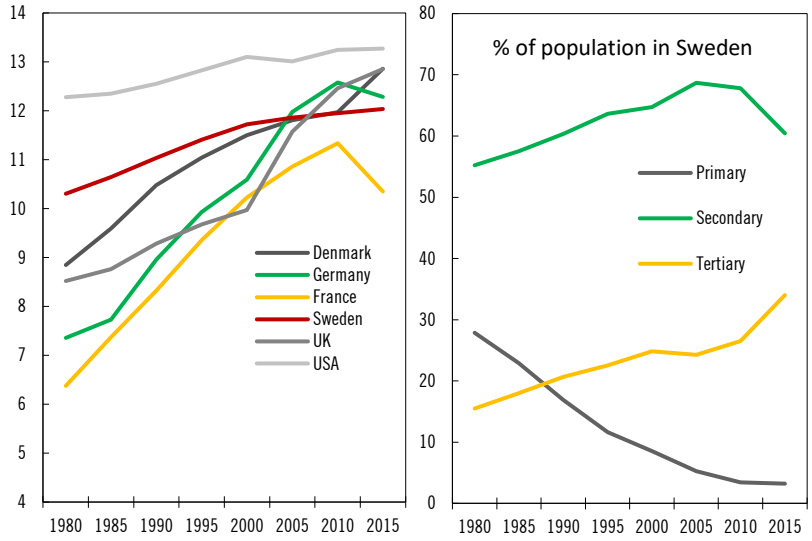
Human Capital

Labor input, measured by the employment and average hours worked, accounts only for the volume of this factor of production. The quality of labor factor, labeled as human capital, includes labor knowledge, skills and its ability, affecting the efficiency of physical (and other forms of) capital utilization, and is thus partly determining the productivity growth. The evolution of labor input quality and changes in labor composition have historically been some of the key growth promoting factors, alongside the TFP growth.

As it is embodied in the labor itself, human capital is very hard to measure. It is typically determined by the level of education and training and experience workers obtain during their working life, on average. In practice, most often it is represented simply by the average years of schooling or completion rates by education level. Educational attainment measured by the average years of schooling has been on a steady rise since 1980 in most of the world economies, including Sweden (see Figure 2.6). Right panel reveals the sources of the average years of schooling increase in Sweden. While the initial

improvements occurred due to a rise in both the shares of population with secondary and tertiary education until early 2000s, the subsequent developments have been entirely driven by the rise in the highest education group shares, once the only primary education group share has reached low levels.[4] This points to the fact that the Swedish education attainment is well in a phase where college education becomes the norm for the labor market.

Figure 2.6 Education as a measure of human capital: average years of schooling (left panel) and the population shares by education level in Sweden (right panel)



Source: Barro-Lee Dataset 2021.

It should be noted that the human capital level is not a uniform measure across the labor force as represented by the average years of schooling. Workers differ in their education level, quality of education, skills and abilities, and thus their contribution to productivity, which may also be changing over time[5]. Differences in productivity contributions are normally captured in wages which are in turn used for the calculation of weighted or quality adjusted labor

[4] Nevertheless, a persistent problem in the labor market is a high level of unemployment among the foreign-born and native low-skill labor.

[5] For example, fast technological progress introducing new ways of working may renders certain forms of education and training obsolete over time. Age, on the other hand, affects human capital through the tradeoffs between a higher work experience (older workers) and a more recent, up-to-date education (young workers).

services[6], but a special attention should be given to potential discriminatory wage penalties, which among other issues render the wage a poor proxy of productivity. (NIER 2008) Finally, common measures of human capital do not fully capture the value of productive services of this type of capital. Labor skills and abilities are only contributing to output if they are properly matched with the productive requirements of the jobs where labor is employed, an aspect which becomes increasingly important in the times of rapid technological and structural changes. Persistent misalignment between the demand and supply of skill at the aggregate and micro level leads to lower labor productivity reflected in workers compensations. OECD (2016b) review on the Swedish labor force skills development and allocation reveals that while 33 percent of firms report difficulties in hiring due to a lack of appropriate skills, around 34 percent of workers experience field of study mismatch, 39 percent are mismatched by qualifications (either higher or lower) and around 11 percent are mismatched by skills.

Physical and knowledge-based capital

Growth in capital intensity, i.e. the capital per unit of labor input (per hour worked, or per worker), is another factor of crucial contribution to the labor productivity growth. Total capital stock grows due to continuous investments, corrected for the depreciation and scrapping of the obsolete capital. In its intensive form, it measures how well-equipped labor factor is when providing its productive services. The growth in capital intensity, labeled as *capital deepening*, is thus determined as the difference between the growth in capital stock and the labor input. Staggered GDP growth trends in the major advanced economies since the 1980s have been partly driven by a poor trend growth of the capital stock. The decades long negative trend may well reflect the link between the population

[6] The OECD Measuring Productivity Manual (OECD, 2001) lays out an approach to account for the heterogenous human capital where workers are grouped by their marginal productivities proxied by different characteristics (age, education, occupation, sex). Each group's contribution to economic growth is then calculated through the contribution of the growth rate in the group's hours worked weighted by its share in total income accruing to the labor factor. Using this approach, a study based on labor data from a subset of the OECD economies finds that the labor quality composition accounted for 20 percent of labor productivity growth in the 2000–2019 period. Not accounting for these aspects, labor quality contribution would have been falsely assigned to the TFP growth.

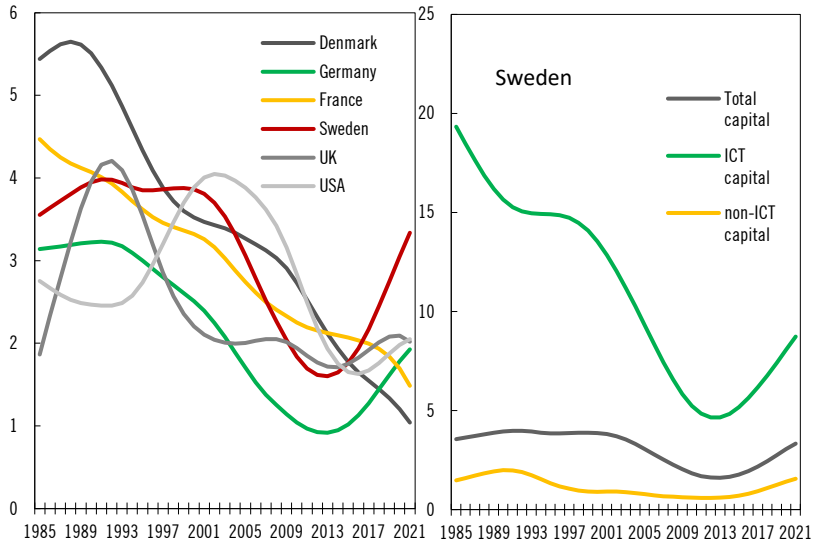
growth and capital accumulation. A lower growth in labor force implies a lower need for investment in order to keep the capital-labor ratios constant and equip the workers sufficiently. At the same time, a lower population growth implies a slower pace in home construction and the provision of public infrastructure.[7]

However, capital deepening has showed similar negative developments over the last four decades, with a higher or lower trend over periods depending on the labor input growth. On average, capital deepening rates have ended up at levels 1–2 percentage points lower in early years of the 2010s compared to the rates in the end of '80s[8], only to start rebounding in the recent decade (Figure 2.7). In Sweden, the slump in capital formation and deepening started in the 2000s, with the contribution of capital deepening to the output growth remaining low and stable a decade later, coupled with a weaker growth performance of total factor productivity (TFP, to be discussed in the following section). (OECD 2016a). Further developments show a strong recovery in the aftermath of the Great Recession (2007–2010) but the capital deepening rate is still remains lower compared to the rates of the end of 80's and the 90's decade.

[7] Arguably, these links between capital accumulation and population and employment trends have greatly affected the prevailing real interest rates in the global economy.

[8] A decade after the wake of the financial crisis of 2007, OECD countries on average experienced a 0.4 percentage point drop in the annual capital deepening rate and can account for the slowdown in trend productivity growth in the 2007–2015 period. (OECD 2016) The financial crises has also taken its toll on the investment optimism and have arguably contributed to the modified consumers propensities to save which may prove to have some long-run consequences on investment growth. See Appendix E for a more detailed discussion on the capital factor developments during the Great recession.

Figure 2.7 Capital deepening (trend), total for selected countries and by capital type in Sweden



Note: The presented trend is calculated by applying the Hodrick-Prescott (HP) filtering on the actual data series.
Source: OECD Economic Outlook Database (112) and own calculations.

Disaggregating the total capital into Information and Communication Technologies (ICT) capital and non-ICT capital, the right panel of Figure 2.7 reveals that the decline in capital deepening in Sweden is largely driven by the deterioration in the ICT capital intensity growth[9], falling from the very high rates experienced before the 2000s.

A bulk of studies that aim to quantify the importance of different contributors to output growth has failed to account properly for the category of knowledge-based or intangible capital (KBC), including items such as innovative property and competencies, software, computerized information. This category of capital is now treated as an investment in national accounts, i.e. as a part of total capital, and has a substantial impact on measures of overall investment and labor productivity growth. In many advanced economies the pace of intangible capital accumulation has accelerated and has outgrown the tangible investment.

[9] Non-ICT capital deepening has also experienced a reduction following the early-'90s recession but has remained stable until the recent decade.

Knowledge-based capital

There are many forms of capital used in the production processes. The most traditional notion of physical capital in its intensive form, indicates how much of the physical capital (machines, equipment, buildings, infrastructure) is used by a worker, and it is a product of the installed capital capacity and the measure of the intensity of its usage. This traditional view differs from the way we think about the new forms of capital in modern economies. The new form of knowledge-based capital (KBC) is a product of firms' investment in non-physical, intangible assets such as research and development infrastructure (R&D), data, software, patents, new organizational processes, firm-specific skills and designs. (OECD 2013b) In many OECD economies, the investment in these forms of capital has accelerated substantially over the recent decades, and in some has outgrown the investment in traditional (tangible) physical capital.[10] The most notable feature of KBC is its potential to generate increasing returns (one unit of KBC can be used repeatedly at no cost beyond the initial cost invested in the first unit) and promote sustained productivity change and growth in output. Moreover, many forms of KBC also produce knowledge spillovers in other activities outside of the firm's limits, fostering sectoral or aggregate growth through this channel as well. In that sense, KBC is not only used in the production of output but may itself be a source of total factor productivity growth through this embodied productivity-raising potential.

KBC is intangible in its nature and, historically, the national accounts analysis and empirical studies have had difficulties in measuring KBC and accounting for several of its forms, e.g. firm-specific training, design, innovative property and organizational quality. Recent two decades have seen substantial advances on this front, most notably the introduction of the expenditure-

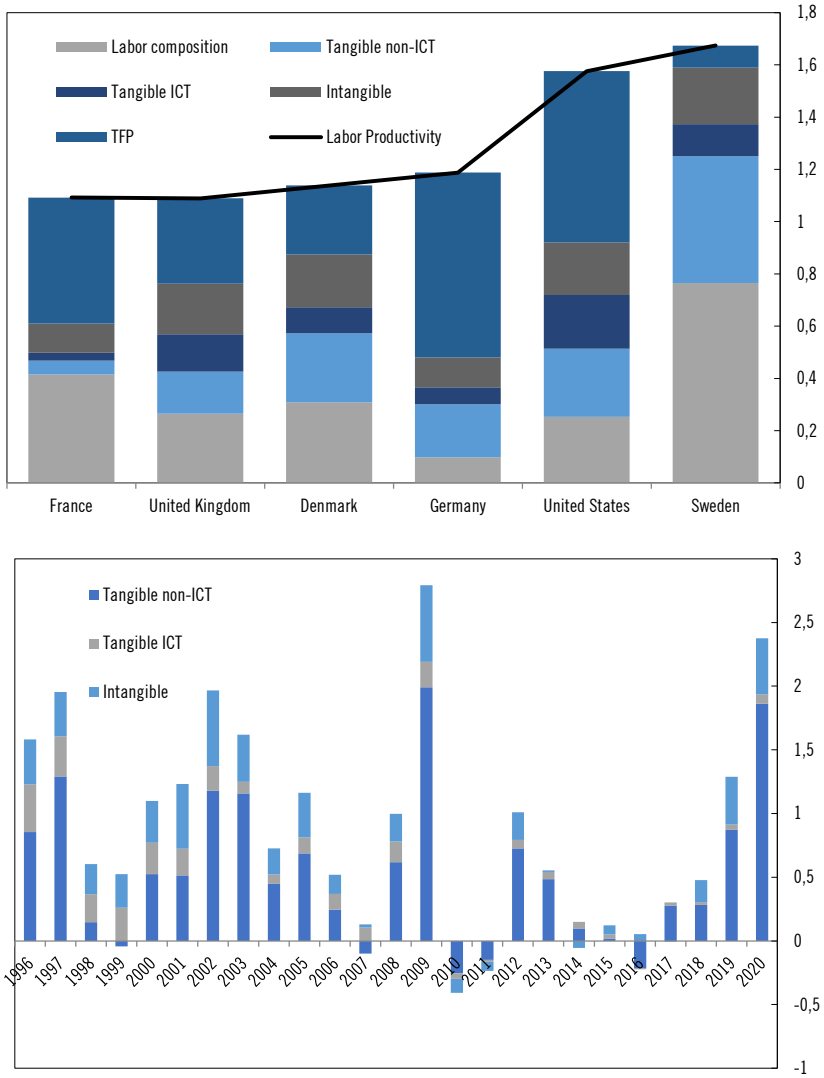
[10] Corrado et al. (2009) find that the intangible investment in the U.S. started to grow faster than tangible investment in the 1970s and accounting for these trends, the contribution of TFP growth to labor productivity growth has been revised downwards, from 35 percent to 25 percent in the 1973–1995 and from 51 percent to 35 percent in the1995–2003 period. Some results of the growth accounting exercises for the EU and the US suggest that the KBC growth has contributed by 20-33 percent of the average labor productivity growth in the 1995–2007 period. (Corrado et al., 2012)

based treatment of KBC (an investment instead of intermediate consumption) which has spurred growth accounting studies estimating the KBC investment contribution to economic growth, but there are still outstanding issues particularly regarding consistency and comparability across countries. An important conclusion is that different kinds of capital have different productivities. In order to properly account for those in a growth accounting exercise, one is advised to consider different forms of capital separately.[11]

Figure 2.8 presents the contribution of different categories of capital deepening to labor productivity growth. Sweden has proved to be among the countries with substantial contribution of intangible and tangible-ICT capital deepening to labor productivity growth since mid-'90s. In the decade leading to the financial crisis, the two components have had the tendency to match or even surpass the tangible non-ICT contribution in some periods. Weaker developments followed during the Great recession but have rebounded after 2017. Arguably, Covid19 pandemic has affected the latest trends favorably as rising investment in intangible and ICT capital in total is associated with the push in the incentives for digitalization. This phenomenon may prove to have longer-lasting effects on labor productivity growth in years to come.

[11] Analysts typically distinguish between several different forms of capital: tangible non-ICT capital (machinery and equipment including transportation and excluding hardware, buildings and structures including or excluding housing), tangible ICT capital, non-tangible or knowledge-based capital (KBC), and human capital. A measure of capital services calculated for each type of capital then takes into account the differences in the type's productivity. (NIER 2008)

Figure 2.8 **Contribution of different types of capital deepening to Labor productivity growth: intangible vs. tangible assets (cross-country in 2015 top, and Sweden1996–2020 bottom)**



Source: EUKlems & INTANProd Database, 2023.

Total Factor Productivity (TFP)

Total factor productivity (TFP) is the ratio of the measure of output in an economy and the measure of total inputs used (labor and

different types of capital), combined according to the production function. TFP growth is thus a difference between the growth rate of total output and the weighted growth rates of inputs. In other words, growth in TFP measures all the changes in output that cannot be attributed directly to the changes in the quantity of labor and capital inputs generating that output. Therefore, assessing the contribution of the total factor productivity (TFP) trend growth depends crucially on the ability to properly quantify the contributions of other factors, as the TFP growth is in turn treated as the residual development. Using modern techniques and considering all the possible types of assets with increasingly important shares in the economy, the TFP growth contribution still stays firmly in the first place of important contributors to labor productivity and total output growth. Trends in the TFP have indeed been driving labor productivity in the advanced economies since the World War II. This empirical finding goes in line with the predictions with almost all of the existing growth models.[12]

Components and drivers of TFP growth

The main component of the TFP growth is technological change (see e.g. Basu and Fernald (2002) for evidence). This is not to say that TFP growth does not change for reasons different than improvements in technology; institutional change, market deregulation and removal of distortionary tax systems can serve as examples of efficiency changes affecting trend TFP growth. However, many of the central efficiency improvement policies and regulations have already been implemented in the advanced economies which probably leaves the technological progress as the main contributor to TFP growth. Some growth studies add the "scale change" component to the classification of TFP growth components – a factor conditional on recognizing potential deviations from constant returns to scale technology which allows for productivity benefits that rise or fall with the scale of production.

A notable efficiency channel affecting TFP growth operates through reallocation of resources within and across firms and

[12] For a comprehensive review on the traditional and modern growth theory, see Appendix A.

industries, driven by exposure to competition in domestic and foreign markets. The Swedish economy, as a small open economy with a large share of firms involved in international trade and competition in global markets, has experienced significant changes and potentially large associated efficiency benefits from globalization. (Jakobsson 2007)

The OECD report "The Future of Productivity" (OECD, 2015) offers a structured analysis of the TFP growth drivers and identifies the three main categories:

- Factors that incentivize innovation – research and development (R&D), digitalization and investment in intangible capital;
- Factors driving knowledge and technologies diffusion – labor skills and qualifications, and public infrastructure; and
- Factors and institutions that ensure efficient allocation of resources within and/or between sectors and firms: competition and business dynamics, globalization and financial development.

Regarding the first group of factors, one should note that a large body of empirical literature points to a positive causal link between research and development (R&D) and TFP growth, stemming from both the private (within firm) and public R&D investment, domestic and foreign.[13] Since 2008, the System of National Accounts treats the R&D expenditure (a part of the knowledge-based capital) as investment that results in the creation of knowledge-based assets, thus contributing to the measured growth in labor productivity and output through capital deepening, instead of through TFP growth. Nevertheless, TFP growth, measuring advances in the ways productive factors are combined, is affected by R&D investment through the spill-over mechanisms. Innovations and knowledge created by R&D introduces new and better-quality inputs as well as better ways of production, but also renders future knowledge creation more efficient which feeds into the TFP growth. These mechanisms are by no means restricted to domestic R&D activities; international

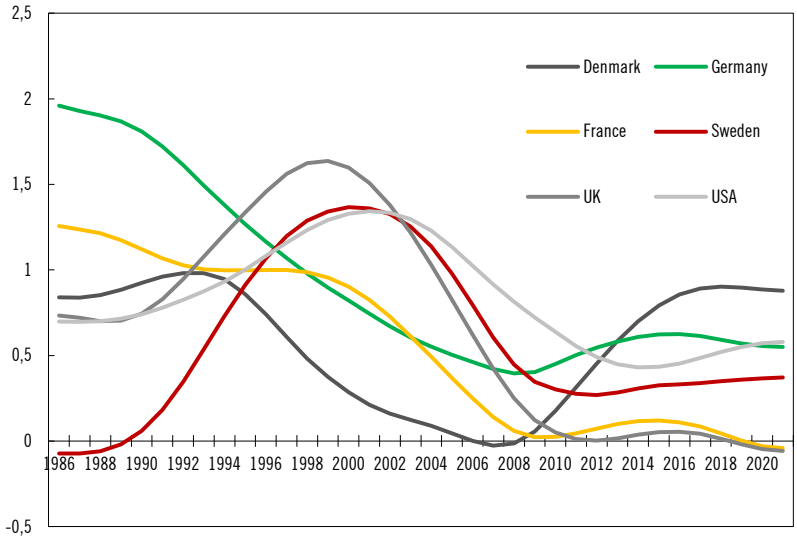
[13] Recent empirical studies and literature surveys include, among others, Wieser (2005), Coe et al. (2009), Hall (2011), Ang and Madsen (2013) and Herzer (2022).

> knowledge transfers occur through FDI, trade in intermediate and final goods and services as well as through the movement of (skilled) labor, materializing the benefits of globalization. Higher level of human capital, investment in tangible ICT capital and better quality of institutions, among other factors, show strong complementarities with R&D in its effect on TFP growth. (Guellec and Van Pottelsberghe, 2004)

The decline in trend TFP growth is not an entirely uniform phenomenon across countries[14], but on average, the slump has been widespread across the developed world (see Figure 2.9). Some research has taken a stand that the TFP growth slump is a result of a diminishing ability of newer technologies to provide substantial productivity benefits (Gordon 2012), while others discuss failures of different government policies promoting innovation and, more recently, the linkages between weak investment and productivity growth that may have applied in the aftermath of the financial crisis. (Arsov and Watson 2019). Recent evidence in Gordon and Sayed (2019) in fact reveals a remarkably similar development in the U.S. and the EU-10, albeit with a time lag in the latter case, pointing to the same causes of the productivity slump – the slowdown of technological progress in the same industries and of roughly the same magnitude.

[14] For example, while some European economies experienced a persistent or step-wise fall in the TFP growth since the end of '80s or early '90s, the U.S. experience prior to early 2000s was positive upon the large uptake of the ICT across the economy. Its TFP growth shows a surge driven by the strong TFP growth in the ICT-intensive industries, possibly due to the interactions between the ICT-related capital and innovation, a phenomenon crucially dependent on the management practices, human capital and decentralization in the firm structures (see e.g. Bloom et al. 2022 and Bresnahan et al. 2002). The U.S. firms ware better positioned in those dimensions and have managed to reap the productivity growth benefits of implementation of the ICT capital.

Figure 2.9 Trend TFP growth in selected countries (in percentage)



Note: The presented trend is calculated by applying the Hodrick-Prescott (HP) filtering on the actual data series.
Source: OECD Economic Outlook Database (112) and own calculations.

After a weaker performance in the '80s, the development of trend TFP growth in Sweden resembled the US and the UK experience, as opposed to the developments in some other advanced European economies such as France and Germany. The second half of the '90s decade and early 2000s was marked by a strong TFP growth (well above 1 percent in trend TFP growth in the 1997–2004 period, NIER 2022). The strongest TFP growth in Sweden occurred in the ICT sector of the economy, a trend that applies throughout the recent three decades, although somewhat weaker compared to other advanced economies. (Tillväxtanalys Rapport 2021:09)

The implications of the financial crisis and the Great Recession for the TFP level and growth were large.[15] TFP is by itself procyclical and was driven down by the large contractions in the economies during the crises, but has remained low even in the years after the crises, raising the issue of potential longer-lasting scaring effects. The financial crisis and the following recession affected Swedish TFP in the similar manner as the other advanced economies. The initial contraction in TFP growth was somewhat stronger, as well as

[15] For more details on the developments and mechanisms during the Great Recession (2007–2010) and the Covid-19 pandemic see Appendix E.

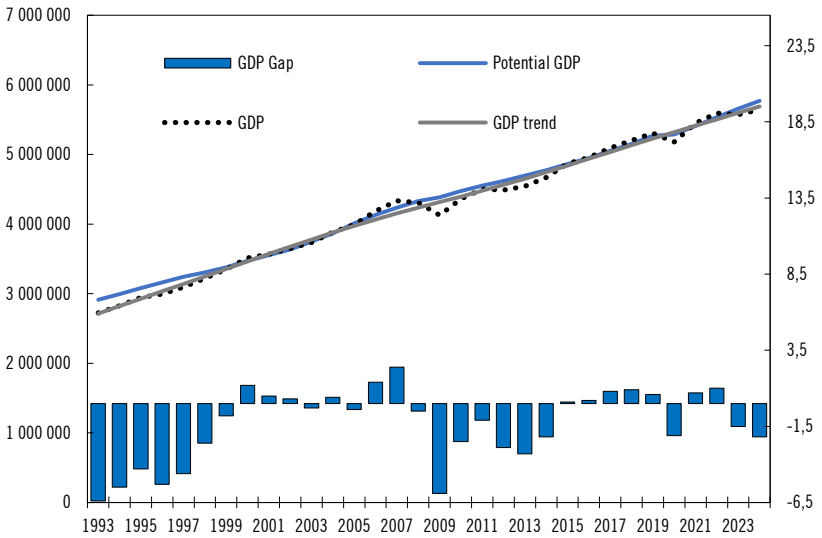
the recovery after 2010 (Tillväxtanalys 2021). Given that the TFP growth is estimated as the residual after other factors' growth contribution to labor productivity growth have been accounted for, these findings should be assessed together with the developments in, first of all, capital deepening which has been somewhat less volatile compared to many other advanced economies.[16] Covid-19 pandemic has brought similar developments in Sweden as in other economies. For a small open economy strongly integrated in the international trade and global value chains, disruptions in foreign demand and international supply chains have imposed considerable threats. However, the Swedish economy has experienced a relatively quick rebound in the productivity and TFP growth measures after the pandemic, supported by a high level of adaptability relying on digital technologies, e-commerce and teleworking. (NIER 2022)

[16] Large falls in TFP growth do not necessarily reflect a reduction in the pace of technological innovation, but may come as a result of smaller contractions in capital deepening in times of large potential output growth drops. Thus, they should rather be understood as falls in efficiency growth. i.e. factors other than technology.

3 Potential GDP – definition(s), measurement and development since the 1980s

To analyze the structural component of GDP, historically and forecasting into the future, economists employ the notion of potential output – the sustainable level of output capturing the key aspects of long-run economic development, particularly important for fiscal analysis "looking through" the transitory variation to assess the structural budget positions.

Figure 3.1 Output concepts – Potential, actual and trend GDP (LHS) in billions constant SEK; GDP gap (RHS) in percentages (Sweden)



Note: The presented GDP trend is calculated by applying the Hodrick-Prescott (HP) filtering on the actual data series.
Source: NIER and own calculations.

Over longer time horizons, as shown in Figure 3.1, one can project a fairly smooth growth path in the actual output data - the GDP trend (grey line). The trend itself is a measure fairly close to the notion of potential output (blue line), but which may diverge to a larger or smaller extent from it over periods.

Over the shorter horizons, (demand-driven) temporary oscillations in the actual GDP (dotted black line) bring forward the interest in the actual-to-potential GDP gap (light blue bars, right axis) and the goals of stabilization policies.

With the focus on the long-run, trend analysis, Section 3 presents the definition and developments of potential output in the recent decades.

3.1 Definition of potential GDP

The potential output (GDP) in the long run[17] is defined as the level of sustainable real output in the economy when all available productive resources-specifically, labor and capital are used in their normal capacity, within the given leading-edge technological capacity. The potential output is a supply-side steady-state concept, free of any temporary fluctuations. Temporary fluctuations from some hypothetical potential are due to "normal" adjustment of the economy to transitory technological and non-technological shocks that should be abstracted from when analyzing potential GDP over the longer horizons.

Potential GDP is to a large extent an abstract theoretical concept and is mostly shaped by structural forces characterized by a slow evolution of demographic trends, capital accumulation and technological progress. However, there is no reason to regard the potential output as a perfectly smooth path. Long-run productivity growth, capital accumulation and labor supply growth are stable and slow processes but are certainly responding to the shifts in structural factors such as demographic transitions and technological transformations. Moreover, extraordinary events such as large economic crises, political instability and armed conflicts, natural disasters and

[17] At this instance, "long-run" concept should be understood as the notion of the time horizon over which the observations and analysis are made, as opposed to the long-run as a notion of time periods stretching long into the future. Long-run term denotes time horizons over which it is possible to observe the trend movements of (stochastic) variables with relative precision.

deep and permanent policy changes, especially in the domain of fiscal policy, can change the course of the potential output. Policies that promote incentives for the development of technology, infrastructure, labor supply and human capital can have substantial implications for potential output.

Economic theory recognizes also the temporary supply-side shocks, such as higher-frequency technology shocks and disruptions in inputs supply and their costs, as factors driving the "natural" level of economic output, a concept similar to potential output but more volatile (see Appendix C for more theory discussions). Practitioners typically abstract from that type of developments when measuring potential output of the economy, occasionally revising the (trend) potential output for some larger and relatively longer-lasting supply-side deviations, still leaving the temporary fluctuations out of the notion of potential. Arguably, this practice reduces the risk of faulty estimates given the large uncertainty surrounding this type of variations, thus avoiding more frequent swings in the structural development of public finances that may also turn out to be unjustified.

Shifting the focus to shorter-run horizons, an economy is exposed to various transitory supply and demand shocks causing cyclical variation in the actual output that is accompanied by movements in inflation (see Appendix C). Stabilisation policy addressing these deviations, i.e. the output gap over the cycle, relies on the proper separation of the finer supply-side dynamics driving potential variables from the movements in the observed variables caused by responses in demand. As discussed above, temporary supply shocks are largely disregarded in the smoothed measures of potential output used in practice or they get incorporated only very slowly and with long delays after successive revisions are made. In other words, in the calculations of cyclical variations in resource utilization transitory supply shocks largely get attributed to the demand side and, consequently, do not affect potential GDP resulting in a wider GDP gap. On the other hand, a more volatile potential GDP (due to temporary supply shocks which would render the blue line in Figure 3.1 less smooth) would have large

implications for the assessment of the current state of the economy, i.e. the output gap, and the stabilization policy.[18]

To a large extent, the choice of the time horizon and the precise concept and measurement method applied in the potential output analysis depends on the policy area of interest. The structural long-term analysis is concerned with the optimization of long-run growth and employment, as well as the issues of long-run sustainability of public finances particularly related to demographic trends. These types of analyses require estimates of potential output that can provide insights into the structural log-run developments but also serve as feedback to the policy actions and allow for a shorter-run fiscal surveillance. In that context, the above policy purposes imply that there is a need for a unified medium-term methodological approach which most international and Swedish institutions tend to adopt.

Therefore, possible distinction between the potential output and growth concepts over the short and medium-to-long run horizons should be mostly understood as a result of a different ranking of criteria put forward by different policy purposes when making methodological choices in the potential output and output gap calculations. (Cotis et al. 2004)

Estimation methods used by main international institutions and in Sweden

Many international organizations and institutions provide estimates of potential output and its growth for advanced economies, most notably the Organisation for Economic Co-operation and Development (OECD), the International Monetary Fund (IMF) and the European Commission (EC), joined by the National agencies such as national economic research institutes and Central Banks. The estimation methods

[18] Recent supply-side disturbances, most notably the war in Ukraine, disruption in production chains caused by the Covid-19 pandemic and the energy supply problems, may have in fact implied significant reductions in the potential output, possibly rendering it lower than the actual GDP, a state consistent with high inflation. However, Coibon et al. (2018) point out that these arguments should be taken with caution, as the potential output estimates not only do account for lower frequency supply-side variations to some extent, albeit at a lag, but are also too sensitive to demand-driven cyclical components which should not be included in the potential measure. Proper revisions of the potential output and the methods for its measurement are thus not a straightforward task.

are very similar, mostly relying on growth accounting approach and expert judgement.

In Sweden, The National Institute of Economic Research (NIER) focuses on estimating the components of potential output when the economy is in the cyclical balance, i.e. when the resources are used normally. For unemployment, a reference period is chosen to represent the cyclical balance in the labor market and different models are used to assess how structural factors, including demographic changes, have affected equilibrium unemployment[19] relative to the reference period. The size and composition of the potential labor force is determined through projections of the cyclically adjusted series using the demographic development, while potential average working time is obtained through Hodrick-Prescott (HP) filtering to isolate the trend and expert assessment on the reasonable levels in the short run. Historical potential productivity in the private sector is estimated by HP-filtering the actual productivity. However, the short- and medium-run productivity forecasts rely on both HP-filtering of recent developments and the estimates from structural vector autoregressive model (SVAR). In the long run, potential productivity growth forecasts are matched to the actual productivity growth average since 1980. These measures are then combined with the public sector actual productivity measures to obtain the aggregate economy potential productivity. (NIER 2021)

The Government of Sweden also relies on similar methods, production function approach and growth accounting, with the analysis and estimation of the equilibrium unemployment rate in focus[20]. (The Government Office 2022)

[19] In calculating potential labor input, i.e. hours worked, NIER relies on the concept of equilibrium unemployment instead of NAIRU (non-accelerating inflation rate of unemployment). The two concepts are similar and overlap in the long run, but in the short run NAIRU measure may be affected by the cyclical movements in supply, prices and expectations, e.g. when a large negative cost shock may temporarily allow for expansionary monetary policy that lowers unemployment without overshooting the inflation target.

[20] The Government uses the long-run equilibrium unemployment and the NAWRU concept (non-accelerating wage rate of unemployment) instead of NAIRU.

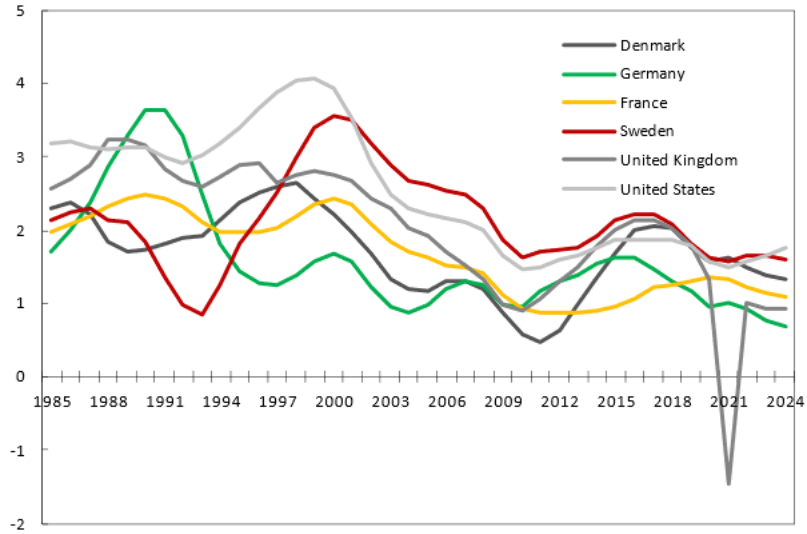
3.2 The development of potential GDP and components

The hypothetical nature of potential output makes it hard to measure and predict its values in the future when an economic analyst has only the real (non-hypothetical) data at hand. However, as noted above, the actual output does usually fluctuate around some fairly smooth long-run trend, driven by a stable growth factor. For this reason, the simplest analysis of the long-run potential output growth starts with an inspection of the long-run averages of the actual output growth (e.g. 10 years out) as presented in Section 2.1. The main assumption is that all temporary deviations will average out and most sluggishly adjusting components will indeed adjust within this time horizon.

Other more sophisticated international estimates of potential growth over the last four decades also reveal a steady decline since the mid-1980s. Figure 3.2 presents the OECD estimates of potential growth for the advanced economies in the recent four decades. The declining trend persisted and has even deteriorated temporarily during the Great recession (2007–2010) initiated by the global financial crisis. As mentioned earlier and also observed in the measures of potential output growth, notable interruption in this downward trend in the late 1990s and early 2000s occurred in the USA and Sweden, possibly due to a surge in innovation in the information and communication technology (ICT), an increase in the TFP growth in the ICT-producing industries, and a wide-reaching implementation of the ICT.[21] The weak performance in potential output growth since the '80s has raised concerns throughout the advanced economies and has called for the analysis of the factors (components) driving potential output and its growth.

[21] The Euro area as a whole has as well experienced the lower reduction in potential growth trend, mostly due to milder developments in the demographic trends, although both the potential growth and the population growth are lower compared to other major advanced economies.

Figure 3.2 Potential growth in selected advanced economies, 1985–2024 (in percentage)



Note: Data for years 2023 and 2024 present the OECD forecast.
Source: OECD Economic Outlook Database (112).

3.3 The development of factors driving the potential GDP

Similarly to the discussion in Section 2.2, one can analyze the trend in potential output through the lenses of its two main components, trend in hours worked and labor productivity, respectively, where each can be further decomposed into the contributing factors. By the methodology used by the main institutions providing the estimates of potential output, all the components of potential labor productivity (except capital stock) are the trend components obtained by applying the HP filter on the actual data series, where the OECD also conducts cyclical adjustment of the series prior to filtering. Capital stock is assumed to contribute to potential output in its full and thus remains unadjusted. For those reasons, the analysis of the potential labor productivity is practically the same as the one presented in Section 2.2 where the trend components of actual GDP can be interpreted also as their potential counterparts. Where most divergence between the measures of potential output

and the actual series trend may occur is in the potential hours worked component which depends on the estimates of the equilibrium unemployment. The definition and the evolution of potential hour worked in the selected advanced economies is presented in Section 3.3.1

3.3.1 Potential hours worked

Trend potential growth in hours worked is a measure of potential labor supply growth in the economy. It is determined by the following factors:

- Trend in the working-age population
- Trend employment rate, and
- Trend in average hours worked conditional on employment/working

The first two factors determine the potential employment of an economy in terms of the number of people working. The trend in working age population is driven by demographic forces, while the trend employment rate, as the employed workers share in the working-age population, is a result of the labor force participation rate and the equilibrium unemployment rate. This rate of unemployment, as a contributor to the measure of potential employment, is shaped by the supply-side factors and features of the labor market and the job-matching process.[22]

Notable demographic changes in the advanced economies in recent decades – slower population growth and population ageing – have been reducing the trend in the potential working-age population (15–74) and its share in the total population in many advanced economies (e.g. USA and France, see Figure 3.3). These developments weigh down on the trend growth in potential output,

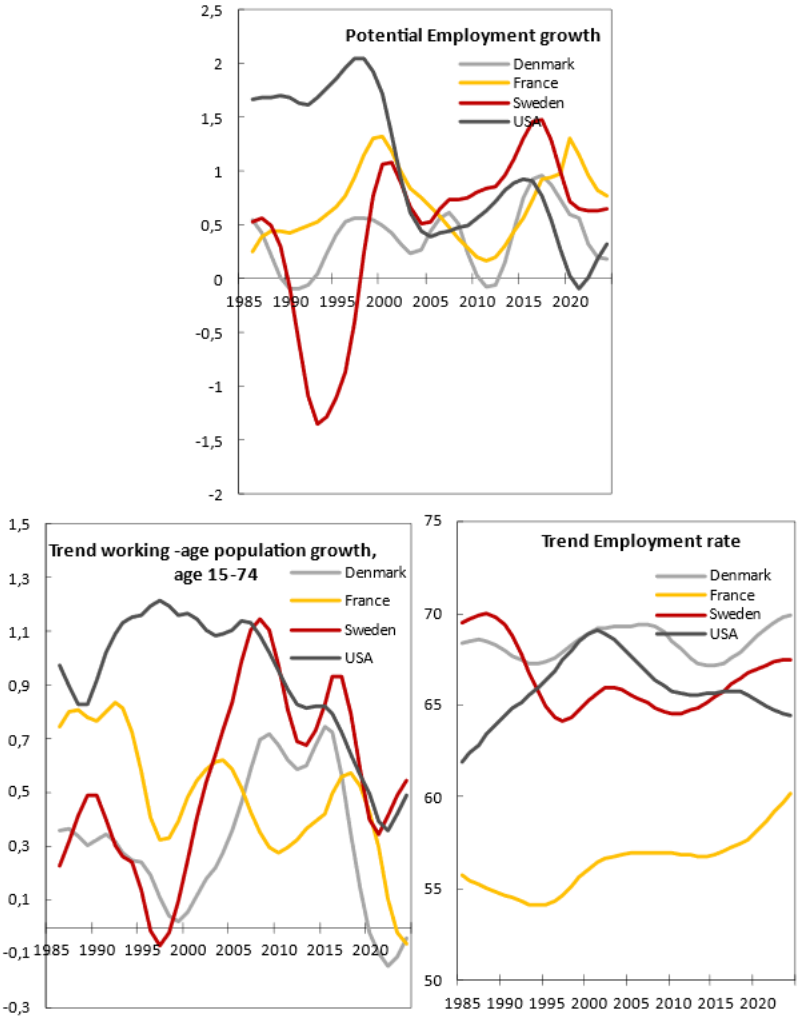
[22] Many institutions reporting the measures of potential variables rely on a shorter-run measure of unemployment, i.e. the rate of unemployment that is consistent with stable inflation (NAIRU). This rate of unemployment is partly driven by the structural factors and partly by the short-run factors and expectations, along with the intensity of the persistence effect (depreciation in skills and human capital of those unemployed under longer spells and thus reduce their prospects in job matchings, translating into persistent, long-lasting unemployment). In the long run, measures of the NAIRU rate (conditional on a constant inflation rate in the long run) should correspond to the equilibrium unemployment rate.

in total and per capita, respectively, as they falter the labor supply growth and the old-age dependency ratio increases. In Sweden (as well as in e.g. Denmark and Norway), on the other hand, the growth in the working-age population has showed a significant rise in the two decades following the end of '90s, only to stagnate or fall recently. Relatively strong fertility rates in Sweden (in the very top among advanced European economies), though below replacement rates, coupled with large immigration waves have contributed to these developments.

Equilibrium employment rates in the economies facing negative developments in the working-age population have been increasing over different periods in the last four decades, offsetting the demographic trends to a lesser (as in the US) or larger (as in France) extent. In Nordic economies, employment rates have been relatively stable[23] since the end of the '90s, only to begin rising in the recent years. It should be noted that Sweden experienced a substantial drop in the employment rate in the first half of the '90s decade contributing to the dip in potential employment growth in its otherwise strong performance over the course of the recent decades.

[23] With a notable exception of Finland which has experienced increases in employment rate.

Figure 3.3 Potential Employment development, with contributing components

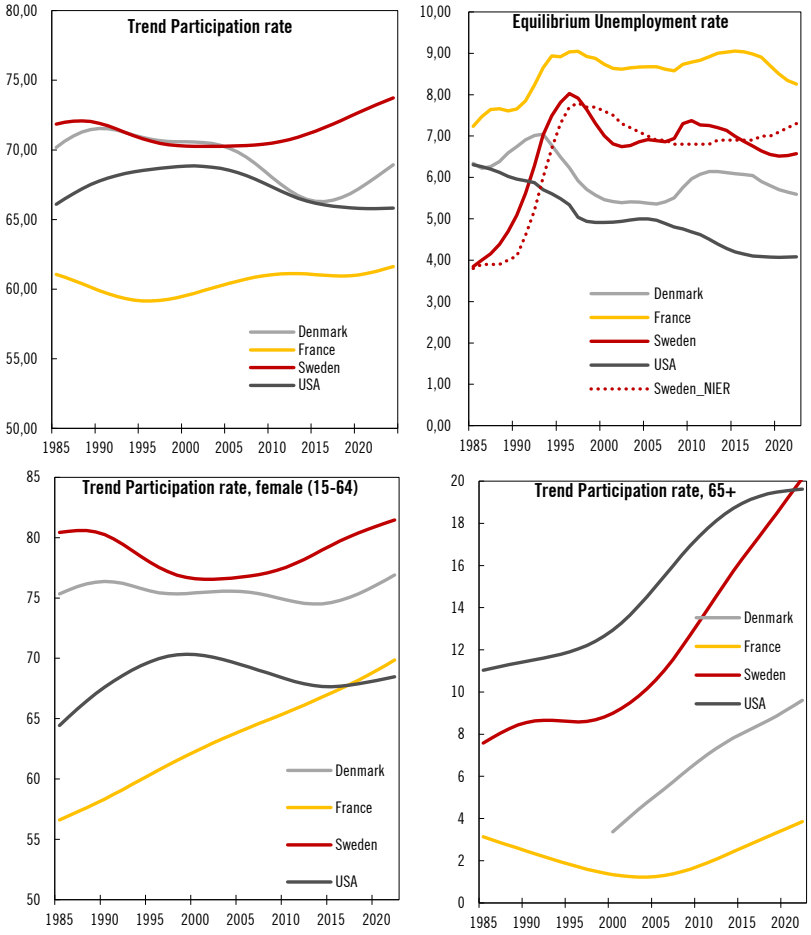


Source: OECD Economic Outlook Database (112).

Two factors stand behind the potential employment rate developments – the labor force participation rate and the equilibrium unemployment rate as shown in Figure 3.4. Participation rates have varied over the observed period, with somewhat stronger positive trends up to the Great Recession (2007–2010) and a downturn in the aftermath of the crises, except in Sweden which has experienced a significant rise in participation rate in the last two decades. Notable

positive contributors to the participation rate have been found in a finer disaggregation by gender and age.

Figure 3.4 Employment rate factors



Note: The presented participation rates trends are calculated by applying the Hodrick-Prescott (HP) filtering on the actual data series.
Source: OECD Economic Outlook Database (112), NIER and own calculations.

An increase in the female participation (that varied in magnitude and timing across the economies), and a notable increase in the older workers (65 years or older) participation rates, especially after 2000s have come as a continuing response to structural and policy changes as well as population ageing, respectively. However, although

increasing the participation, females and old workers tend to work fewer hours which has muted the effect on potential hours worked growth[24]. The population is projected to age further which will expectedly bring further changes in the rates across the age segments of the working-age population, potentially also in the definition of the working-age.

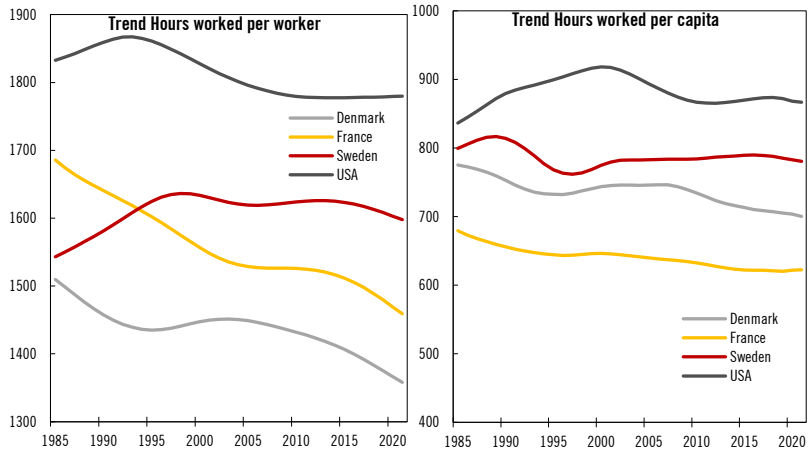
Observed stagnation or decrease in the rate of equilibrium unemployment in Figure 3.4[25] has contributed positively to the developments of the potential employment rates as more people in the labor force are able to find jobs. In Sweden, the equilibrium unemployment rate experienced a large increase in the early '90s due to a series of adverse macroeconomic shocks, and has since fallen but remains high relative to the pre-'90s period (at around 7 percent on average), higher than the EU average of 6 percent in April 2023. Immigrant and (young) low-skilled workers are particularly vulnerable groups that have worse prospects in the highly technologically- and knowledge-intensive economy (Lundborg et al. 2007).

Finally, potential total hours worked trend draws significantly on the developments in the trend hours worked per worker, besides the trend in potential employment (Figure 3.5). Hours worked per worker have been on decline, markedly affected by the increase in the share of part-time employment that stretches beyond cyclical trends. Swedish scenario does not show such marked changes. After a large increase in the '80s and early '90s, average working hours have been relatively stable since early 2000s. Looking at the measure of hours worked per capita in comparison, as an indication of the ageing and rising dependent population share effects, most advanced economies do not show more significant drops relative to the per worker measure. This phenomenon is possibly yet to change as more older workers retire at a higher age and the demographic trends develop further.

[24] In countries with the most notable increase in the share of these groups in the labor force, average hours worked per employed have declined.

[25] The Figure presents the OECD data which uses the trend NAIRU equilibrium unemployment concept until 2021. For Sweden, as reported by the NIER, a long-run, purely structural concept measure of the equilibrium unemployment is also presented by the dashed line. In general, the two concept should converge when analyzed over a longer time horizon.

Figure 3.5 Trend Average Hours Worked



Note: The presented trend is calculated by applying the Hodrick-Prescott (HP) filtering on the actual data series.

Source: OECD Economic Outlook Database (112), SCB and NIER, and own calculations.

Overall, the common feature of the advanced economies has been a decline or stagnation in the potential employment growth which has then failed to contribute to the potential output growth.

In Sweden, however, there has not been such an obvious negative overall development, Potential labor force growth has stabilized at around 1 percent, mainly due to the strong and rising participation rate in prolonged periods, and a stronger increase in the trend working-age population. Nevertheless, the growth in the labor force and the high labor force participation are still coupled with a high equilibrium unemployment as a limiting factor to the contribution of potential employment to potential output growth.

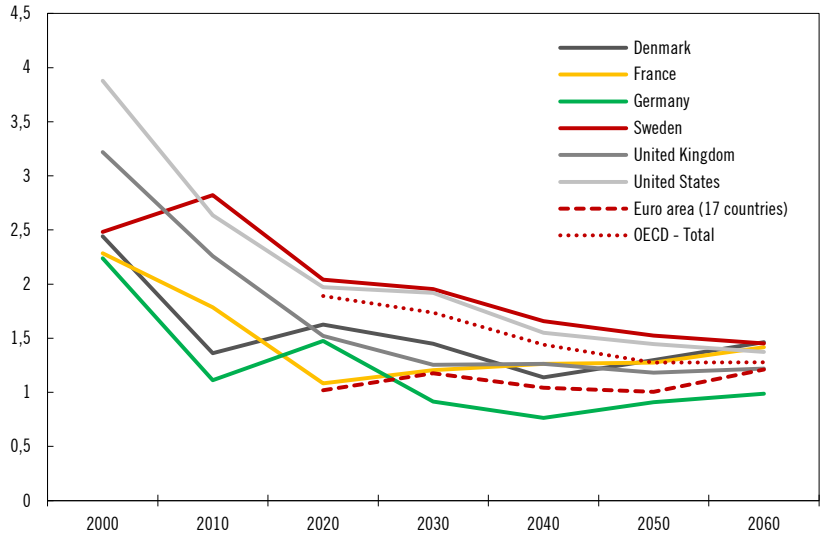
4 Forecasts

4.1 Potential growth and its deriving forces in future

According to the OECD forecasts in 2020 (Figure 4.1), the global potential output growth is projected to slow further in most advanced economies up to 2060, with a relative stagnation in European economies that have previously experienced lower rates.

Figure 4.1 OECD Potential Growth Forecast, 2060

10Y annual rate average, forecast from 2020; annual growth



Source: OECD Economic Outlook Database (108), long-run projections.

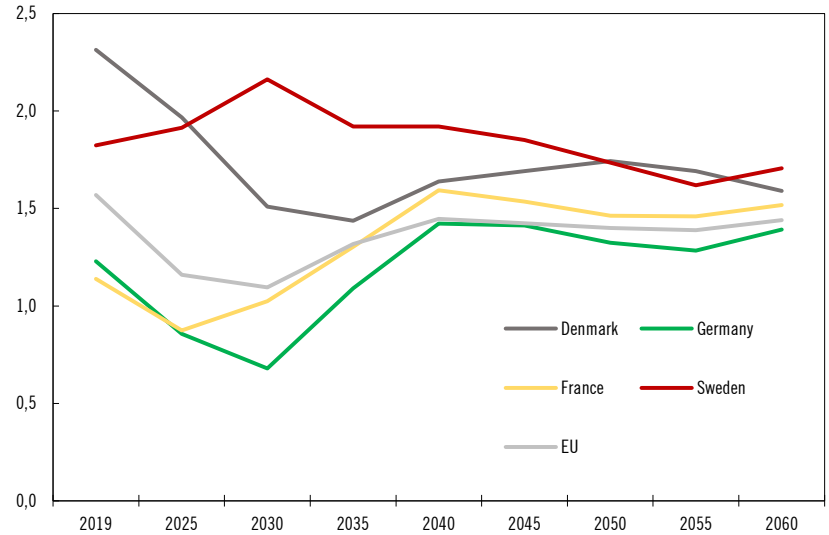
The forecast is relatively uniform across countries with all presented economies potential growth converging to 1–1.5 percent by 2060.[26]

[26] In a global perspective, from a historical 3.6 percent in global potential output growth in the decade before the Great Recession, global economy is projected to slow down to 2.8 percent growth in the 2024-2029 period and keep slowing down at a lower pace thereafter.

Demographic trends are determined to be the key factor responsible for this growth tendency.

The EU Commission forecasts on the EU countries is somewhat more optimistic (Figure 4.2). Growth on average is projected to reach 1.2 percent up to 2030, increase slightly in 2030s and 2040s, and afterwards stabilize.

Figure 4.2 EU Commission Potential growth forecast, 2060



Source: EU Commission, DG ECFIN 2021 Ageing Report.

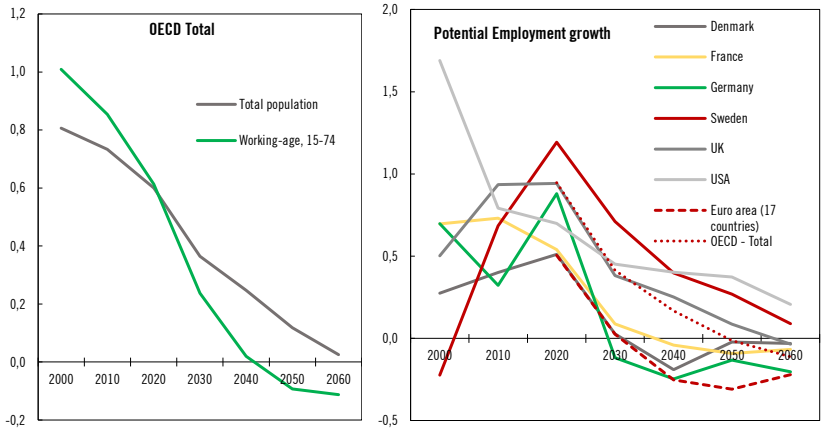
The EU Commission projections as well stress out the demographic trends as the main growth reducing component, which again puts forward the future labor productivity growth as the main driver of positive developments. The forecasts on these components of potential output growth in future are presented in the sections below.

4.1.1 Labor supply growth in future

Demographic trends are expected to be the most important component of the growth decline globally until 2060. After having contracted from 2 to 1 percent over the past six decades, global population growth is projected to nearly halt by 2060. Although a

slower growing population relaxes some of the (resource) sustainability threats, it lowers the growth in labor input. OECD forecast (Figure 4.3) predict a stable decline in potential employment growth up to 2060 due to a strong contraction in working-age population growth, with the resulting rates being close to zero or slightly negative. After having resisted the negative demographic trends in the previous decades, Sweden is also projected to experience similar trends as other advanced economies, albeit at slightly higher rates.

Figure 4.3 OECD Population growth and working-age population growth projections, Potential Employment growth



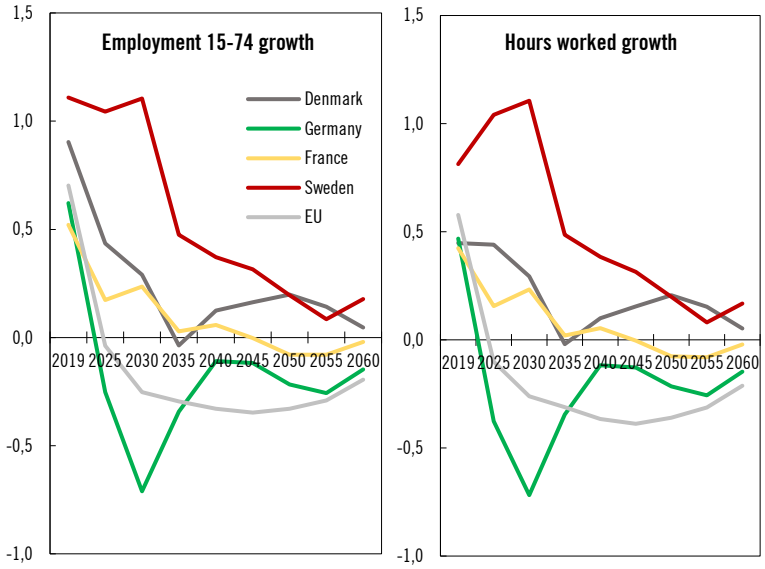
Source: OECD Economic Outlook Database (108), long-run projections.

Projections of the EU Commission are very similar (Figure 4.4). Potential labor input growth will make a negative contribution to potential output growth (-0.2 percentage points in the EU) due to a reduction in the working-age population (not matched by favorable development in participation and employment rates, especially for women[27], which increases potential labor force and employment),

[27] When translating the demographic changes into their effects on potential output growth, many forecasters often assume constant participation (and structural unemployment) rates which implies that a reduction in working-age population ratios come with a reduction in employment ratios. However, Goldman Sachs (2022) finds a much weaker correlation between the two stemming from the fact that longer life expectancy and better health incentivizes workers to work longer before retirement and thus increase the labor force participation rates. As a consequence, the negative demographic trends in the societies that are ageing fast have lesser implications for the labor force trends, compared to the forecasted trends not accounting for positive changes in participation of elderly population.

coupled with a decline in the average hours worked. Again, Sweden is expected to share the general potential employment trend of the other advanced economies, although at a lag and at higher levels.

Figure 4.4 EU Commission forecast on labor input components growth, 2060

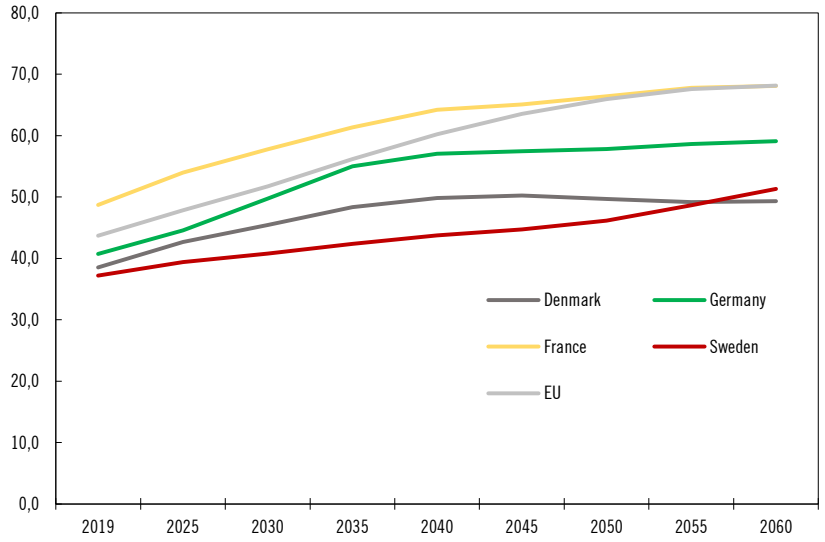


Source: EU Commission, DG ECFIN 2021 Ageing Report.

The phenomenon of slower population growth is coupled with population ageing which increases dependency ratios and causes economic challenges for the development of potential growth per capita. Moreover, the sustainability of health and pension systems are at risk, as the share of working-age population declines.

Figure 4.5 Economic old-age dependency ratio

Inactive population 65+ / employment 20–74



Source: EU Commission, DG ECFIN 2021 Ageing Report.

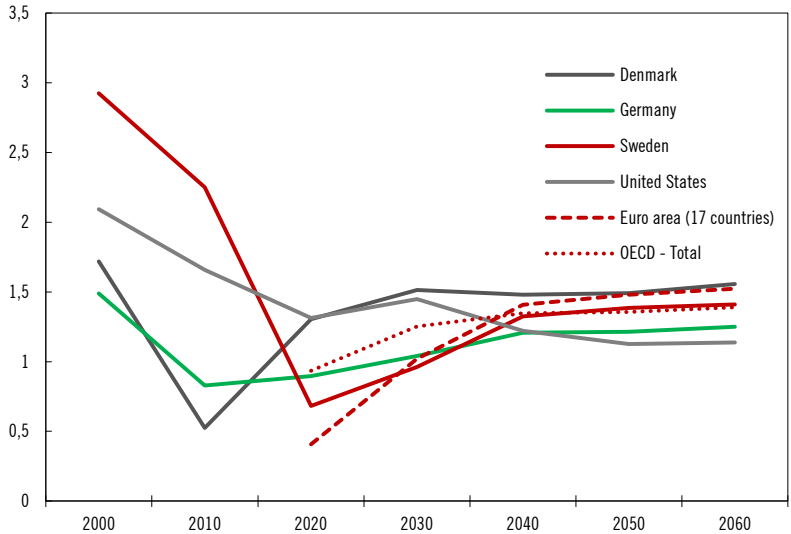
In the EU population, the share of people of 65 years of age or more was 20.8 percent in 2021, while this number is expected to rise to 30 percent by 2050, increasing the dependency ratio to close to 70 percent (less than two working-age adults on every elderly person, Figure 4.5). The European Commission Ageing Report (2021) is estimating the ageing costs (pension, health care, long-term care and education expenditure) as a share of GDP to rise by 1.9 percentage points from initial 24 percent in 2019, with the health care costs being the biggest contributor to the increase. At the same time, the young population is shrinking, failing to fully replace the middle-aged workers at the peak of productivity with large consequences for labor productivity growth. Sweden is projected to have lower dependency ratios compared to other advanced economies, but also rising to slightly above 50 percent by 2060 (it is projected to rise by 15.7 percentage points by 2060). The expected increase in the size of the working-age population is not enough to keep dependency ratio constant.

4.1.2 Labor productivity growth in future

OECD (2015) notes that with the slowdown in population growth (and rise in population aging which is relevant for potential growth in per capita terms) and the limitations in human capital development which is hindered by decreasing marginal returns to education at its higher levels, the weight of TFP growth in driving future growth prospects will be rising (see Figure 4.6).

Figure 4.6 OECD Trend growth in TFP forecast, 2060

2000–2060 (annual average)

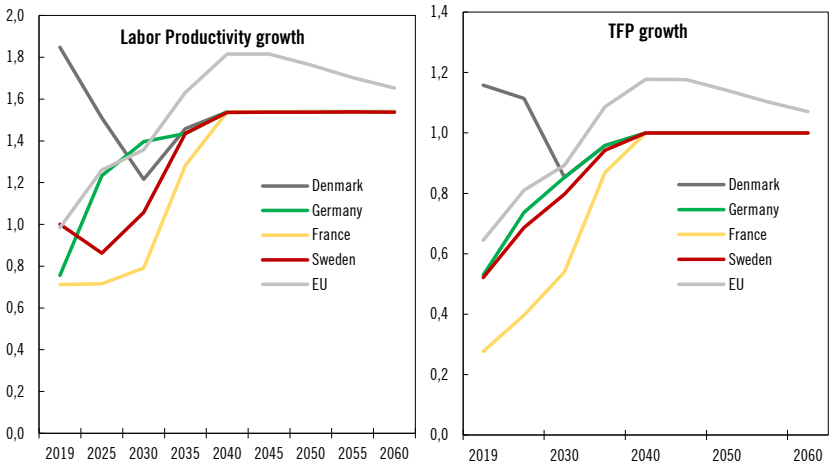


Source: OECD Economic Outlook Database (108), long-run projections.

Trend TFP growth is expected to rise in most presented countries up to rates of 1.5 percent by the 2040s and afterwards stabilize, except in the US where the developments are negative (shrinking to 1.2 percent).

EU Commissions predictions are somewhat more pessimistic. TFP growth as the sole source of potential output growth is expected to recover but only up to 1–1.2 percent for the selected countries presented in Figure 4.7. The resulting labor productivity growth is projected to rise from less than 1 percent to 1.5 percent by 2030 and to remain stable throughout the period.

Figure 4.7 EU Commission forecasts on labor productivity growth (left) and TFP growth (right), 2060



Source: EU Commission, DG ECFIN 2021 Ageing Report

At the same time, there are large uncertainties on how the future TFP growth will develop and potential failures of predictions and their implications are analyzed in the assessment of risk scenarios. Learning from the recent history, the ICT sector and the investments in tangible and particularly non-tangible ICT capital can be expected to be the forerunners of future TFP growth. However, the ability to reap the full productivity benefits surrounding ICT is strongly dependent on the organizational quality and management practices. These issues are all tied to specific characteristics at the firm-level, and the firm's incentives to push the technological frontier outwards. Research literature and discussions (e.g. OECD 2015) point to the role of superstar multinational firms in TFP growth at the global frontier as well as in the diffusion of frontier technologies to other firms. Superstar global firms are the most productive firms within industries, they operate at the global level and are more likely to patent compared to other firms. Even though the aggregate productivity at the country levels experienced a slow-down over the 2000s, productivity growth at the global frontier (superstar) firms level remained stable. This in turn leaves the issue of impediments for successful technological diffusion from the global frontier firms to the lagging national firms, which becomes increasingly important as the main channel of technological catch-

up and the revival of economic growth. Countries that host a significant share of successful global companies and start-ups in their industries, such as Sweden, are well positioned for the upturn in the projections for the future.

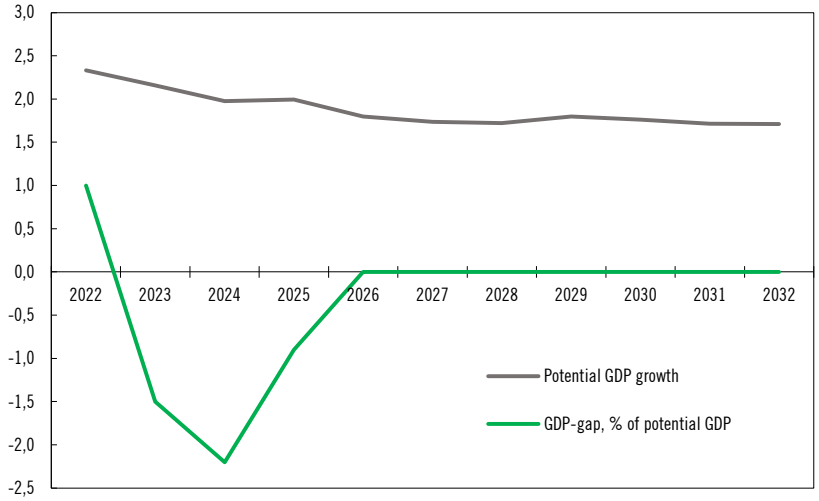
Concerning the very new technologies and their development and transmission, economists and the industry typically agree that the benefits of the second stage of the digital revolution (driven by the AI technologies) will be realized. Labeling these advances as a General Purpose Technology (GPT) economic models and historical experience tell us that the GPTs, not only require the necessary complementary resources and conditions, but also wide adoption with a significant lag. In his New York Times Opinion post Krugman (2023) debates on the two key questions: how large the productivity effects will be, and how quickly they will come about. While the first question hardly can be answered by any expert or policy maker, the answer to the second question relies greatly on our experience from the past which suggests very long lags before the AI benefits finally materialize. At least longer than what most people currently expect. Nevertheless, adoption lags are greatly affected by the policy.

4.2 Potential growth developments in future Sweden

This section discusses the NIER (2022) forecasts on the future of Swedish potential output in the next decade (up until 2032) from the perspective of the main driving factors, and also those that are specific for the Swedish economy.

Predictions on the potential growth slowdown are similar to the EU commission projections. Regarding the relation of potential growth to the actual GDP growth in the near future, the Swedish economy is predicted to overcome the current negative output gap by 2026 (Figure 4.8).

Figure 4.8 Swedish Potential GDP growth and the GDP-gap, 2023

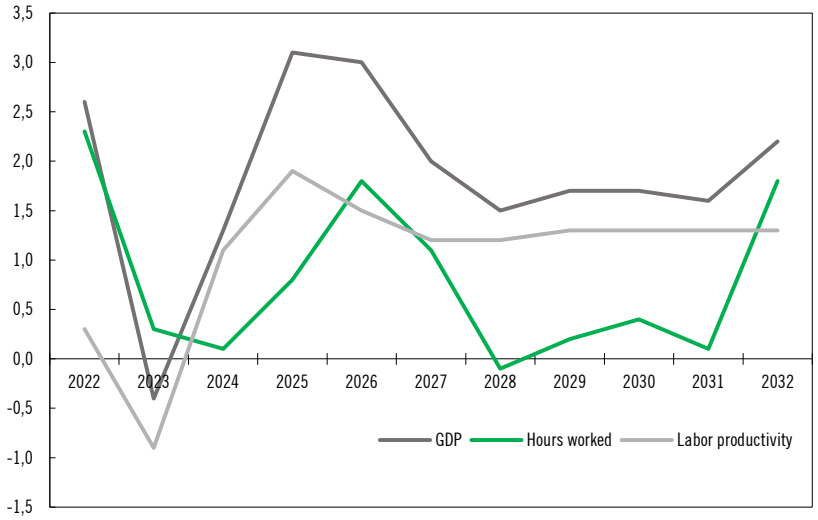


Source: NIER 2023.

In the developments thereafter, the most important contributor to output growth in the following 5-year period will be the stable (1.3 percent) labor productivity growth as the growth in hours work halt (Figure 4.9).

In the public finance sustainability analyses by NIER made for this report, the forecast extends to 2100. Labor productivity is predicted to grow at 1.3 percent per year, and until 2050 GDP growth forecast is just above 1.5 percent per year after an initial cyclical adjustment.

Figure 4.9 Swedish GDP growth projections with contributing factors growth, 2032

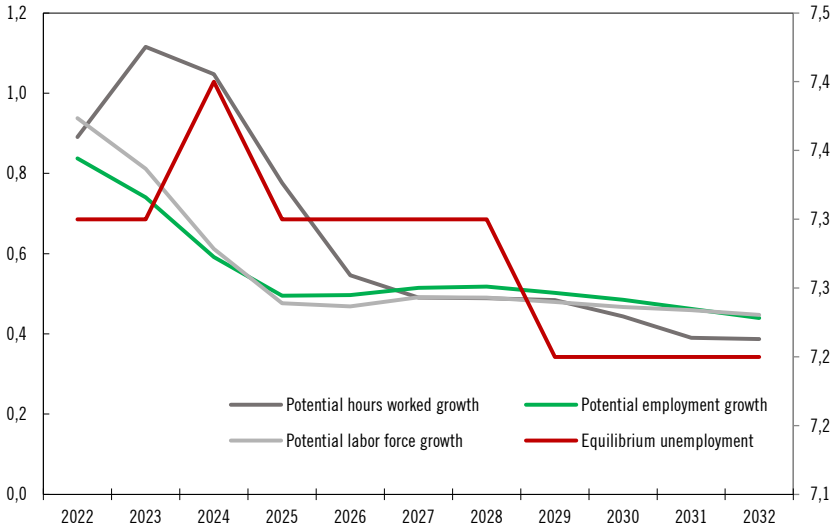


Source: NIER 2023.

Potential labor input growth

The labor input growth predictions are in line with the forecasts of international institutions in terms of the downward trend and the resulting potential employment and hours worked growth rates in 2032 (0,4 percent). A fall in the potential labor force growth (stemming from working-age population growth and participation rates) to 0,5 percent is only to some extent compensated by a predicted fall in equilibrium unemployment rate by 0,1 percentage points by 2028 (Figure 4.10).

Figure 4.10 Potential hours worked growth with components (equilibrium unemployment right axis), 2023

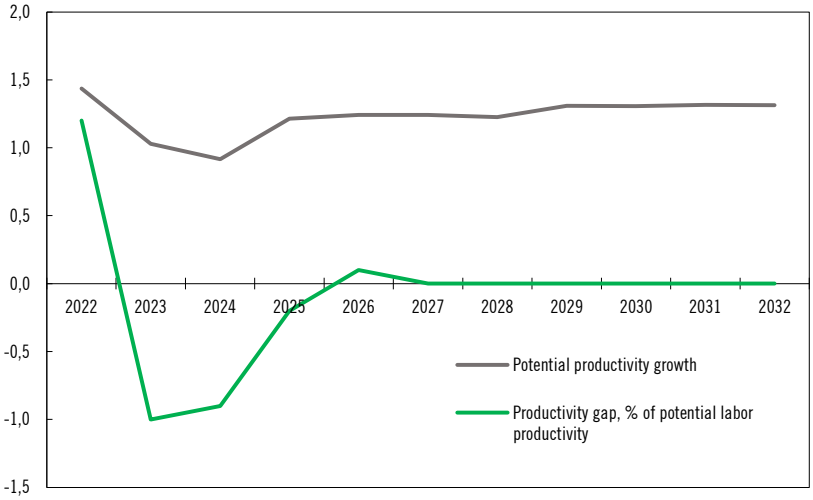


Source: NIER 2023.

It is argued that structural transformation in the economy brings increases in the separation rates of worker-job matches as the firms and workers adjust to the new environment. However, the changes brought by the Covid-19 pandemic, namely the shift towards stronger digitalization, have rendered the adjustment faster and has also allowed for the short-time and distance work. These changes are contributing to a reduction in separation rates and, thus, a fall in equilibrium unemployment rate until 2032. Furthermore, lower growth rate of potential labor force reduces the time for successful job matching, while the weakening in the persistence effect (of unemployment) and the applied policy measures are also expected to start showing reducing effects on equilibrium unemployment rate in the near future. Job matching efficiency is expected to deteriorate due to changes in the workforce composition from several categories of the new foreign-born labor force, but the overall effect on unemployment rate by 2032 is negative. (NIER 2021).

Potential labor productivity growth

Figure 4.11 Potential productivity growth and the productivity gap, 2023



Source: NIER 2023.

Potential productivity growth is expected to rise from 1 percent to 1,2 percent by 2025 and then experience another rise by 0,1 percentage point by 2029 where it will stabilize. The negative productivity gap is projected to turn slightly positive in 2026 and diminish thereafter (Figure 4.11). Several important factors for the productivity development are put forward.

Technological change is virtually impossible to predict, but judging by the innovation climate and incentives, the NIER predicts a rise in its pace in the near future. Furthermore, technical transformation towards production that uses sustainable energy sources may be productivity-enhancing, another factor expected to contribute to productivity growth but possibly only after 2030 when several larger projects are to be implemented. Regarding the human capital trend, some relatively small negative effects of a drop in measured skills of youth in 2012 (PISA results for 15-year olds) who are now entering the labor force are to be expected. This may be coupled with the deterioration in education outcomes due to distance learning during the pandemic. Finally, the composition of sectoral output in the total potential GDP may have large

consequences for the growth rate as the sectors experience very different rates of productivity growth. Public (excluding health) and health sectors both have lower productivity growth rates compared to the business (private) sector. The public sector is projected to experience very weak productivity growth rates in the next decade, while the health sector is expected to increase its share in the total economy as the population ages, each in turn contributing to the aggregate economy reducing its productivity growth further relative to the business sector.

4.2.1 Lasting scarring effects and benefits of the big crises

Large economic, natural and geo-political crises have often had longer-lasting consequences for the economies and their potential growth. The world economy has experienced two such events in the last 15 years which has raised numerous discussions on how and whether the effects of these event should be included in the revised measures of potential growth.

Most advanced economies have rebounded their productivity growth rates to a larger or lesser degree during the decade following the financial crisis and the resulting Great Recession (2007–2010). As discussed previously in the text, the capital deepening, productivity and potential output growth rates have still remained below their pre-crisis levels, but the prospects were deemed relatively positive before the Covid-19 pandemic. Nevertheless, there are several caveats when making projections on the lags until the full recovery. Damaging consequences of skill depreciation due to longer unemployment spells and the (permanent) industry exit of a significant number of small and medium enterprises are among those caveats.

On the other hand, after-pandemic recovery brings its own challenges – recovering the healthy industry dynamics, but also realizing potential benefits for the structural transformation and further digitalization. The overall effect is yet to be evaluated.

Possible longer-lasting effects of Great Recession and Covid-19 pandemic

Two main consequences of the Great Recession are discussed in the literature. First, longer spells of unemployment have had negative consequences on laid-off workers skills but the true magnitude of the effect on potential output growth will only become known when estimates for the previous decade and the near future have been sufficiently revised. OECD (2013a) estimates that most low-skill workers who lost jobs in larger share were also relatively quick in returning to employment using the same set of skills they possessed. Furthermore, a significant number of workers have returned to education or postponed the first job market entry and stayed in education, which have certainly had positive impact on human capital that will persist in the future.

Another caveat relates to the uncertainty on the magnitude and implication of the "cleansing effect" of the Great Recession. Recessions drive unproductive firms out of business and reallocate resources towards more productive firms and their more efficient use, ultimately raising aggregate productivity. The question surrounding the Great Recession is whether its cleansing effect has been too harsh. Some evidence on the U.S. economy shows that the recessionary effects were similar as in previous episodes but less productivity-enhancing as the remaining firms faced tough conditions in the financial and credit market. OECD (2015) These facts may leave prolonged consequences for the healthy industry dynamics.

The economic research and literature on the long-run consequences of the Covid-19 pandemic is still relatively scarce and inconclusive. The forecasts on future developments are very uncertain as the scope of the crises was unprecedented – it affected almost all aspects of the society simultaneously, as well as all countries at the same time in a prolonged manner. Differently from the previous recessions, the pandemic crisis has caused changes in both the producers behavior and the consumers preferences. The question is then on how long these effects are going to last.

As with the Great recession, the "cleansing effect" operating at the within-industries level would typically cause productivity-enhancing reallocation but those in turn could have been limited by credit constraints and massive (and long lasting) policy reaction of the governments during the pandemic which may have kept unproductive firms in business. These firms have managed to avoid exit from the industry that would have otherwise occurred in normal times or a recession, and would have thus allowed for a productivity enhancing resource reallocation. Instead, these businesses will present a burden on the productivity growth during recovery.

On the positive note, the pandemic has incentivized the adoption of digital technologies and teleworking. Although it is very hard to establish a causal relationship between digitalization and productivity growth (as more productive firms can also be expected to have higher incentives and capacity to invest in digitalization), but at the aggregate level, acknowledging the reallocational effects, recent trends on productivity of the digitally intensive sectors point to further productivity benefits due to their higher ability to adapt to the new conditions. Teleworking, on the other hand, involves several effects that are perhaps easier to identify but include both positive and negative factors so that the overall assessment is hard to establish. The future forecasts on the summarized relationship between teleworking and workers efficiency may well prove to be of an inverted U-shape type, but the estimates are that teleworking is here to stay. (OECD 2022)

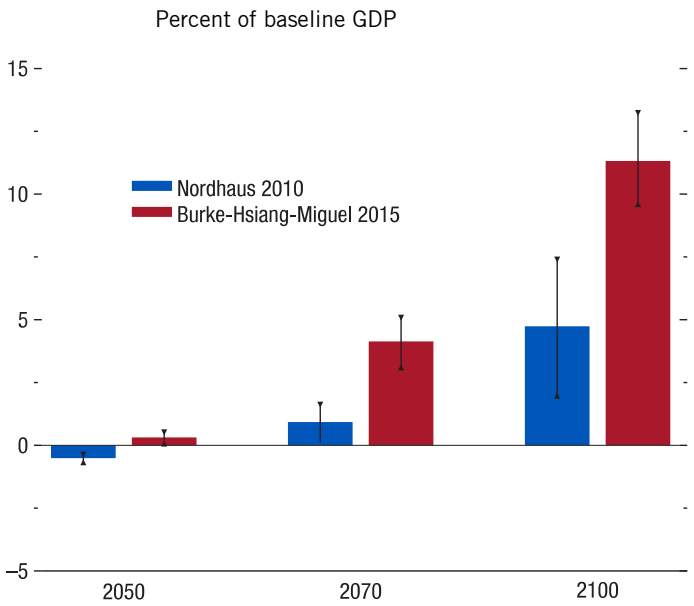
4.3 Greening of the economy – important factors in future potential growth

In order to reach the goal of net carbon neutrality by 2050 (2015 Paris Agreement), world economies need to conduct large and rapid policy interventions. By 2030, global emissions need to be reduced by at least 25 percent compared to today's levels which among other things requires greenhouse gas (GHG) emission taxes, emission trading systems, government regulation of emissions and investment in low-carbon technologies. The hesitation among many

policy makers around the world have been significant, against the widely accepted agreement that consequences of inaction may be catastrophic and that the long-term benefits in terms of output, financial stability and health are large (October 2020 IMF World Economic Outlook; IPCC 2022). Some short-to-medium horizon negative macroeconomic consequences of climate policy implementation are also raised as concerns (e.g. a potential large inflation shock upon implementation).

The IMF World Outlook 2020 reports the results of the analysis of the effects of climate mitigation policy on climate problems and the economic outcomes of the global economy. Optimal policy package (in terms of reaching the agreed limits for emission and global temperature rise) costs are moderate while they are expected to have net positive effect on global growth in the initial years, supporting the recovery from Covid-19 pandemic. Down the road, the GDP growth slows down and after 15 years the policy package is expected to produce a 1 percentage point lower GDP level relative to the baseline, and the estimated GDP costs of transition are within the range of the 1 percent–6 percent of GDP by 2050. These amounts are deemed relatively small in comparison to the expected 120 percent of cumulative GDP growth by 2050. After 2050 and until 2100, the estimates on both the benefits of avoided damage and on the GDP level and growth gains are substantial (see Figure 4.12). From the perspective of different policy components, carbon pricing is lowering GDP due to rising costs of energy while the green fiscal stimulus raises it directly (investment spending) and indirectly (green infrastructure investment boosts the productivity of the low-carbon sectors, incentivizing more private investment), but the package as a whole requires debt financing and thus has an effect on the fiscal costs.

Figure 4.12 Medium- to long-term output gains from climate change mitigation



Note: The figure shows the variation over output gains from climate change mitigation due to uncertainty from two sources: local costs of higher temperatures, from either Nordhaus (2010) or Burke, Hsiand, and Miguel (2015); and climate sensitivity, measured as the increase in long-term temperature with respect to a doubling in CO2 concentration, with a range of 1.5–4.5 and a midpoint of 3 (see IMF report text for discussion).
Source: IMF staff estimates, IMF World Outlook 2020.

Important aspect of climate mitigation policy and investment is its ability to generate significant returns to the support of technological innovation, largely absent from the models used to conduct policy scenario evaluations. Carbon taxes and green R&D subsidies both affect technological innovation and produce long run growth benefits. It is estimated that the resulting technical change stemming from changes in carbon prices and a complementary 70 percent subsidy would reduce the needed carbon prices for achieving the emissions targets by half, compared to the scenario without the technical change channel. At the same time, focusing on the period until 2050, the actual GDP would be starting to approach the baseline earlier, around mid-2040s (Figure 4.13[28]). The drawback

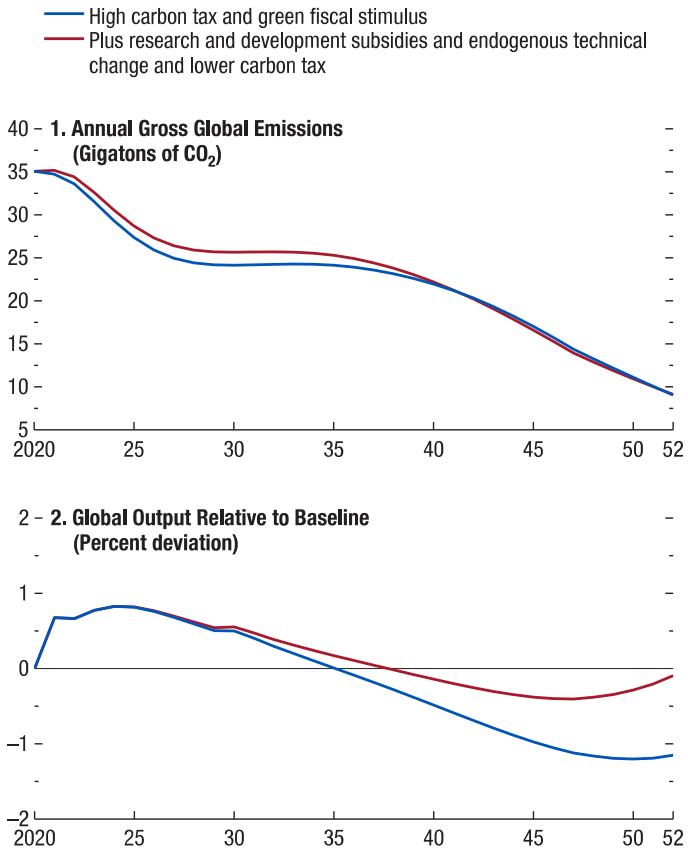
[28] The figure is comparing the scenario accounting for the technical change, (lower) carbon tax, fiscal stimulus and R&D subsidies to the scenario with only carbon tax and fiscal stimulus (though it's a high carbon tax here). Thus, carbon tax is included in both, just showing that it

stemming from the nature of technological innovation and diffusion is the fact that the positive effects come only after a certain lag, i.e. after 2030, relative to a scenario without R&D subsidy and endogenous technical change.

Finally, another aspect of green technologies spillovers should be noted. New energy sources and decarbonizing technologies may provide significant productivity benefits, but it may as well be the case that the climate transition will bring about negative pressures on potential GDP growth due to a reallocation of investments to climate adaptation purposes. These investments may raise the steady-state level of potential GDP but the transition dynamics and the welfare losses along it coming from sectoral reallocations should be taken into account.

may be lower if we allow for the assumption on positive technological change. It may be argued that the market allocation should be more efficient, but we should also account for this important growth driving channel.

Figure 4.13 The role of Green Technological Change



Note: The panels compare the G-cubed simulation of the comprehensive policy package with a simulation run using an extension of the Hassler et al. (2020) integrated assessment model with endogenous technological change. The second simulation features a lower carbon tax and a green research and development subsidy and includes the endogenous response of technology to policies. See Online Annex 3.5 of the IMF report (2020) for more details.
Source: IMF staff estimates, IMF World Outlook 2020.

The recent IMF World Outlook 2023 report points to several challenges in the climate change mitigation policy. The global financial crisis and the war in Ukraine that have led to a retreat from cross-border economic integration have also resulted in reduced international action on vital global public goods, such as climate change mitigation and pandemic resilience. The impact on economic well-being is likely to be negative, with costs particularly high in the short term. To speed up the green transition, international coordination on carbon pricing can limit the overall costs of

mitigation. While there are encouraging signs of international cooperation on adaptation to climate change, more needs to be done, including channeling aid to vulnerable countries. Furthermore, the International Energy Agency predicts an 80 percent reduction in global fossil fuel extraction by 2050, requiring a significant reduction in production. This could have economic repercussions for fossil fuel exporters, as the industry negatively impacts a country's economic growth and institutions, as well as on their trading partners. A new data set on oil, coal, gas, and metal extraction from 1950 to 2020 identifies that a typical episode of contraction is a 10 percent contraction in extraction activity in the episode's first year that cumulates to a 40 percent reduction over 10 years. The macroeconomic effects of these declines are negative, with a typical episode leading to a 1 percent initial decline in real GDP, a 5 percent decline after five years, and a slow depreciation of the real exchange rate. The impact on manufacturing and services sectors is significant and negative, with a negative impact on employment. The estimated GDP impact is larger for middle- and low-income countries than for those with high incomes. A final issue to address when designing log-term fiscal policy measures is an associated expected development of the natural interest rate in response to the climate change mitigation policies. Namely, the transition to a cleaner, more sustainable global economy by 2050 is expected to lower global natural rates by 50 basis points, with potential temporary increases, depending on the actual policy applied.

5 Discussion

5.1 What do the forecasts show? Discussion

> The forecasting work is an interplay between models and assessments. To varying degrees, models assume that history repeats itself or that economic relationships are stable over time, and therefore they also need to be supplemented by analyses and judgements by experts who have an insight into mechanisms and economic developments that the models do not always capture. The overall information from the models is finally weighed together with other information to produce forecasts for economic activity and inflation. The experts' assessments become particularly important when unusual events and/or structural changes that alter the functioning of the economy take place. (Riksbanken, 2022)

Forecasting potential output and its growth in the near future and in the long run implies facing difficult tasks. Producing some medium run projections involve the assessment of the prolonged economic implications of the Covid-19 pandemic, the war in Ukraine, disruptions in energy supplies and the outlooks for the future. For decades to come, certain longer horizon issues also come into play, such as the climate change, demographic developments, large natural disasters and possible health crises and geo-political dynamics. However, the central topic is certainly the development and effects of general-purpose technologies (GPT) which will drive the course of future potential output growth in the long run. The sections below discuss the findings on future global and Swedish potential growth.

Predicted demographic changes are difficult to discuss from the stand point of an economic policy makers. These developments are driven by the deep structural processes and the variables such as fertility rates are difficult to tackle with a single or a small set of policies. Favorable developments require a whole environment of

good economic and social conditions over a prolonged period. This is not to say that policy cannot affect potential labor input growth. Indeed, the forecasts show that economies that manage to sustain labor force inflow that matches the skill requirements of jobs across industries and that have well-functioning labor markets with efficient job matching are expected to fare better in terms of potential labor input growth in future. The Swedish economy ranks well in most of these aspects. Nevertheless, participation and employment rates, as well as the average working hours, all have their limits and cannot produce sustained growth of potential GDP. As discussed in the previous section, this necessarily shifts the focus to the development of labor productivity, and in particular the TFP growth, as the labor input growth may be assumed negligible in the long run.

At the global level, views on the future of TFP growth have become polarized. The "techno-pessimists" point to the rising costs and falling productivity of innovation as more technologies get invented, besides the challenges brought about by negative demographic developments, deteriorating benefits of education, inequality, sustainability issues and large levels of indebtedness across the world. "Techno-optimists", on the other hand, stress out the positive effect of new technologies, particularly the artificial intelligence (AI), in facilitating continuing innovation. (OECD 2015) There are still many aspects of the new technologies that we don't understand either theoretically or empirically, but that are crucial for assessing the effect of intangible capital investment and digital technologies on innovation and for the productivity forecasts accordingly. How long it will take to feel the peak of the productivity benefits is perhaps even more difficult to say but the existing economic theories on GPTs, the secondary innovations and their diffusions could provide certain guidelines.

In the aspects currently considered to be the most relevant for the TFP growth (as discussed in previous sections), Sweden is well equipped to expect stable if not positive developments in TFP growth. Both ICT-producing sectors and the ICT-using sectors have showed high rates of investment in non-tangible assets, coupled with rising intensity of digitalization. Old modes of production processes and businesses have been replaced by the new digital core activities. The intensity of digitalization is relatively high across

most sectors and firms, with large firms, employing the major share of the labor force, being more digitally-intensive relative to the medium and small firms. (Tillväxtanalys Rapport 2018:01). Among the possible risks for poor performance in the near or medium-term future one should note the negative effects of rising industry concentration which does not favor small and young firms, typically responsible for a high rate of innovativeness. Moreover, the observed and previously discussed skill shortages and mismatches in Swedish labor market should be taken into consideration.

Globalization has proved to incentivize labor reallocation across industries and firms, promoting better worker-to-firm match qualities especially in the ICT-intensive industries (see e.g. Davidson et al. 2012 and Baziki et al. 2016 for the results for Sweden). Experiencing a very high level of openness and global value chain integration, Swedish economy should be able to continue enjoying those benefits, especially after the full rebound in global trade following the Covid-19 pandemic. All these aspects grant strong support for forecasting Swedish labor productivity growth to be among the highest in the group of advanced European economies as shown in the OECD and EU projections.

5.2 Important remaining factors

World economy is a highly integrated network of regions, markets, and global production chains. The use of digital technologies is erasing the borders even further. Virtually every economic decision has to be based on the information about conditions in various segments of those networks, and every action has implications for other parties involved. From this perspective, two policy aspects which will certainly have implications for the development of potential output in the near and far future should be mentioned as some final remarks.

Climate change as an international challenge

Judging from the experience of many countries, Goldman Sachs (2022) argues that there is no necessary strong negative correlation between potential economic growth and environmental

sustainability, and the policies designed to tackle each of the issues can be de-coupled. This is not to say that preserving environmental sustainability does not require policy measures that will harm potential growth at some horizon, or the opposite, that they will promote it through the technologically advanced "green" production – it is to raise the point that the two can also be considered somewhat independently.

However, the climate change issues cannot be addressed independently from other countries. Sweden is at the forefront in terms of the implemented policies but the effectiveness of these policies in fighting the climate problems will depend on the policy responses of other economies. This in turn may require recalibration of the national policies and a possibly larger negative effects on potential GDP growth, at least in the medium-term projections.

Globalization – reversal (deglobalization), slowdown (slowbalizations) or the rise of new forms?

Globalization has proved to be a powerful force in shaping living standards and income distribution across the world over the major part of our economic history, only to be interrupted by large recession episodes often accompanied by a rise in protectionist policies. Having experienced two of the largest crises in just 15 years, an unprecedented disruption in globalization momentum has followed. As globalization and technological progress are highly interlinked processes, this creates increased risks for the evolution of TFP. Moreover, continuing efficiency gains in the future will largely depend on the countries' tendency to revert to protectionism. Goldman Sachs (2022) predicts a slowdown in the following decade(s), with the risk of deglobalization always present. Swedish economic agents have understood the benefits of globalization for a small open economy early, but the future benefits in Sweden are crucially dependent on the decisions and policies of other players in the global markets. A hardly predictable mix of political, technological and economic factors and shocks that is driving technological development in a globalized world is largely out of the reach of national policies, but is an important factor to take into account when producing potential productivity and growth forecasts.

5.3 Scope for methodological improvement

Currently used potential GDP measurement methods by NIER, among others, largely disregard the lower frequency supply shocks when estimating potential productivity. The intention is to capture only the long run, structural supply-side developments, while shorter horizon supply-side variation is only revisited occasionally for relatively large disturbances. Given the possibility of intensified occurrence of such shocks in the national and global economy, the method is put on test. The most significant risk is that the potential output measure used for the assessment of the cyclical position of the economy, i.e. the output gap, is not capturing the normal adjustments to supply-side shocks and thus gives misleading signs for the stabilization policy.

Furthermore, as noted by the OECD regarding their measurement, the coefficients relating external measure of cyclical indicators to labor efficiency or participation needs constant updating for the proper estimation of the potential GDP components.

On the other hand, as the OECD points out in the description of its method (Chalaux and Guillemette, 2019), long-run scenario forecasting is based on the same production function used for the calculation of historical or near future potential output and growth. The change in the parameters (or the functional form itself for that matter) occurs, it will not be captured by the measures. Most notably, labor income shares are assumed to be constant at two-thirds, while there is considerable evidence that those shares have been on a decline in many countries. This does not affect the estimates of potential GDP, but it affects the estimates of its components and thus projections for the future. A possible solution would be to employ time-varying model parameters.

Finally, inclusion of the natural resource capital for greater degree of freedom in making forecasts on the climate change policy effects, as well as different measurement techniques for the aspects related to the Digital economy and the rise in consumer welfare, are just some of the possible venues for methodological improvement.

References

Acemoglu, Daron (2007). *Introduction to Modern Economic Growth*. USA: Massachusetts Institute of Technology.

Aghion, Philippe, David Hemous, and Enisse Kharroubi. (2014). *Cyclical fiscal policy, credit constraints, and industry growth.* Journal of Monetary Economics, 62, pp. 41-58.

Ang, James.B. and Jakob B. Madsen (2013). *International R&D Spillovers and Productivity Trends in the Asian Miracle Economies*. Economic Inquiry, 51(2), pp. 1523–1541.

Araujo, Carlos Hamilton (2009), *The Role of Potential Output Growth in Monetary Policymaking in Brazil*. Federal Reserve Bank of St. Louis Review, 91(4), pp. 383-85.

Arsov, Ivailo and Benjamin Watson (2019). *Potential Growth in Advanced Economies*. Reserve Bank of Australia, Bulletin-December 2019, Global Economy.

Barro, Robert J. (2006). *Rare disasters and asset markets in the twentieth century*. Quarterly Journal of Economics, 121 (3), pp. 823–866.

Barro, Robert J. and Jong-Wha Lee (2013). *A New Data Set of Educational Attainment in the World, 1950-2010.* Journal of Development Economics, 104, pp.184-198.

Basu, Susanto and John G. Fernald (2009). *What Do We Know (And Not Know) About Potential Output?*. Federal Reserve Bank of St. Louis Review, 91(4), pp. 187 -213.

Baziki, Selva B., Borota Milicevic, Teodora and Rita Ginja (2016). *Trade Competition, Technology and Labor Re-allocation*. Working Paper Series, UCLS, Department of Economics, Uppsala University, No 2016:1.

Bernanke, Ben S. (1983). *Non-Monetary Effects of the Financial Crisis in the Propagation of the Great Depression.* The American Economic Review, 73(3), pp. 257-276.

Blagrave, Patrick, Mr Roberto Garcia-Saltos, Mr Douglas Laxton, and Fan Zhang. (2015). *A simple multivariate filter for estimating potential output*. International Monetary Fund.

Bloom, Nicholas, Sadun, Raffaella and John Van Reenen (2012). *Americans do I.T. better: US multinationals and the productivity miracle*. NBER Working Paper Series, Working Paper 13085.

Bontadini, Filippo, Carol Corrado, Jonathan Haskel, Massimiliano Iommi, and Cecilia Jona-Lasinio (2023). *EUKLEMS & INTANProd: industry productivity accounts with intangibles - Sources of growth and productivity trends: methods and main measurement challenges. https://euklems-intanprod-llee.luiss.it/*

Boianovsky, Mauro and Kevin D. Hoover (2009) *The Neoclassical Growth Model and 20th Century Economics*. History of Political Economy, 41, 1-23.

Bresnahan, Timothy.F., Brynjolfsson, Erik and Lorin M. Hitt. (2002). *Information Technology, Workplace Organisation and the Demand for Skilled Labor: Firm-Level Evidence*. Quarterly Journal of Economics, Vol. 117(1), pp. 339-376.

Burke, Marshall, Hsiang, Solomon M. and Edward Miguel (2015). *Global Non-Linear Effect of Temperature on Economic Production*. Nature 527 (7577), pp. 235–39.

Cahn, Christophe and Arthur Saint-Guilhem (2009). *Issues on Potential Growth Measurement and Comparison: How Structural Is the Production Function Approach?* Federal Reserve Bank of St. Louis Review, July/August 2009, 91(4), pp. 221-40.

Chalaux, T. and Y. Guillemette (2019). *The OECD potential output estimation methodology.* OECD Economics Department Working Papers, No. 1563, OECD Publishing, Paris, https://doi.org/10.1787/4357c723-en.

Coe, David T., Helpman, Elhanan, and Alexander W. Hoffmaister (2009). *International R&D spillovers and institutions*. European Economic Review 53(7), pp. 723–741.

Coibion, Olivier, Gorodnichenko, Yuriy and Mauricio Ulate, M (2018). *The Cyclical Sensitivity in Estimates of Potential Output*. Brookings Papers on Economic Activity, 2018(2), pp 343–441.

Corrado, Carol, Charles Hulten, and Daniel Sichel. (2009). *Intangible capital and US economic growth*. Review of income and wealth, 55(3), pp.661-685.

Corrado, Carol, Haskel, Jonathan, Iommi, Massimiliano and Cecilia Jona-Lasinio (2012). *Intangible Capital and Growth in Advanced Economies: Measurement and Comparative Results*. C.E.P.R. Discussion Papers No. 9061.

Cotis, Jean-Philippe, Elmeskov, Jorgen and Annabelle Mourougane (2004). *Estimates of potential output: benefits and pitfalls from a policy perspective*. Published in Euro Area Business Cycle: Stylized Facts and Measurement Issues, 35-60.

Davidson, Carl, Heyman, Fredrik, Matusz, Steven, , Fredrik and Susan Chun Zhu (2012). *Liberalized Trade and Worker–Firm Matching*. American Economic Review 102(3), 429–434.

Dieppe, Alistair and M.Ayhan Kose (2020). The Global *Productivity Slump: What policies to rekindle*. The Brookings Institution, November 2020.

European Central Bank (2022). *The impact of the COVID-19 shock on euro area potential output: a sectoral approach*. ECB Working Paper Series No 2717, European Central Bank.

European Commission (2021). *The 2021 Ageing Report: Economic & Budgetary Projectionsfor the EU Member States (2019–2070)*. European Economy 148/2021.

European Commission (2023). *The impact of demographic change – in a changing environment*. Commission Staff Working Document 21.

Gancia, Gino and Fabrizio Zilibotti (2005). Horizontal Innovation in the Theory of Growth and Development. Handbook of Economic Growth, in: Philippe Aghion & Steven Durlauf (ed.), Elsevier, edition 1, volume 1, chapter 3, pp. 111-170.

Girouard, Nathalie and Christoph André (2005*). Measuring Cyclically-adjusted Budget Balances for OECD Countries*. OECD Economics Department Working Papers 434.

Goldman Sachs (2022). *The Path to 2075 – Slower Global Growth, But Convergence Remains Intact*. Global Economics Paper.

Gordon, Robert J. (2012). *Is US Economic Growth Over? Faltering Innovation Confronts the Six Headwinds*. NBER Working Paper 18315, National Bureau of Economic Research, Cambridge, MA.

Gordon, Robert J., and Hassan Sayed (2019). *The Industry Anatomy of the Transatlantic Productivity Growth Slowdown*. NBER Working Paper 25703, National Bureau of Economic Research, Cambridge, MA.

Governement Office (2022). *Method for the calculation of potential variables november 2022*. Ministry of Finance, International and Economic Department, Promemoria.

Guellec, Dominique and Bruno Van Pottelsberghe De La Potterie (2004). *From R&D to productivity growth: Do the institutional settings and the source of funds of R&D matter?* Oxford Bulletin of Economic and Statistics, 66 (3), pp. 353-378.

Hall, Bronwyn H. (2011). *Innovation and productivity*. NBER Working Paper 17178, National Bureau of Economic Research, Cambridge, MA.

Herzer, Dierk (2022). *The impact of domestic and foreign R&D on TFP in developing countries*. World Development, 151.

International Monetary Fund (2020). *World Economic Outlook, A Long and Difficult Ascent*, IMF October 2020.

International Monetary Fund (2023). *World Economic Outlook, A Rocky Recovery*, IMF April 2023.

Jakobsson, Ulf (2007). *The Globalisation of Swedish Economy*. Confederation of Swedish Enterprise, 430.

Jones, Larry E. and Rodolfo E. Manuelli (2005). *Neoclassical Models of Endogenous Growth: The Effects of Fiscal Policy, Innovation and Fluctuations*. Handbook of Economic Growth, in: Philippe Aghion & Steven Durlauf (ed.), Handbook of Economic Growth, Elsevier, edition 1, volume 1, chapter 1, pp. 13-65.

Jovanovic, Boyan Peter L. Rousseau (2005). *General Purpose Technologies*. Handbook of Economic Growth, in: Philippe Aghion & Steven Durlauf (ed.), Handbook of Economic

Growth, Elsevier, edition 1, volume 1, chapter 18, pp. 1181–1224.

Krugman, Paul. (2023), *A.I. May Change Everything, but Probably Not Too Quickly*. New York Times (March 2023).

Lippi, Francesco (2003). *Monetary policy with unobserved potential output*. Bank for International Settlements, BIS Papers No.19, part 11.

Lundborg, Per, Vartiainen, Juhana and Göran Zettergren (2007). *Den svenska jämviktsarbetslösheten: En översikt av kunskapsläget*. NIER Special study No.11.

Nanda, Ramana, and Tom Nicholas. (2014). *Did bank distress stifle innovation during the Great Depression?* Journal of Financial Economics, 114(2), pp. 273-292.

NIER (2008). *Hours, Capital and Technology – What Matters Most?* Occasional Studies No. 17.

NIER (2015). *En beskrivning av hur Konjunkturinstitutet beräknar potentiell BNP*. Prognosavdelningen.

NIER (2021). *Lönebildningsrapporten 2021*. NIER.

NIER (2022). *Lönebildningsrapporten 2022*. NIER.

Nordhaus, William D. (2010). *Excel file for RICE model as of April 26, 2010*. Ann Arbor, MI: Interuniversity Consortium for Political and Social Research [distributor], 2010-11-17. https:// doi .org/ 10 .3886/ ICPSR28461 .v1.

OECD (2001), *Measuring Productivity – OECD Manual: Measurement of Aggregate and Industry-level Productivity Growth*, OECD Publishing, Paris, https://doi.org/10.1787/9789264194519-en.

OECD (2013a). *OECD Employment Outlook*. OECD Publishing.

OECD (2013b). *New Sources of Growth: Knowledge-Based Capital*. Key Analyses and Policy Conclusions, Synthesis Report.

OECD (2015). *The Future of Productivity*. OECD Publishing.

OECD (2016a) *Links Between Weak Investment and the Slowdown in Productivity and Potential Output Growth Across the OECD*. OECD Economics Department Working Papers No.1304.

OECD (2016b). *Getting Skills Right: Sweden, Getting Skills Right*. OECD Publishing.

OECD (2020). *OECD Economic Outlook No 108 (Edition 2020/2).* OECD Economic Outlook: Statistics and Projections (database), https://doi.org/10.1787/c59fcffd-en

OECD/APO (2022). *Identifying the Main Drivers of Productivity Growth: A Literature Review*. OECD Publishing, Paris.

OECD (2022). *OECD Economic Outlook No 112 (Edition 2022/2).* OECD Economic Outlook: Statistics and Projections (database), https://doi.org/10.1787/954d1179-en

Orphanides, Athanasios (2003. *The Quest for Prosperity without Inflation*. Journal of Monetary Economics 50, pp. 633–663.

Romer, Paul M. (1986). *Increasing Returns and Long-Run Growth*. Journal of Political Economy. 94 (5), pp. 1002–1037.

Schembri, Lawrence (2018). *The (Mostly) Long and Short of Potential Output*. Remarks by the Deputy Governor of the Bank of Canada, Ottawa Economics Association and CFA Society Ottawa.

Solow, Robert M. (1956). *A contribution to the theory of economic growth*. Quarterly Journal of Economics. 70 (1), pp. 65–94.

Solow, Robert M. (1957). *Technical change and the aggregate production function*. Review of Economics and Statistics, 39 (3), pp. 312–20.

Tillväxtanalys (2018). *Hur kan staten främja användandet av digitaliseringens möjligheter i näringslivet?* Rapport 2018:01.

Tillväxtanalys (2021). *Produktivitetstillväxt och dess drivkrafter – Sverige ur ett internationellt perspektiv*. Rapport 2021:09.

Wieser, Robert (2005). *Research and development productivity and spillovers: Empirical evidence at the firm level*. Journal of Economic Surveys, 19(4), pp. 587-621.

Williams, John C. (2017). *The Perennial Problem of Predicting Potential*. Economic Letter, Research from Federal Reserve Bank of San Francisco, 2017-32.

World Bank (2021). Global Productivity: *Trends, Drivers, and Policies*. Editor Alistair Dieppe, The World Bank Group.

Appendix A: The theories of economic growth

Economic growth has long been one of the main topics of economic literature and debates, but the modern analysis relying on formal mathematical models became the central theme of macroeconomics and economic theory in the 1950s. Seminal contributions by Robert Solow (1956, 1957) incentivized decades-long research in the field of neoclassical growth towards the modern endogenous growth theory of today. (Boianovsky and Hoover 2009)

Before the Solow-Swan growth model, widely used Harrod-Domar framework stressed out the crucial role that saving and investment in physical capital played in the process of economic development. However, the model did not necessarily predict full employment or stable economic growth in the long run. With its closer link to microeconomic mechanisms and empirical facts, the Solow model brought a more realistic yet simple and tractable framework for the analysis of important questions such as what determines the long-run stable economic growth and why some nations are rich while other are poor. (Acemoglu 2007)

Neoclassical growth theory

At the core of neoclassical growth theory (including the Solow growth model as its main representative) is the neoclassical aggregate production function which, as opposed to the Harrod-Domar framework, introduces diminishing returns to individual production factors. This implies that the benefits of additional capital accumulation become exhausted over time and the economy converges to a steady-state growth path where output and capital stock growth simply follow the exogenous growth of population.

The only factor that can bring sustained growth in output and capital per worker, i.e. growth in living standards, is the sustained technological progress, offsetting diminishing returns to capital accumulation and steadily promoting labor productivity. Although the model points to the main growth-driving force, its main weakness is that it leaves technological progress fully exogenous, failing to provide explanations on what induces firms and societies to make, diffuse and use better technologies. Moreover, it is also silent on what determines the saving rate which drives capital accumulation.

Neoclassical growth theory included a wide range of models, from perfectly competitive to those modeling and analyzing various imperfections and market failures. The most prominent of the extensions has been the neoclassical study of the role of human capital and knowledge in economic growth. Although many models have provided plausible answers to why some countries development is more successful than that of others and why social institutions matter crucially, this model class did not explain how sustained economic growth is actually created and maintained over time. (Jones and Manuelli 2005)

One of the first models to address this key issue was the AK model which relaxed the central assumption of diminishing returns to capital and featured sustained endogenous economic growth coming from the inside of the economic system as a result of continuous capital accumulation. Importantly, it opened the avenue for policy implications with respect to economic growth in the long run. This model led to further developments, ultimately the Romer's model (Romer 1986) that started the endogenous growth theory.

Endogenous growth theory

In his pursuit of the explanations of the "black-box" growth mechanisms, Romer first depicted technological progress and knowledge creation as a by-product of capital accumulation in the form of technological spillovers. This early framework stressed out two important issues: first, ideas and knowledge are non-rival, i.e. one firm using a certain technology is not preventing another one from using the same knowledge, generating increasing returns to

scale and sustained growth, and second, non-competitive elements (in this case technological spillovers, i.e. externalities) have been introduced in the model to generate growth. Maintaining the first notion in his following work, the second feature took the form of monopolistic competition that first generated growth through increased specialization of labor across growing range of activities, and later across growing number of goods. New goods now came as a product of deliberate costly investment in innovation in order to capture monopolistic profits. The main idea was that a larger number of available final or intermediate goods raises the well-being of consumers. This endogenous growth model of "expanding varieties" was later extended in many ways, relating the growth process to market structure and competition policy, as well as the intellectual property rights policy.

Complementary approach in the introduction of deliberate innovation activity in the growth model was to assume that research and development results in quality improvements of goods, replacing the previously invented versions ("vertical innovation"). This process of "creative destruction" was motivated by Schumpeter's ideas. Alternatively, "process innovation" created cost reductions that again drove the competitors out of the market. At the same time, these types of models with competitive innovation bring the issues of industrial organization and anti-trust policy in the center of attention even more, also raising the issue of potential excessive innovation brought about by incentives for market entry and business stealing. (Gancia and Zillibotti 2005) Due to these model predictions, growth-enhancing policy gained an increasingly important role as government intervention was no longer predicted to have only the level, but both the level and the growth effects. Two main questions stand out: first, what are the optimal government subsidies to research that can render the market equilibrium optimal, provided the absences of distortionary taxation and the possibility of redistribution, and second, what are the optimal subsidies to capital accumulation which was distorted due to the presence of monopolistic markups. (Acemoglu 2007)

Another issue regarding the treatment of technological progress in the literature is worth noting. A branch of literature paid special attention to the notion of "General Purpose Technologies" (GPT) which refers to technological changes that transform the businesses

and the way of living fundamentally. Technological development is recognized as uneven, coming in bursts in the form of GPT's. Of particular interest today is the notion of Information Technology (IT) as a GPT, often compared to the electrification and the profound effects it had on the societies. While electrification was argued to be more broadly adopted, IT is considered as more revolutionary. More importantly, the productivity slowdown that was discussed broadly in the text and that has caused so much debate and concern, is regarded as a normal development through the lenses of the GPT growth models. While we have experienced a somewhat stronger productivity slowdown compared to that in the era of electrification, the continuing adoption and the fall in relative price of IT is probably a good reason for optimistic predictions on future developments of labor productivity. (Jovanovic and Rousseau 2005).

Heterogenous firms and industry dynamics

As mentioned in the text, the potential growth contributors typically interact with each other producing both positive and negative spillovers which then have important implications for the labor productivity and potential output growth. Human capital may increase returns to innovation and produce spillover to TFP, TFP trend affects investment climate, and investment in intangible capital incentivizes innovation and dampens the traditional notion of decreasing returns to factors. All these links and interactions were basically invisible in the country- and industry-level data as they operate on the firm level and also have significant reallocative impact on resource utilization by heterogenous firms within industries. With a rise in the availability of the micro level data at the firm and worker level (with the Nordic countries as one of the pioneers in the collection of this type of data and the resulting branch of research), we were able to identify two main features of the TFP growth: first, the process occurs within the firms in a very different manner and extent, and second, it depends crucially on resource distribution changes across firms, firm creation and destruction, i.e. the industry dynamics. OECD (2022) Between 1995 and 2017, advanced economy productivity growth was almost entirely driven by within-sector productivity gains, i.e. the gains at the firm level and from

reallocation of resources across firms within the industries (World Bank 2021). This is still a relatively young and active area of research but has provided evidence from the firm level analysis that has helped us first describe and then understand the determinants and changes of aggregate productivity. Some of the most recently debated phenomena refer to a still understudied effect of globalization - the role of superstar global firms in raising industry concentration and market power, and the associated implications for potential productivity growth in the long run.

Appendix B: Decomposition of output growth

Output growth ($\hat{y}$), by identity, is a sum of the growth in hours worked ($\hat{h}$) and the growth in output per hour ($\hat{y}$-$\hat{h}$), or labor productivity growth, i.e.

$$\hat{y} = \hat{h} + (\hat{y} - \hat{h})$$

Turning to the production function, output growth can be expressed as the sum of the input factors growth, where these growth rates are weighted by the contribution of each of the factors to the output,

$$\hat{y} = \widehat{tfp} + \alpha\hat{k} + (1 - \alpha)\hat{l},$$

with $\hat{k}$ as the growth rate of capital, $\hat{l}$ the growth rate of labor input, $\widehat{tfp}$ as the growth rate of total factor productivity (tfp), while α and (1-α) measure the capital and labor contribution to the production of output, i.e. their earning shares in total income, respectively.

The labor input has two components – the amount of labor (in hours worked) and the quality of labor input (lq) in terms of its skills and ability, so one can define the growth in labor input as $\hat{l} = \hat{h} + \widehat{lq}$, and derive the labor productivity growth as $(\hat{y} - \hat{h}) = \widehat{tfp} + \alpha(\hat{k} - \hat{l}) + \widehat{lq}$, where $(\hat{k} - \hat{l})$ stands for capital deepening or growth in capital per unit of labor input. Subsequently, one can analyze the trend growth in output through the lenses of its two main components, trend growth in hours worked and labor productivity, respectively,

$$\hat{y} = \hat{h} + \left[\widehat{tfp} + \alpha\left(\hat{k} - \hat{l}\right) + \widehat{lq}\right].$$

Appendix C: The definition of potential GDP in academic literature and DSGE-models

In the academic literature and in dynamic stochastic general equilibrium (DSGE) models in particular, potential GDP is defined differently than the way it is commonly defined by forecasters (see main text). In the New Keynesian theory, potential GDP is defined as the level of production that would occur if all prices and wages were fully flexible, i.e. they immediately adapt to changing economic circumstances. According to the theory, inertia in prices and wages is the reason why actual GDP generally differs from the potential level. In a market economy, prices and wages convey information between different firms and between firms and households. Prices convey information to households about companies' cost situation: different companies' relative prices signal how their relative production costs differ. If prices are sluggish, i.e. if there are nominal rigidities there is a risk that households get the wrong signals about the relative costs and therefore demand too many products. This can lead to non-optimal resource utilization within individual companies and industries, as well as in the economy as a whole. If prices and wages are fully flexible, then there is no such mismanagement with the economy's combined resources. This is why potential GDP is defined as the level of production that would be possible if price and wage levels were flexible.[29]

Therefore, a notable feature of the aggregate economy's cyclical behavior stems from the (undesired) movements in relative prices

[29] One should, however, note that when an economy is operating at its potential level, and have a normal resource utilization, that alone does not mean that the economy grows in accordance with its long-run growth rate. Supply and demand shocks will still affect an economy with flexible wages and prices and thereby temporarily move it away from the long-run growth rate.

due to a slow and non-uniform nominal values adjustment to economic shocks. These rigidities play a crucial role in the evolution of actual output in the short and medium run as they cause the employment of aggregate economic resources to deviate from their potential employment, thus causing deviations of the actual output and its growth from the potential. The deviations are of demand-side nature and are accompanied by upward or downward inflationary pressures. In those lights, the short-to-medium run potential output is also defined as the highest level of current output an economy can sustain without generating excess inflation. In theory, this level of output is named "the natural" output.[30] This is the key variable for the stabilization policy over the cycle and is estimated for the purpose of following the output gap (potential or natural to actual output difference) which can then be addressed through measures of the monetary and fiscal policy. Economic policy attempting to stabilize these deviations, i.e. the output gap, relies on the proper separation of the supply-side dynamics driving potential variables from the movements in the observed variables caused by the nominal rigidities, which renders the short-run analyses very sensitive to the potential output measurement methodology (Basu and Fernald 2009).[31]

[30] In a market economy, the core factor motivating the saving and investment decisions of economic agents, thus driving productive capital accumulation, is the real interest rate. On an economy-wide basis, the real interest rate at its natural or neutral level corresponds to an equilibrium in which the economy produces its natural level of output. With a very slow population growth and a strong willingness to trade current for future consumption (strong patience) as is the case in the most advanced economies, this rate can be associated with the growth rate of potential output stemming from technological progress (Barro 2006). The economy-wide real interest rate usually refers to the interest rate paid out on the risk-free government bonds. Although different theories describe the connection between the natural real interest rate and potential growth, empirical evidence on a strong correlation between the two are harder to establish. The natural rate of interest may as well be responding to the safety and liquidity factors, besides being linked to the productivity trend.

[31] For a more extensive discussion see Appendix D and Section 3. It may also be worth noting that neither the long-run "trend" measure nor the short-to-medium-run measures of potential output are necessarily aligning with the definition of an optimal output - a theoretical concept of a potential output in a world without distortionary taxation or market imperfections and failures.

Appendix D: Measuring potential growth

Section 3 defined potential output and its growth, and showed developments in the last four decades. In this appendix we will discuss the methods that are used to measure potential GDP.

Potential output is very hard to measure. When it comes to the calculation and estimation of potential GDP, its driving components and their corresponding growth, there are at least three major obstacles. First, the economics data (both the actual GDP and its components) are continuously revised for improved precision which makes it difficult to settle the estimate of potential growth on any horizon. Second, newly incoming information about history and the information resulting from new economic events change the predictions on the behavior of the underlying supply-side forces driving potential growth, and revisions are required. Finally, potential output and its components are mostly latent, unobserved concepts and it is very hard to separate the structural supply-side shifts from other type of movements in the observed variables that should not be considered.[32]

Measuring issues concerning potential output are of substantial interest to policymakers for several different reasons. First, these estimates provide a sense of the structural performance of the economy and the potential growth rates that could be attained. Therefore, these estimates are important for macroeconomic forecasts. Second, potential output measures allow for the construction of the output gap - the difference between actual

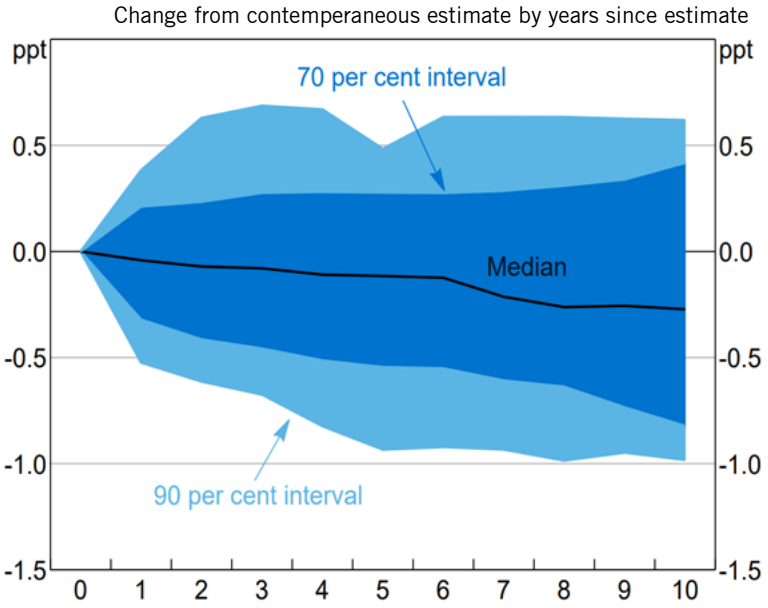
[32] It is not rarely the case that economic analysts have made overly optimistic estimates of potential output growth that have had significant implications for the effects of the applied policy measures (e.g. the overestimation of the US potential output in the '60s and '70s, see Orphanides 2003). Therefore, any estimate that is used for the analysis of the potential growth and its driving factors should be taken with a significant degree of caution. (Williams 2017)

output and potential output – which is a useful indicator of the economy's position in the business cycle and the prevailing inflationary pressures. Third, potential output measures are used to make cyclical adjustments of other variables, e.g. tax revenues and government spending which then provides estimates of structural fiscal deficits.

By construction, potential output should capture the movements in output that are driven by longer-lasting structural factors. The goal is, thus, to remove the temporary cyclical components that are driving the actual output. This is a systematic difficulty that has rendered many of the estimation methods biased and unable to provide estimates free from responses to temporary shocks (Coibion et al. 2018). Another complication arises irrespective of whether an error occurs because of a false interpretation of cyclical change as a movement in the potential output, or a change in potential output is attributed to cyclical dynamics. Both create ex-post serial correlation in errors over time. Being a latent variable, potential output does not reveal its actual value in the period after the forecast is made and the adjustments to the estimate or forecast are made only gradually over time through a slow learning process. (Lippi 2003)

The revisions of the real-time estimates for potential GDP growth are frequent. Figure D.1 reveals that the estimates tend to stabilize around five years after the initial publication at which point the resulting assessment of the annual potential growth rate is within a range of -1 to 0.5 percentage points from de initial assessment. Given that most advanced countries have potential growth estimates between 1 and 2 percent, these revisions are considerable.

Figure D.1 Potential growth estimate uncertainty, IMF (source: Arsov and Watson 2019)



Note: IMF estimates from 2000 to 2019 for Canada, France, Germany, Italy, Japan, Spain, United Kingdom and United States
Sources: IMF; RBA

Methods and comparisons across uses

There is a large diversity in methods for measuring potential output and potential growth, typically grouped in two main categories – **purely statistical** and **model-based** methods. In practice, most forecasting institutions use some type of hybrid methods, combining the two approaches.

Purely statistical methods

The standard technique in the purely statistical group of methods is the *univariate approach* which uses only the data on GDP and decomposes it statistically into the trend and cyclical components, where the trend presents the potential output by assumption. The most common are statistical filters, including the Hodrick-Prescott (HP) filter, band-pass filters, Kalman filters, and Beveridge-Nelson

decompositions. A complementary approach is the *multivariate* one (Blagrave et al., 2015), originating in the Okun's (1962) definition of potential output as the level of output which can be achieved without giving rise to inflation. This then points to the movements in other variables, specifically inflation and unemployment rate, in relation to the movements in potential output and output gap. The structure of the filter links the output gap to the labor market and changes in inflation. When inflation is persistently below the target, this method would yield higher estimates for potential output. The method requires only the data on output, inflation and unemployment, and the estimates are more robust in real-time than those obtained by using the HP filter. However, the method still suffers from uncertainties and the general critiques aimed at the purely statistical methods. These methods are not based on economic models and provide hardly any information on what drives growth in potential output, they often act like moving averages and fail when large and unanticipated changes in GDP occur. Finally, the estimates are often considered too volatile relative to the priors of the policymakers. (Araujo, 2009)

Model-based methods

In the second group of methods, the model-based approaches, economists rely on the use of macroeconomic constructions, such as Cobb-Douglas production function, structural vector auto-regression system, dynamic stochastic general equilibrium (DSGE) models, and other macro models. These methods impose stronger restrictions on the economic data derived from the underlying modeling of the economy. For this reason, the potential output may be much more difficult to estimate than with the use of statistical methods, while also failing to account for all the key determinants of potential output. They are also sensitive to model specification and always raise debates on the "true" underlying model. For this reason, the choice of the specific method within the group most often falls on the simplest production function-based method, i.e. growth accounting.

Growth accounting[33] starts from the aggregate production function (typically, a Cobb-Douglas) and decomposes the potential output growth into its three main production sources: hours worked (possibly extended with human capital), the capital stock per worker, and total factor productivity (TFP). The trend growth in each supply-side component is estimated separately and is then combined within the imposed production function to produce the estimate of potential growth. This method allows for the valuable decomposition of the potential growth into contributing components but requires the estimation of trends (potential components) of several variables along with the estimation of the production function parameters. This procedure often comes with biases in the estimates.

Structural models' approach

Some policy and international institutions, in particular the Central Banks conducting monetary policy, rely on the use of structural macroeconomic models (typically New Keynesian DSGE models) which describe the behavior of the main macroeconomic variables in response to various shocks hitting the economy. In recent decades, the DSGE-models literature has shown substantial progress in developing theoretical frameworks with microeconomic foundations that can be applied to the data. Once the parameters of the model are assigned their calibrated or estimated values, the shocks can be identified and the potential output can be backed out from the model as the output level that would have prevailed in the absence of price and wage rigidities that prevent faster adjustment of the economy to shocks. The difference between this measure of potential output and the actual output is regarded as the output gap which, when positive, creates inflationary pressures the monetary policy is attempting to address. This is the real-time assessment of the potential output which responds to transitory demand shocks over the cycle, as well as the lasting supply shocks. The latter shocks, on the other hand, are the only ones taken into consideration by the

[33] In this context, growth accounting should be understood differently from the historical data growth accounting that is assessing the actual contributing components of realized output. In potential growth accounting exercise, all factor components and the resulting potential growth are in fact assessments or estimates of the potential trends.

statistical and production function approaches which tend to strip out the cyclical components from the estimates of trend potential output. (Coibion et al. 2018)

The initial practice of using the DSGE model approach, particularly in the interest of deriving the output gap, unveiled differences in the measures of potential output obtained from the DSGE models and the production function approach, where the latter tend to show less variability. However, once the production function measure is incorporated fully into a DSGE framework, the two approaches tend to converge and the model-consistent production function measures of potential output exhibit fluctuations in response to various macroeconomic shocks. (Cahn and Saint-Guilhem, 2009) In these lights, it is most often the practice to combine the presented methods when measuring potential output, its growth and the output gap, with more or less focus on sophisticated statistical procedures or structural models.

Methods used by International and Domestic institutions

Table D5.1 Sources of Potential Growth estimates, advanced economies

	Countries	Method	Frequency
IMF	Advanced economies and some emerging economies	Growth accounting measure, aggregated using Cobb-Douglas production function	Semi-annual
OECD	Advanced economies	Growth accounting measure, aggregated using Cobb-Douglas production function	Annual
EU Commission	28 members of European Union	Growth accounting measure, aggregated using Cobb-Douglas production function	Semi-annual
Bank of Canada	Canada	Growth accounting measure, aggregated using Cobb-Douglas production function	Quarterly
Bank of Japan	Japan	Growth accounting measure, aggregated using Cobb-Douglas production function	Quarterly
Federal Reserve Bank of New York (Holston-Laubach-Williams)	U.S, Canada, Euro area, U.K..	Multivariate estimator	Quarterly
Congressional Budget Office	U.S.	Growth accounting measure, aggregated using Cobb-Douglas production function	Semi-annual
Office for Budget Responsibility	U.K.	Multivariate Estimator	Annual
Japan Cabinet Office	Japan	Growth accounting measure	Quarterly
NIER	Sweden	Growth accounting measure	

Appendix E: Effect of large crises on potential output and growth

Two economic shocks of unprecedented magnitude in the recent history - the Great recession of 2007 and the Covid-19 pandemic - have been regarded as events that will undoubtedly have a longer lasting effects on the potential output and, arguably, on its long-run growth rate. The two shocks share some of the distinctive features and the impacts on the economy. (Dieppe and Kose 2020)

Great Recession 2007-2010

Investment growth has slowed down significantly in the aftermath of the Great recession as a result of, among other factors, higher policy uncertainty, unfavorable terms-of-trade shocks for exporters, slowdown of the FDI flows and elevated debt ratios. Coupled with the investment slump, some other structural factors have also been stagnating, namely the average educational attainment, diversification of production and urbanization.

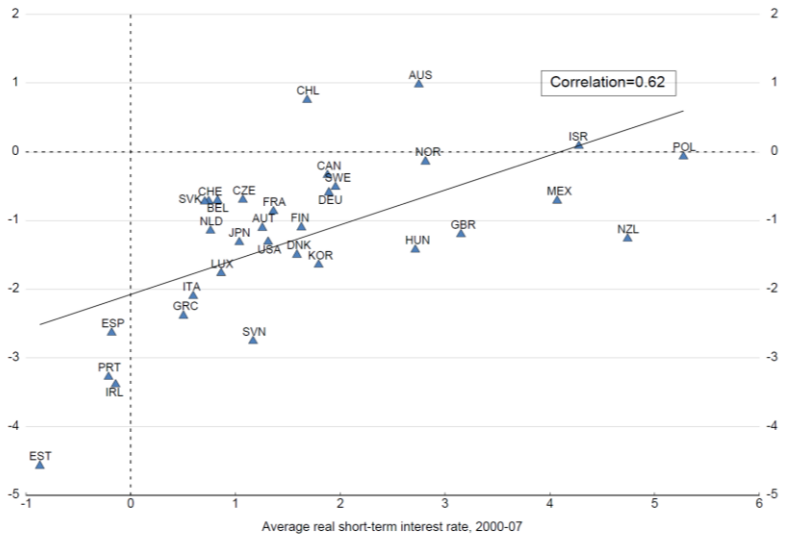
A part of the reduction, particularly in residential investment as a share of GDP, is directly linked to the global financial crisis of 2007, while the other parts of the weakening investment phenomenon stem from the accelerator response of investment to the negative demand shock associated with the crisis. This has been labeled the hysteresis effect in the literature where a continued low demand results in a prolonged negative effect on the potential growth trend via the weak investment channel.

OECD countries evidence, especially that of the Southern Europe, shows that countries that have previously experienced greater misallocations of capital in the period of unusually low interest rates have also suffered the most severe abruptions

(declines) in capital growth (see Figure E.1). Finally, in an accounting sense, the fall in the capital deepening contribution to potential growth also comes from a trend rise in capital depreciation rates mainly associated with shortening lives of the ICT-related assets. As this trend certainly dates before the crises, the focus of the capital deepening analysis should mostly fall on the former two factors: weak demand and pre-crisis misallocations of resources. Nevertheless, it is very hard to identify the main culprit for the waning trend productivity growth among the two.

Government investment has also experienced a downturn in the aftermath of the crisis which may have had a spillover effect on the business investment and productivity as well. Existing literature finds that the link between public and private sector investment is strong and positive, particularly when market failures result in private under-investment. OECD (2016a).

Figure E.1 Post-crises (2007–2015) change in annual growth of capital stock (capital deepening) in percentage points and the pre-crises interest rate (source: OECD 2016)



Note: Excludes Iceland and Turkey.
Source: OECD (2016a).

In the decade following the wake of the crisis capital deepening prevailed as the main contributing factor to lower productivity

growth. A 0.4 percentage point drop in the annual capital deepening can alone account for the slowdown in trend productivity growth in the 2007–2015 period in the OECD economies (OECD 2016a). The capital deepening contribution to potential output growth was estimated to be less than one quarter percentage point in one-third of OECD countries, and somewhat stronger in only four countries in the above period.

In many aspects Sweden has shared the experience of other advanced economies, most notably regarding the prolonged fall in capital per worker and TFP growth contributions to potential output growth where the latter development started already in the pre-crisis period. (OECD 2016a).

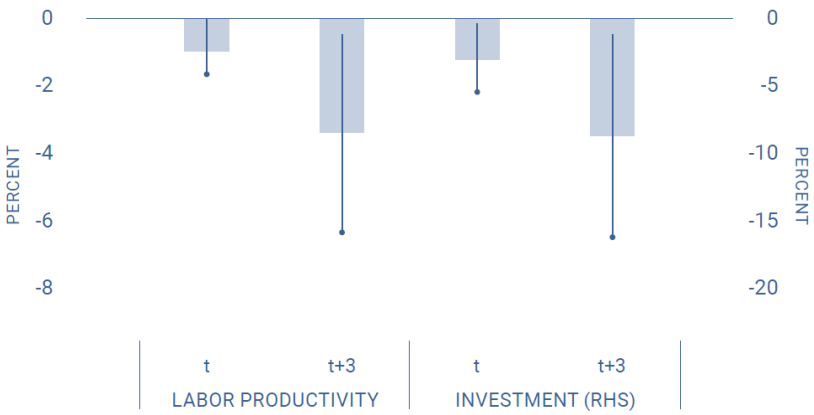
The effects of economic crises, and negative events in general, have also large implications for the TFP growth. High uncertainty associated with periods of crises gives agents an incentive to postpone or cancel their investment and other business decisions until more information is revealed and uncertainty diminishes. This is hindering reallocation of resources and ultimately harms innovation incentives which are the drivers of TFP growth. (Bernanke, 1983).

Uncertainty and pressures in the financial system bring distortions in the credit system. In normal times, KBC investment may be expected to be countercyclical, but credit constraints in crises periods can be a factor working in the opposite direction. If firms depend on external financing, financing innovation through borrowing may be difficult to obtain given the drop in earnings (Aghion, Hemous and Kharroubi, 2014). Accordingly, Nanda and Nicholas (2014) find that the rates of filing patents in the U.S. dropped temporarily during the Great recession. In general, recessions of moderate intensity create aggregate TFP benefits through destruction of less productive firms (the "cleansing effect" of recessions), but severe credit constraints limit the scope for experimentation and distort the foundation of the creative destruction as the engine of growth.

Covid-19 Pandemic

The Covid-19 pandemic produced a global recession in about 90 countries, the highest fraction recorded in a negative economic event. With the experience of previous health crises (Figure E.2), prolonged reductions in measured potential labor productivity growth can be expected to occur following investment and capital deepening erosion, disruptions in trade which lowers efficiency, and stagnation in human capital formation, also affected by persistent unemployment. The effects of the pandemic are expected to amplify the TFP growth slump and leave longer-lasting traits in debt, capital obsolescence and unemployment. (Dieppe and Kose 2020) Supported by several policy measures, the Swedish economy has not exhibited such strong reductions in labor productivity as was the case in the Great recession since the hours worked declined together with the fall in production in the wake of the pandemic. Both were soon to rebound, but the increase in production was of a higher pace and labor productivity grew, (NIER 2022).

Figure E.2 The effect of epidemics on productivity and investment



Note: Bars show the estimated impacts of the four most severe biological epidemics (SARS 2002-03, MERS 2012, Ebola 2014-15, Zika 2015-16) on labor productivity and investment levels relative to non-affected emerging markets and developing economies (EMDEs). The sample consists of 30 advanced and 86 EMDEs.
Source: Dieppe (2021).

Economic research has investigated the potential implications of the pandemic for the multi (total)-factor productivity growth. While

most results are inconclusive, some early studies applying different methods find no significant effects overall and in the long run (see Table E.2 below).

Table E.2 Studies on the pandemic effects on multi-factor productivity

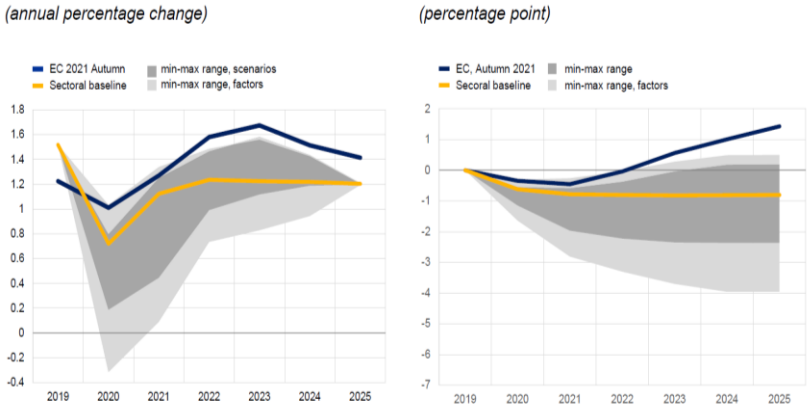
	Method	Effect on MFP
Furceri and Mourougane (2012).	Local projections on past financial crises in OECD countries.	No significant effect in the long term.
Oulton and Sebastián-Barriel (2013).	Estimations looking at episodes of past banking crisis in 61 countries.	Persistent impact on the level: 0,8 percent (not significant).
Furceri et al. (2021).	Local projections on episodes of past crises.	No significant effect for recession on average. Persistent impact on the level: 3 percent after 5 years for deep crises.
Bloom et al. (2022).	Firms' responses to a questionnaire.	Broadly unchanged, but fall by 1 percent when accounting for the deterioration in quality.

Source: OECD/APO (2022).

The European Central Bank (2022) discusses different "scenario forecasts" of the post-pandemic recovery. Overall, the summary of the results of all the scenario studies, the sectoral baseline (baseline scenario taking into account the change in weights of different sectors), and the ECB's own scenario forecast (at the top of the range of other estimates), reveals a negative tendency both for the potential output growth and the potential output level with output losses amounting to 4 percent of potential output by 2025 (Figure E.3).

Figure E.3 Range of estimates on the Post-Covid19 recovery scenarios

Potential output growth (left) and the loss in potential output level (right)



Note: the min-max range of factors shows the potential output growth calculated with the minimum/maximum level of the three factors of production across all scenarios.
Source: European Central Bank 2022.

While large shocks such as those discussed above cause grave economic distress and call for special policy measures, they often also present opportunities. The pandemic crises, for example, has incentivized certain technological transformations that may have significant positive productivity effects in some sectors. Distance work, adoption of a higher share of digital technologies in work practices in manufacturing, finance and education, and onshoring of production with greater capital intensity represent some of these productivity and welfare improving aspects. (Dieppe and Kose 2020).

Statens offentliga utredningar 2023

Kronologisk förteckning

1. Skärpta straff för flerfaldig brottslighet. Ju.
2. En inre marknad för digitala tjänster – ansvarsfördelning mellan myndigheter. Fi.
3. Nya regler om nödlidande kreditavtal och inkassoverksamhet. Ju.
4. Posttjänst för hela slanten. Finansieringsmodeller för framtidens samhällsomfattande posttjänst. Fi.
5. Från delar till helhet. Tvångsvården som en del av en sammanhållen och personcentrerad vårdkedja. S.
6. En lag om tilläggsskatt för företag i stora koncerner. Fi.
7. På egna ben. Utvecklad samverkan för individers etablering på arbetsmarknaden. A.
8. Arbetslivskriminalitet – arbetet i Sverige, en bedömning av omfattningen, lärdomar från Danmark och Finland. A.
9. Ett statligt huvudmannaskap för personlig assistans. Ökad likvärdighet, långsiktighet och kvalitet. S.
10. Tandvårdens stöd till våldsutsatta patienter. S.
11. Tillfälligt miljötillstånd för samhällsviktig verksamhet – för ökad försörjningsberedskap. KN.
12. Förstärkt skydd för demokratin och domstolarnas oberoende. Ju.
13. Patientöversikter inom EES och Sverige. S.
14. Organisera för hållbar utveckling. KN.
15. Förnybart i tanken. Ett styrmedelsförslag för en stärkt bioekonomi. LI.
16. Staten och betalningarna. Del 1 och 2. Fi.
17. En tydligare bestämmelse om hets mot folkgrupp. Ju.
18. Värdet av vinden. Kompensation, incitament och planering för en hållbar fortsatt utbyggnad av vindkraften. Del 1 och 2. KN.
19. Statlig forskningsfinansiering. Underlagsrapporter. U.
20. Förbud mot bottentrålning i marina skyddade områden. LI.
21. Informationsförsörjning på skolområdet. Skolverkets ansvar. U.
22. Datalagring och åtkomst till elektronisk information. Ju.
23. Ett modernare socialförsäkringsskydd för gravida. S.
24. Etablering för fler – jämställda möjligheter till integration. A.
25. Kunskapskrav för permanent uppehållstillstånd. Ju.
26. Översyn av entreprenörsansvaret. A.
27. Kamerabevakning för ett bättre djurskydd. LI.
28. Samhället mot skolattacker. U.
29. Varje rörelse räknas – hur skapar vi ett samhälle som främjar fysisk aktivitet? S.
30. Ett trygghetssystem för alla. Nytt regelverk för sjukpenninggrundande inkomst. S.
31. Framtidens yrkeshögskola – stabil, effektiv och hållbar. U.
32. Biometri – för en effektivare brottsbekämpning. Ju.
33. Ett förbättrat resegarantisystem. Fi.
34. Bolag och brott – några åtgärder mot oseriösa företag. Ju.
35. Nya regler om hållbarhetsredovisning. Ju.
36. Genomförande av minimilönedirektivet. A.

37. Förstärkt skydd för den personliga integriteten. Behovet av åtgärder mot oskuldskontroller, oskuldsintyg och oskuldsingrepp samt omvändelseförsök. Ju.
38. Ett förstärkt konsumentskydd mot riskfylld kreditgivning och överskuldsättning. Fi.
39. En inre marknad för digitala tjänster – kompletteringar och ändringar i svensk rätt. Fi.
40. Förbättrade möjligheter för barn att utkräva sina rättigheter enligt barnkonventionen. S.
41. Förutsättningarna för en ny kollektivavtalad arbetslöshetsförsäkring. A.
42. Ett modernare regelverk för legaliseringar, apostille och andra former av intyganden. UD.
43. En samordnad registerkontroll för upphandlande myndigheter och enheter. Fi.
44. En översyn av regleringen om frihetsberövande påföljder för unga. Ju.
45. Övergångsrestriktioner – ökat förtroende för offentlig verksamhet. Fi.
46. Jakt och fiske i renbetesland. LI.
47. En utvecklad arbetsgivardeklaration – åtgärder mot missbruk av välfärdssystemen. Fi.
48. Rätt förutsättningar för sjukskrivning. S.
49. Skyddet för EU:s finansiella intressen. Ändringar och kompletteringar i svensk rätt. Fi.
50. En modell för svensk försörjningsberedskap. Fö.
51. Signalspaning i försvarsunderrättelseverksamhet – frågor med anledning av Europadomstolens dom. Fö.
52. Ett stärkt och samlat skydd av välfärdssystemen. S.
53. En ändamålsenlig arbetsskadeförsäkring – för bättre ekonomisk trygghet, kunskap och rättssäkerhet. Volym 1 och 2. S.
54. Centraliseringen av administrativa tjänster till Statens servicecenter – en utvärdering. Fi.
55. Vem äger fastigheten. Ju.
56. Några smittskyddsfrågor inom socialtjänsten och socialförsäkringen. S.
57. Åtgärder för tryggare bostadsområden. Ju.
58. Kultursamhället – utvecklad samverkan mellan stat, region och kommun. Ku.
59. Ny myndighetsstruktur för finansiering av forskning och innovation. U.
60. Utökade möjligheter att använda preventiva tvångsmedel 2. Ju.
61. En säker och tillgänglig statlig e-legitimation. Fi.
62. Vi kan bättre! Kunskapsbaserad narkotikapolitik med liv och hälsa i fokus. S.
63. Sveriges säkerhet i etern. Ku.
64. Ett förändrat regelverk för framtidens el- och gasnät. KN.
65. Bättre information om hyresbostäder. Kartläggning av andrahandsmarknaden och ett förbättrat lägenhetsregister. LI.
66. För barn och unga i samhällsvård. S.
67. Anonyma vittnen. Ju.
68. Som om vi aldrig funnits – exkludering och assimilering av tornedalingar, kväner och lantalaiset. Aivan ko meitä ei olis ollukhaan – eksklyteerinki ja assimileerinki tornionlaaksolaisista, kväänistä ja lantalaisista. *Slutbetänkande*. Som om vi aldrig funnits. Vår sanning och verklighet. Aivan ko meitä ei olis ollukhaan. Meän tottuus ja toelisuus. *Intervjuberättelser*. Som om vi aldrig funnits. Tolv tematiska forskarrapporter. Aivan ko meitä ei olis ollukhaan. Kakstoista temattista tutkintoraporttia. *Forskarrapporter*. Ku.
69. Ökat informationsflöde till brottsbekämpningen. En ny huvudregel. Ju.

70. Ordning och reda – förstärkt och tillförlitlig byggkontroll. LI.
71. Speciallivsmedel till barn inom öppen hälso- och sjukvård. S.
72. En enklare hantering av vattenfrågor vid planläggning och byggande. LI.
73. Genomförandet av vaccineringen mot sjukdomen covid-19 – en utvärdering. S.
74. Förenklade förutsättningar för ett hållbart vattenbruk. LI.
75. Stärkt konstitutionell beredskap. Ju.
76. Vidareanvändning av hälsodata för vård och klinisk forskning. S.
77. Behörig myndighet enligt EU:s avskogningsförordning. LI.
78. Hemlig dataavläsning – utvärdering och permanent lagstiftning. Ju.
79. Arbetsrätten under krig och krigsfara. A.
80. Ett starkare straffrättsligt skydd– mot sexuella kränkningar, bedrägerier i vissa fall och brott med hatmotiv avseende kön. Ju.
81. Ett enklare bilstöd. S.
82. Ökad kontroll över tandvårdssektorn. S.
83. Samordnat juridiskt stöd och vägledning för hälso- och sjukvårdens digitalisering. S.
84. En hållbar bioekonomistrategi – för ett välmående fossilfritt samhälle. LI.
85. Långtidsutredningen 2023. Finanspolitisk konjunkturstabilisering. *Huvudbetänkande*. Fi.
86. Trends in GDP Growth and its Driving Factors. *Bilaga 1 till Långtidsutredningen 2023*. Fi.
87. Drivkrafter bakom globala trender i den neutrala räntan. *Bilaga 2 till Långtidsutredningen 2023*. Fi.
88. Ränte-tillväxt-differensen – utveckling och drivkrafter. *Bilaga 3 till Långtidsutredningen 2023*. Fi.
89. Makrotillsynsregleringar och finansiell stabilitet. *Bilaga 4 till Långtidsutredningen 2023*. Fi.
90. Samspelet mellan finans- och penningpolitik i Sverige. *Bilaga 5 till Långtidsutredningen 2023*. Fi.
91. Penning- och finanspolitisk konjunkturstabilisering. *Bilaga 6 till Långtidsutredningen 2023*. Fi.
92. Nytt ramverk för finanspolitiken. *Bilaga 7 till Långtidsutredningen 2023*. Fi.
93. Budgetprocessen i det finanspolitiska ramverket. *Bilaga 8 till Långtidsutredningen 2023*. Fi.

Statens offentliga utredningar 2023

Systematisk förteckning

Justitiedepartementet

Skärpta straff för flerfaldig brottslighet. [1]

Nya regler om nödlidande kreditavtal och inkassoverksamhet. [3]

Förstärkt skydd för demokratin och domstolarnas oberoende. [12]

En tydligare bestämmelse om hets mot folkgrupp. [17]

Datalagring och åtkomst till elektronisk information. [22]

Kunskapskrav för permanent uppehållstillstånd. [25]

Biometri – för en effektivare brottsbekämpning. [32]

Bolag och brott – några åtgärder mot oseriösa företag. [34]

Nya regler om hållbarhetsredovisning. [35]

Förstärkt skydd för den personliga integriteten. Behovet av åtgärder mot oskuldskontroller, oskuldsintyg och oskuldsingrepp samt omvändelseförsök. [37]

En översyn av regleringen om frihetsberövande påföljder för unga. [44]

Vem äger fastigheten. [55]

Åtgärder för tryggare bostadsområden. [57]

Utökade möjligheter att använda preventiva tvångsmedel 2. [60]

Anonyma vittnen. [67]

Ökat informationsflöde till brottsbekämpningen. En ny huvudregel. [69]

Stärkt konstitutionell beredskap. [75]

Hemlig dataavläsning – utvärdering och permanent lagstiftning. [78]

Ett starkare straffrättsligt skydd– mot sexuella kränkningar, bedrägerier i vissa fall och brott med hatmotiv avseende kön. [80]

Klimat- och näringslivsdepartementet

Tillfälligt miljötillstånd för samhällsviktig verksamhet – för ökad försörjningsberedskap. [11]

Organisera för hållbar utveckling. [14]

Värdet av vinden. Kompensation, incitament och planering för en hållbar fortsatt utbyggnad av vindkraften. Del 1 och 2. [18]

Ett förändrat regelverk för framtidens el- och gasnät. [64]

Kulturdepartementet

Kultursamhället – utvecklad samverkan mellan stat, region och kommun. [58]

Sveriges säkerhet i etern. [63]

Som om vi aldrig funnits – exkludering och assimilering av tornedalingar, kväner och lantalaiset. Aivan ko meitä ei olis ollukhaan – eksklyteerinki ja assimileerinki tornionlaaksolaisista, kvääniistä ja lantalaisista. *Slutbetänkande.* Som om vi aldrig funnits. Vår sanning och verklighet. Aivan ko meitä ei olis ollukhaan. Meän tottuus ja toelisuus. *Intervjuberättelser.* Som om vi aldrig funnits. Tolv tematiska forskarrapporter. Aivan ko meitä ei olis ollukhaan. Kakstoista temattista tutkintoraporttia. *Forskarrapporter.* [68]

Landsbygds- och infrastrukturdepartementet

Förnybart i tanken. Ett styrmedelsförslag för en stärkt bioekonomi. [15]

Förbud mot bottentrålning i marina skyddade områden. [20]

Kamerabevakning för ett bättre djurskydd. [27]

Jakt och fiske i renbetesland. [46]

Bättre information om hyresbostäder. Kartläggning av andrahandsmarknaden och ett förbättrat lägenhetsregister. [65]

Ordning och reda – förstärkt och tillförlitlig byggkontroll. [70]

En enklare hantering av vattenfrågor vid planläggning och byggande. [72]

Förenklade förutsättningar för ett hållbart vattenbruk. [74]

Behörig myndighet enligt EU:s avskogningsförordning. [77]

Socialdepartementet

Utbildningsdepartementet

Utrikesdepartementet