# Euro area productivity growth could slow further in the event of a downturn

3 Oct 2019 – Analysis – International economy

Michaela Elfsbacka Schmöller
Senior Research Economist

The euro area productivity slowdown in the early 2000s can mainly be attributed to weakening innovation. However, since 2008 productivity growth has slowed due to a crisis-induced drop in technology adoption. This implies that a shortfall in aggregate demand may spill over to the supply side, as weak demand depresses technology investments and thus makes recessions deep and long-lasting. These findings contrast with conventional macroeconomics, which assumes that cyclical fluctuations do not affect technology growth. Policies which support sound economic conditions are therefore also key for productivity growth.

## Productivity has slowed since the early 2000s and decelerated further during the crises

Understanding the causes of subdued productivity in the euro area is key, as productivity growth constitutes an important determinant of long-run growth and workers' real income growth. In the euro area, productivity began to slow already at the beginning of the 2000s: average labour productivity growth both in the euro area aggregate and its major member states has ranged substantially below the productivity growth performance realized in the past (Table 1). In the euro area, for example, average yearly labour productivity growth came down from 1.4% in the 1990s to 1.2% during 2000–2007. The productivity slowdown intensified during the euro area crises, with euro area productivity growth dropping to 0.7% on average. Productivity growth in the subsequent upswing ranged somewhat above the productivity growth performance observed during the crises.[1]

Table 1.

**Euro area labour productivity growth decreased in the early 2000s and the slowdown intensified during the crises**

| | 1990–1999 | 2000–2007 | 2008–2012 | 2013–2018 |
|---|---|---|---|---|
| Euro area* | 1.39 | 1.24 | 0.70 | 0.82 |
| DE | 2.42 | 1.65 | 0.55 | 0.78 |
| FR | 1.82 | 1.50 | 0.19 | 0.85 |
| IT | 1.40 | 0.41 | –0.08 | 0.21 |
| ES | 1.24 | 0.44 | 1.72 | 0.59 |

*Data availability for EA aggregate from 1996 onwards.

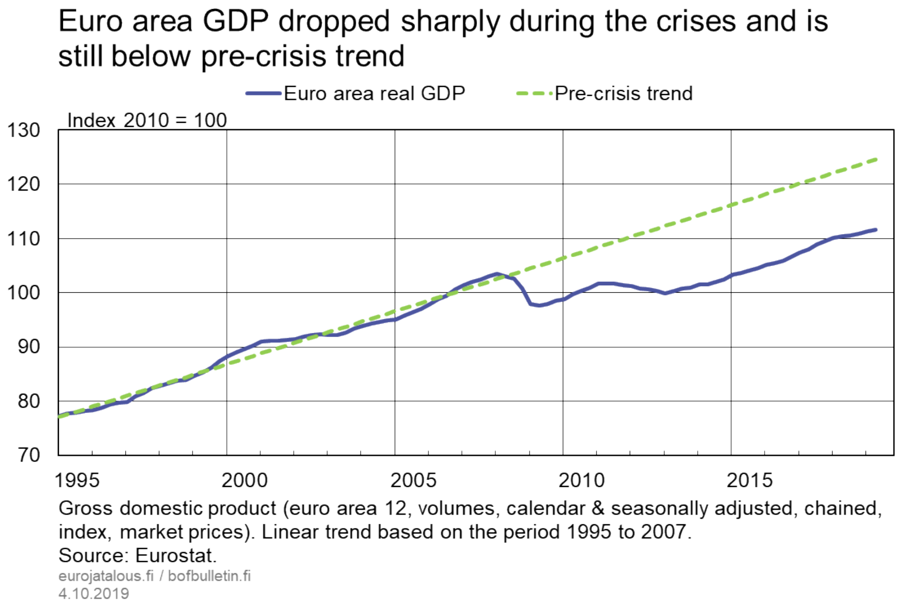
Average labour productivity growth rates. Labour productivity per hour worked.

Source: The Conference Board.

Conventional macroeconomic models, however, are not designed to give answers on the underlying causes and drivers of slowing productivity. Standard macroeconomic frameworks in particular postulate that total factor productivity, which can be understood as the economy's technology stock, is determined solely by structural factors that are independent of, say, firms' and households' consumption and investment decisions. As a consequence, total factor productivity growth is unaffected by cyclical fluctuations in economic activity, which stands in contrast to the procyclical drop in productivity growth observed during the euro area crises. Moreover, this class of models is geared to explain small-scale economic fluctuations and hence cannot explain the marked and lengthy drop in euro area GDP observed in the context of the recent crises (Chart 1).

1. Spain constitutes an exception to this pattern, as the country experienced pre-crisis a large-scale misallocation to low productivity sectors and its respective reversal following the crises, which led to productivity gains.

Chart 1




This article presents the main results from an estimated structural macroeconomic model for the euro area which features endogenous technology growth and through that overcomes the shortcomings of the standard macroeconomic modelling approaches outlined above.[2] Technology growth in this model evolves in a two-phase process. First, new technologies are invented as the result of research and development (R&D) efforts. Second, firms make a decision about whether or not to put into use the invented technologies in their production processes by weighing the corresponding gains from these technologies against their respective costs. This is called the technology adoption stage. The following sections summarize the most important drivers of the euro area productivity slowdown, the main insights for explaining the patterns of euro area output as of 2008 and the respective policy implications.

## Slowing innovation an important driver, but as of 2008 subdued technology adoption predominant

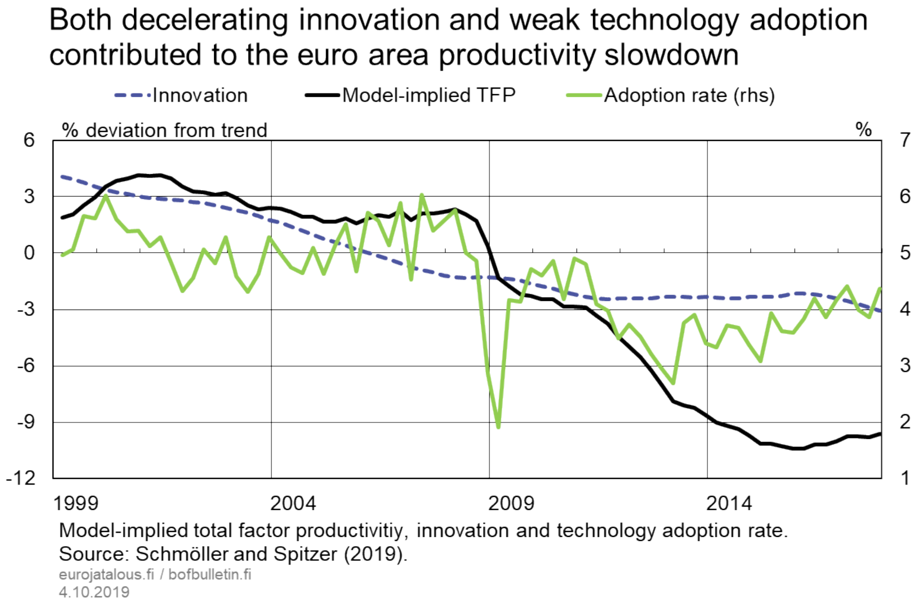
Total factor productivity (TFP) growth measures changes in economic output that do not directly result from movements in production factors, such as labour and capital. It can also be understood as a measure of the growth of the technology stock in the economy and constitutes the main determinant of long-run labour productivity and output growth. When analysing total factor productivity, it is important to note that it is not a directly empirically observable variable and instead has to be estimated, which implies that any TFP measure also always reflects the respective underlying assumptions made.[3] The

---

2. Technically, the model this article is based on is a medium-scale DSGE model with endogenous technology growth through R&D and technology adoption, as proposed by Anzoategui, Comin, Gertler and Martinez (2019), estimated on euro area data. For a more detailed overview of our methodology and results, see Schmöller and Spitzer (2019).
3. TFP in the model underlying this article consists of a part which is the direct consequence of innovation and technology adoption as well as of a technology shock which captures fluctuations in technology growth not directly

estimated model this analysis is based on (Schmöller and Spitzer (2019)) gives insights on the respective roles of innovation and technology adoption in explaining the slowdown in euro area total factor productivity growth.

Chart 2




In this setting, innovation, i.e. the creation of new technologies, results from investment in research and development (R&D). Innovations, however, naturally only translate into productivity gains once firms incorporate (adopt) them in their production processes. If firms do not adopt new innovations, productivity will not improve even if the innovations have been substantial. In reality, technology adoption does not occur instantaneously, but usually with a lag, given its costs and firms' initial observing approach to the potential gains from using the new technology. Chart 2 illustrates total factor productivity[4] and its underlying driving factors as implied by the model. The results suggests that the euro area productivity slowdown can in its early stages be predominantly ascribed to decelerating innovation, which is discernible in the chart from total factor productivity (black line) decelerating in synch with innovation through R&D (blue line) over this period. This finding supports the explanation for the productivity slowdown proposed, among others, by Gordon (2015), which considers slowing innovation capacity as a key explanation of the productivity slowdown. The model-based analysis suggests that also during the euro area crises and onward weak innovation has acted as a drag on productivity, demonstrated in the chart by the corresponding flattening of innovation. As from 2008, however, the shortfall in technology adoption (green line), which dropped substantially during the crises and improved only slowly in the subsequent recovery, has constituted the most important driving force. This channel has also been emphasized by other studies on the topic (see Anzoategui et al. (2019) and

---

explicable by the model. Importantly, the endogenous part of TFP which results from R&D and technology adoption activities constitutes the lion's share of TFP, suggesting that the importance of standard technology shocks is strongly reduced in this framework vis-à-vis the standard macroeconomic setup.

4. For simplicity, only the endogenous component of TFP is illustrated in this chart since, as demonstrated earlier, it constitutes a close measure of overall TFP throughout the sample.

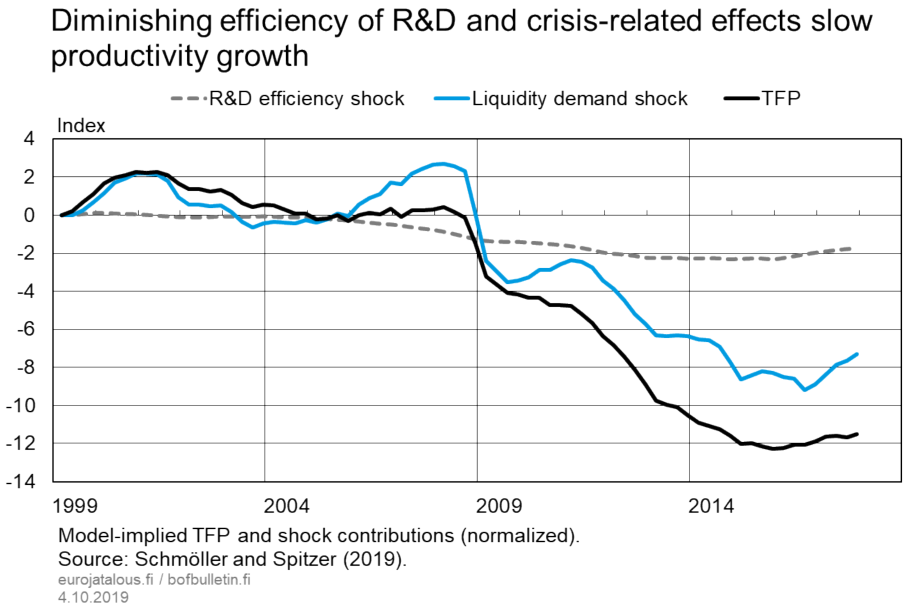
Bianchi et al. (2019)). The result is also closely linked to the discussion on the potential lagged effect the key innovation of artificial intelligence may have once it diffuses to the wider economy, given the presently prevailing lags in firms' technology adoption (Brynjolfsson et al. (2017)).

## Innovation has decelerated, and the crises have also weighed on productivity

Chart 3 demonstrates the driving forces behind slowing innovation and technology adoption underlying the euro area productivity slowdown from the model-based analysis.[5] It illustrates total factor productivity (black line), as well as two central contributors to technological progress in the model. The illustrated downward movement in the R&D efficiency contribution (grey line) to total factor productivity growth suggests that a decline in the power of research and development investments in generating new innovations added to the euro area productivity slowdown in the 2000s and has weighed on productivity also in subsequent periods. The decline in the efficiency of R&D efforts in generating new innovation has, for instance, also been empirically documented by Bloom, Jones, Van Reenen and Webb (2019) for a wide range of sectors in the US economy. They propose that innovations may have become more difficult to find and maintaining a certain level of innovations may require higher R&D efforts than was necessary in the past. The results propose that as of 2008 a recessionary shock (blue line) constitutes the most important driver of slowing technology adoption and hence productivity.[6] Put differently, these findings imply that the euro area crises substantially weighed on firms' capacity for adopting new innovations in production, which may have delayed measurable productivity gains from existing innovation. In the aftermaths of the euro area crises the deceleration in TFP came to a halt, shown in the chart by the fall in the black line coming to an end, which reflects the improving overall economic conditions in the euro area and the fading out of adverse crises-related effects translating into improvements in technology adoption.

5. More specifically, the chart illustrates the contribution of two central shocks to total factor productivity, namely the liquidity demand shock and the shock to R&D efficiency.
6. Technically, the recessionary shock referred to constitutes the shock to liquidity demand, which features transmission properties as a financial shock.

Chart 3



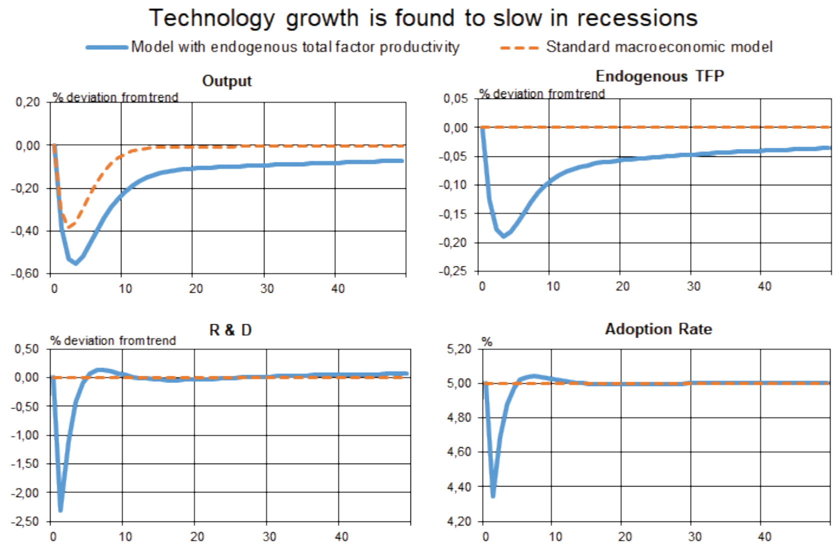

## Aggregate demand matters for technology growth

The finding that the worsening of euro area productivity growth performance since 2008 can be considered at least partly as crises-induced holds important implications, as it suggests that demand-side shocks can spill over to aggregate supply – in contrast to the conventional view in macroeconomics. It also has important consequences for euro area economic dynamics, since demand-supply spillovers can lead to deep and long-lasting recessions, as illustrated by Chart 4, which compares the response of the economy following a recessionary shock in the model underlying this analysis (blue line) and in a conventional macroeconomic model without endogenous technology growth (red line).[7] The most important difference in the model used in this analysis is that total factor productivity falls relative to trend, as illustrated in the fall of the blue line in the upper right panel, as the incentive to invest in R&D and above all firms' capacity for technology adoption falls during a recession (lower left and right panel). This described feedback from overall economic conditions to the evolution of technology growth can generate deep and lengthy recessions, as visible in a marked and prolonged output drop, demonstrated in the blue line of the upper left panel, while the output in standard macroeconomic models (red line in the upper left panel) returns substantially faster to equilibrium. Hence, spillovers from aggregate demand to productivity and thus aggregate supply help in explaining two phenomena: firstly, the pronounced acceleration of the euro area productivity slowdown during the crises, and secondly, the marked output drop, the slow nature of the subsequent recovery, and the ongoing shortfall of output below its pre-crisis trend level in the euro area.

---

7. The event of a recession is simulated by means of a contractionary liquidity demand shock, as the latter generates the typical co-movement of key economic variables over the business cycle and moreover constitutes the main driving force of economic fluctuations in the model underlying this analysis.

Chart 4




Response of the economy to a recessionary demand shock.
Source: Schmöller and Spitzer (2019).
eurojatalous.fi / bofbulletin.fi
4.10.2019

## Demand-supply spillovers may render the effects of the zero lower bound more severe

Given the possibility of adverse spillovers from aggregate demand to the supply side of the economy, policies stabilizing aggregate demand take on a crucial role in this context. It is well established that the zero lower bound[8] constraint can be a severe obstacle to monetary policy in economic stabilization. More specifically, output losses and the deviation of inflation from target can generally be considered more severe when the zero lower bound binds, in the absence of further measures such as non-standard monetary policy tools.[9] The results of this analysis imply that the effect of the ZLB may be yet more detrimental than conventionally assumed, given the adverse effects that shortfalls in aggregate demand may exert on aggregate supply.[10] The drop in aggregate demand owed to a binding ZLB intensifies the deceleration in TFP due to the yet more diminished incentive for technology-enhancing investments, rendering the corresponding drop in output even more marked. Hence, the ZLB constraint intensifies spillovers from aggregate demand to aggregate supply, which emphasizes the importance of additional policy measures, such as non-standard monetary policy tools, in stabilizing aggregate demand in zero lower bound episodes. This finding naturally also highlights the potential gains from additional policy tools outside the scope of monetary policy at the ZLB, in

8. In practice, the effective lower bound, i.e. the actual lower bound for nominal interest rates, is understood to be slightly negative, without loss of generality in our findings.
9. For reference see, for instance, Eggertsson and Woodford (2003).
10. We simulate a binding zero lower bound constraint by a large-scale adverse liquidity demand shock hitting the economy, which – as stated previously – induces the standard co-movement of key economic variables over the business cycle. The size of the liquidity demand shock is picked as sufficiently large to make the zero lower bound constraint on monetary policy bind. When this large shock hits the economy, monetary policy will be constrained in economic stabilization given the constraint on nominal interest rates.

particular of well-targeted expansionary fiscal policy in countries with sufficient fiscal space.

## The productivity slowdown may further intensify in the event of a euro area downturn

There is a risk at the current juncture that the productivity slowdown would intensify further if the euro area economic outlook were to worsen. This concern is based on the results from a macroeconomic model for the euro area in which total factor productivity grows when new technologies are invented and subsequently adopted by firms in production (Schmöller and Spitzer (2019)). A central finding of this analysis is that the worsening of the productivity slowdown as of 2008 can be predominantly attributed to a crises-induced drop in firms' adoption of new technologies, since amidst the recession firms postponed productivity-enhancing investments to the future. This result implies that weak aggregate demand may feed through also to aggregate supply via its depressing effect on technology growth. This challenges the conventional macroeconomic take on the interaction between demand and supply, which assumes that technology growth is uninfluenced by cyclical fluctuations in the economy. Importantly, these demand-supply spillovers can adversely feed back to GDP and turn into deep and long-lasting recessions, as for instance observed in the context of the euro area crises.

As to the implications for policy, the risk of adverse spillovers from deficient aggregate demand to the economy's supply side further underlines the importance of maintaining a sound state of the economy. Consequently, constraints to policies stabilizing aggregate demand, such as the zero lower bound on nominal rates, may be more detrimental than generally envisaged, which emphasizes the role of supplementary policies. Moreover, the documented subdued technology adoption by firms implies that ensuring a smooth diffusion of key technologies to the wider economy and reducing the productivity differentials between frontier and laggard firms may hold substantial productivity gains. Strengthening education and retraining would foster firms' capacity to absorb new technologies by providing them with an adequately skilled workforce and would at the same time boost the potential for future R&D and innovation in the euro area.

Furthermore, from the perspective of this analysis, measures boosting innovation constitute a straightforward policy choice. Well-targeted infrastructure investments in research and development would have the benefit of boosting aggregate demand at present, while lifting euro area productivity growth in the future, especially when aimed at key technologies. As the efficiency of R&D in generating innovations may have declined, R&D investments may have to be increased significantly to attain a given level of innovation output. In addition to the quantity also the quality of R&D could be improved, for instance by reaping multiplier effects by means of cross-border research efforts in the euro area.

The model underlying this analysis naturally only captures a subset but not all possible channels determining euro area productivity growth, and the discussed policy measures should not be considered exhaustive, but merely a selection of adequate options in line with the model-based analysis. Finally, it is well-documented that the euro area productivity slowdown is due to a host of structural factors which, in the absence of major unexpected shifts in technology growth, will continue to weigh on productivity growth in the future.

## References:


Anzoategui, D, D. Comin, M. Gertler and J. Martinez (2019): 'Endogenous Technology Adoption and R&D as Sources of Business Cycle Persistence', American Economic Journal: Macroeconomics, Vol. 11 (3), pp. 67–110.

Bianchi, F., H. Kung and G. Morales (2019): 'Growth, Slowdowns, and Recoveries', Journal of Monetary Economics, Vol. 101, pp. 47–63.

Bloom, N., C. I. Jones, J. Van Reenen and M. Webb (2019): 'Are Ideas Getting Harder to Find?', Working Paper.

Brynjolfsson, E. et al. (2017): 'Artificial Intelligence and the Modern Productivity Paradox: A Clash of Expectations and Statistics', NBER Working Paper 24001.

Eggertsson, G. B. and M. Woodford (2003): 'The Zero Bound on Interest Rates and Optimal Monetary Policy', Brookings Papers on Economic Activity, Vol. 2003, No. 1 (2003), pp. 139–211.

Gordon, R. J. (2015): 'Secular Stagnation: A Supply-Side View', American Economic Review: Papers & Proceedings, Vol. 105(5), pp. 54–59.

Schmöller, M. and M. Spitzer (2019): 'Endogenous TFP, Business Cycle Persistence and the Productivity Slowdown', Bank of Finland Research Discussion Paper 21/ 2019.


### Tags

euro area, economic growth, productivity slowdown, monetary policy