

Weekly Report

Productivity Growth in Germany: No Sustainable Economic Recovery in Sight

By international comparison the productivity development of the overall economy in Germany has taken a serious hit after the reunification boom. Since then Germany has fallen behind not only in comparison to the USA and emerging-market nations like South Korea, but also in comparison to other EU countries. However, the economic upswing in 2006 led to a temporary increase in hourly productivity of labor per employed person. Can this increase be interpreted as a return to a higher trend growth? Econometric tests indicate that it probably primarily concerns a cyclically induced increase. Thus the decline of the medium-term growth rate came at best to a standstill. If the productivity growth should improve on a sustained basis, then a growth-orientated economic policy is required.

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Productivity analyses of the overall economy have always been a significant indicator for the sustainable success of the development of a country's economy. Ultimately the long-term productivity growth of the overall economy determines the chances of increase in prosperity for the population.¹ Productivity is defined as the ratio of gross domestic product (GDP) to total working hours. The volume of working hours of the domestic labor force applies in this case. In addition to labor productivity which can be measured either by labor force or by working hours, total factor productivity (TFP) is frequently considered which along with the employment of labor includes the efficiency of capital inputs.² In the following, productivity per working hour is employed for the analysis because we use data from official statistics on a quarterly basis and not on an annual basis which are published with a significant delay to calculate the TFP from them.^{3, 4}

¹ OECD: Compendium of Productivity Indicators 2008, OECD, Paris 2008.

² Van Ark, B., O'Mahony, M. and Timmer, M. P.: T Van Ark, B., O'Mahony, M. and Timmer, M. P.: The Productivity Gap between Europe and the United States: Trends and Causes. In: Journal of Economic Perspectives, No. 22, 2008.

³ Destatis: Volkswirtschaftliche Gesamtrechnungen [National Accounts], Fachserie [Technical Series] 18 Reihe [Series] 1.2 and 1.3, 1. Vierteljahr [first quarter] 2008. Statistisches Bundesamt [German Federal Statistical Office], Wiesbaden 2008.

⁴ The current revisions of the gross domestic product (GDP) lie within an appropriate and justifiable framework that is quite up to date. By international comparison the quarterly German data for the gross domestic product are among the best with regard to consistency and revisions necessary afterwards: According to a study of the OECD the early quarterly GNP estimates of the Federal Statistical Offices of Germany, those of France and Great Britain are the most reliable and precise, closely followed by those of the USA, Canada and the Netherlands. This is all the more remarkable because Germany is rated as top in Europe not only in terms of up-to-dateness but also regarding its rapid notification of its quarterly gross domestic product (GDP) after only 45 days. Since the year 2000 the publication of the GDP has been accelerated from 65 days up to only 45 day after the close of the report quarter, among other reasons, due to pressure from the financial world and to demand of the ECB for current data for the Eurozone. See Pressemeldung Nr. 307 des Statistischen Bundesamts Deutschland (Press Release No. 307 of the

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For this reason productivity per working hour is better suited for detecting cyclical fluctuations early on as well as changes in the medium-term growth rate than the TFP. It also directly depicts the efficiency of an economy based on the employment of labor and it is not encumbered with methodological problems of a precise calculation of capital stock data.

Germany Falls Behind in an International and Historical Comparison

Germany's medium-term annual-average output growth declined from 1.9% in the period of 1995-2000 down to 1.4% in the period of 2001-2006. This development is slightly better than the value for the Eurozone in total at 1.2% and also somewhat better than the EU-15 member states at 1.3%; however, it is considerably less than the development of the G7 nations for this period at 1.9%. In particular the US and Great Britain at 2.2% and also Japan and the Nordic countries like Finland and Sweden, however, performed significantly better by a country comparison in this period of time (Figure 1).

The current economic growth in Germany is unsatisfactorily slow not only in an international comparison but also from a historical viewpoint. For instance the labour productivity per working hour⁶ for the period 1990-1995 still grew by 2.9%.

However, for this period the special effect of the reunification with East Germany must be taken into consideration. Even before the reunification, however, the average growth rate of GDP stood at a substantial 2.5% in the years 1985-1990. All in all, the decline by more than one percentage point in the average annual growth rate in Germany is striking by comparison to the two preceding decades (Figure 2).⁷

Increase in Labour Productivity since 2006 only a Cyclical Effect

A change in the productivity growth rate can be decomposed into various components. Besides pure

Federal Statistical Office) vom 3. August 2007 [Press Report No. 307 of the German Federal Statistical Office from 3rd August 2007]."

⁵ The EU-15 countries include those EU countries which were members before the Eastern enlargement in 2004. These include the following countries: Germany, France, Italy, the Netherlands, Belgium, Luxembourg, Great Britain, Spain, Portugal, Ireland, Denmark, Austria, Sweden, Finland and Greece.

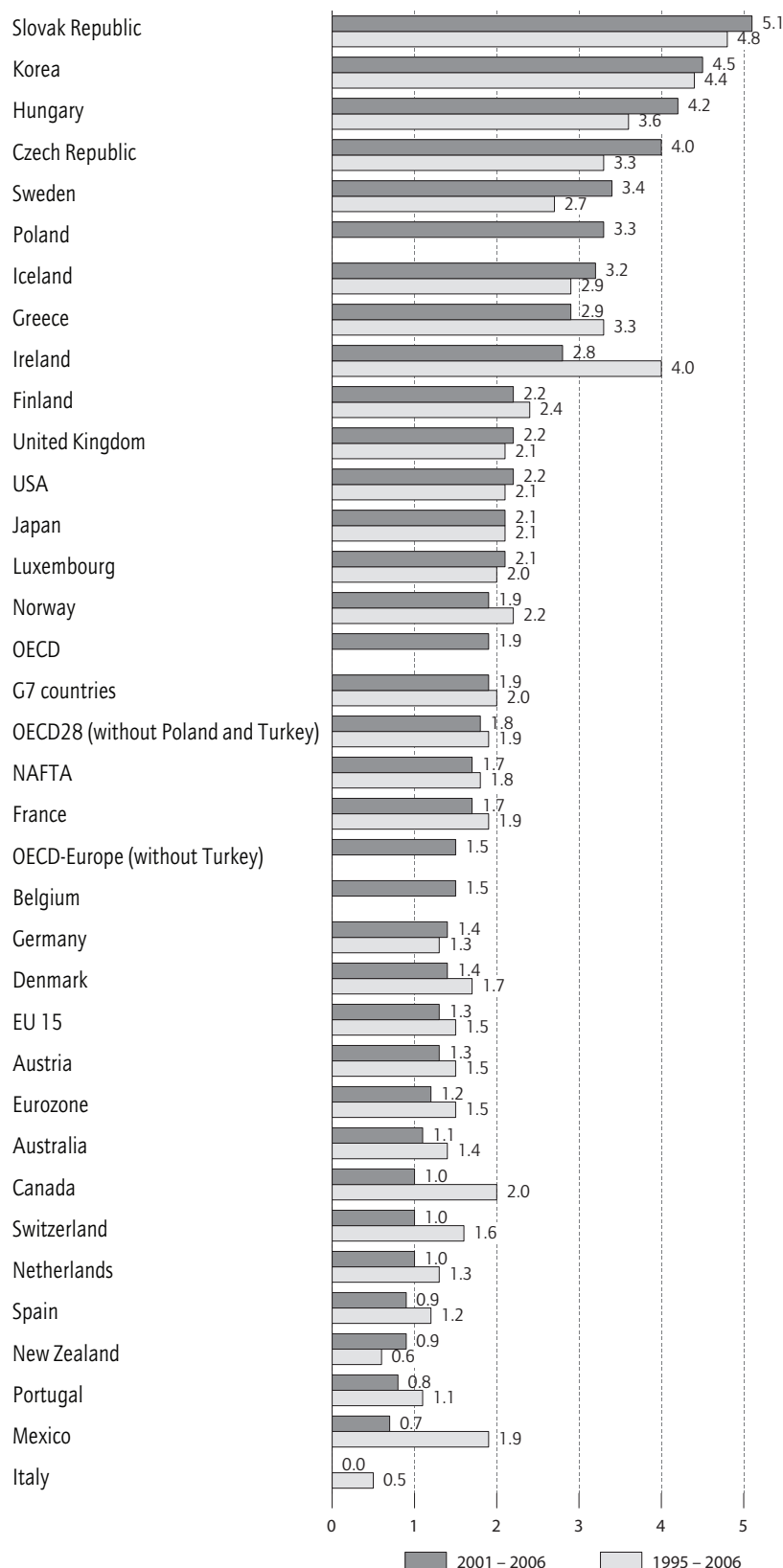
⁶ Productivity is defined as the ratio of real gross domestic product to total working hours; i.e. the volume of labor of the domestic labor force is taken.

⁷ Erber, G., Fritsche, U.: Produktivitätswachstum in den USA und Deutschland: Fällt Deutschland weiter zurück? [Productivity Growth in the USA and Germany: Is Germany falling further behind?] Wochenbericht des [Weekly Report of the] DIW Berlin, No. 30/2005.

Figure 1

Annual Average Growth Rate of the Productivity of Labor per working hour within the OECD Countries

in percent



Source: OECD.

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random fluctuations as a result of external shocks (for example through an increase in energy prices or innovations), for the most part two driving elements have a significant influence: cyclical fluctuations and long-term changes in the trend.

The analyses of the trend productivity growth rate carried out below with the model employed here (see box on p. 22) permit statements about the extent by which changes of work-hour productivity are determined by random fluctuations, business cycle influences or from structural changes related to the long-term trend rate. This is important in particular for the economic policy perspective: Political actions taken to raise productivity depends on the causes related to its decline. Only if the influence of structural factors like for example the inflexibility of the labor market or the shortcomings in the qualification of the labor force were targeted, such policies addressing these issues could have a significant impact on the trend rate.

A variance decomposition into trend and cyclical components shows that over the *entire* period studied from 1960 till 2008 cyclical influences have about the same importance for productivity growth as do changes in their long-term trend rate. However, these two systematic elements only account for about half of the variation observed: Random fluctuations that are uncorrelated over time account for the remaining fifty percent of the variance (Figure 3).

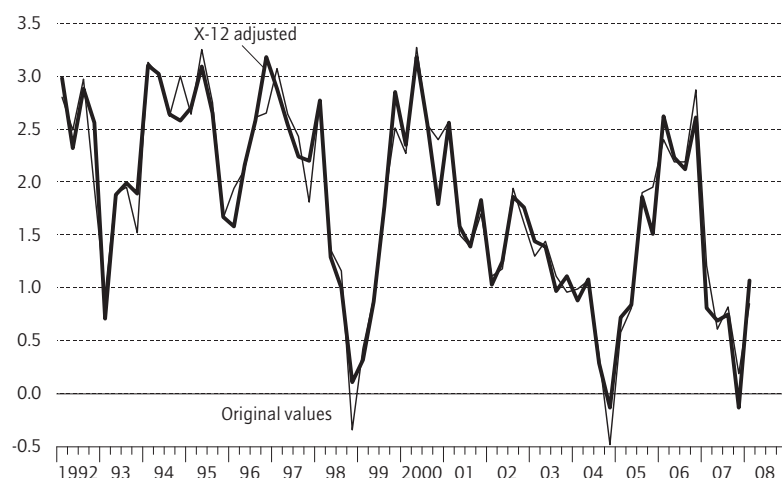
By contrast, another pattern emerges when one looks at the development since the beginning of the 1990s: The variance share of trend fluctuations of the total variance declined from a little more than a quarter down to about 15%, whereas the share of the cyclically induced variations rose to about 48%. Consequently, a distinct shift occurred between the three variance components. The contribution of the cyclical components increased considerably relatively to the two others, i.e. the trend and the random variations. It is now more than three times higher compared to changes in the trend rate. By contrast, random fluctuations now explain only about one third of the entire variance.

These structural changes between the three variance components indicate long-term changes in the different sources of labour productivity growth. In particular this hampers the reliable determination of changes in the trend rate because the noise and cyclical pattern have become more dominant over time. As the determination of the trend rate is, however, of utmost importance for the medium to long-term estimation of the growth perspectives an economy, it consequently still deserves particular attention.

Figure 2

Labour productivity per working hour in Germany¹

Annualized percentage change of the respective quarter



¹ Real Gross Domestic Product (GDP, base year 2000) and total working hours.

Sources: German Federal Statistical Office - Destatis; IAB.

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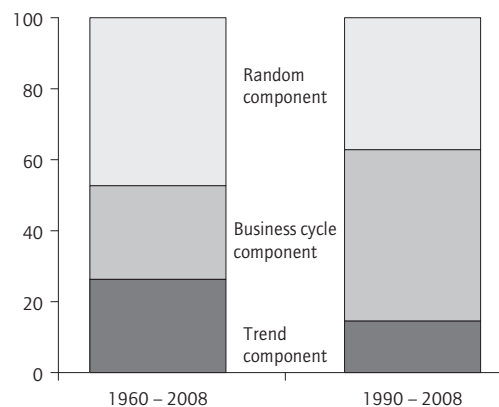
What does Growth Theory say to the Trend Rate?

In the traditional neoclassical growth theory the increase in productivity is the rate at which the economy in an equilibrium state (steady state) grows at a constant rate. The development of the endogenous growth theories led to the possibility that the medium-term increase in productivity is being viewed as variable and dependent on the formation

Abbildung 3

Variance Decomposition of Labour Productivity Growth Rates

in percent



Source: Own Calculations.

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Box

Determination of the Trend and Cyclical Component of Productivity Growth

In the analysis two methods were employed: 1) a testing method for structural breaks in the trend of the growth rate of the hourly productivity of the overall economy and 2) a method for the joint modeling of the cyclical and trend component of productivity increase in a state-space model. Both approaches are based on a semi-structural approach by Robert Gordon.¹ This approach assumes that procyclicality as well as a lead with respect to GDP growth of productivity growth belongs to the stylized facts of business cycle analysis. The growth rate can accordingly be divided into a 'trend component' (which is modeled either via broken deterministics or stochastically with the 'Random Walk' approach) and a cyclical component. The cyclical component is determined and filtered out through a regression analysis of the hourly productivity growth rate (annualized) on future values of changes in the output gap. To conduct the analysis up to the current boundary, the GDP was forecasted through an ARIMA (1,1,0) process, and the output gap was calculated by means of a Hodrick-Prescott filter (1600).

A double procedure was pursued with regard to tests for structural changes in the trend growth. In a first step, the influence of the business cycles on the simultaneous and future changes (up to four quarters) in the output gap (Δx) were filtered out by a regression of the annualized productivity growth rate (Δy); in a second step the productivity increase that had thus been corrected for the cyclically adjusted productivity increase was regressed to a constant (α):

$$\text{Step 1:} \quad \Delta y_t = \sum_{i=0} \beta_i \Delta x_{t+i} + \varepsilon_t$$

$$\text{Step 2:} \quad \varepsilon_t = \alpha + u_t$$

The subsequently employed Andrews and Ploberger test (1994) is exemplary for a range of structural break tests.² It is based on sequential structural break tests, whereas

the most likely point of interruption is determined using the maximum of the test statistics, respectively the minimum of the error probability.³ The critical values refer to the tabulated data in Hansen (1997).⁴

In parallel to the structural break tests a second approach was pursued which models changes in the trend rate more smoothly. This approach did not test for structural breaks in the deterministic part of the model; rather a smooth trend function describes the trend growth rate as a time-varying function. For this purpose a state-space model was estimated with a time-variable coefficient for the trend growth.⁵ The assumed process—which the coefficient describing the trend growth complies with—is a 'random walk'. The state-space model consists of two equations: the measurement equation which describes the 'observable' part of the model and a state equation which defines which process the trend follows.

$$\Delta y_t = \alpha_t + \sum_{i=0}^4 \beta_i \Delta x_{t+i} + \varepsilon_t$$

$$\alpha_t = \alpha_{t-1} + u_t$$

The measurement equation is nearly identical with the regression described above, in which – based on simultaneous and future changes in the output gap – the productivity growth is corrected for cyclical effects. The model's expectancy value is, however, described by means of the state equation as a non-stationary stochastic process ('random walk'). High flexibility is hence given in the adaptation. Smoothed values of α_t were used for the evaluation. Both equations, including the variance of the residuals of the measurement and state equations (ε_t, u_t) were estimated simultaneously.

¹ Cf.: Gordon, R. J.: Exploding Productivity Growth: Context, Causes, and Implications. In: Brookings Papers on Economic Activity, Vol. 34, No. 2, 2003, 1–73.

² Hansen, B. E.: The New Econometrics of Structural Change: Dating Changes in U.S. Labor Productivity. In: Journal of Economic Perspectives, No. 15, 2001, 117–128.

³ Andrews, D. W. K., Ploberger, W.: Optimal Tests When a Nuisance Parameter Is Present Only Under the Alternative. In: Econometrica, 1994, 1383–1414.

⁴ Hansen, B. E.: Approximate Asymptotic P-Values for Structural Change Tests. In: Journal of Business and Economic Statistics, 1997, 60–67.

⁵ Cp. Hamilton, J. D.: Time Series Analysis. Princeton, 1994.

of human capital inputs in particular. The formation of human capital and the ability for innovation are viewed as endogenous factors determined by the respective factor accumulation. In endogenous growth

theory the trend-rate of productivity is considered as variable.⁸ This approach provides the basis for the following analysis.

⁸ Solow, R. M.: A Contribution to the Theory of Economic Growth. In:

If, for example, the average productive capacity changes this could be due to the aging of the working population, i.e. demographic development changes the trend rate. Access to a larger amount of a higher qualified labour force can, however, positively influence the average level of human capital and through this channel labour productivity growth. Other structural factors can be more flexible labor markets which enable a more rapid adjustment and reallocation of the labor force according to market conditions. Additionally changes in the relationship of the relative factor prices leads to the substitution processes between the respective production factors: In this way, for example, falling wages offer no incentives to increase the labour productivity through a higher automatization, i.e. investment in new capital equipment.

Besides changes through the employment of the amount of labour changes in human capital and changes through technical advancements, investments in modern capital equipment play as well a significant role in the development of labour productivity. A detailed study of the origin of the different causes, however, cannot be carried out within the framework of this analysis.

The Current State: High Volatility of Productivity Growth Rates

If one looks at the recent developments since the last cyclical upswing, then the labour productivity increased in the year 2006 with a growth rate of about 2.4%. The recovery reached by this a magnitude comparable to the rates observed in the first part of 1990s until 1997. There was at least temporarily a hope—as already in the year 2000 with an increase to 2.6%—that this increase has not been caused only by cyclical factors like an export boom. However, the development of the productivity growth showed up to be unsustainable in 2007. In the first quarter of this year the preceding sharp decline could be compensated temporarily, due to the unusually high production growth: Productivity growth recovered to 1.1% compared to the previous year. By contrast, in the fourth quarter of 2007 there was already even a slight decline of 0.1% compared to the quarter of the previous year. The latest figures from the German Federal Statistical Office on the gross domestic product and the numbers of the employed labor force for the second quarter lead to the anticipation

of a new sharp decline in the growth of the hourly labour productivity.⁹

This indicates a persistent high volatility in the productivity growth rates, which clearly impedes a determination of the actual trend rate. In order to be able to derive a better picture of the long-term development from these data, approximations of the trend rate have therefore been calculated based on econometric statistical methods.

Econometric Determination of the Trend Rate of Productivity

In an initial approach, the trend is adjusted by removing cyclical effects and the hypothesis is tested whether the trend rates in various periods show differences that are statistically significant.

In order to obtain a precise date for a break-point of the various periods of the trend growth rate, the approach by Robert Gordon has been applied.¹⁰ In this approach the aim is to produce an adjusted medium-term productivity growth trend from which the cyclically induced productivity has already been removed through an appropriate filtering process. A starting point for this approach is that cyclicalities are induced in productivity growth through general standard business cycles. This assumption is essential for the attribution of fluctuations in productivity growth to cyclical or trend-induced changes (for details on methodology, see box on p. 22).

In this manner the annual growth rate of the productivity per working hour was adjusted in an initial step by a first step regression removing the respective cyclical effects. In a second step the trend rate from the first quarter of 1970 up to the first quarter of 2008 was estimated and its invariance was tested during this time period. Every probable break-point in the trend rate was tested for its statistical significance. Afterwards the time span was cut from the statistical break-point onwards towards the end of the sample. This process was repeated until no further statistical significant break-point could be identified.¹¹ The respective results are provided in Table 1.

⁹ "The German economy declined in the second quarter of 2008 for the first time again in almost four years: Adjusted for price, season and calendar effects, the gross domestic product (GDP) was lower by 0.5% than in the first quarter of 2008." see Destatis: Schnellmeldung zur Wirtschaftsleistung im 2. Quartal 2008 [Rapid Press Release regarding the Economic Performance in the Second Quarter of 2008]. Press Release No. 290 from 14th August 2008; see as well Destatis: Leichter Anstieg der Erwerbstätigenzahlen [Slight Increase of Labor Force Figures], Press Release No. 276 from 31st July 2008. The volume of work increased in the second quarter compared to the previous year by 3.5%.

¹⁰ Cp. Gordon, R. J.: Exploding Productivity Growth: Context, Causes, and Implications. In: Brookings Papers on Economic Activity, Vol. 34, No. 2, 2003, 1–73.

¹¹ In order to back up the results, the procedure was repeated in the

Quarterly Journal of Economics, Vol. 70 No. 1, 1956, 65–94; Solow, R. M.: Growth Theory and After. Nobel Prize Lecture to the memory of Alfred Nobel, December 8, 1987; Aghion, P., Howitt, P.: Endogenous Growth Theory. Cambridge, MA 1997; Jones, Ch. I. (2005): Growth and Ideas. In: P. Aghion und S. Durlauf (Hrsg.): Handbook of Economic Growth. Amsterdam 2005, Vol. 1B, 1063–1111.

The results provide an indication of two structural breaks in the years 1977 and 1998 which can be determined with relatively high statistical significance.¹² Moreover, the results indicate that the increase of the trend productivity changed in the years around 1982/1983 (a recession with two pronounced downswings) and after the reunification boom. The two latter results are, however, statistically still relatively uncertain—so are possible changes in the trend productivity rate around 2006.

For this reason a so-called state-space model has been used which permits a greater flexibility in modeling the trend growth rate from one quarter to the next (for more details, see box on p. 22).

Figure 4 depicts the development of the trend rate of labour productivity resulting from the econometric estimation of the model. Obviously in this case, too, dating can be performed quite well: In the left half of the line graph a decline appears in the productivity growth in the 1970s, followed by a clearly discernable increase from 1982 to 1991. Then the increase in trend productivity flattened out until the year 1998, followed by a short-term recovery and another subsequent decline. However, by the end of the period under review—from 2006 onwards—the decline of the growth rates seems to have come to a temporary standstill.

Even so, it should not go unmentioned that an econometric determination of the trend growth rates, given the generally high volatility of the overall productivity growth rate, is always combined with some high degree of uncertainty. For this reason confidence bands for ± 2 standard errors (this comes close to a 95% confidence region) are included in Figure 4.

Conclusion

In the past months—especially with the widening of the subprime mortgage crisis in the US and its effects on the global financial markets—uncertainty has increased not only with regard to the short-term development of the economy. Because of the comparatively high volatility in the labour productivity per working, the determination of the trend growth rate by employing econometric-statistical models is as well associated with a high degree of uncertainty. The present analysis suggests that the trend in the growth rate of labour productivity no longer seems to be declining—as had been the case in the

time periods between the most "likely" points of interruption.

¹² The structural break that occurred as a consequence of the accession of East Germany to the Federal Republic of Germany has been eliminated beforehand by chaining the time series.

Table 1

Results of the Andrews Ploberger (1994) Tests

Base period	Most likely period of structural break	Error probability in % (H0*: no structural break)
1st Quarter 1960 to 1st Quarter 2008	2nd Quarter 1977	0
1st Quarter 1960 to 2nd Quarter 1977	4th Quarter 1969	55
3rd Quarter 1977 to 1st Quarter 2008	1st Quarter 1998	6
3rd Quarter 1977 to 1st Quarter 1998	4th Quarter 1982	11
1st Quarter 1983 to 1st Quarter 1998	1st Quarter 1991	20
1st Quarter 1998 to 1st Quarter 2008	1st Quarter 2006	20

* Null hypothesis

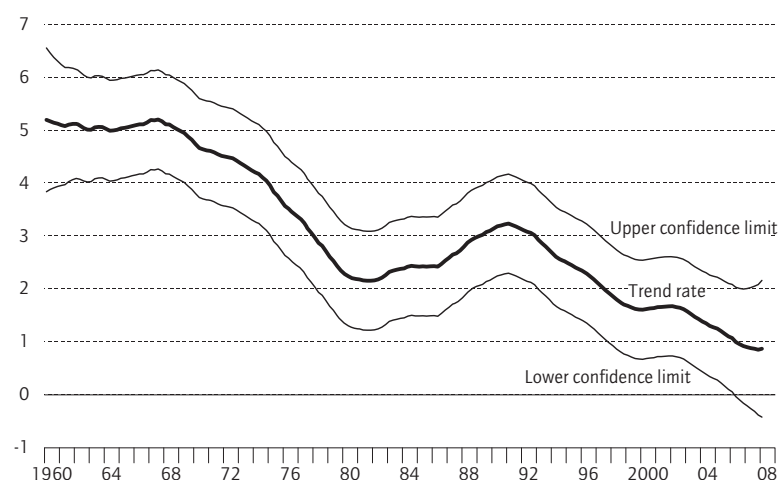
Source: own calculations.

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Figure 4

Trend Rate of the Labour Productivity per Working Hour in Germany

Annualized percentage growth rates



Confidence region = ± 2 standard errors.

Source: Own Calculations.

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previous years. The decline of the trend growth rate has obviously come to at least a temporary to a standstill. Whether this development is a sign for a lasting recovery cannot be answered conclusively through the current econometrics tests. The uncertainties in the global financial markets, the rise in the inflation consumer prices as well as the volatility in the international exchange rate system create considerable risks also for the future development of labor productivity.

Moreover, the desired positive effects of information and communication technologies on the trend rate of productivity—as it was temporarily the case in the US since the middle of the 90s¹³—has not occurred

¹³ Jorgenson, D. W., Stiroh, K. J.: Raising the Speed Limit: U.S. Economic Growth in the Information Age. In: Brookings Papers on Economic Activi-

in Germany.¹⁴ Although Germany could earn the title as the world export champion in global competition, this development was mainly facilitated by an extremely moderate increase in unit labor costs. The low increase in unit labor costs, however, is not attributable to an acceleration in productivity growth, but is rather due to pay restraint.¹⁵

Hence, the development up to now is at best a second-best solution for the successful economic development, because it inhibits further positive development regarding an increased earned income particularly due to the induced weakness in domestic demand. In contrast, a sustainable improvement in the productivity and economic growth is only attainable by advancing a structural adjustment towards new growth fields (energy, environment, health) as well as exploiting the potentials for utilizing information and communication technologies, nanotechnology and biotechnology (bioengineering) and by pursuing an accompanying supportive growth-oriented economic policy.¹⁶

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