

## Potential growth of the German economy – medium-term outlook against the backdrop of demographic strains

*Over the next few years, Germany will be facing perceptible demographic challenges. The domestic labour force will shrink and age. The present article examines the possible implications of this on the potential growth of the German economy. If the dampening effects of demographics can be mitigated by appropriate reform measures, it will largely be possible to maintain the current rate of potential growth of roughly 1¼% per year until 2020. For example, the supply of labour could be stabilised by a further increase in labour force participation and by boosting labour-market-oriented immigration. Furthermore, constant productivity gains can be achieved by improving the skills of the labour force and by means of technological progress.*

*As regards the domestic reserves, the labour force will be stabilised by the fact that older employees, who will make up an ever increasing percentage of the working population, will go on working for longer than hitherto. Moreover, labour force participation among persons with family commitments could rise – in part thanks to the further expansion of childcare facilities. It is furthermore assumed that Germany will achieve an annual net immigration of around 200,000 over the next few years, the vast majority of which will be immediately available to the labour market.*

*Notwithstanding the effects offsetting the demographics-driven decline in the potential labour force, the number of hours worked will be virtually no longer possible to increase significantly in structural terms. Potential growth will therefore be driven in future mainly by gains in productivity. A strong pace of growth is conditional on the willingness to invest remaining at a high level so as to give a further boost to capital intensity. Enterprises' capacity to innovate as well as the education and training of the labour force will play an important role in ensuring that technological progress diffuses in the production process. Dampening effects on aggregate hourly productivity, mainly as a result of the (re)integration of lower-skilled persons into the labour market in the second half of the last decade, will probably be less of a factor in future.*

*For Germany, as for the euro area as a whole, an increase in the mobility of labour within Europe has to be regarded as an opportunity for growth and a stability factor. Labour mobility helps in reducing the considerable labour market differences that exist at present and thus also helps reduce the risk of persistent wage and price differentials. The best growth results will be achieved if production factors are allocated not only through cross-border capital flows, but also through migration, particularly as this facilitates macroeconomic adjustment processes within monetary union.*

## Current macroeconomic situation

*German economy in very good shape*

The German economy is in decidedly good shape at present. Notwithstanding the temporary slowdown in activity due to the easing of demand from East Asia and the strains on the real economy in connection with the euro-area sovereign debt crisis, German enterprises generally face favourable conditions for sales on both the national and international markets. This is the outcome of a high degree of price and non-price competitiveness that has been achieved over the past decade and a half as a result of orienting the range of goods supplied and adjusting cost structures to the requirements of increasingly globalised goods and factor markets. At the same time, other shortcomings standing in the way of a persistent unfolding of growth forces were mitigated by reform policies aimed at making the labour market more flexible and consolidating public budgets as well as safeguarding the long-term sustainability of the social security systems.

*Successful adjustment to a changed environment*

In effect, this stopped the decline in potential growth that had been under way since the 1970s. There was not any new marked acceleration, however. From a macroeconomic perspective, the success of the reform measures lies rather in the fact that they allowed the labour market and public finances to adjust to an environment characterised by moderate real and nominal economic growth. In this process, it was to be accepted that some parts of domestic demand tended to weakness for a time. The dampening effects have largely receded, however. Households' income expectations are currently more optimistic than at any time for years and the propensity to purchase persists at a high level despite cyclical risks.

*Marked improvement in the labour market situation over the past few years*

The labour market, in particular, provides impressive evidence of the far-reaching change in the German economy. For instance, total underemployment – which may be seen as a measure of the lacking absorption capacity of the primary labour market<sup>1</sup> – was at roughly six

million persons at the beginning of 2006 and exceeded today's level by more than 50%. Since then, there has been ongoing sharp growth in employment subject to social security contributions – with the exception of a brief interruption in the wake of the deep recession in winter 2008-09. The gain in the quality of employment is indicated by the fact that atypical forms of employment, which previously played a key role in stabilising employment, have taken a back seat. In the first quarter of 2012, seasonally adjusted registered unemployment was at 6.8% of employed persons, which is the lowest rate since reunification. Full employment has been virtually achieved in some regions and, for various professions, firms are experiencing increasing difficulties in finding suitable staff in view of the high level of demand.

Despite the improvements of recent years, the labour market will again be a major starting point for pivotal structural decisions given that the demographic factors will become increasingly pressing over the coming years. So far it has been possible to satisfy the dynamic demand for labour from the unemployed and inactive labour market reserves. Looking ahead, the looming shortages in the labour market could lead to stronger wage growth, implying that the demand for labour would adjust to the shrinking supply. In this case, overcoming the demographic strains in the social security systems would become dramatically more difficult. Alternatively (and this is the key assumption in the medium-term projection described below), the tensions in the labour market could be kept within limits by broadening the potential labour force. To do this, better use has to be made of the domestic reservoir, and work-

*Options for the medium-term growth potential*

<sup>1</sup> According to the concept of the Federal Employment Agency, total underemployment comprises not only registered unemployed persons but also persons who are not counted as unemployed only on account of their participation in labour market policy measures or owing to their short-term inability to work. In addition, underemployment comprises persons in active labour market policy measures or government assisted self-employment and long-term unemployed persons over 58 years of age who are possibly not counted as unemployed.

ers from abroad also have to be attracted for the German labour market through immigration. This would be successful not only in terms of growth and employment; it would also limit the risks to price stability and at least partly alleviate ageing-related problems.

## Conceptual principles of the mid-term projection

*Determination of the longer-term growth prospects ...*

The medium-term projection has gained in importance with both national and international economic observers as an instrument for quantifying the growth prospects of an economy for a period of time which extends beyond the usual horizon of economic forecasts. The methods used differ mainly with regard to their objective. One major distinguishing feature in this context is whether solely the medium to long-term growth path of potential output is under consideration – as in this instance – or whether the intention is to extrapolate actual output by modelling the demand side.<sup>2</sup> As it plausibly has to be assumed that both variables converge in the long run, the arithmetical discrepancy – specifically, the cyclical component of gross domestic product (GDP) – generally plays a subordinate role. When simultaneously determining the longer-term growth prospects, it is also important to take into consideration the supply and demand-side relationships of capital formation.

*... implemented as a supply-side medium-term projection up to 2020*

The medium-term projection presented here, which covers the period until 2020, generally uses the same analytical framework as the non-parametric method that is usually applied to estimate potential output using a production function approach.<sup>3</sup> The computational basis is the breakdown of output growth into the contributions of the primary factors of production, ie labour and capital, as well as total factor productivity (TFP). In contrast to the traditional approach to potential output estimation, which covers the short-term horizon of economic forecasts between two and three years, the medium-run analysis also incorporates implica-

tions of economic theory into the modelling. For example, growth theory provides the insight that output and capital services grow at the same rate in a growth equilibrium (steady state). The pace of growth is equal to the sum of the trend rates of hours worked and labour-augmenting technological progress. On this basis, fixed capital formation can be determined endogenously in the model with additional consideration being given to the fact that a change in the relationship between the factors of production occurs in the adjustment to a steady state. Furthermore, the composition of the potential labour force also produces effects on the aggregated hourly productivity.

The incorporation of enterprises' and households' behavioural adjustments in response to changes in the economic setting and structural policy measures plays a major part in the medium-term projection.<sup>4</sup> It would seem prudent to consider various scenarios not only in terms of differing policy options but also in view of the major uncertainty that exists with regard to relevant economic benchmark figures and interactions for the long term. For the baseline scenario, however, there exists the technical requirement that it be consistent up to the end of the macroeconomic projection's forecast horizon with the path of potential output which comes out of the traditional method on the basis of forecast figures.

*Behavioural adjustments and structural policy measures of relevance*

---

<sup>2</sup> The German Federal government's medium-term projection, for example, refers to actual GDP. This is also the target variable of the relevant calculations in the joint diagnosis of leading economic research institutes in which a projection of potential output is also published.

<sup>3</sup> See Deutsche Bundesbank, The development of production potential in Germany, Monthly Report, March 2003, pp 41-52.

<sup>4</sup> In terms of economic policy measures, economic forecasts are regularly based on the status quo assumption, that is that their effects are usually included in the projections only if they have been decided or specified in sufficient detail and they are likely to be adopted. This approach seems unhelpful for medium-term projections. First, the assumption of an economic policy status quo over a period of eight years is not very plausible. Second, it is scarcely possible to tell whether behavioural changes that are effective in the long term would arise with or without the support of structural policy.

## The changeover in capital measurement for potential output estimations

Aggregate capital services, which the Bundesbank uses in its production function method of estimating potential output, will be measured in a new way in future.<sup>1</sup> Until now they have been measured by the real gross capital stock, which is the procedure followed by the German Federal Government, the German Council of Economic Experts and in the economic research institutes' joint assessment. According to the official fixed asset accounts, the real gross capital stock is obtained by aggregating the various asset classes on the basis of their stock values at the previous year's replacement prices. However, not the capital stock itself is relevant for production, but the use made of the capital invested. Hence, in the past, the calculation was based on the assumption that the (period-based) value derived from the use of an asset is proportional to its (time-related) replacement value. This hardly seems plausible given that aggregation is performed over asset types with very different service lives and quality features.

In the Bundesbank's potential output estimation, capital will be measured by weighting the asset types shown separately in the fixed assets accounts according to their share of the user costs of all assets used in production. This procedure is in keeping with significant contributions to the academic literature and recommendations by international experts.<sup>2</sup> This mitigates a major conceptual shortcoming of the previous method for measuring capital to a considerable extent, even though it does not eliminate it entirely.<sup>3</sup>

Under the new capital measurement methodology, user costs have to be estimated

for the asset types "machinery and equipment", "vehicles", "intangible assets", "non-residential property" and "residential property". According to the neoclassical investment theory, the user costs of asset type  $i$  can be calculated as follows:

$$r_i = \frac{1-u_i}{1-\tau} (\rho + \delta_i - \pi_i^e) q_i,$$

where  $\rho$  is the real return required by the investor,  $\delta_i$  is the rate of capital consumption and  $q_i$  is the procurement price of capital good  $i$ . The expected relative capital gain or loss from asset class  $i$  is referred to as  $\pi_i^e$ . Parameter  $\tau$  is the marginal tax rate on entrepreneurial profits and comprises either personal income or corporation tax, the solidarity surcharge and local business tax as well as real property tax, and  $u_i$  is the present value of all future tax rebates and subsidies associated with an investment in asset class  $i$ .<sup>4</sup>

User costs are calculated on an annual basis; however, official statistics can be used only in part. These include capital

<sup>1</sup> Details on the new approach to measuring capital may be found in T A Knetsch, A user cost approach to capital measurement in aggregate production functions, Deutsche Bundesbank, Discussion Paper No 01/2012.

<sup>2</sup> An important starting point for academic work on this topic is D W Jorgenson and Z Griliches (1967), The explanation of productivity change, Review of Economic Studies 34, pp 249-283. An extensive overview of this literature may be found, for example, in the OECD Manual "Measuring Capital", 2nd edition, 2009.

<sup>3</sup> The published asset types form the statistical basis for the new aggregation. Since these are aggregated at a low level using the weighting concept of official statistics, a measurement error remains. However, the relatively low degree of heterogeneity among the asset types means that it is probably considerably smaller than the differences documented here.

<sup>4</sup> In particular, these include the divergence of the tax-effective depreciation rule from the time profile of capital consumption owing to technical wear and tear and economic obsolescence.

goods deflators and the average depreciation rates for technical wear and tear and economic obsolescence. Other sources and own estimates have to be used for expected figures. For instance, ex ante real interest rates are used to approximate the real return required by the investor.<sup>5</sup> The calculation of expected relative capital gains/losses includes asset-specific price expectations which are based on an econometric modelling of expectations formation, as appropriate survey data are unavailable. The impact of the fiscal parameters on user costs is determined using the Devereux-Griffith approach,<sup>6</sup> taking also tax-related differences resulting from the choice of financing into account.

Aggregate capital services  $K$  are expressed as a Divisia index and therefore follow the following construction principle:

$$\Delta \ln K = \sum_{i=1}^I s_i \Delta \ln K_i,$$

where  $K_i$  represents the stock of assets of type  $i$ . The index weight  $s_i$  is calculated from its share in total user costs, ie  $(r_i K_i) / (\sum_{j=1}^I r_j K_j)$ .<sup>7</sup>

The conceptual difference between aggregate capital services and capital stock is expressed mathematically by differing weighting methods. Under the balance sheet aggregation approach used for the official fixed assets accounts, the weight  $(q_i K_i) / (\sum_{j=1}^I q_j K_j)$  is generally allocated to asset type  $i$ .<sup>8</sup> Comparison of the formulae illustrates that the weighting differences result from those user cost components that show very strong variations between the asset types. This is especially true of the annual depreciation rates, which are around ten times higher for intangible assets than for buildings. Certain differences also exist with regard to the expected relative capital gains or losses. Assets from information

and communication technology (ICT) are expected to be subject to a larger loss of value than equipment with a low ICT content or than buildings.

Capital services of the business sector (excluding real estate) are considered under the disaggregated approach to potential output estimation.<sup>9</sup> Just over one half of these capital services are accounted for by machinery and equipment, whose share of all commercially used capital goods, by contrast, is only somewhat more than one-third (according to the aggregation method using replacement prices). The weight of intangible assets, which in the official fixed assets accounts have a stock value of 2% of fixed capital tied up in the business sector, is as much as 6% under the user cost approach to capital measurement. The weighting difference for motor vehicles is not quite so great, at one-eighth (capital services) compared with one-tenth (capital stock). On the other hand, commercial properties exercise considerably less influence on aggregate capital services. Weighted by user costs, well over one-quarter is accounted for by this asset type, which accounts for more than half of the business sector's total asset stock.

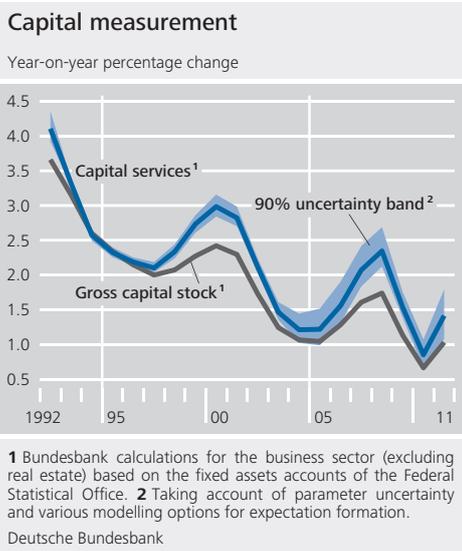
<sup>5</sup> See Deutsche Bundesbank, Real interest rates: movements and determinants, Monthly Report, July 2001, pp 31-47.

<sup>6</sup> See M P Devereux and R Griffith (1999), The taxation of discrete investment choices, Revision 2, IFS Working Paper Series No W98/16. The calculations refer to corporations.

<sup>7</sup> Specifically, Törnqvist weights are used, ie the arithmetic mean of the shares in the current and preceding period.

<sup>8</sup> Since the general revision of August 2011, real assets are shown at previous year's prices. For this reason, the asset types are weighted on the basis of the value shares of the previous year.

<sup>9</sup> Owing to their structure, residential properties are not included in assets of the business sector (excluding real estate). See Knetsch (2012) for the results for the capital services of the overall economy which contain the use of the housing stock.



Rising by 2¼% on average per year in the observation period between 1992 and 2011, enterprises' aggregate capital services expanded roughly ¼ percentage point more than the corresponding gross capital stock. This was because investment in movable and intangible assets was somewhat more dynamic on average than construction activity. Moreover, the time series characteristics of asset-specific fixed capital formation combined with the weighting differences show that, by comparison, capital services react more strongly to cyclical fluctuations.

The calculation of user cost is prone to estimation uncertainty due to the options that exist in terms of modelling assumptions and parameter settings. For example, the literature suggests that the real yield required by the investor not be changed over time.<sup>10</sup> Moreover, there are various econometric methods for modelling expectation formation. However, sensitivity analyses show that the proposed measurement of capital is fairly robust to variations in the user cost components. Simulations in which the parameters fluctuate within plausible ranges and several modelling assumptions are changed produce, on average, a 90% un-

certainty band of ±½ percentage point around the point forecast of the annual rate of change in the business sector's aggregate capital services. Generally speaking, depreciation rates have the greatest effect on estimation uncertainty; official statistics provide an extremely sound database for these, however.<sup>11</sup>

The new measurement of capital is also reflected in the estimation of total factor productivity (TFP), as TFP is mathematically a residual in the non-parametric method of potential output estimation. The estimates of potential growth can, in principle, be affected by the fact that capital services and TFP are treated differently in detrending. As the effects are reversely signed, they have very little impact on the rate of change in potential output. However, they amount to an appreciable magnitude in the supply-side decomposition of potential growth. From a conceptual perspective, the new method may be seen as an improvement in quality which is not qualified by the fact that the calculation of user costs gives rise to an additional source of measuring uncertainty.

<sup>10</sup> See, for example, W E Diewert (2005), Issues in the measurement of capital services, in C Corrado, J Haltiwanger and D Sichel (eds), *Measuring capital in the New Economy*, Chicago and London: Chicago University Press, pp 479-556.

<sup>11</sup> The calculation bases for the statistical measurement of capital and depreciation rates are explained in O Schmalwasser and M Schidlowski, *Kapitalstockrechnung in Deutschland*, *Wirtschaft und Statistik* 11/2006, pp 1107-1123.

*Disaggregated estimation approach*

In the present analysis, the longer-term outlook for growth is estimated in sectorally disaggregated form. As in the Bundesbank's more short-term estimation of potential output,<sup>5</sup> the production function approach is confined to the sector of market-oriented producing enterprises in the medium-term scenario, too. One major ingredient here is the adequate measurement of aggregated capital services (for details, see the box on pages 16-18). In the case of public and household-related services, the conceptual preconditions for a production function modelling are partly lacking due to the prevailing non-market output and, in some cases, input-oriented output measurement.<sup>6</sup> The results of the medium-term projection are presented in terms of their nature and scope in the same way as the traditional potential output estimation.

## Longer-term labour supply trends

*Potential labour force ...*

The supply side of the labour market is usually measured by the potential labour force. From a conceptual point of view, this comprises all persons who are immediately available to the labour market. In arithmetical terms, the potential labour force is divided into persons in work, persons actively seeking work and those inactive labour market reserves who are ready and willing to take up employment immediately.<sup>7</sup> The latter group comprises, without exception, persons taking part in educational and training courses that are supported by the labour agencies. The number of persons who have stopped seeking work but who would be immediately available is usually subject to cyclical fluctuations. Within this group, only those persons who would also share these characteristics in a normal cyclical situation are included in the potential labour force. This reflects the basic idea behind the concept of "potential" that cyclical factors are not to be taken into consideration.

A comparison of the potential labour force with the aggregate demand for labour de-

scribes the labour market situation without regard to working hours as an additional adjustment parameter. Generally speaking, from the desired goods production given cost-effective adjustment of capital services, it is possible to derive only the total number of hours to be worked, but not how these are split into the person and time components. In the short and medium term, the split chiefly depends on the options for the configuration of production technology and organisation. Taking a longer-term perspective, the preferences of the (potential) labour force also play a part, however. For the estimation of potential growth, the trend number of hours worked is the relevant measure of labour used in production. Let us therefore define the potential labour force in full-time-equivalents, as it is computationally equivalent to the trend number of hours worked but uses the wording introduced to measure the supply of labour.

*... and regular or wanted working time ...*

In the case of the full-time employed, the working hours component comprises the actual number of hours worked in a normal cyclical situation. In the case of part-time workers, however, it is the number of working hours wanted if they are restricted by the employer in

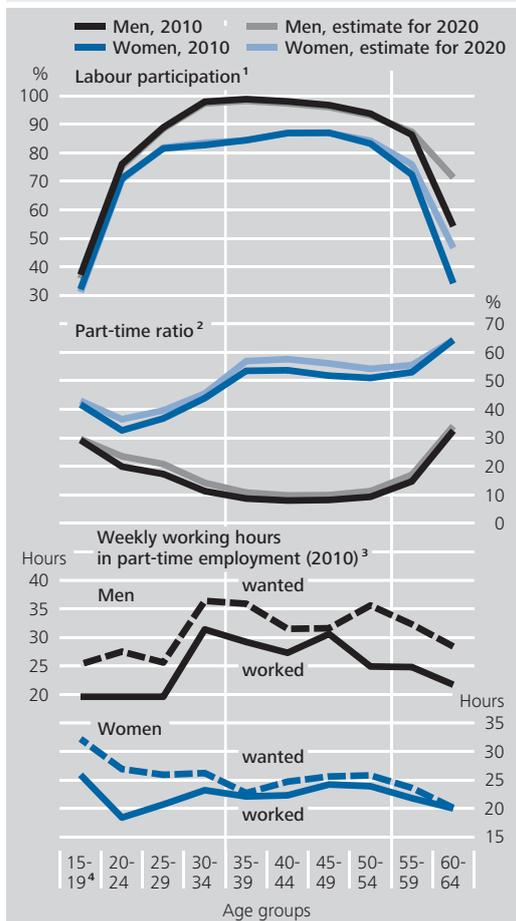
*... give the trend path of hours worked*

<sup>5</sup> See Deutsche Bundesbank, Advances in strengthening the economy's growth potential, Monthly Report, October 2007, pp 35-45.

<sup>6</sup> The new classification of economic activities (WZ 2008) in the national accounts, which was introduced last year, makes it easier to perform a differentiated calculation by sector. The market-oriented business sector comprises not only manufacturing but now also the sectors "trade, transport, hotels and restaurants", "information and communication", "financial and insurance activities" and "business services" as well as "real estate and renting", for which a specific production technology is assumed in the medium-term projection. The public and household-related sector is composed of the sectors "public services, education and healthcare" and "other services".

<sup>7</sup> The concept of the potential labour force is defined more narrowly here than in the concept of the Institute for Employment Research (IAB), according to which pensioners, persons unfit to work, interns, pupils and students can also be taken into account if retirement from work or not entering gainful employment is induced by the labour market situation. (See J Fuchs and B Weber, Umfang und Struktur der westdeutschen Stillen Reserve: Aktualisierte Schätzungen, IAB-Forschungsbericht 11/2010, p 11). In many of these cases, the criterion of immediate availability is unlikely to be fulfilled; they should therefore not be classified as part of the potential labour force during the observation period but, at most, in the future.

### Labour participation and part-time employment by age and gender



**1** Bundesbank calculations based on Statistisches Bundesamt (Federal Statistical Office), Fachserie 1, Reihe 4.1.1. **2** Bundesbank calculations. Source: Institute for Employment Research. **3** Bundesbank calculations. Source: the German Socio-Economic Panel (SOEP). **4** In the SOEP, age group comprises only persons between 18 and less than 20 years of age.  
 Deutsche Bundesbank

the amount of time they work. In the case of unemployed persons, consideration is given to whether they wish to start part-time or full-time work. With regard to the potential for the supply of labour that exists in the currently inactive part of the labour force, the interrelationship between (renewed) labour market participation and the desire for part-time work owing to personal circumstances or family commitments becomes very clear.

The starting point for estimating the potential labour force at full-time equivalents is the development in the working-age population, which – apart from migration effects – is virtu-

ally predetermined by the demographic benchmarks in the observation period up to 2020. Given balanced net migration, the number of persons resident in Germany of at least 15 years of age who have not reached the statutory retirement age<sup>8</sup> will have fallen by 1½ million by 2020 from 54¼ million in 2011. This would per se result in a contraction in supply. In the baseline scenario presented here, however, the assumption is made that labour force participation will rise further, which tends to counter this effect. Increasing participation relates, firstly, to older members of the labour force. Some years ago, when structural unemployment was at a high level, employees were often retired early, in some cases by means of government-assisted early retirement programmes. Although labour market participation by the population age group between 60 and 64 years has doubled over the past decade to just under 45% in 2010, considerable reserves still exist in this age group. Secondly, it might be possible to attract a greater percentage of women into starting work again (earlier) after they have quit or interrupted working life due to family formation. The improved compatibility of family and work has led to the labour force participation of women aged between 25 and 49 years being 3½ percentage points higher than in 2000. At 81¼%, however, the rate was below the figures measured for the North European countries (86¾%) and France (84¼%), for example.

*Further increase in age-specific and gender-specific labour force participation ...*

Despite these age-specific and gender-specific effects, average labour force participation will increase by no more than ¼ percentage point up to 2015 and even a slight decrease may be expected in this respect by 2020. The main reason for this is that, in the coming years, more and more people will be advancing into those age groups which are likely to be still character-

*... does not have any major impact in the aggregate owing to cohort effects*

**8** This takes account of the fact that the phase of a gradual raising of the statutory retirement age has begun in 2012. This will end in 2029 when the “pension at 67” has been reached. The effect of this increases the working-age population by roughly ¾ million up to 2020 compared with a measurement based on constant age limits, ie uniformly 15 to 64 years.

ised by a comparatively low labour force participation in the future, too. The scale of this cohort effect is illustrated by the fact that the average labour force participation excluding adjustment of the age-specific and gender-specific participation rates would fall by 1¼ percentage points up to 2015 and by 2½ percentage points up to 2020. In the baseline scenario, the potential labour force – excluding net migration – will decline by only around 1 million persons, or 2½%, up to 2020, while the reduction would amount to 2¼ million, or 5½%, under the conditions of unchanged participation behaviour and balanced net migration.

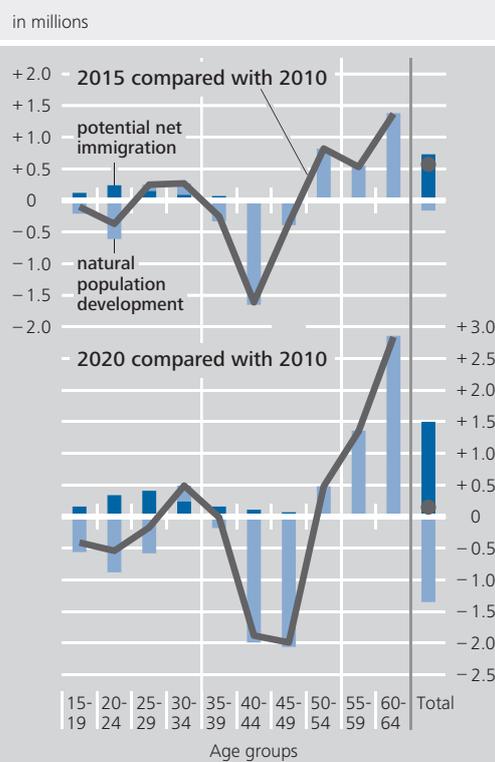
*Negative working hours effect*

Members of the labour force remaining longer in work will probably see a reduction in regular working hours in many cases. According to Socio-Economic Panel (SOEP) data, the weekly working hours wanted by persons of between 60 and 64 years of age are 5½% below the number of working hours preferred by the age group that is ten years younger. A comparatively low number of working hours is also preferred by many persons seeking (re)integration into the labour market who, at the same time, have family obligations. In the case of women, for example, the desired working time of 36 hours per week at the age of 20 to 24 years falls to an average of 32 hours in the 25-49 year-old age group. The improved utilisation of domestic reserves for the labour market is therefore likely to be linked to a negative effect on working hours. Despite higher participation, it would therefore be virtually impossible on balance to stabilise the potential labour force at full-time equivalents given balanced net migration. The number of working hours available on the supply side in this (hypothetical) scenario in 2015 would thus be an estimated ¾% below the current level; in relation to 2020, the decline would be 4%.

*Substantial migration gains ...*

As things stand and looking ahead, the available reservoir of workers in Germany – given plausible assumptions – is not nearly large enough to satisfy the foreseeable demand for

**Change in the working age population by age group**



Deutsche Bundesbank

labour. Supplementing the supply of labour by substantial migration gains received new impetus in 2010 after Germany had become steadily less attractive as a destination for immigrants over the previous decade. Given the quite stable outflow figures, this had resulted in a virtually nil migration surplus towards the end of that period. According to the provisional estimate of the Federal Statistical Office, the migration balance in 2011 almost doubled on the year to 240,000 (+128,000).<sup>9</sup> The granting of complete freedom of movement for citizens of the eight central and east European EU member states (EU8) which joined the EU in 2004 played a major part in this, although this special factor was by no means dominant.<sup>10</sup> It is possible to tell from the country profile that the

<sup>9</sup> This estimate was published in January 2012 and is essentially based on reports for the first half of 2011. The results now available for some months of the second half of the year indicate a perceptibly higher migration surplus.

<sup>10</sup> For details, see Deutsche Bundesbank Monthly Report, February 2012, pp 46-48.

## Results of the labour supply estimation

Period	Potential labour force at full-time equivalents	of which				memo item: NAIRU <sup>1</sup>
		Working hours	Labour participation	Working-age population	of which	
					Net immigration	
Year-on-year change %						
1996-2000	- 0.1	- 0.8	0.7	0.0	0.3	8.6
2001-2005	- 0.1	- 0.4	0.6	- 0.3	0.3	8.4
2006-2010	- 0.4	- 0.2	0.2	- 0.4	0.0	7.4
2011-2015	0.0	- 0.2	0.2	0.0	0.3	6.5
2016-2020	- 0.4	- 0.1	- 0.1	- 0.2	0.2	5.8

<sup>1</sup> Non-accelerating rate of unemployment (NAIRU) as a percentage of the labour force, measured according to the concept of the International Labor Organization (ILO).

Deutsche Bundesbank

significant labour market differences within Europe are generating perceptible push and pull effects that, overall, benefit the supply of labour in Germany. These offsetting mechanisms are likely to exert their greatest effect in the coming years. The baseline scenario therefore assumes an annual net inflow of some 200,000 persons by 2015.<sup>11</sup> In the period from 2016 to 2020, it is assumed that the migration surplus will fall to 150,000 persons per year.

*... concentrated on younger age groups*

The assumption made in the medium-term projection that roughly 90% of the net immigrants are of working age is consistent with the underlying hypothesis of primarily labour-market-related migration movements, with the largest surpluses being achieved in the case of persons aged between 15 and 29 years.<sup>12</sup> The higher age groups account for about one-quarter of working-age immigrants. This is due not only to the fact that, as they become older, people become more and more reluctant to leave their existing place of residence to take up a job but also to increased return migration to their home country by older non-German citizens.

*Potential labour force possibly stable by 2020*

Overall, the potential labour force would increase in the baseline scenario by just under 1% up to 2015 owing to rising labour force participation and the cumulative migration effect.

From 2016, the negative demographic factors would gain the upper hand, however, and the current level would be reached again approximately in 2020. The number of working hours available on the supply side could still rise marginally at first, but is likely to fall by 1¼% by 2020.

Under the assumptions made, migration will lead to the age groups between 15 and 49 years containing somewhat larger numbers. This shift in age structure will, however, be dominated by the ageing of the existing domestic resident population. In 2020, the number of persons aged between 40 and 50 will be ¾ million below the 2011 level, whereas the group of persons between the age of 55 years and retirement will increase on roughly the same scale. Against this backdrop, the increase in labour force participation in the age range before the statutory retirement age is of considerable importance for the trend development in the supply of labour up to 2020. This is especially true if it is not associated with an excessively sharp reduction in working hours.

*Labour force participation and working hours of the baby boomers of considerable importance*

<sup>11</sup> This takes account of the fact that complete freedom of movement for workers who are Romanian or Bulgarian citizens, which is scheduled to be granted at the start of 2014, will act as a significant special factor.

<sup>12</sup> This is in line with the age profile of the net inflows in 2010, for example.

## Fixed capital formation, productivity trend and potential growth in the longer term

*Fixed capital formation in a calm wage and price environment*

One of the key conditions for investment decisions is that the required human resources are available at the production site in an appropriate cost-benefit ratio. The baseline scenario envisages a path for the labour supply that basically maintains the favourable circumstances that exist at present for the foreseeable future. In line with the assumptions, unemployment will thus converge towards a level at which price stability is not at risk. Under these conditions, wage growth will persist in a range that is compatible with the stability requirement. Accordingly, marked changes in the relative factor prices that might produce a massive shift in the cost-minimising relationship between labour and capital in the production process are not anticipated in the baseline scenario.

*Steady state convergence*

The fact that an economy moves in the long term along an equilibrium path that is characterised by a constant capital-to-output ratio can be well substantiated by growth theory and is also documented empirically for numerous countries.<sup>13</sup> Assuming a production function with constant returns to scale, it follows that the average speed of accumulating fixed capital is measured as the sum of the trend change in the number of hours worked and the rate of labour-augmenting technological progress. Along with the innovative capacity of the economy, the education and training of the labour force and other factors that have an autonomous impact on hourly productivity, the trend in the potential labour force at full-time equivalents is thus a crucial factor for investment dynamics in a long-run equilibrium. Added to this are increases or decreases depending on how the ratio of factors of production – measured in labour efficiency units – approaches its long-term equilibrium value.

It is helpful for the medium-term projection to verify the various different factors influencing

the productivity trend on the basis of an observable variable such as output per working hour. The model framework for this is supplied by the breakdown of the trend rate of hourly productivity into the trend TFP growth and the contributions of technology-driven and adjustment-related capital deepening (for further details, see the box on pages 24-25). This makes it possible to reconcile the trend extrapolation of the residually measured TFP component and the assumption about the convergence path of the factor input relationship with the quantification of the trend growth of hourly productivity and fixed capital formation in a way that is substantiated by growth theory.

*Computational breakdown of the productivity trend*

With regard to the change in output per working hour in the business sector, it seems appropriate to assume an increase of around 1½% per year on a medium to long-term average, with the TFP component accounting for more than two-thirds of this. According to the assumptions for the medium-term projection, the technology-driven capital deepening contributes around one-fifth, while adjustment of the factor input relationship is of secondary importance. The observation that the trend TFP growth slowed on average in the second half of the past decade is due mainly to composition effects, which are reflected in the autonomous component. This was the consequence of the fact that the reform efforts in the labour market succeeded in (re)integrating less skilled members of the labour force into the work-process. Moreover, after the end of the industry-based upswing in the winter of 2008, the process of sectoral reallocation became more important again.<sup>14</sup>

*Recovery of the trend rate of hourly productivity ...*

<sup>13</sup> The observation of a long-term constant capital-to-output ratio is one of “Kaldor’s facts” which are explained by neoclassical growth theory. See, for example, R J Barro and X Sala-i-Martin (1995), *Economic Growth*, New York et al, McGraw-Hill.

<sup>14</sup> For more details, see Deutsche Bundesbank, *To what extent has the potential output of the German economy been impaired by the economic and financial crisis? An interim assessment*, Monthly Report, December 2009, pp 24-25.

## On the technical relationship between the trend rate of hourly productivity, the trend growth of total factor productivity and capital deepening

The non-parametric method of estimating potential output is based on a growth accounting exercise using an aggregated production function of the form  $Y = AF(K, L)$  given that  $F(\cdot)$  exhibits constant returns to scale and that the primary factors of production, capital services  $K$  and hours worked  $L$ , are remunerated with their marginal product when producing the quantity of goods  $Y$ .<sup>1</sup> Factor  $A$  measures total factor productivity (TFP). From a conceptual perspective, TFP contains unbiased technological progress; empirically, TFP is the residual component of growth accounting.

In this model framework, the growth rate of potential output is given by the equation<sup>2</sup>

$$\hat{y} = \hat{a} + (1 - s) \hat{k} + s \hat{l}, \quad (1)$$

where  $\hat{a}$  represents mean TFP growth. Changes in capital services and the cyclically adjusted hours worked are denoted as  $\hat{k}$  and  $\hat{l}$ , respectively, and the labour income ratio as  $s$ .

A simple transformation yields the equation for the trend rate of hourly productivity:

$$\hat{y} - \hat{l} = \hat{a} + (1 - s) (\hat{k} - \hat{l}), \quad (2)$$

where  $(\hat{k} - \hat{l})$  represents the trend change in the relationship between capital services and hours worked. In mathematical terms, the trend rate of hourly productivity comprises mean TFP growth and capital deepening which is expressed by the second term.

In the non-parametric estimation of potential output it is irrelevant whether unbiased or factor-augmented technological progress is chosen. This is due to the fact that the residual component of growth accounting can also be represented as labour or capital-

augmenting technological progress.<sup>3</sup> In turn, from the standpoint of neoclassical growth theory, it is an advantage to specify an aggregated production function with labour-augmenting technological progress. The key argument in this is the formal outcome that – without any further restrictive assumptions regarding the production function<sup>4</sup> – it is only in this case that the existence of a growth equilibrium (steady state) can be ensured.<sup>5</sup> Thus, if a production function of the form  $Y = F(K, BL)$  is assumed, the steady state of the economy is characterised by the fact that the relationship between the factors of production – measured as the ratio between capital services and hours worked in efficiency units  $BL$  – remains constant over time. Hence, the condition of  $\hat{k} - \hat{b} - \hat{l} = 0$  holds in a growth equilibrium.

In order to shed light on the implications growth theory has for trend rate hourly productivity, equation (2) is extended as follows:

$$\hat{y} - \hat{l} = \hat{a} + (1 - s) \hat{b} + (1 - s) (\hat{k} - \hat{b} - \hat{l}), \quad (3)$$

where  $\hat{b} = \hat{a}/s$  must apply as a result of the observation equivalence of both representations of technological progress.

<sup>1</sup> See also R M Solow (1957), Technical change and the aggregate production function, Review of Economics and Statistics 39, pp 312-320.

<sup>2</sup> All special features resulting from the disaggregated method are disregarded in this case.

<sup>3</sup> See also C R Hulten (2001), Total factor productivity: a short biography in C R Hulten, E R Dean and M J Harper (eds), New developments in productivity analysis, Chicago and London: Chicago University Press, pp 1-53.

<sup>4</sup> Assuming a Cobb-Douglas production function, a steady state growth equilibrium exists for each form of factor dependence in terms of technological progress.

<sup>5</sup> For proof of this, see, for example, R J Barro and X Sala-i-Martin, Economic Growth, New York et al: McGraw-Hill, 1995, pp 54f.

Capital deepening is thus composed of two elements. The technology-driven part  $(1 - s)\hat{b}$  is based on the idea that technological progress increases labour efficiency and that, as a result, *ceteris paribus* capital services increase at a faster rate than hours worked.<sup>6</sup> The adjustment-related part  $(1 - s)(\hat{k} - \hat{b} - \hat{l})$  is due to the fact that the steady state of the economy has not been reached at the time of observation and that a change in the combination of factor inputs takes place as a result. Adjustments of this kind arise, for example, from macroeconomic shocks which influence structural parameters such as the propensity to save, capital consumption, technological progress and population growth and which are also reflected in permanent shifts in relative factor prices. Adjustment-related capital deepening carries either a positive or a negative sign depending on whether the steady state convergence requires an increase or a decrease in the combination of factor inputs.

The decomposition of the trend rate of hourly productivity shown in equation (3) is of analytical importance for the medium-term projection in that it allows the settings for the TFP rate and the formation of fixed capital to be reconciled against the backdrop of the labour supply projection within a model framework that has a sound basis in growth theory. This also makes it possible to include considerations of whether perceptible changes in the factor price or factor input relationships can be expected during the projection horizon and quantify them in terms of their impact on productivity.

---

<sup>6</sup> Technological progress not only has a direct effect on hourly productivity through the TFP component; there is also an indirect transmission channel through technology-driven capital deepening.

*... because the dampening effects due to labour market integration petered out ...*

For the projection horizon under consideration here, it may be expected that, as a general trend, the employment opportunities in the services sectors will be more abundant than in the highly productive manufacturing sector. Furthermore, the skills profile of the working population and migrants would exert a dampening impact on aggregate productivity if the domestic and foreign labour market reserves do not match the average values of the current labour force potential in terms of skills, motivation and efficiency. Reductions are likely with regard to the possible further lowering of structural unemployment, since this will increasingly concern persons who have not been employed for an extended period of time. The impact is likely to be very limited compared with the period following the labour market reforms, however.

*... and the labour market reserves do not justify any reduction*

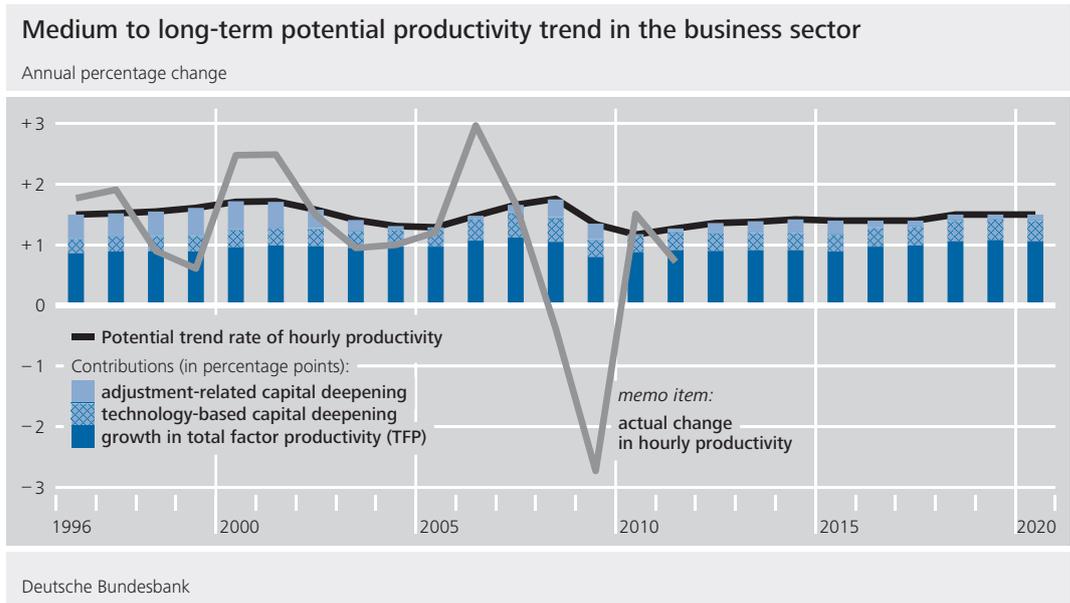
The quantitatively important increase in labour force participation among older persons does not necessarily have to be accompanied by losses in productivity since reduced physical ca-

pability can possibly be offset by occupation-specific human capital and experience.<sup>15</sup> Given primarily labour-market-induced immigration, it seems reasonable generally to assume a good match between job requirements and the qualifications and skills of successful foreign applicants. Recently, a start was made on the implementation of measures making it substantially easier to supplement the domestic labour force by means of immigration.<sup>16</sup> A significant nega-

---

<sup>15</sup> There is mixed empirical evidence regarding the interrelationship between age and productivity, with measurement problems being a factor. Nevertheless, the literature highlights the finding that, as a result of targeted measures, enterprises can counteract a reduction in labour productivity due to an ageing of their workforces. See, for example, A Börsch-Supan, M Erlinghagen, K Hank, H Jürges and G G Wagner (eds), *Produktivität in alternden Gesellschaften*, Stuttgart: Wissenschaftliche Verlagsgesellschaft, 2009, and C Göbel and T Zwick (2012), Age and productivity: sector differences, *De Economist* 160,1, pp 35–57.

<sup>16</sup> These include not only lowering the often prohibitively high income thresholds and extending the right of residence for persons seeking work but also, along with the abolition of the selective “priority review” and the swift recognition of educational qualifications acquired abroad, the suspension or lowering of numerous administrative hurdles.



tive effect on productivity cannot therefore readily be deduced from the skills profile of immigrants. Overall, the trend rate of hourly productivity could recover again gradually and, from the middle of this decade, reattain the average pace of expansion in the 1990s and the first half of the past decade.

*Components of the medium-term projection*

Under these circumstances, the growth potential of the business sector is expected to be about 1½% per year. Given the largely neutral impact of the number of hours worked up to 2015, growth is entirely derived from the increase in productivity. In mathematical terms, roughly three-fifths of this consists of the trend growth in TFP. By far the largest part of the remaining two-fifths will be due to the fact that this is backed, in line with the assumptions, by labour-augmenting technological progress, leading to the formation of fixed capital in a growth equilibrium. In the following five years, the average pace of growth could be maintained despite the moderate decline in the potential labour force at full-time equivalents thanks to somewhat higher productivity gains. With the exception of the healthcare sector, public and household-related service providers, whose share of value added at basic prices amounts to somewhat more than one-fifth, will – as in the past – fail to match the pace of

expansion of the market-based part of the economy.

If the supply of labour can be stabilised by rising labour force participation and increased immigration, there is a good prospect that potential growth of the German economy may reach an average of 1¼% per year by the end of this decade. This means that potential growth would be as high, on average, in the next few years as it has been since German reunification.

*Potential growth of 1¼% per year possible in the longer term*

## Germany's growth outlook and the European context

Given the high competitiveness of its enterprises and households' optimism, the long-term outlook for the German economy may be rated as favourable. A part in this is played by the very positive labour market situation as well as the private sector's overall comparatively low level of indebtedness. Against the backdrop that interest rates in Germany are likely to be relatively low for the foreseeable future and that the public sector is no longer very far away from a balanced budget, actual growth in the coming years could be higher on average than growth in potential output. It is assumed in the baseline scenario that the sovereign debt crisis will not escalate markedly. The consequences

*Conditions for rising labour force participation and higher immigration already in place in some cases*

### Medium-term projection of potential output

Period	Annual potential growth as a percentage	Contributions to potential growth					
		Business sector	of which			Public and household services	Residual component <sup>1</sup>
			Total factor productivity	Capital services	Hours worked		
1996-2000	1.5	1.0	0.7	0.6	-0.2	0.4	0.1
2001-2005	1.2	0.9	0.6	0.4	-0.2	0.3	0.0
2006-2010	1.2	0.8	0.6	0.4	-0.1	0.3	0.0
2011-2015	1.3	1.0	0.6	0.4	0.0	0.3	0.0
2016-2020	1.2	1.0	0.7	0.4	-0.2	0.2	0.0

<sup>1</sup> Contribution of the "agriculture, hunting and forestry" sector and of the trend component of net taxes on products.

Deutsche Bundesbank

of demographic change will become very obvious as early as the present decade. Under the conditions of the status quo, it is not difficult to infer risks to growth and prosperity. However, such a scenario is unlikely to be realistic in view of the fact that changes in the behaviour of enterprises and households are already becoming apparent at the current juncture. In general, these will lead to a more positive development in the potential labour force in the coming years than is indicated by many statistical projections.<sup>17</sup> Appropriate economic policy decisions, such as a far-reaching scaling-back of incentives for early retirement and a nationwide expansion of adequate childcare facilities, have already been made and are gradually taking effect.

the context of an administrative management that, moreover, would first have to be put to the test in Germany. Despite the fact that formal restrictions hardly exist, the option of securing a foothold in the German labour market has so far been taken up only by a very few workers who are currently faced with rather unfavourable job prospects in their home countries owing to a poor economic outlook or oppressively high unemployment. The migration balance with regard to a number of countries in southern Europe has recently been influenced quantitatively more by the marked decline in the number of persons returning to their country of origin. This shows that labour market differences between the home and (potential) host country are indeed important as a factor stimulating migration, but that language barriers and an absent social environment have to be seen as factors that can delay or even reverse the decision to move the centre of one's life to another country.

The strengthening of labour mobility does not have only an equilibrating function for the

*Substantial effects still to be expected from immigration*

It is likely that the stimuli of the new immigration regulations relating to non-EU citizens will only gradually reach a perceptible scale. Beyond this group, however, they are sending the message that Germany is opening itself further to an influx of labour. The signalling effect of this should not be underestimated since it could give impetus to labour mobility within the EU. Given the good level of education across broad sections of the population and their geographical and cultural proximity, success in recruitment is likely to be achieved far more quickly in neighbouring countries than in

<sup>17</sup> These include calculations which follow, with regard to immigration, the often-used central variants of the 12th coordinated population projection published in autumn 2009. The actual migration surpluses of the years 2009 to 2011 are cumulatively already 350,000 higher than the estimates made at the time.

*Labour mobility  
as a growth  
opportunity and  
stability factor in  
Europe*

European labour markets, however. The single currency area benefits from this in the form of other stabilising effects. For example, the risk of persistent wage and price differentials across the euro-area member states is reduced, which generally benefits the regional congruence of monetary policy. Moreover, the allocation of the production factors to their most productive use is performed very efficiently when it is backed not only by cross-border capital flows but also by migration. The spatial flexibility of both production factors enhances growth opportunities and can tend to counteract the emergence of current account imbalances. The

fact that the German economy is safeguarding its high level of performance and investing in domestic production sites is consistent with this scenario as long as the personnel resources are also available at the same time. The import demand from Germany, which has been very important for economic growth in the euro area as a whole in the past three years,<sup>18</sup> could become entrenched in this context.

---

**18** See Deutsche Bundesbank, The pronounced rise and fall in Germany's current account surplus vis-à-vis its euro-area partner countries between 1999 and 2011, Monthly Report, March 2012, pp 18-20.