Gern, Klaus-Jürgen; Meier, Carsten-Patrick; Scheide, Joachim

Working Paper

Evidence of the new economy at the macroeconomic level and implications for monetary policy

Kieler Diskussionsbeiträge, No. 401

Provided in cooperation with:
Institut für Weltwirtschaft (IfW)

Suggested citation: Gern, Klaus-Jürgen; Meier, Carsten-Patrick; Scheide, Joachim (2003) : Evidence of the new economy at the macroeconomic level and implications for monetary policy, Kieler Diskussionsbeiträge, No. 401, http://hdl.handle.net/10419/2940

KIELER DISKUSSIONSBEITRÄGE

401 KIEL DISCUSSION PAPERS

Evidence of the New Economy at the Macroeconomic Level and Implications for Monetary Policy

by Klaus-Jürgen Gern, Carsten-Patrick Meier and Joachim Scheide

CONTENTS

- The notion of new economy was coined in the United States when there was increasing evidence that, as a result of the introduction of new technologies, the traditional behavior of macroeconomic variables might have changed. The expansion of the 1990s differed from its predecessors in three important respects: productivity, inflation, and cyclical variability.
- In the United States, labor productivity increased much faster in the 1990s than in the previous decades and, contrary to the usual pattern, accelerated with the duration of the expansion. The view that most of the productivity acceleration was only cyclical and therefore not sustainable over a longer period of time has proven overly pessimistic. Productivity growth has remained on its elevated since the economy peaked.
- In other large industrial countries, by contrast, productivity growth has continued to decline or has improved only very slightly at best. Differences in productivity trends between the United States and other large industrial countries can be explained partly by the fact that in the United States IT production is more important and IT implementation relatively advanced. In addition, the identification of IT-related productivity gains in Europe is complicated by the general trend towards deregulation in labor and product markets and moderate wage increases that contributed to a rise in labor intensity, which tends to lower advances in productivity.
- In contrast to productivity developments, the behavior of inflation is consistent with a new economy in all large industrial countries. The moderate inflation can, however, be explained by adequate monetary policies and cyclical influences. Similarly, the analysis of cyclical variability concludes that changes in economic policies are a more important factor in explaining the reduced fluctuations in U.S. GDP than the advent of IT.
- A technology shock which raises the permanent level of output and, at least temporarily, the growth rate of the production potential has implications for monetary policy. In a world with rational expectations and sticky prices, the optimal reaction of monetary policy to an acceleration of potential output growth is to raise interest rates. The reason is that the expectation of higher incomes in the future causes current spending to grow faster than potential output and thus leads to inflationary pressure.
- In reality the optimal response of monetary policy to a shift in production potential is difficult to assess given the uncertainty concerning the timing and magnitude of new economy effects on the real economy. Being too expansionary probably has more severe consequences than erring on the other side, because the positive real effects would work through anyway, while inflationary expectations, once triggered, are difficult to reduce.

Contents

This paper is part of a research project entitled "The New Economy: Characteristics, Causes, and Consequences." Financial support from the Heinz Nixdorf Foundation is gratefully acknowledged.

1 Introduction

The term "new economy" has different meanings in different contexts. In the macroeconomic context, the notion of a new economy implies that previously found macroeconomic relationships have changed under the influence of new technologies. Section 2 looks at whether available evidence supports such a conclusion, and provides a comparison of developments in the United States with those in other large industrial countries. In Section 3, the possible implications of a new economy for monetary policy are analyzed using a small dynamic macroeconomic model. Conclusions are provided in the final section.

2 Evidence of a New Economy

2.1 Anatomy of the New Economy: The Example of the United States

The concept of a new economy was introduced in the United States as early as the mid-1990s, primarily because of increasing evidence that the traditional behavior of macroeconomic variables might have changed. Central to the concept was the suspicion that technology was driving an acceleration of productivity growth in combination with the presumption that the pricing power of firms was structurally reduced as a consequence of globalization (Shepard 1997). As a result of these factors, the growth potential, often called the "speed limit" of the economy, would have significantly increased. In addition, proponents of the idea of a new economy expected that implementation of new technologies would reduce cyclical fluctuations, partly because the possibilities of information technologies allowed companies to lower the optimal level of inventories which tend to swing widely and pro-cyclically (DeLong 2000). Another reason to expect that business cycles could be of less importance in the new economy than in the past was that the probability of monetary policy turning restrictive was deemed to be smaller, given reduced inflationary risks. Monetary restriction has usually preceded recessions in the post-war past.

However, macroeconomic indications for a structural change in macroeconomic relationships in the United States were not conclusive in the mid-1990s. Productivity growth was not exceptionally strong. The low inflation rate was no puzzle at least until 1997, as unemployment was, while on the decline, still at levels that should lead to disinflation, according to traditional NAIRU analysis (Krugman 1997). A comparison of economic growth in the United States in a longer-term perspective reveals that output growth over the 1990s was actually not exceptionally strong. The average annual growth rate of GDP at 3.4 percent was only slightly higher in the 1990s than in the 1970s and 1980s (3.2 percent), and was significantly lower than in the 1960s. In terms of many real economy indicators, the most recent expansion trails expansions in the past (see Zarnowitz 2000), e.g., as concerns GDP growth and employment growth.[1] Against this background it is understandable that most economists were reluctant to revise upward the growth rate of potential output (e.g., Krugman 1997; Blinder 1997; Nielsen 1999).

Nevertheless, the expansion of the 1990s differed from it predecessors in three important respects: (1) Productivity developments, (2) inflationary performance, and (3) cyclical variability.

As concerns (1), labor productivity has broken its downward trend. Productivity rose by more than 2 percent per annum on average over

[1] Recall the discussion about "jobless growth" in the early phase of the upturn.

the 1990s, much faster than in the 1970s and 1980s and nearly as fast as in the years of prosperity after World War II. Most unusual is the pattern of productivity growth within the cycle: Typically productivity rises fastest in the early years of an expansion when existing capacities are increasingly utilized, and decelerates towards the end of the boom when more and more inputs with less marginal productivity are entering the production process. While productivity growth more or less behaved according to this cyclical pattern in the expansions of the 1960s and 1980s,[2] productivity in the 1990s accelerated with the duration of the expansion (Figure 1).

The view that most of the productivity acceleration was only cyclical and therefore not sustainable over a longer period of time has proven overly pessimistic. Although the record-long expansion of the 1990s came to an end in 2000 and the growth rates of recent years have been revised downwards repeatedly (Figure 2), productivity growth remained on its elevated level. In the recession of 2001, productivity did not decline in contrast to other recessions of the past, and productivity picked up strongly again in 2002 despite a relatively slow recovery (Figure 3).

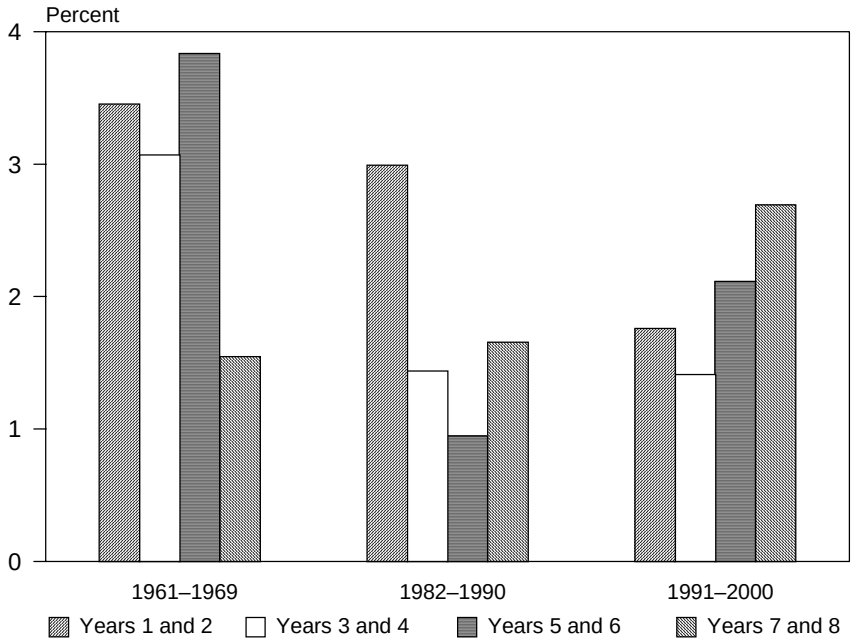
When it comes to interpreting the acceleration in productivity growth since 1995 there are methodological differences as well as differences in argumentation. While Gordon (1999; 2000) adjusts the productivity for cyclical fluctuations and focuses on the structural (trend) component, Oliner and Sichel (2000), work with cyclically unadjusted data, arguing that a sensible adjustment was impossible given the high degree of uncertainty about the level of the output gap. Both approaches, however, conclude that a large part of the acceleration in annual productivity growth since 1995, which is quantified as being 0.8 percentage points (Gordon 2000) and 1.1 percentage points (Oliner and Sichel 2000) is due to rapid productivity growth in the computer-producing industries themselves, even if their share in the total economy is still relatively small. The contribution of these industries to the acceleration in overall productivity growth is given at around 0.3 percentage points. The main point which is disputed is whether there is a productivity-enhancing effect of IT investment outside the IT industries. Such an effect can be found (Jorgenson 2002), but the acceleration of productivity growth is mainly due to capital deepening as a result of the strong decline in the prices of IT goods. By contrast, there is little evidence of an increase in the rate of total factor productivity growth stemming from factors such as changes in production and organization or the realization of economies of scope, for example.

As concerns (2), the strong rise in labor productivity was not anticipated and did not lead to a corresponding increase in wages. While wage inflation did pick up in the second half of the 1990s, wage growth remained moderate when measured against productivity. Unit labor costs did not rise, with the consequence that inflation remained subdued. By contrast, in each of the similar situations of high capacity utilization at the end of the 1960s and at the end of the 1980s, consumer price inflation rose markedly to rates of around six percent. At the peak of the most recent cycle in 2000, inflation reached only 3.5 percent. The core rate of inflation which is a better gauge of underlying inflationary tendencies was even lower, at around 2.5 percent. That being said, there are additional factors which contributed to the benign inflationary developments, notably a reduction of the health insurance portion of labor costs related to the introduction of managed care schemes and an improvement in the terms of trade (Gordon 2002).

As concerns (3), one postulated feature of the new economy in macroeconomic relationships is a reduced volatility in output over time. The reasoning behind this, as noted above, is that the importance of inventory cycles is expected to be reduced as a result of the application of information technologies. In addition, the increased amount of information should result in greater price flexibility, with the consequence of less output fluctuations caused by nominal rigidities. The development in the United States in the late 1990s seemed to support this view; the standard

[2]There was no expansion of comparable length in the 1970s.

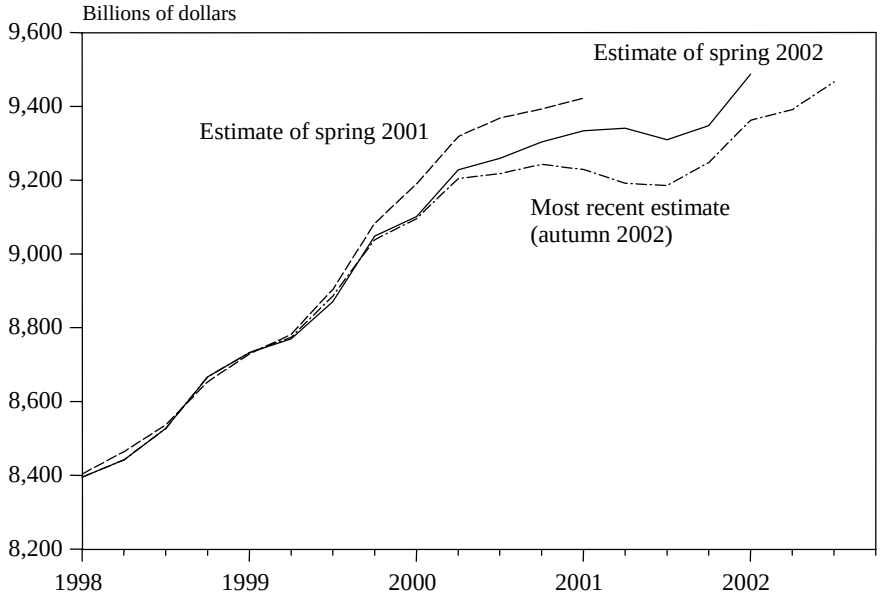
Figure 1:
United States: Productivity Growth[a] in Selected Upswings



[a]Real GDP per person engaged; average annual percentage change over previous year. – [b]Years 7–9 for the 1991–2000 cycle.

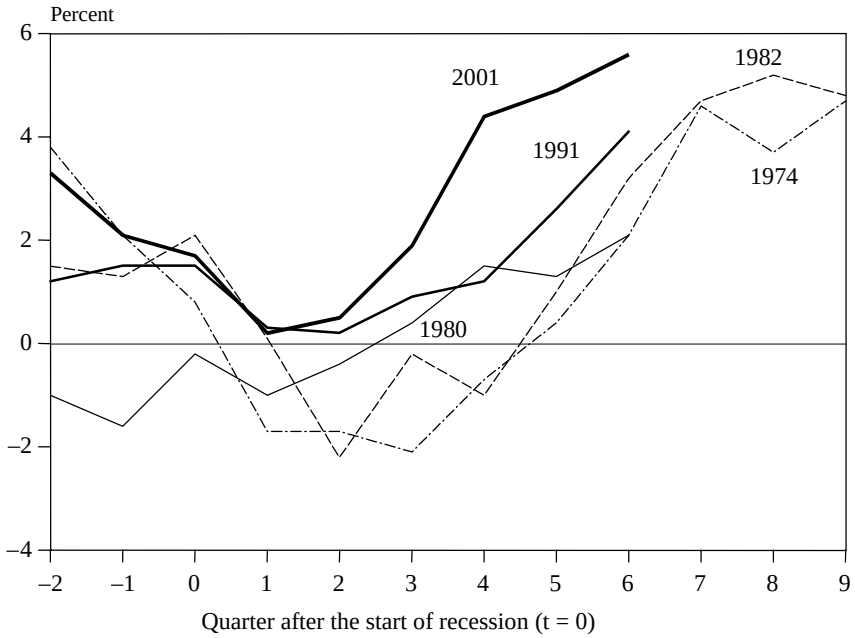
Source: OECD (2002a); own calculations.

Figure 2:
Real GDP in the United States according to Different Official Estimates



Source: U.S. Department of Commerce, Bureau of Economic Analysis *Survey of Current Business* (various issues). Washington, D.C.

Figure 3:
Comparison of Labor Productivity Performance in U.S. Recessions[a]



[a]Output per hour worked in the private nonfarm sector. Dating of recessions according to NBER Business Cycle Dating Committee (http:// www.nber.org/cycles/recessions.html)

Source: U.S. Department of Labor, Bureau of Labor Statistics, http://www.bls.gov

deviation of real GDP growth was significantly reduced in the course of the 1990s. The standard deviation was 0.9 percentage points in 1995–1999, compared with 2 percentage points in 1985–1989, the corresponding late years of the expansion in the 1980s (Davies et al. 2000). It can, however, be argued that the apparent stability of the expansion in the second half of the 1990s was primarily the result of a lucky string of external shocks and an improved macroeconomic policy mix, rather than an effect of new technologies. With the experience of the recent recession, it can at least safely be said that the sometimes heard notion of new economy optimists that the cycle is dead has been proven wrong.

All in all, however, there is still sufficient evidence to conclude that the potential growth rate of the U.S. economy seems to have increased during the 1990s. It is, however, not clear how sustained the acceleration of productivity is. If the growth of computer investment should slow down in the coming years to a rate more similar to the years before 1995, a major portion of the productivity growth acceleration would probably disappear (Gordon 2002). In addition, there is a severe identification problem with respect to the nature of technical progress. The degree to which long-term growth is affected by labor productivity acceleration critically hinges on the question whether the technical progress is characterized by Hicks, Harrod or Solow neutrality (Klodt et al. 2003: Chapter 2.3). Currently, potential output is still growing at rates above those experienced in the 1980s and early 1990s, although estimates have been substantially reduced from growth rates as high as 4 percent (Greenspan 2000) to around 3 percent, as is assumed in the medium-term projections of the Congressional Budget Office or can be inferred from the development of the output gap in the calculations of the OECD (2002a).

2.2 International Evidence

When comparing economic growth in the United States with that in other large industrial

Table 1:
Real GDP per Head in Large Industrial Countries, 1960–2000

	1960–1970	1970–1980	1980–1990	1990–2000	1990–1995	1995–2000
United States	2.5	1.4	2.3	2.3	1.5	3.0
Japan	8.2	3.5	3.1	1.4	1.3	1.6
Germany[a]	3.8	2.7	2.3	1.8[b]	1.2[c]	1.8
France	3.9[d]	2.5	1.4	1.5	0.7	2.4
Italy	5.1	3.0	1.7	1.5	1.3	1.7
United Kingdom	1.3	1.6	2.3	2.0	1.4	2.5

[a]Until 1990 West Germany. – [b]1991–2000. – [c]1991–1995. – [d]1963–1970.

Source: OECD (2002a); own calculations.

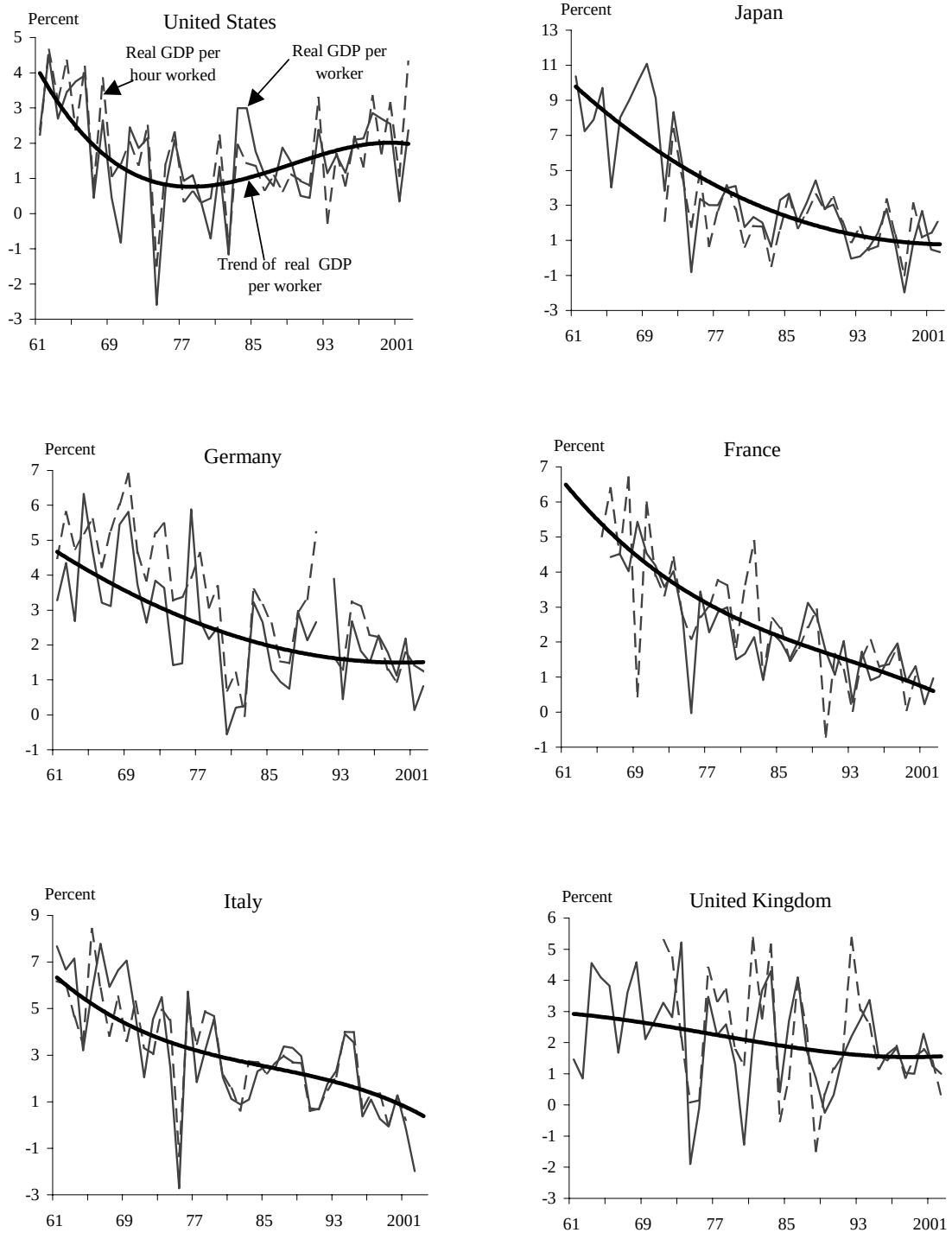
countries, it should be kept in mind that growth in the United States is nourished by a substantial increase in the population. Therefore, it is reasonable to focus on per capita growth. By that measure, growth in the 1990s was highest in the United States (Table 1). While over the decades there has been no significant slowdown in growth discernible in the United States, growth rates have tended to decline over time in the other countries, with the exception of the United Kingdom. There, per capita income growth has accelerated in the last twenty years, although from a low level compared with the other large industrial countries.

Notably, growth in the second half of the 1990s was not significantly higher than in the first half of the decade in Japan, Germany, and Italy. By contrast, France and the United Kingdom experienced an acceleration of output growth similar to the development in the United States. This improvement in per capita growth would, however, only be attributable to the new technologies if it was combined with an acceleration in productivity growth. Figure 4 presents the growth rate of real GDP per person engaged and per hour worked as well as the trend of productivity growth for the period 1961–2002, approximated by a polynomial function to allow for changes in the slope of the trend.[3] While an upward shift in trend productivity in recent years is clearly visible in the United States, in the other countries the trend line is pointing upwards only very slightly at best. This is true also for France and the United Kingdom; the strong increase in production there was due not to an acceleration in labor productivity but rather almost entirely to an increased employment growth.

While the missing acceleration of productivity in recent years casts some doubt on the hypothesis of new economy effects, it is still possible that significant productivity-enhancing effects of the information technologies are at work also in Europe. In the 1970s and 1980s, output per person rose faster in Western Europe and in Japan than in the United States. Labor market rigidities contributed to high productivity growth, particularly in continental Europe, and led to a relatively low labor intensity of growth; the increase in labor productivity growth was brought about by replacing low-qualified labor with capital or imports (Siebert 1997). In the years since 1997, the situation has obviously changed: In Western European countries, almost across the board, employment increased faster and unemployment decreased stronger than could have been expected according to past experience given the respective growth in output. This can be seen in Figure 5, which plots per capita growth rates with the change in unemployment rates for the years 1975–2002. The data points for the years 1997–2002 (depicted by circles) tend to fall significantly below the regression line in Germany, France, and Italy, and also in the United Kingdom, although less sig-

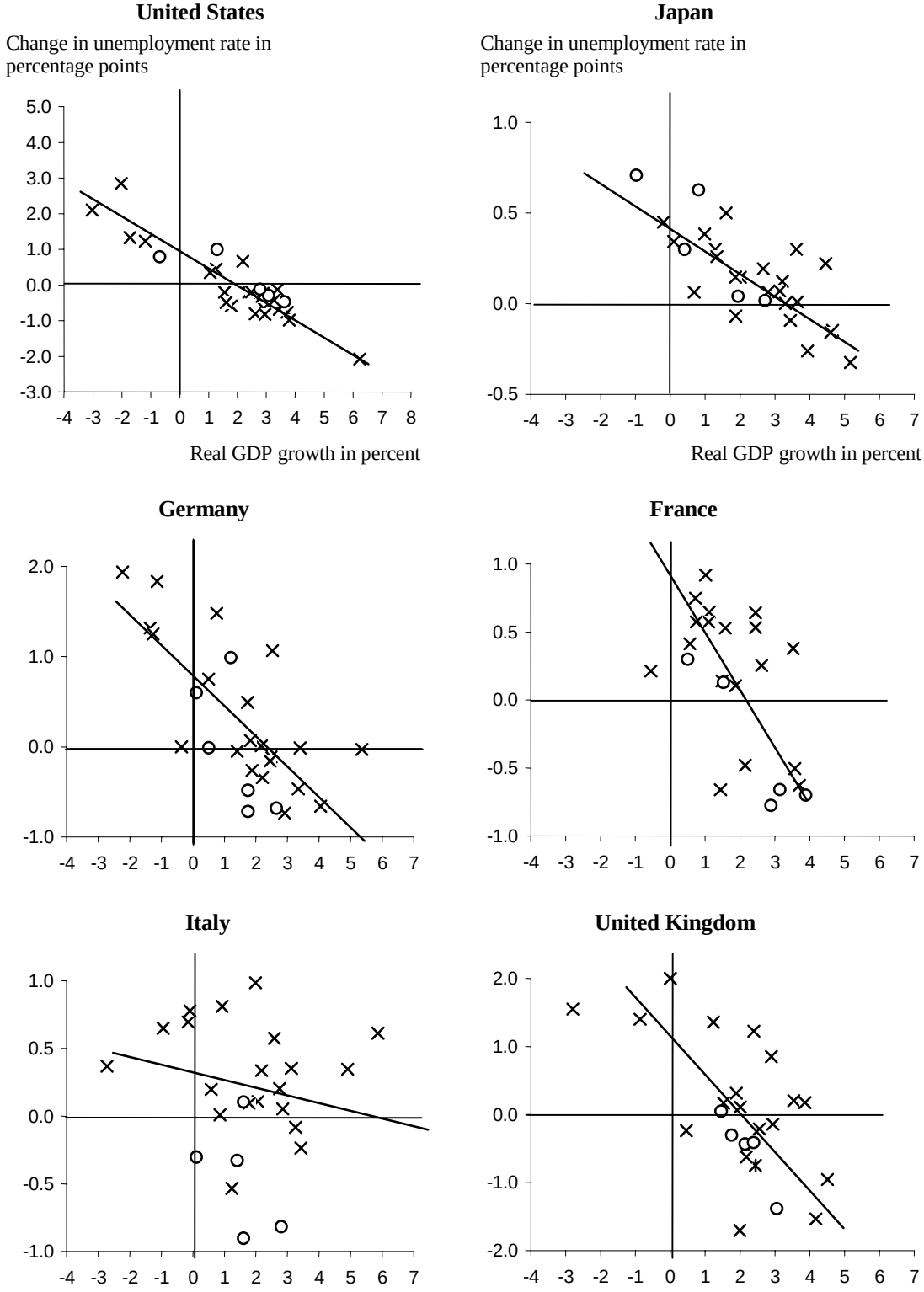
[3]The trend line is given only for the growth rate of output per person engaged. Data for hours worked are not completely available for the present country sample and the time period under consideration. Developments in hourly productivity are, however, not very different from those in output per person, although in some countries hourly productivity in recent years has tended to rise faster, e.g., in Germany (see Deutsche Bundesbank 2002).

Figure 4:
Productivity in Large Industrial Countries, 1961–2001 (percentage change over previous year)



Source: OECD (2002a); own calculations and forecast.

Figure 5:
Growth of Real GDP per Head and Change in Unemployment Rate in Large Industrial Countries, 1975–2002



Note: + denotes years from 1975 to 1996, O denotes years from 1997 to 2002; 2002: forecast.

Source: OECD (2002a); own calculations and forecasts.

Table 2:
Variability of the Macro Economy in Selected Large Industrial Countries

	Variability of real GDP growth			Variability of consumer price inflation		
	1989[a]	1999[a]	Change	1989[a]	1999[a]	Change
United States	2.0	0.9	–1.1	1.5	0.4	–1.1
Japan	1.0	2.2	1.2	1.0	0.9	–0.1
Germany	1.1	1.2	0.1	1.5	1.1	–0.4
France	0.9	1.2	0.3	2.6	0.5	–2.1
United Kingdom	1.3	1.3	0.0	1.5	0.7	–0.8

[a]Five-year moving average of trailing five-year standard deviations.

Source: Davies et al. (2000).

nificantly. This result is in contrast with what would have been expected in the case of a new economy (as defined above) in these countries, as information technologies would lead to an acceleration of productivity growth, with the result that a given increase in output is achievable with less employment growth and a smaller decrease in unemployment. The new economy would find its expression in circles lying above the regression line, as in the case of the United States. Policies to make labor markets more flexible, deregulation of product markets, and moderate wage policies, however, have led to a decline in structural unemployment in Western Europe. This tends to depress labor productivity, counteracts possible positive effects of new technologies on labor productivity, and complicates identifying new economy effects.

What about the other aspects of the paradigm of a new (macro-)economy? Inflation was at historically low levels in the latter half of the 1990s also in Western Europe, and it accelerated only modestly towards the end of the boom, similar to the United States. Particularly in the United Kingdom, where capacities in the whole economy have been highly utilized during recent years, inflationary developments have been in stark contrast with those in previous boom phases. One explanation is that the Bank of England tightened monetary policy relatively early—like the Fed did in the United States in the middle of the 1990s—which prevented inflationary expectations from emerging. Similarly, monetary policy in continental Europe was stability oriented. Besides, until 2000, slow inflation was no surprise according to the concept of the NAIRU, as capacity utilization was only approaching normal levels.

A reduced variability of output fluctuations during the 1990s—as in the case of the United States—which could be taken as an indication of a new economy, cannot be found in the other large industrial countries (Table 2). But variability had been already as low in the 1980s in Western Europe as it became in the latter half of the 1990s in the United States. This suggests that factors other than the new economy might be more important in explaining the reduction in fluctuations of output in the United States. For example, monetary policy, but also fiscal policy, was less volatile in the 1990s than in the 1980s. In Japan, where fiscal policy in the previous decade was characterized by repeated phases of expansion and restriction, the variability of output even increased significantly in the 1990s compared to the 1980s.

2.3 Will Europe Stay Behind?

Given the different results regarding the development of productivity across the large industrial countries, the question arises why there is no such acceleration in productivity in Europe, or in Japan, as in the United States. Furthermore, we will touch upon the question whether the other large industrial countries will be able to close in on the United States in the foreseeable future.

The current differences can be partly explained by the fact that statistical offices in the different countries have different methodologies

when it comes to splitting the value of IT production into a price component and a volume component. While some countries do not take changes in product quality into account, and some make adjustments to account for this factor from time to time, others—including the United States—utilize so-called hedonic price indices. With this technique, the price developments of the most important distinguishable characteristics of a product are estimated separately. As a result, the statistically documented decline in prices of IT goods—and as a result the associated increase in the volume of IT investment and consumption of IT goods—differs strongly across countries; it is particularly pronounced in the United States (OECD 2000b). Using the U.S. deflator for deflating the German investment in information processing equipment in the 1990s, for example, yields an average annual increase in real investment of 27 percent instead of 6 percent as given by the officially published figures based on the German deflator, which uses a different methodological approach (Deutsche Bundesbank 2000).[4] This leads to an underestimation of German production and, consequently, productivity compared to the U.S. approach.[5] That said, even when the same deflator is used, the increase in German investment in data processing equipment still substantially lags the increase in U.S. investment, which rose by 43 percent per annum over the 1990s.

Adding to differences in statistical methodologies are differences in the structure of the economy, which are of a more substantial nature. The share of IT in value added is higher in the United States than in the other large industrial countries, particularly countries in Continental Europe (Table 3). The extraordinarily rapid productivity growth in these sectors is therefore less important for overall economy productivity growth in these countries.

Another important aspect is that the United States have a technological leadership in the implementation of new technologies. For example, indicators of Internet use show a clear lead of the United States compared to the large European economies and Japan.[6] One factor that impedes the diffusion of new information technologies in these countries is the lack of qualified workers in this field. This in turn partly reflects the fact that the new technologies are still less deeply rooted in the population.

Lower incidence of IT implementation not only can imply that benefits in form of rising productivity are correspondingly lower. It is possible that effects on productivity are absent altogether or even negative as long as a "critical mass" of diffusion is not reached, which allows network effects, for example, to be exploited. This conclusion can be drawn from theoretical arguments from general purpose technologies models and from the analysis of important technological innovations in the past (Greenwood 1999). The better U.S. economic performance may therefore partly be explained by the U.S. lead in the adoption and diffusion of IT. If this factor is indeed relevant, we might expect that positive productivity effects will be increasingly visible also in those countries that have been lagging so far. As judged by the above indicators, this will be the case probably first in the United Kingdom and last in France and Italy.

The acceleration of productivity growth can be expected to be less pronounced than in the United States given that the importance of IT industries in total output will remain relatively small for the time being. An additional aspect is that the implementation of new general purpose technologies is associated with structural changes in the economy. In order to quickly and fully harvest the potential new economy productivity gains it is especially important to have flexible product and labor markets, a precondition which is currently less fulfilled in Europe, or in Japan, than in the United States.

---

[4] In 2002, the German Statistical Office also started to make use of hedonic price indices for PCs and, most recently, for passenger cars (*Börsen-Zeitung* 2003).

[5] Because actual production and potential output are both underestimated to the same extent, this does, however, not affect the level and the development of the output gap, which is particularly relevant for monetary policy advice.

[6] See OECD (2002b) for an extensive account of relevant statistics. It should be noted that in some smaller European countries, such as Ireland, Finland, and Sweden, IT production is much more important and application of new technologies much more advanced than in the large countries.

Table 3:
Indicators of the Significance of ICT Industries[a] in Large Industrial Countries

	Share of IT value added in business sector value added (2000)	Internet subscribers per 100 inhabitants (January 2000)	Internet hosts per 1,000 inhabitants (July 2001)	Households with Internet access (2001)
United States	11.3	18.2	272.8	50.5
Japan	9.6	8.4	48.1	35.1
Germany[a]	6.1[a]	17.5	50.3	27.0
France	8.6	5.1	27.3	17.8
Italy	7.1	8.6	40.4	18.8[b]
United Kingdom	10.4	12.4	69.4	40.0

[a]1999, excluding rental of IT goods and IT wholesale trade. – [b]March 2000.

Source: OECD (2002b).

3 Implications for Monetary Policy

Investigating the implications of an acceleration of productivity growth raises some methodological difficulties. Issues concerning the conduct of monetary policy are usually discussed within a framework that does not explicitly account for economic growth. Instead, much of the framework popular in modern monetary analysis assumes the steady-state growth path of the economy to be given exogenously by population growth and technological progress and models only the deviations of actual output from the underlying growth path. The easiest way to integrate an acceleration of productivity growth into this framework is by using a technology shock that permanently raises the level of output. Whether economic growth will be permanently higher may be disputed in practice; the following analysis assumes that eventually the economy moves back to its old steady-state growth path. Under this assumption, the optimal responses of the monetary authority to a positive supply shock are explored.

3.1 A Theoretical Model

As noted by McCallum (2001a), recent years have witnessed a remarkable convergence in the macroeconomics profession on the analytical framework that is useful for analyzing monetary policy issues. There is relatively widespread consensus that goods prices do not adjust instantaneously to changes in economic conditions, so in that sense the framework is Keynesian rather than classical. Moreover, there is substantial agreement on the fact that expectations should play a major role in such a framework and that expectations should be assumed to be rational. Finally, many researchers agree that monetary policy can be represented by some type of central bank reaction function, the exact form of which is open to debate.[7]

In the most simple case, on which we focus in the following exposition, the framework just outlined can be represented by the following system of three equations. Here r_t is the one-period interest rate, p_t, y_t, and $\bar{y}_t$ are the logarithms of the price level, GDP, and potential output, π^* is the target inflation rate of the central bank, Δ represents a change from the previous period, and $E_t z_{t+k}$ denotes the expectation of *z* in period *k* conditional on information available in period *t*:

$$(1)\quad y_t = E_t y_{t+1} + b(r_t - E_t \Delta p_{t+1})$$

aggregate demand

[7]See also Goodfriend and King (1998), Clarida et al. (1999), King (2000), and McCallum (2001a) for expositions of various variants of this framework.

(2) $\Delta p_t = \alpha(y_t - \bar{y}_t) + \beta E_t \Delta p_{t+1}$
price adjustment

(3) $\Delta r_t = \bar{r} + \Delta p_t + \mu_1(\Delta p_t - \pi^*) + \mu_2(y_t - \bar{y}_t)$
monetary reaction function.

Equation (1) is a forward-looking expectational IS function that relates current spending positively and with a unit coefficient to expected future income and negatively to the real rate of interest ($b < 0$). As shown, for example, by McCallum and Nelson (1999), it can be justified from the consumption/saving decision of an intertemporally optimizing agent combined with the assumption that components of aggregate demand other than consumption can be neglected. Effectively this "new IS curve" indicates that it is expected lifetime income rather than current income which governs consumption/saving decisions, a view that was also stressed by the older literature on permanent income and life-cycle theories of consumption (Modigliani and Brumberg 1954; Friedman 1957).

Forward-looking spending decisions imply that the effect of a shock to current output, such as a change in potential output, cannot be analyzed without making an assumption on how future output is affected. If the change in output is permanent and the full amount occurs immediately, so that it comes completely unexpected, consumers will increase current spending by the same amount. If it is permanent but is realized with some delay, consumers rationally expecting a higher future income will increase current spending by more than the change in output in an attempt to move some of the future income to the current period. If instead output increases only temporarily, consumers will decide to move some of the higher current income to future periods and thus spend less than the full increase in output in the current period. As will be shown below, this "consumption smoothing" behavior of intertemporally optimizing agents is crucial for the implications of the new economy for monetary policy.

Equation (2) is a standard price adjustment equation of the Calvo–Rotemberg type. It can be justified from the pricing decision of an intertemporally optimizing representative firm that faces nonzero price adjustment costs. It relates the change in the aggregate price level, the inflation rate, positively to the output gap $y_t - \bar{y}_t$ and to expected future inflation ($0 < \beta < 1$, $0 < \alpha < 1$). Under monopolistic competition, firms set prices as a mark-up on marginal costs. The output gap in the "new Phillips curve" serves as a proxy for the latter.[8] The second term of the equation implies that price-setting is forward-looking: Knowing that their prices will be sticky in future periods, rational firms take expected future nominal marginal costs into consideration when setting current prices. If nominal marginal costs are expected to be permanently higher in the future, the firm will increase its price one-for-one. If in contrast the change in nominal marginal costs is only temporary, the firm will change its price by a smaller amount (King 2000: 62).

Finally, equation (3) represents the reaction function of the central bank or policy rule. Under this rule, the central bank adjusts the nominal interest rate upwards when actual inflation is above the central bank's target level π^* and/or when the output gap is positive ($\mu_1, \mu_2 > 0$). To be effective in stimulating or dampening economic activity and thus to control inflation, the response of the central bank to a deviation in inflation from the target has to be strong enough to change the real interest rate. This is guaranteed, for example, with the standard specification proposed by Taylor (1993), where $\mu_1 = \mu_2 = 0.5$. This parameter choice has been shown to be optimal under a relatively wide range of assumptions (Taylor 1999) and will therefore also be used in the present study. The parameter $\bar{r}$ can be interpreted as the equilibrium real interest rate, which following standard practice is assumed to be constant (and zero) in the present analysis. Note that, while the model (1)–(3) does not contain any monetary aggregates, it can still be thought of as a monetary model, as the central bank's control over the

[8] The proportionality between real marginal costs and the output gap is given when the economy has a fixed production factor (such as a predetermined capital stock) or if higher real wages are required to induce workers to increase labor supply. See King (2000: 62).

short-run interest rate must be thought of as stemming from its ability to control the monetary base (McCallum 2001b).

To use the model for the analysis of a shock to potential output, equations (1) to (3) have to be augmented by an equation describing the evolution of potential output. Following the procedure in McCallum (2001a, 2001b), a simple first-order autoregressive process is assumed, that is

(4) $\bar{y}_t = \rho\, \bar{y}_{t-1} + u_t, \quad 0 \le \rho < 1$

potential output,

where u_t is an exogenous shock that contains the assumption concerning the nature of change in potential output, e.g., whether it is temporary or permanent. The autoregressive parameter, ρ, will be adjusted to represent different assumptions concerning the speed with which the full amount of the increase in potential output is realized. If $\rho = 0$, potential output jumps immediately to its new level given by the shock series u_t; adjustment is instantaneous. In contrast, if $0 < \rho < 1$, the shift in potential output is persistent and adjusts gradually to a shock. For a temporary change in potential output, this implies that although the shock may only be there for one period, the economy will be affected for more than one period.

More interesting here, however, is the case of a permanent change in the level of potential output. Since with $0 < \rho < 1$ the full effect of the change is reached only after a number of periods, the economy will for some time be in an adjustment period, during which output will be constantly increasing, albeit with a declining rate. Since expectations are rational, consumers will know that output will rise in the future and will act accordingly. Effectively, thus, the assumption $0 < \rho < 1$ can serve to study the effects of a temporary change in the growth rate of output, although the model is formulated in the level of output only.

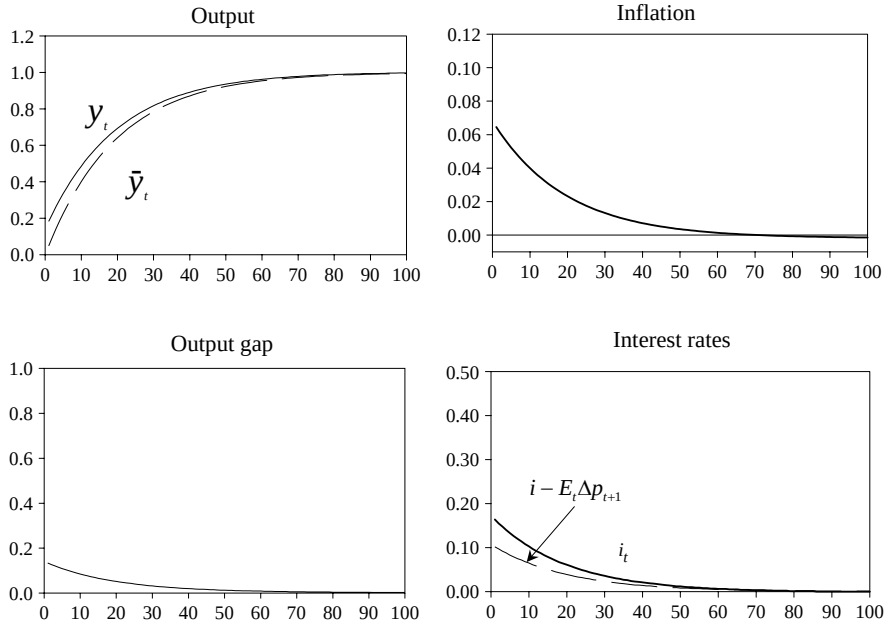
3.2 Effects of Changes in Potential Output

In order to solve the model numerically, certain values for the parameters of the model have to be assumed. To keep the analysis in line with previous studies, the parametrization here is chosen to be identical with that in McCallum (2001a), apart from the fact that the model presented there also contains an interest-rate-smoothing parameter that is omitted here (like in McCallum 2001b), as it does not have qualitative implications for the analysis. The values of the parameters in equations (1) to (3) are b = –0.4, β = 0.99, α = 0.03, μ_1 = 0.5 and μ_2 = 0.5. The central bank's target for inflation is assumed to be zero. The autoregressive parameter of the process for potential output, ρ, will either be zero or 0.95 and the shock, u_t, will have a size of unity. Impulse response functions will be used to analyze its dynamic effects on actual output (GDP), potential output, the output gap, inflation, and the reaction of the central bank to the shock as represented by the nominal and the real interest rate.

Take the probably most relevant case first, a permanent positive shock to potential output combined with a high degree of persistence (ρ = 0.95), which results in a period of output growth at declining rates until the full effect of the change in potential output is reached. The path effectively assumed for potential output is depicted by the dashed line in the upper left part of Figure 6 together with the response of actual output. It is apparent that potential output first rises steeply and then gradually loses momentum until it reaches its new level at around period 100.[9] Important for monetary policy is that actual output rises even faster than potential output over the whole adjustment period, implying a positive output gap and a deviation in

[9] Usually, one period is thought to be one quarter, so the analysis implies that it takes 25 years before the full effect of the shock is approximately reached. Two-thirds of it will, however, materialize within the first 20 periods, that is, within 5 years. Clearly, the lengths of time the shocks need to reach approximately their full effect depend on the persistence parameter, ρ, which was simply taken from the literature to keep the results here comparable.

Figure 6:
Effects of a Permanent Positive Shock to Potential Output That Becomes Effective Gradually

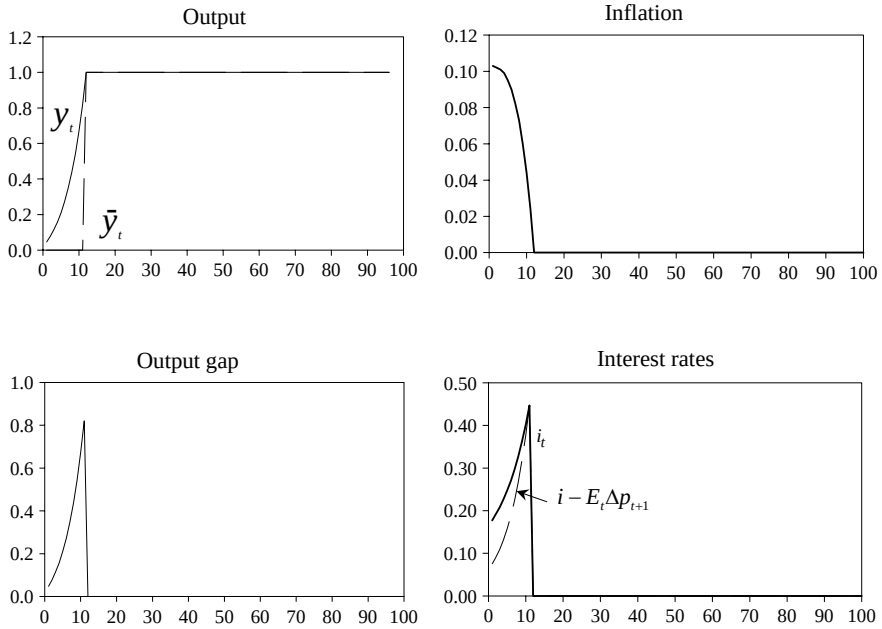


inflation from the central bank's target rate. The reason for the increase of actual over potential output is that as long as consumers expect income to be higher in the future than today they will "smooth" their consumption path by spending some of their additional future income already today. To keep inflation tamed, the central bank has to increase the nominal interest rate by more than the increase in expected inflation in order to raise the real interest rate and dampen aggregate demand. Since the deviation of aggregate demand from potential output is the greatest when the growth rate is the highest, that is, immediately after the shock, interest rates are also at their maximum at that point and decline gradually with the growth rate of the economy. This proportionality between the real interest rate and the growth rate of potential output is a result that emerges from a wide variety of models (see also King 2000).

In sharp contrast to the previous result, a permanent increase in potential output that occurs immediately ($\rho = 0$) (and without being expected beforehand) does not affect monetary policy at all. As output jumps immediately to its new permanent level, consumer spending is increased by the same amount because lifetime resources have increased. With actual and potential output moving exactly in line, no output gap arises and inflation thus remains at its target level. Consequently, interest rates can remain at their original level. The impulse responses (not shown) therefore are simply zero for the output gap, the inflation rate, and the interest rate are unity for both actual and potential output.

A variant of the previous case that is potentially are more relevant for practical central bank policy is as follows: there is an immediate increase in potential output at some point in time which, however, does not come as a surprise but is anticipated a number of periods in advance. The impulse responses for this case are depicted in Figure 7, where it is arbitrarily assumed that the jump in potential output occurs at period 12, but is expected from period 1 onwards. From period 12 onwards, all impulse responses run as in the case analyzed before: both potential and actual output jump to their new levels, the output gap and the inflation rate fall to zero, and so do nominal and real interest rates. However, in the time up to period 12, consumers will already spend part of the higher income they expect to receive in the future. The output gap that arises during this period causes inflation to rise above

Figure 7:
Effects of a Permanent Positive Shock to Potential Output Expected in Advance

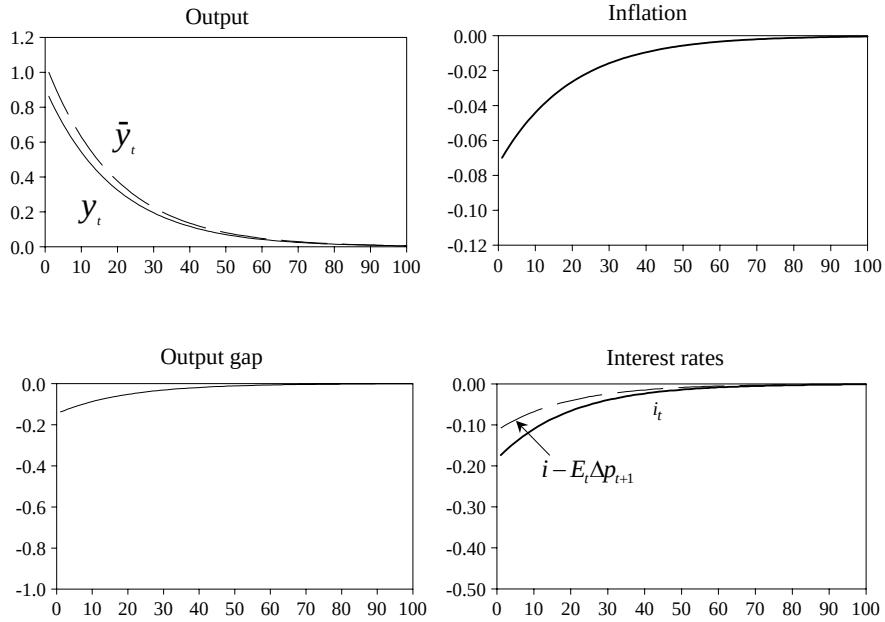


target and this requires an interest rate hike by the central bank. Interest rates will increase further until period 11, although by less than the output gap, since actual inflation is increasingly dampened by the expectation of zero inflation after the jump in potential output. Note that the results of the analysis do not depend on the expected shift in potential output to come true. Even if the expectation proves wrong and potential output remains at its previous level, all other variables will jump to their new equilibrium values. Therefore, one can conclude that an optimistic expectational effect related to a change in potential output will lead to higher inflation which then necessitates an increase in interest rates.

Finally, the model can be used to study the effects of an unexpected temporary increase in potential output. While this scenario is not one that one would associate with a typical new economy technology shock it may nonetheless be useful in the present context, as it shows that it is important for monetary policy to know whether the supply shock is permanent or temporary. The reason for this is that the implications for monetary policy differ sharply from the previously analyzed cases. Figure 8 shows the impulse response functions for a temporary increase in potential output in period 1. Actual output now falls short of potential output, as consumers try to move some of their income gain in period 1 to future periods and therefore increase spending by less than the temporary shift in potential output. Since inflation falls below the central bank's target, interest rates have to be lowered to stimulate demand. Thus, instead of an interest rate hike, the optimal monetary policy reaction to a productivity shock that is only temporary is an interest rate cut.

Summarizing, the model analysis has shown that the implications of a positive productivity shock for monetary policy depend on whether it is permanent or temporary and whether it is expected or unexpected. Whenever there is the expectation that output will be higher in the future than today—be it due to hard facts or due to widespread (over-)optimism in the economy—monetary policy has to dampen the increase in spending that arises from this today by increasing interest rates in order to keep inflation under control. If instead the productivity shift comes largely unexpected, there will not be

Figure 8:
Effects of a Temporary Positive Shock to Potential Output



much of a premature spending effect and therefore no interest rate hike is required. In case the productivity shift is (expected to be) only temporary, interest rates even have to be lowered.

3.3 What Can Monetary Policy Do Realistically?

Which model is appropriate in a world in which we observe changes like the new economy? It is true that the dynamics of various markets are likely to change in the new economy; also, financial markets may be affected, so that the interpretation of variables which the central bank has to look at may be different. But there is no theoretical reason to believe that the new economy affects the macroeconomy in such a way that the usual links in the standard macro models are not appropriate anymore. The new economy does not imply that "inflation is dead" or that there is no Phillips curve anymore—or a totally different one—or that there is a completely new process of inflation or of other relationships. In addition, the assignment which implies that monetary policy should keep inflation under control is still valid, so we do not need a "new" monetary policy (Plosser 2001). The strategies which are normally defined for monetary policy, be it an interest rate rule of the Taylor type, like in our theoretical model, or a rule for a monetary aggregate, can cope with such shocks on the supply side. In other words: it is still true that inflation is a monetary phenomenon, and that excessive money growth causes inflation.

The model simulations show the different time paths for output and inflation in a stylized fashion. The problem is, however, that in the real world, things are not so straightforward because the monetary authority has to identify the nature (transitory or real, gradual or sudden) and the size of the shock either in advance or as soon as it happens. This poses a substantial identification problem in practice which probably cannot be solved. The variety of estimates shows that potential output is difficult to estimate even if there are no shocks; this is especially true for the estimates concerning the level in the current year or even in the current quarter which are needed even if the central bank follows a rule which is mostly backward-looking. In fact, figures of potential output are frequently revised by the various national and international insti-

tutions; this is true for estimates with production functions or with time-series methods such as the Hodrick–Prescott filter. Although the latter method can be more up-to-date because no estimates of, for example, the capital stock are needed as in the case of the production function method, it nevertheless has the end-point problem: in order to estimate the current level of trend (or potential) output, a forecast of real GDP for the next three years is needed. Such a forecast, however, would be highly dubious because one would have to know the effects of the technology shock; so the estimate might be biased.[10]

It is true that a central bank always has to act under uncertainty, so there is a risk involved in the possible policy actions. An important element of uncertainty is inherent to the model that the central bank assumes for the real world, because the responses differ accordingly, not only in terms of the size of the interest rate change but also in terms of the sign. For example, in some macro models a sudden jump in potential output leads to a negative output gap and a fall of inflation. The typical response according to the Taylor rule would be to lower interest rates. This was actually the discussion in the United States in the second half of the 1990s, when monetary policy was considered accommodative, i.e., more "expansionary" than it would have been otherwise. In contrast, in the model presented here the optimal response is quite different. Forward-looking agents anticipate the increase in potential output and consume more today. The result is an increase in the output gap and a rise in inflation. Both factors call for an increase in the real interest if the central bank wants to stabilize inflation.

All in all, optimal reactions put high demands on the information at the central bank. Not only would it be necessary to know the nature and timing of the shock and the response of the economy, it would be necessary to know the size of the shock as well because this affects the size of the change in interest rates. In recent years, the revisions of output and productivity data in the United States have been quite substantial, which implies that it would have been possible to make major mistakes if the central bank had relied on current estimates. Doing too much or too little would lead to more instability in the economy, as it would require a corrective move later on. A central bank has to be concerned with its credibility, which is negatively affected if interest rates are changed too frequently or too much.

Given the serious information deficiencies, the role of monetary policy in a world where the new economy has an impact on potential output is quite limited. The success story of the U.S. economy in the second half of the 1990s is mainly due to the positive supply shock and not so much the policy of the Fed.

As far as the policy of the ECB is concerned, it is safe to say that it did not prevent the new economy from having a positive effect by following a presumably nonaccommodating policy. First of all, there was only a very small impact on the supply side compared to the United States as the discussion in Section 2 shows. Second, with respect to the first pillar of the monetary policy strategy, all the ECB has to do in the case of a known positive supply shock is to raise the reference value for M3. The magnitude of this change is, however, very small. There is hardly any claim saying that potential output growth in the euro area accelerated by half a percentage point because of new economy effects. Even if this were so, the reference value of 4.5 percent would have to be raised by only half a percentage point as well. But we have to remember what the development of M3 was in reality: between 1999 and 2001, M3 rose by approximately one percentage point faster annually than implied by the reference value. So if anything, the ECB more than accommodated what the possible impact of the new economy was on potential output during that period.

---

[10] Apart from that, all the other shocks and their effects on the economy need to be estimated as well.

4 Conclusions

This paper has looked at evidence of a new economy in macroeconomic terms and discussed possible consequences for monetary policy. It was found that the developments in the United States since the mid-1990s are broadly consistent with such a new economy: trend productivity growth has accelerated, inflation has remained low despite a substantial decrease in unemployment, and the variability of output fluctuations has been reduced. In contrast to the United States, there is no visible break in productivity growth trends in other large industrial countries. Identification of IT-related productivity gains is, however, complicated by the general tendency towards deregulation in labor and product markets and moderate wage increases that contributed to a rise in labor intensity, which in itself lowers productivity growth. The fact that inflation remained low also in Europe and that the variability of output had been already as low in the 1980s in Western Europe as it became in the latter half of the 1990s in the United States could indicate that other explanations for these phenomena, particularly macroeconomic policies, are more important than new technologies.

As concerns the implications for monetary policy of a technology shock which raises the permanent level of output and, at least temporarily, the growth rate of the production potential, these are found to be rather limited. While in a macro model, the optimal policy would be to raise interest rates, it is difficult to assess the timing and magnitude of new economy effects on the real economy. This paper suggests that being too expansionary because of a too optimistic assumption about the advent of the new economy has more severe consequences than erring on the other side, because the positive real effects work through anyway, while inflationary expectations, once triggered, are difficult to reduce.

References

Blinder, H.S. (1997). The Speed Limit: Fact and Fancy in the Growth Debate. Online resource (last access on March 3, 2003) http://www.prospect.org/print/V8/34/blinder_a.html

Börsen-Zeitung (2003). Inflationsberechnung auf neuer Grundlage. 24 January: 3.

Clarida, R., J. Gali, and M. Gertler (1999). The Science of Monetary Policy. *Journal of Economic Literature* 37 (4): 1661–1707.

Davies, G., M. Brooks, and N. Williams (2000). Technology, the Internet and the New Global Economy. Goldman/Sachs Global Economics Paper 39. London.

DeLong, J.R. (1999). Speculative Microeconomics for Tomorrow's Economy. http://econ161.berkeley.edu/OpEd/Virtual/technet/spmicro.html

DeLong, J.R. (2000). Macroeconomic Implications of the "New Economy". http//econ161.berkeley.edu/OpEd/Virtual/ne macro.html

Deutsche Bundesbank (2000). *Monatsbericht*. August. Frankfurt am Main.

Deutsche Bundesbank (2002). *Monatsbericht*. September. Frankfurt am Main.

Friedman, M. (1957). *A Theory of the Consumption Function.* New York.

Goodfriend, M., and R.G. King (1998). The New Neoclassical Synthesis and the Role of Monetary Policy. In B. Bernanke and J. Rotemberg (eds.), *NBER Macroeconomics Annual 1997*. Cambridge, Mass.

Gordon, R.J. (1999). Has the "New Economy" Rendered the Productivity Slowdown Obsolete? http://faculty-web.at.nwu.edu/economies/gordon/researchhome.html

Gordon, R.J. (2000). Does the “New Economy” Measure up to the Great Inventions of the Past? NBER Working Paper 7833. National Bureau of Economic Research, Cambridge, Mass.

Gordon, R.J. (2002). Technology and Economic Performance in the American Economy. NBER Working Paper 8771. National Bureau of Economic Research, Cambridge, Mass.

Greenspan, A. (2000). Global Economic Integration: Opportunities and Challenges. Remarks at a Symposium Sponsored by the Federal Reserve Bank of Kansas City in Jackson Hole, Wyoming. http://www.federalreserve.gov/boarddocs/speeches/2000/20000825.htm

Greenwood, J. (1999). The Third Industrial Revolution: Technology, Productivity, and Income Inequality. *Federal Reserve Bank of Cleveland Economic Review* 35 (2): 2–12.

Heilemann, U., R. Döhrn, H.D. von Loeffelholz, and E. Schäfer-Jäckel (2000). Der Wirtschaftaufschwung in den Vereinigten Staaten in den neunziger Jahren—Rolle und Beitrag makroökonomischer Faktoren. Untersuchungen des Rheinisch-Westfälischen Instituts für Wirtschaftsforschung 32. Essen.

Jorgenson, D.W. (2002). Information Technology and the U.S. Economy. In H. Siebert (ed.), *Economic Policy Issues of the New Economy*. Berlin: Springer.

King, R.G. (2000). The New IS-LM Model: Language, Logic, and Limits. *Federal Reserve Bank of Richmond Economic Quarterly* 86 (3): 45–103.

Klodt, H., et al. (2003). *Die neue Ökonomie: Erscheinungsformen, Ursachen und Auswirkungen.* Kiel Studies 321. Berlin: Springer.

Krugman, P. (1997). How Fast Can the US Economy Grow? http://web.mit. edu/krugman/www/howfast.html

McCallum, B. (2001a). Should Monetary Policy React Strongly to Output Gaps? *American Economic Review* 91 (2): 258–262.

McCallum, B. (2001b). Monetary Policy Analysis in Models Without Money. *Federal Reserve Bank of St. Louis Economic Review* (July/August): 145–160.

McCallum, B., and E. Nelson (1999). An Optimizing IS-LM Specification for Monetary Policy and Business Cycle Analysis. *Journal of Money, Credit, and Banking* 31 (3): 296–316.

Meyer, L.H. (2000). The New Economy Meets Demand. *BIS Review* 48, 9 June.

Modigliani, A., and R.E. Brumberg (1954). Utility Analysis and Aggregate Consumption Functions. An Interpretation of Cross-Section Data. In K.K. Kurihara (ed.), *Post-Keynesian Economics*. New York.

Nielsen, J.U.-M. (1999). New Economics? *Intereconomics* 34 (1): 39–45.

OECD (2000). *Economic Outlook* 67. June. Paris.

OECD (2002a). *Economic Outlook* 72. December. Paris.

OECD (2002b). *Measuring the Information Economy*. Paris.

Oliner, S.D., and D.E. Sichel (2000). The Resurgence of Growth in the Late 1990s: Is Information Technology the Story? Finance and Economics Discussion Series 2000-2. Division of Research & Statistics and Monetary Affairs. Federal Reserve Board, Washington, D.C.

Plosser, C. (2001). Does the “New” Economy Call for a “New” Monetary Policy? *The Cato Journal* 21 (2): 169–175.

Quah, D.T. (1999). The Weightless Economy. *The Business Economist* 30 (1): 40–53.

Shepard, S.B. (1997). The New Economy: What It Really Means. http://businessweek.com/1997/46/b3553084.htm

Siebert, H. (1997). Labor Market Rigidities: At the Root of Unemployment in Europe. *Journal of Economic Perspectives* 11(3): 37–54.

Siebert, H. (2000). The New Economy—What Is Really New? Kiel Working Papers 1000. Institute for World Economics, Kiel.

Taylor, J.B. (1999). *Monetary Policy Rules.* Chicago.

Taylor, J.B. (1993). *Discretion versus Rules in Practice.* Carnegie-Rochester Conference Series on Public Policy 39. Amsterdam.

Zarnowitz, V. (1999). Theory and History Behind Business Cycles: Are the 1990s the Onset of a Golden Age? *Journal of Economic Perspectives* 13 (2): 69–90.

Zarnowitz, V. (2000). The Old and the New in US Economic Expansion of the 1990s. NBER Working Paper 7721. Cambridge, Mass.

Kieler Diskussionsbeiträge

Kiel Discussion Papers

387. The European Electricity Market: Centralization of Regulation or Competition between Regulatory Approaches? By Lars Kumkar. Kiel, Mai 2002. 28 S. 8 Euro.

388. IWF und Weltbank: Trotz aller Mängel weiterhin gebraucht? Von Peter Nunnenkamp. Kiel, Mai 2002. 34 S. 8 Euro.

389./ 390. Fit für die EU? Indikatoren zum Stand der Wirtschaftsreformen in den Kandidatenländern. Von Federico Foders, Daniel Piazolo und Rainer Schweickert. Kiel, Juni 2002. 69 S.16 Euro.

391. Fortschritte beim Aufbau Ost. Forschungsbericht wirtschaftswissenschaftlicher Forschungsinstitute über die wirtschaftliche Entwicklung in Ostdeutschland. Kiel, Juni 2002. 53 S. 8 Euro.

392./ 393. Subventionen in Deutschland. Von Alfred Boss und Astrid Rosenschon. Kiel, August 2002. 71 S. 16 Euro.

394. 75 Punkte gegen die Arbeitslosigkeit. Von Horst Siebert. Kiel, August 2002. 23 S. 8 Euro.

395. Vom Mangel zum Überfluss – der ostdeutsche Wohnungsmarkt in der Subventionsfalle. Von Dirk Dohse, Christiane Krieger-Boden, Birgit Sander und Rüdiger Soltwedel. Kiel, September 2002. 52 S. 8 Euro.

396. Euroland: Upswing Postponed. By Kai Carstensen, Klaus-Jürgen Gern, Christophe Kamps and Joachim Scheide. Kiel, Oktober 2002. 19 S. 8 Euro.

397. Central Exams Improve Educational Performance: International Evidence. By Ludger Wößmann. Kiel, Oktober 2002. 45 S. 8 Euro.

398. Makroökonomische Reformen und Armutsbekämpfung in Bolivien: Ebnet die HIPC-Initiative den Weg zu sozialverträglicher Anpassung? Von Rainer Schweickert, Rainer Thiele und Manfred Wiebelt. Kiel, Februar 2003. 41 S. 9 Euro.

399. Higher Economic Growth through Macroeconomic Policy Coordination? The Combination of Wage Policy and Monetary Policy. By Klaus-Jürgen Gern, Carsten-Patrick Meier and Joachim Scheide. Kiel, Februar 2003. 29 S. 9 Euro.

400. Why the Case for a Multilateral Agreement on Investment Is Weak. By Peter Nunnenkamp and Manoj Pant. Kiel, März 2003. 41 S. 9 Euro.

401. Evidence of the New Economy at the Macroeconomic Level and Implications for Monetary Policy. By Klaus-Jürgen Gern, Carsten-Patrick Meier and Joachim Scheide. Kiel, März 2003. 21 S. 9 Euro.

Mehr Informationen über Publikationen des Instituts für Weltwirtschaft unter http://www.uni-kiel.de/ifw/pub/pub.htm, mehr Informationen über das IfW unter http://www.uni-kiel.de/ifw/

Institut für Weltwirtschaft an der Universität Kiel, 24100 Kiel
Kiel Institute for World Economics