CHAPTER 3

German Productivity Growth: An Industry Perspective

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Germany had the advantage of a catch-up phase through the early 1970s, but thereafter, and especially since the mid-1990s, productivity growth has been relatively slow. This aggregate picture masks considerable intersectoral differences. This chapter reports that while Germany has maintained an enduring strength in its traditional manufacturing competencies, it has lagged in services delivery and, perhaps more importantly, in the so-called knowledge economy—both in the production of information and communication technology (ICT) goods and in the use of ICT to raise productivity in private services provision. These "new" areas have been key engines of productivity growth since the mid-1990s in the United States and some other advanced countries. An uptick in German services productivity growth occurred from 2005 to 2007. This is indicative of the scope and potential for progress, but it could have been a cyclical phenomenon. To foster more efficient production and widespread use of ICT in services delivery will require complementary measures: (a) further development of venture capital and private equity markets (backed by a more efficient insolvency process); (b) increased commercial use of intellectual property rights held by university and research institutions; (c) removal of uncertainties regarding tax treatment; and (d) further European integration in services provision.

INTRODUCTION

In the years after World War II, Germany increased its productivity at a fast clip, thereby rapidly shrinking the United States' lead in income levels. However, this productivity catch-up was interrupted in the mid-1990s. Between 1995 and 2007, Germany's private economy experienced annual productivity growth of 1.7 percent, slightly above the European average but lagging behind the United States, the United Kingdom, Sweden, Austria, and Finland (Inklaar, Timmer, and van Ark, 2008, Table 1, page 142; and Molagoda and Perez, 2011, Table V.1, page 70).

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BOX 3.1 The Productivity Resurgence in the United States

Jorgenson, Ho, and Stiroh (2008) argue that the sources of U.S. productivity growth have changed twice since 1995. From 1995 to 2000, productivity growth was led by the ICT-producing sectors and investment in them. Since 2000, the sources of productivity growth have shifted to sectors that were the most intensive users of information technology.

Triplett and Bosworth (2006) highlight the role of the services sector. They find that the post-1995 ICT investment boom contributed both directly to higher U.S. productivity growth in the services industries via capital deepening and indirectly via higher TFP growth. Their results suggest that in the United States, both labor productivity in the services sector and TFP growth rates more than doubled after 1995, and the services sector became the source of economic growth.

In a subsequent paper, the same two authors extend the industry-based approach to consider the post-2000 period and find that the services sector again accounts for the post-2000 rise in U.S. productivity (Bosworth and Triplett, 2007). Both the 1995–2000 increase in productivity growth and the more recent uptick were driven by strong investment that increased U.S. labor productivity through capital deepening and by accelerating productivity (particularly TFP) in services.

This aggregate performance masks considerable sectoral differences—both within Germany and in Germany's performance relative to other industrialized economies. While Germany's productivity growth in manufacturing industries was above the EU-15 average from 1995 to 2005, its productivity growth in the information and communication technology (ICT) industries, while strong, has been lagging that in other advanced countries (U.S, France, Netherlands, and Sweden), and productivity in the private services sector has been weak and below that in both the United States and the EU-15.

Within Germany, the deceleration in overall productivity growth in the private economy—from 2.4 percent in the 1980s to 1.9 percent during 1995–2000 and dropping further to 1.2 percent in 2000–05—appears to be largely due to the slowing growth of productivity in private services (The Conference Board, 2009). This contrasts with the experience of the United States and selected other countries over the same period, when productivity accelerated from 1995 to 2005 on the back of ICT's widespread and quick deployment in many sectors of the economy, especially the traditionally less productive service sectors (Box 3.1).[1]

Germany's experience mirrors that of Europe as a whole. An industry-based analysis applied to European countries finds that while the EU-15's manufacturing and utilities performed in line with the United States during 1995–2005, local services—not just financial services, but more broadly distribution and business services—accounted for the bulk of the productivity growth difference with the United States during that period (van Ark, O'Mahony, and Timmer, 2008,

[1] Jorgenson, Ho, and Stiroh (2004) first highlighted the role of the production and use of ICT in accounting for productivity gains in the case of the United States.

and Molagoda and Perez, 2011).[2] Unlike in the United States, where total factor productivity (TFP) growth in the services sector accelerated after 1995, in Europe it declined (especially in distribution, finance, and business services). Several studies have argued that low TFP growth in the service sectors in EU countries in turn reflects the delay in investing in ICT assets and implementing the related new technologies and processes (McKinsey Global Institute, 2010).

These delays have been attributed, among other factors, to the relatively less attractive conditions in Europe for venture capital and other market-based sources of financing for high-growth, high-risk projects (Box 3.2).[3] In addition to the availability of long-term financing, traditional explanations for Europe's lagging productivity growth also emphasize policy and institutional factors such as strict regulations in product and labor markets.[4] But these seem less relevant in the case of Germany, which is one of the most deregulated advanced countries in retail trade, according to OECD indicators, and where some reforms (e.g., transport services deregulation) constitute an example of best practice in Europe. It is true, however, that despite a recent improvement Germany remains more heavily regulated in professional services than most other advanced countries.

This study applies the industry-based approach to Germany during the 1980–2007 period to help shed light on the historical sources of growth and productivity trends. We use the best available data on cross-country comparisons of the sources of productivity growth at the industry level from the EU KLEMS database. This enables us to document a pick-up in labor productivity growth in the private economy in Germany since 2005, led by higher TFP growth. This is indicative of the scope and potential for progress. However, it remains too early to conclude that a structural shift has taken place. The fact that TFP is measured as a residual and the finding that the TFP growth acceleration was not accompanied by a boom in ICT investment—unlike the U.S. experience in the late 1990s and early 2000s—suggests that the recent improvement may be short-lived and driven by cyclical rather than structural factors.

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[2] An argument is often made that productivity differentials, particularly in the services industries, are biased or illusionary because of differences in data across countries. The results in Inklaar, Timmer, and van Ark (2006), however, suggest that the productivity gap findings are robust to the use of various productivity measurement models. A related argument is that the strong post-1995 productivity growth in the U.S. services sector was illusionary because it was the result of an unsustainable boom in consumer expenditure and household debt. While scale effects from increased demand may have played a role in productivity improvements—notably for the distribution sector—the fact that the acceleration in retail output and productivity occurred mainly during the late nineties and early 2000s, whereas the rise in household debt occurred later, from 2003 to 2007, makes it difficult to attribute all the productivity improvements to the credit boom (van Ark, 2010).

[3] Allard and Everaert (2010) argue that measures to develop capital markets further in Europe will not only result in the establishment of more attractive conditions for venture capital but also create room for banks to focus more on supporting smaller firms—in relatively large numbers in the euro area; these smaller firms are at a higher risk of being constrained in financing but at the same time are key for innovation.

[4] See Allard and Everaert (2010) for a discussion of the role of labor and service market reforms in lifting euro area long-term growth.

BOX 3.2 The Slowdown in Europe's TFP Growth

There is no shortage of attempts to explain the post-1995 weak European TFP growth performance. Several studies have documented that Europe's lag in adopting ICT technologies in the service sectors and shifting to a "knowledge economy" is a key factor behind Europe's poor TFP performance (see for example van Ark, O'Mahony, and Timmer, 2008).

Empirical research has confirmed the role of "new economy" factors, such as human capital and ICT investments, in explaining subsequent TFP growth rates. For example, Molagoda and Perez (2011) find that a significant impact is made by human capital levels (proxied by the share of high skilled labor to overall labor) and ICT capital intensity (measured by the ratio of ICT capital to non-ICT capital) on TFP growth differences across industries and countries (see also Nahuys and van der Wiel, 2005, and EU ICT Task Force, 2006).

Other studies argue that policy/institutional factors (e.g., rigidities in product, labor, and financial markets) have reduced incentives to shift rapidly to ICT and to adjust production processes accordingly. Using micro establishment level data from the U.S. and Germany, the results in Bartelsman and others (2010) suggest that the degree of *market experimentation* by firms (i.e., the degree to which firms experiment with different ways of conducting business) is lower in Germany compared to the United States, among both young businesses and businesses actively changing their technology. The authors conjecture that this result could be related to the financial system being more market-based in the United States than in Europe, which possibly lowers risk aversion to project financing and creates greater financing possibilities for entrepreneurs with small and innovative projects.[a] The effect of strict employment protection legislation (EPL) is less clear-cut and largely depends on the institutional system in which firms operate and the type of technology used in the sector.[b]

[a] Voss and Müller (2009) similarly find that financing aspects are a key limiting burden for young German start-ups. Venture capital is hard to access and concentrates on ICT, medical research, medical appliances, and biotech.

[b] Bartelsman and others (2010) investigate the impact of EPL on ICT adoption. They find evidence that both the share of employment and productivity *levels* in ICT-intensive sectors are relatively lower in high-protection EU countries, suggesting that EPL slows the adoption of new ICT. However, they do not investigate the direct impact of EPL on TFP growth and innovation.

Using the historical experience of the United States as a productivity leader from 1995–2004 as a benchmark, our conclusions highlight the importance of raising TFP growth more durably through innovation policy and greater incentives for the use of ICT in the service sectors[5]:

- Over 1995–2004, Germany's lower TFP growth was the single most important factor driving German-U.S. productivity growth differences in the private economy, contributing almost three-quarters of the productivity growth differential.

[5] The importance and cross-cutting nature of ICT is reflected in Germany's high-tech strategy and, more broadly, in Europe's 2020 growth agenda, which also notes the link between ICT usage and services' productivity.

- Germany's lower investment in ICT assets was also important, explaining over a third of the productivity gap with the United States during that period.
- At the industry-level, the productivity growth differences are driven by TFP and are particularly large for service industries, especially for distribution, finance, and business services.
- Productivity lags in the service sectors in turn appear to reflect Germany's delay in shifting to a knowledge economy, as indicated by a lower share of ICT in total research and development expenditure, lower internet penetration (relative to the United States), and lower ICT readiness scores relative to some other advanced countries. Notably, Germany lags several other OECD countries in some key areas of ICT infrastructure (e.g., availability of secure servers) and financing for high-risk, high-innovation potential projects.

The purpose of this chapter is to provide background on the question of why Germany has not enjoyed higher productivity growth, despite several favorable competitiveness indicators, including levels of innovation and spending on research and development above the EU-15 average (Figure 3.1).[6] It does so by providing essential facts and placing Germany's experience in international perspective. The next section provides facts on aggregate output and growth patterns in Germany relative to the United States (considered as the productivity benchmark) during 1950–2009. A further section does the same for a number of

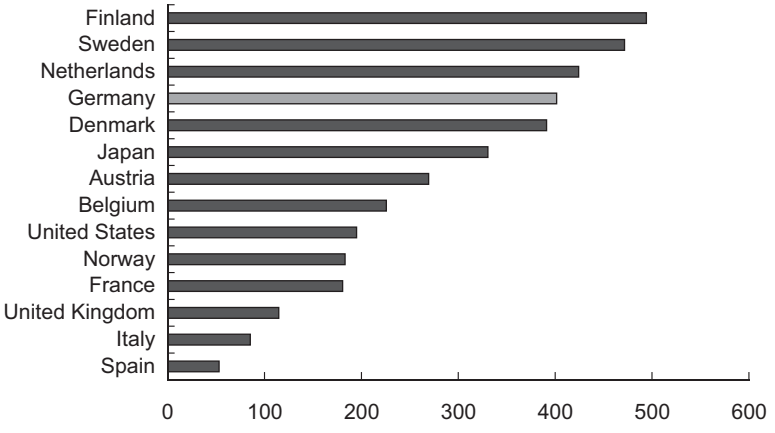

Figure 3.1 Selected Countries: Patent Applications (Number of applications per million population, 2010)

Sources: European Patent Office and Conference Board.

[6] See McKinsey Global Institute (2010). Recent structural reforms to support competitiveness include the 2008 business tax reform, the Hartz IV reforms, and deregulation in transport services.

industry-level sectors, including goods, ICT, and private services, extending earlier work by van Ark, O'Mahony, and Timmer (2008) through 2007. Within the services sector, we separately analyze the drivers of growth and German-U.S. productivity differentials in distribution services, finance and business services, and personal services. The section also documents Germany's relative progress in adopting a knowledge economy, as measured by a number of variables and business survey indicators usually viewed as related to higher ICT investments and a favorable environment for innovation.

GERMAN AND UNITED STATES PRODUCTIVITY: STYLIZED FACTS

Germany's postwar productivity catch-up with the United States was interrupted in the mid-1990s. During the period 1950–1995, labor productivity grew at a relatively fast clip, and Germany achieved parity with the United States by 1995. In 1995, however, German productivity growth started lagging the United States, and by 2009 its levels of hourly output were almost 10 percent below U.S. levels (Figure 3.2 and Table 3.1).

During 1995–2004, the productivity gap with the United States widened despite higher labor input in the latter country, where the productivity resurgence in the mid-1990s was accompanied by significant job creation. Instead, the productivity gap reflects both slower capital accumulation and slower TFP growth in Germany. Germany's overall slower capital accumulation contributed almost three-quarters (74 percent) of the total productivity gap during 1995–2004. In particular, its lower investment in ICT assets—including computing equipment,

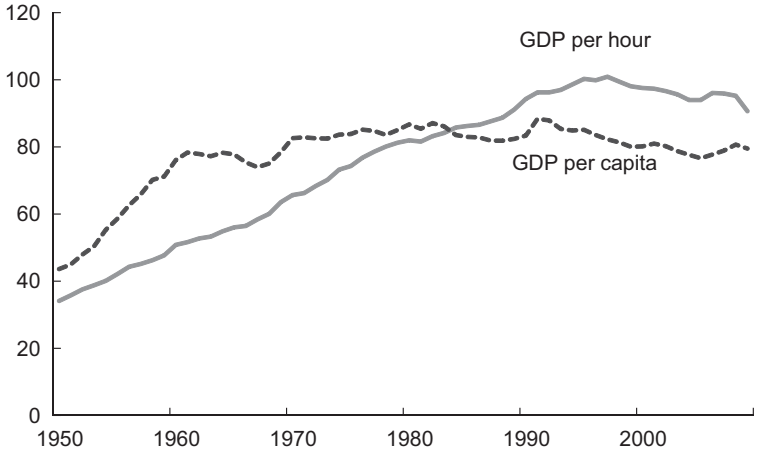

Figure 3.2 Total Economy GDP per Hour Worked and GDP per Capita (Percent of U.S. levels)

Sources: The Conference Board Total Economy Database, September 2010; Timmer, Ypma, and van Ark (2003); and IMF staff estimates.

TABLE 3.1

Levels of Labor Productivity and Factor Inputs (Percent of U.S. levels)							
	1950	1973	1995	2004	2007	2008	2009
GDP per capita[a]	43.6	82.5	85.1	77.7	78.9	80.7	79.5
Hours worked per capita	124.8	104.4	88.3	84.3	83.7	83.8	82.7
GDP per hour worked[a]	34.1	70.2	100.3	94.0	95.9	95.2	90.6
Capital input per hour worked[b]		83.9	107.9	102.7	n.a.	n.a.	n.a.

Sources: The Conference Board Total Economy Database, September 2010; Timmer, Ypma, and van Ark (2003); and IMF staff estimates.

[a] Output levels are converted by GDP purchasing power parities for 2009 using the Elteto-Koves-Szulk (EKS) method.

[b] Measured as gross fixed capital stock per hour worked. Entries for 1973 refer to 1980.

communication equipment, and software—was the single biggest factor explaining the productivity gap during that period, contributing over half of it (0.6 percent out of an annual productivity gap of 1.1 percent with the United States). The contribution of non-ICT capital growth and TFP growth to the productivity growth differential with the United States were also important: the former contributed 0.3 percent (22 percent of total) and the latter 0.2 percent (15 percent of total) to the productivity gap. Lower growth in labor skills in Germany relative to the United States explained the remainder (0.1 percent, or about 10 percent of the total).

When focusing on developments over time in Germany and the United States, a deceleration in TFP growth explains the bulk of Germany's weak performance since the mid-1990s.[7] German labor productivity growth slowed by 1 percentage point between the 1990–1995 period and the 1995–2004 period, mainly reflecting a reduction in TFP growth by 0.6 percentage points between the two periods (Table 3.2). In other words, slower TFP growth accounts for 60 percent of the deceleration in annual labor productivity growth during 1995–2004, with lower investment and (to a much lesser extent) slower growth in labor quality explaining the rest.[8] Investment in ICT assets in Germany increased only moderately between 1995–2004 and 1990–1995, not enough to offset the decline in TFP and investment in non-ICT assets. In contrast, higher TFP growth and investment—especially in ICT assets—contributed in almost equal parts to the U.S. revival in the mid-1990s. Specifically, the 1 percentage point increase in U.S. labor productivity growth between 1995–2004 and 1990–1995 reflects a 0.5 percent increase in the contribution of capital accumulation (the bulk of which is from investment in ICT assets), accompanied by a 0.4 percent acceleration in TFP growth. This simultaneous acceleration in ICT investments and TFP has been linked to the emergence of a so-called "knowledge economy" in the United States and other advanced countries during the mid-1990s, as discussed in

[7] TFP is computed as a residual, thus it also includes measurement errors and the effects from unmeasured outputs and inputs, such as research and development and other intangible improvements, including organizational improvements.

[8] Lower investment in non-ICT assets and labor quality contributed 37 percent and 10 percent, respectively, to the declining trend in productivity growth between the two periods.

TABLE 3.2

Contributions to Growth of GDP
(Annual average growth rates, in percentage points[a])

		Germany			United States		
		1990–1995	1995–2004	2004–2007	1990–1995	1995–2004	2004–2007
1	GDP (2)+(3)+(4)+(7)	2.2	1.4	2.1	2.5	3.3	2.5
	Contributions from						
2	Hours worked	–0.4	–0.2	0.3	0.8	0.7	1.7
3	Labor quality	0.2	0.1	–0.1	0.2	0.2	0.3
4	Capital stock (6)+(7)	1.0	0.7	0.8	1.0	1.5	0.9
5	ICT capital	0.3	0.4	0.3	0.6	1.0	0.4
6	Non-ICT capital	0.7	0.3	0.5	0.4	0.6	0.5
7	TFP	1.4	0.7	1.2	0.5	0.9	–0.5
	Memo item:						
	Labor productivity growth	2.6	1.6	1.8	1.7	2.7	0.8

Source: The Conference Board Total Economy Database, September 2010; and IMF staff estimates.
[a] Based on the difference in the log of the levels of each variable.

Jorgenson, Ho, and Stiroh (2004), Triplett and Bosworth (2006), Bosworth and Triplett (2007), and more recently Jorgenson, Ho, and Stiroh (2008).

In 2005, a productivity catch-up resumed, mainly reflecting a U.S. slowdown. Germany's annual labor productivity growth accelerated only moderately (by 0.2 percent) in 2004–2007 relative to 1995–2004, as a pick-up in employment offset higher TFP growth (by 0.5 percent) and a higher contribution of non-ICT capital investment (by 0.2 percent). However, since TFP is measured as a residual, the recent turnaround could be largely due to unmeasured cyclical factors—including higher capacity utilization immediately precrisis in Germany. Moreover, unlike in the United States in the mid-1990s, the recent productivity acceleration in Germany was not accompanied by higher investment in ICT assets, which also suggests that cyclical factors might have been at play rather than a structural shift to a more "knowledge-driven" economy.

The results discussed so far apply to the total economy, including both public and private services. When public services—including health, education, and other public services—are excluded, the productivity growth gaps between Germany and the United States that emerged in the mid-1990s are magnified and TFP, rather than capital accumulation, explains the bulk of the gap.[9] Germany's labor productivity in the private economy grew at broadly the same rate during 1995–2004 as the total economy (including public services) grew, namely at 1.6 percent (Table 3.3). The acceleration in U.S. productivity growth therefore becomes even more striking when focusing only on the private economy: productivity

[9] Other excluded services are public administration and defense. Following van Ark, O'Mahony, and Timmer (2008), we also exclude real estate (ISIC 70), because output in this industry mostly reflects imputed housing rents rather than sales of firms.

growth in the private economy there rose by 3.1 percent annually over that period, compared to 2.7 percent for the total economy. The U.S. productivity lead is thus especially pronounced in the private economy. Specifically, we find that:

- The annual productivity gap with the United States during 1995–2004 for only the private economy is 1.5 percent, compared to 1.1 percent for the total economy (including public services).
- Since 2005, the results continue to show the resumption of a productivity catch-up when only the private economy is considered. During 2004–2007, the German resurgence is more pronounced when public services are excluded, and the U.S. slowdown is less extreme. Both trends suggest that a catch-up process has resumed more recently, although as noted above it is too early to conclude that the overall lag in German productivity growth has reversed, given the importance of cyclical factors over this relatively short period and the lack of a pick-up in ICT investments.
- TFP growth drives the differences between the two countries' private-economy productivity growth rates during 1995–2004, contributing over two-thirds (72 percent) of the productivity gap (compared to 15 percent for the total economy, including public services). The effect of slower investment in ICT capital on Germany's private economy is also an important factor, accounting for more than a third (35 percent) of the slower labor productivity growth in Germany relative to the United States over that period (compared to more than half when the total economy is considered). The contribution of differences in the pace of labor skill growth increases marginally (to 12 percent of total) when only the private economy is considered.[10]
- When focusing on developments over time in the two countries, a U.S. slowdown, rather than significantly higher productivity growth in Germany, continues to account for most of the recent turnaround since 2005. Within Germany's private economy, the pick-up in TFP growth (by 1.2 percent) since 2005 is more pronounced than for the total economy including public services (by 0.5 percent). Similar to the result for the total economy, the contribution of ICT capital accumulation to productivity growth in the private economy fails to accelerate in 2004–2007, unlike the U.S. experience of the mid-1990s, suggesting that recent developments may reflect

[10]The overall contribution of human capital would be underestimated in a growth-accounting framework if human capital mainly influences labor productivity growth through its impact on TFP growth. Higher education, in particular, arguably has a supportive role in fostering technological improvements and enabling a fast adjustment to new technologies. Using a sample of 13 EU countries plus the U.S., Molagoda and Perez (2011) confirm empirically the significant role of human capital in explaining TFP differences across countries through both its direct impact on innovation by the productivity leader and indirectly by increasing the size of knowledge spillovers. The largest impact of human capital is found for countries at or close to the productivity frontier, possibly because innovation is a relatively more skill-intensive activity than imitation. See also Vandenbussche, Aghion, and Meghir (2006).

TABLE 3.3

Contributions to Growth of Real Output in the Market Economy (Annual average growth rates, percentage points)

		Germany			United States		
		1980–1995	1995–2004	2004–2007	1980–1995	1995–2004	2004–2007
1	GDP (2)+(3)	1.9	1.1	2.4	3.3	3.8	2.8
2	Hours worked	–0.5	–0.6	0.5	1.3	0.7	1.4
3	Labor productivity (4)+(5)+(8)	2.4	1.6	1.9	2.0	3.1	1.4
	Contributions from						
4	Labor composition	0.2	0.1	–0.2	0.2	0.3	0.1
5	Capital stock per hour (6)+(7)	1.3	1.1	0.6	1.0	1.4	0.6
6	ICT capital per hour	0.3	0.5	0.4	0.7	1.0	0.5
7	Non-ICT capital per hour	1.0	0.6	0.2	0.3	0.4	0.1
8	TFP	0.8	0.4	1.6	0.8	1.4	0.6
	Labor productivity contribution from the knowledge economy (4)+(6)+(8)	1.4	1.1	1.7	1.7	2.8	1.2

Sources: EU Klems database, November 2009 release; and IMF staff estimates.
Note: ICT: information and communications technology; TFP: total factor productivity. Numbers may not sum exactly due to rounding.

temporary cyclical factors rather than the emergence of a knowledge economy typically associated with *both* higher investment in ICT assets and higher TFP growth.

The results above are broadly consistent with existing empirical evidence suggesting that slow increases in ICT investments and TFP growth were the two most important contributors to the aggregate productivity gap with the United States in the mid-1990s. According to Molagoda and Perez (2011), these two factors account for 42 percent and 33 percent, respectively, of the German-U.S. labor productivity differential in the private economy over the 1995–2007 precrisis period.[11] Based on their results, similar findings would be obtained using the United Kingdom or Sweden as productivity leader benchmarks instead of the United States.

AN INDUSTRY PERSPECTIVE

This section shifts from the aggregate perspective of the previous section to a sector-level (more disaggregated) perspective, allowing us to document the contributions of each sector to aggregate labor productivity growth and the key sources of productivity growth at the sector and industry level. Based on industry-level

[11] Molagoda and Perez (2011) do not provide the breakdown over 1995–2004 and 2004–07, only the full sample average results.

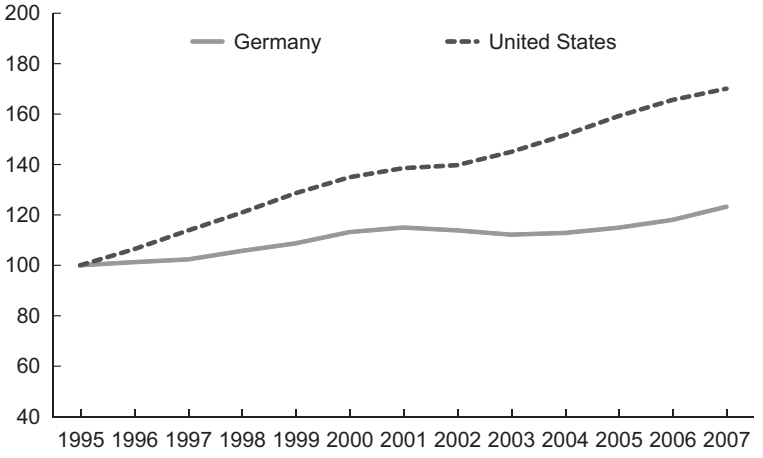

Figure 3.3 Value Added in the Services Sector (Gross value added, volume indices, 1995=100)

Sources: EU Klems database, November 2009 release; IMF staff estimates.

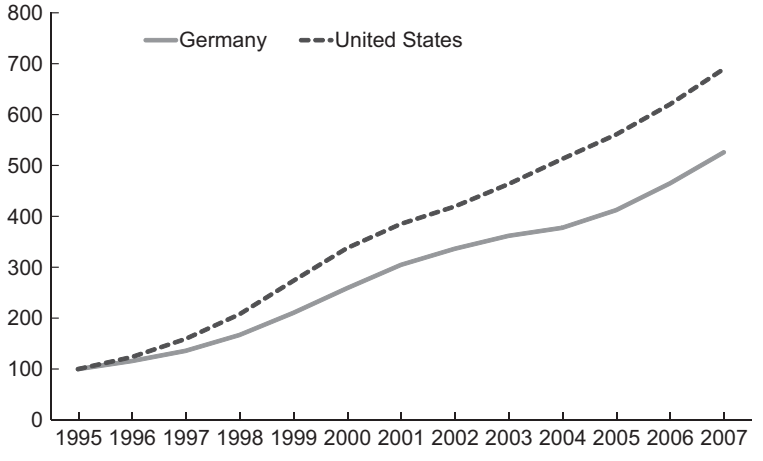

Figure 3.4 ICT Capital Services (Volume indices, 1995=100)

Sources: EU KLEMS database, November 2009 release; IMF staff estimates.

measures of output, inputs, and TFP from the EU KLEMS database, the results show that productivity differences are strong across industries too. In the case of the German-U.S. differential in productivity growth, we find that private services and, to a lesser extent, ICT production are the main sectors accounting for the aggregate productivity gaps in the private economy (Figures 3.3 and 3.4).[12] Private services (including wholesale and retail trade, hotels and restaurants, transport services, and financial and business services) also explain the bulk of

[12] ICT production includes production of electrical machinery and telecommunication services.

BOX 3.3 The Rising Importance of Service Sectors

Both Germany and the United States have experienced a major shift of production and employment from manufacturing and other goods-producing industries (such as agriculture and mining) toward services. Over the period 1980–2007, the share of hours worked in manufacturing declined by more than 30 percent in Germany and was almost halved in the United States. Private services—including trade and transportation services, hotels and restaurants, and business and financial services—now account for 60 percent of private employment in Germany (compared to over two-thirds in the United States). In the United States, the number of hours worked is now nearly five times larger than in market services than in manufacturing. Even in Germany, where manufacturing plays an important role (accounting for 28 percent of total private output), the number of hours worked in market services is almost three times greater than that for manufacturing.

This shift has important potential implications for productivity growth. Historically, innovation and technical change in manufacturing have been the central source of productivity growth. With the emergence of the knowledge economy in the mid-1990s, the center of gravity of productivity improvements may have shifted to service industries. The experience of the United States in the mid-1990s bears out this hypothesis. The U.S. revival reflected the rising growth contributions of ICT productivity and investment, especially in the distribution (trade and transportation) and other private services sectors. Due to the rising importance of the service sectors, durable productivity gains in Germany will need to extend to these industries in order to have a lasting impact on both real incomes and potential growth.

Germany's long-term declining trend in productivity growth since the mid-1990s, and the reverse trend in the United States over the same period (Box 3.3, Table 3.4, and Figure 3.5). We also find that productivity gaps in the private services industries largely reflect slower investment in ICT assets and the attendant slower TFP growth.

By contrast, productivity in the goods production sectors (including agriculture, mining, and manufacturing other than electrical machinery, utilities, and construction) has consistently been higher in Germany than in the United States. This principally reflects the traditional German strength in manufacturing, a

TABLE 3.4

Major Sector Contribution to Average Annual Labor Productivity Growth in the Market Economy (Annual average growth rates, percentage points)

		Germany			United States		
		1980–1995	1995–2004	2004–2007	1980–1995	1995–2004	2004–2007
1	Market economy (2)+(3)+(4)+(5)	2.4	1.6	1.9	2.0	3.1	1.4
2	ICT production	0.3	0.5	0.5	0.4	0.9	0.7
3	Goods production	1.1	1.1	0.6	0.8	0.5	–0.1
4	Market services	0.9	0.2	0.9	0.8	1.9	0.9
5	Reallocation	0.0	–0.1	–0.2	–0.1	–0.2	–0.2

Source: EU KLEMS database, November 2009 release and IMF staff estimates.

Notes: ICT: information and communications technology. "Reallocation" refers to labor productivity effects of reallocation of labor between sectors. ICT production includes manufacturing of electrical machinery and post and telecommunications services. Goods production includes agriculture, mining, manufacturing (excluding electrical machinery), construction, and utilities. Market services include distribution services; financial and business services, excluding real estate; and personal services. Numbers may not sum exactly due to rounding.

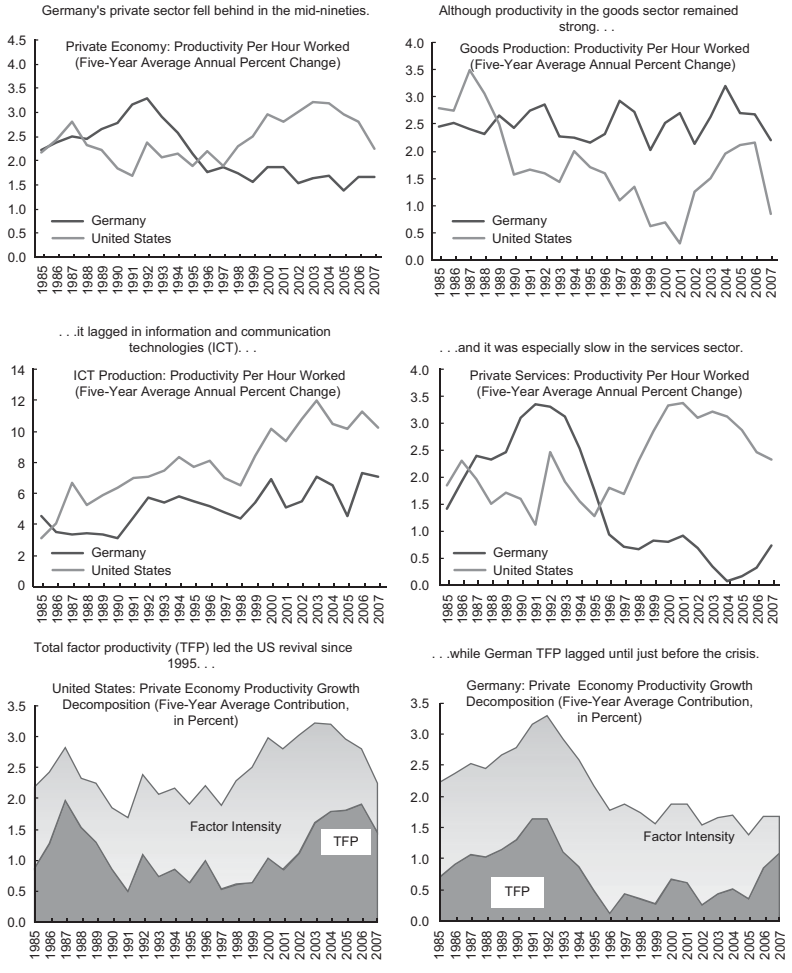

Figure 3.5 Germany: Productivity Trends in the Private Economy, 1985–2007

Sources: EU KLEMS database; and IMF staff estimates.

strength that makes Germany a formidable exporter of a wide range of precision manufactured products. Productivity growth in the ICT production sectors (including production of electrical machinery and telecommunication services) has been rising in line with worldwide trends but has lagged the United States since the mid-1980s (Figure 3.5).

Within the services sector, German-U.S. productivity differentials are concentrated in a handful of industries. Productivity gaps during 1995–2004 were especially large in distribution services (including trade and transportation) and in financial and business services. The distribution sector contributed a third of the overall annual productivity gap of 3 percent during 1995–2004. In finance and business services, the gap was even bigger, at almost 2 percent (nearly two-thirds of the total). In both cases, productivity growth differences reflect to a large

TABLE 3.5

Contributions of Sectors to Average Annual Labor Productivity Growth in Market Services (Percentage points)

	Germany			United States		
	1980–1995	1995–2004	2004–2007	1980–1995	1995–2004	2004–2007
Market services labor productivity	2.1	0.3	1.7	1.6	3.3	1.6
Distribution services contribution	1.0	0.9	1.0	1.1	1.9	0.7
from factor intensity growth	0.4	0.3	0.2	0.4	0.6	0.3
from TFP growth	0.6	0.6	0.7	0.7	1.3	0.4
Finance and Business services contribution	0.6	–0.7	0.4	0.0	1.2	0.2
from factor intensity growth	1.4	1.4	0.7	0.9	1.2	0.3
from TFP growth	–0.8	–2.2	–0.2	–1.0	0.0	–0.1
Personal services contribution	0.1	–0.2	0.1	0.2	0.1	0.3
from factor intensity growth	0.2	0.0	0.0	0.0	0.1	0.1
from TFP growth	–0.2	–0.2	0.1	0.1	0.1	0.3
Contribution from labor reallocation	0.4	0.3	0.2	0.3	0.0	0.3

Sources: EU KLEMS database, November 2009 release; and IMF staff estimates.

Note: Factor intensity relates to the total contribution from changes in labor composition and in capital deepening of information and communications technology (ICT) and non-ICT assets. The reallocation effect refers to the impact of changes in the distribution of labor input between industries on labor productivity growth in market services. Numbers may not add up due to rounding. TFP: total factor productivity.

extent differences in TFP growth at the sectoral level (i.e., efficiency of input use) rather than differences in factor intensity growth (i.e., growth in both human and physical capital inputs).

The closure of the gap vis-à-vis the United States between 2005 and 2007 mainly reflected slower productivity growth in the United States' distribution and financial and business services and improved performance in Germany's financial and business services. In Germany, the turnaround in financial and business services reflects higher TFP growth rather than larger contributions of capital accumulation and labor quality. However, international experience suggests that sustaining this trend will require concurrent improvements in TFP and investment—especially in ICT assets—since both are drivers of innovation effects on services productivity.

The continuing productivity gaps in the services sector reflect in part Germany's lag, by advanced country standards, in the use of ICT. Compared to some other advanced economies, Germany lags in research and use of ICT. This is evidenced by the low share of ICT in total research and development spending, compared to the average in OECD countries, and by the relatively low extent of

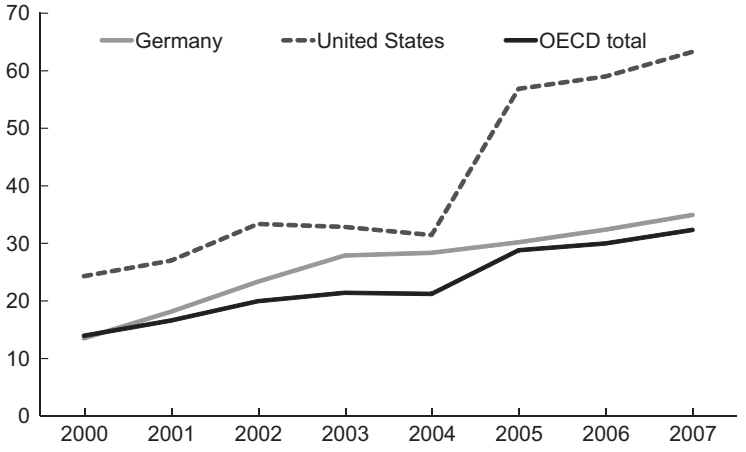

Figure 3.6 Internet Subscribers (Percent of population)

Source: Organisation for Economic Co-operation and Development.

business and government internet use. The latter in turn seems caused by several infrastructure and financing factors, including:

- a relatively low number of secure internet servers;
- low public investment in advanced technologies compared to some other OECD countries; and
- a comparatively low willingness of the financial system to provide financing for high-risk, innovative projects (Box 3.4).

Internet penetration in Germany (measured by the number of subscribers as a share of total population) is in line with the average for OECD countries, but it is lower than in the United States (Figure 3.6).

A limited initial public offering (IPO) market and tax obstacles appear to be contributing to the limited development of German private equity and venture capital markets and thus to the limited availability of risk financing. Difficulty in achieving successful exits, lack of entrepreneurial talent, and unfavorable tax policies (including tax obstacles to cross-border investments and double taxation) are the main unfavorable climate factors for venture capital in Germany, according to a 2010 survey of 516 firms in nine countries: 72 percent of respondents cited lack of entrepreneurial talent and tax policies as the main obstacles, and 67 percent considered exit difficulties the main issue. Eliminating tax obstacles to cross-border investments and double taxation would require coordinated action at the EU level to remove these and other regulatory barriers (e.g., separate registration requirements), thus allowing even smaller funds to invest EU-wide more efficiently, develop specialized sectoral expertise, and reap economies of scale.[13]

[13] While there is a consensus among the member states on promoting mutual recognition of national frameworks, no significant measures have yet been taken that would make fundraising and investing across borders easier (European Commission Enterprise and Industry Directorate General, 2009).

BOX 3.4 Productivity Growth in the Information Age

International experience suggests that innovation and productivity growth in services are closely related to the wider use of information and communication technology (ICT). In the U.S. private services sector since 1995, high levels of investment in ICT have been followed by rapid productivity growth. Other high-performing economies, such as Sweden, Finland, and the U.K. also have relatively high ICT uptake; in addition, the high-productivity countries are characterized by a relatively high level of human capital employed in the services sector (Molagoda and Perez, 2011).

Germany lags some advanced countries both in the use of ICT and in human capital in the services sector. Government usage of ICT and the number of secure servers are in the mid- to lower-range. The ratio of high-skilled labor employed in the services industries in 2007 is below 20 percent, compared to almost 50 percent for the U.S. and more than 40 percent for Finland (Molagoda and Perez, 2011). In the group of advanced nations, Germany's ICT research and development share in total research and development also falls in the mid- to lower-range. While public policy to support ICT development and use remains controversial, the evidence suggests that ICT development and use can be fostered through innovation policies, including promoting the availability of risk capital and increasing the commercial use of intellectual property rights held by universities and research institutions. A common European market for services would also generate economies of scale and raise incentives to invest in new technologies.

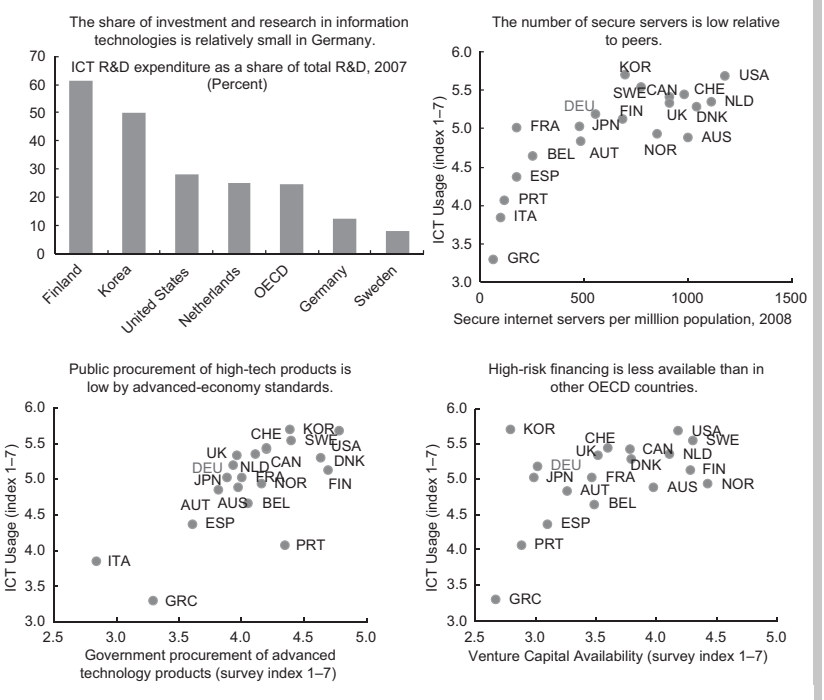

Figure 3.4.1 Research and Use of Information and Communication Technology

Sources: The Global Information Technology Report, 2009–10; and Organisation for Economic Cooperation and Development.

The lack of exit opportunities in Germany reflects the small share of global IPO listings in Deutsche Boerse.[14] Reasons for a limited IPO market in Germany compared to other key financial centers seem related to market liquidity: a shallower pool of equity capital compared to the United States, the United Kingdom, or the countries associated with the Euronext exchange, and a narrower investor base compared to the United States or the UK. It is these factors that limit the IPO market, rather than cost factors such as listing requirements and underwriting fees, where Germany appears very competitive (Oxera, 2006).

Another reason for Germany's delay in adopting the Internet economy and constraining factors for innovation is deficiency in the insolvency law, which results in relatively less creditor-friendly legislation than in the United Kingdom and thus less willingness of banks to lend to high-risk projects. Specifically, German banks face costlier and lengthier proceedings relative to the United Kingdom and thus potentially higher legislation-induced credit risk (Schmieder and Schmieder, 2011). In response, they demand relatively more credit risk mitigation than U.K. and U.S. banks do, but still recover less than do U.K. banks. Banks' lower willingness to lend to risky projects in turn could hinder entrepreneurship and risk-taking. To be on par with U.K. banks, Schmieder and Schmieder (2011) calculate that formal bankruptcy proceedings in Germany would have to be shortened by about one half.

Relatively limited use of public procurement to provide sustained ICT demand in Germany, as compared to other advanced countries such as Korea, Sweden, and the United States, may be another factor explaining the comparatively low investment in new, high-risk technologies. The premise is that there are positive externalities in the use of ICT caused, for example, by network effects or complementary investments, such as organizational change, that go unmeasured, and large fixed costs from the required infrastructure investments (servers, infrastructure software, storage).[15] Business models for ICT companies or services companies that make heavy use of ICT are thus reliant on scale to be profitable. A transparent procurement process that enables greater usage based on open standards can create synergies.

Greater European integration in services provision would also help raise investment in new, high-risk technologies, It would generate economies of scale and raise incentives to invest in and provide risk financing for innovative applications of ICT in services. Obstacles to an integrated European market for online and off-line services include a variety of compliance and regulatory issues,

[14] The number of IPOs expected in Germany in 2011 is 20, compared to a backlog of 150 deals in the U.S at end-February; Deutsche Boerse lagged other IPO markets in China, London, New York, Tokyo, Mumbai, Australia, and Korea in 2010, both in number of deals and funds raised (Ernst & Young, 2011).

[15] See, for example, Stiroh (2002) and McKinsey Global Institute (2010). While the potential offered and challenges posed in using public procurement as an instrument for innovation have been largely ignored or downplayed, a number of empirical studies conclude that over long time periods, state procurement triggered greater innovation impulses in more areas than did research and development subsidies (see Edler and Georghiou, 2007, for a review of the evidence).

including country-specific consumer-protection laws, VAT rules, electronic waste regulations, varying copyright rules, and postal systems. Moreover, the need to tailor products to each national market requires maintaining region-specific teams and translating every item, website, and online application, in several different languages. Finally, price-comparison websites, which make online shopping attractive in the United States, are relatively few in Europe, where existing sites remain national.[16] While these obstacles can be overcome,[17] they result in higher costs of doing business for services firms that attempt to operate across borders, and they further add to barriers to entry for smaller, start-up firms that do not have the administrative and personnel resources to cope with different national regulations.

Closing the productivity gap with the United States in private services could raise TFP growth, and thus potential growth, by up to 0.6 percentage points annually. The overall impact on potential growth could be higher if the TFP increase is associated with higher investment in new technologies, as was the case in the United States in the mid-1990s. Shifting adoption patterns for new IT services and products, such as cloud computing (forecast to grow at more than five times the rate of traditional IT products), suggest that the share of these growing markets, currently heavily concentrated in the United States at 70.2 percent, is likely to decline in the United States to 51.4 percent by 2014, while the share of Western Europe and Asia/Pacific, excluding Japan, is set to grow rapidly (IDC, 2010). Countries that plan for this shift by creating a favorable market environment, in terms of availability of risk financing and significant additional investment in broadband and complementary infrastructure, are likely to benefit disproportionately from this catch-up effect.[18] EU regulations that hinder the development of new IT service industries, such as EU laws that restrict the movement of data and access to databases across borders, may also need to be revisited, for example to allow storage of data by companies based in the EU with vendors based outside the region.

CONCLUSION

International experience suggests that ICT applications in traditionally low-tech industries such as the retail and wholesale sectors lead to technology and innovation effects, which in turn raise TFP growth. While large and internationally

[16] See *The Economist*, October 28, 2010.

[17] Successful internet start-ups, such as Berlin-based Wooga, illustrate the scope for exploiting the synergies of a European user market.

[18] Much of the available empirical research refers to the impact of the Internet or the "digital economy" rather than ICT infrastructure. A recent study using data for the 48 U.S. states over 2003–05 suggests that for every 1 percentage point increase in broadband penetration in a particular area, employment growth is estimated to increase 0.2–0.3 percentage points per year (Crandall, Litan, and Lehr, 2007). The study also finds that state output is positively associated with broadband use, although the impact is not statistically significant.

connected German companies are perceived to be at the forefront of innovation and usage of new technologies, overall ICT uptake and the prioritization of ICT in national growth strategy are both low in Germany relative to some other advanced countries.

In this paper we argue that policy measures are needed to raise the low annual TFP growth rate of only 0.5 percent during the last decade (see Chapter 2). While the more recent pick-up in productivity growth in Germany since 2005 is encouraging, the improvement could be largely cyclical, since it has not been accompanied by a concomitant rise in ICT investments. The experience of other fast-growing advanced countries suggests that to ensure a sustained rise in productivity and TFP growth in the private economy and to close the productivity gaps in the service sectors, Germany needs to encourage more widespread usage of ICT and human capital as well as investment and innovation, particularly in the private services sector (i.e., outside Germany's traditional strengths). The required measures to raise incentives to invest in higher-risk, higher-growth sectors include:

1. further development of venture capital and private equity markets (backed by a more efficient insolvency process);
2. increased commercial use of intellectual property rights held by universities and research institutions;
3. removal of uncertainties regarding tax treatment; and
4. further European integration in services provision.

Strong supply-side policies alone—including improvements of insolvency law system and the financing environment—are important to kick-start innovation and encourage risk-taking, but they may not be sufficient to sustainably raise incentives to invest in new technologies. Some have argued that ICT uptake is also importantly shaped by the availability of a large enough market due to the presence of network effects and large fixed costs to IT infrastructure investments.

In Germany's case, there may be scope for greater but transparent public procurement of high-tech products to support overall incentives for innovation and the development of new ICT applications. Greater harmonization of rules and regulations to foster greater European integration in services provision could help raise competition among service providers and thus lower prices and increase incentives for ICT investments and ICT usage, in a more efficient way than targeted subsidies. A common European market for services would also enable the realization of economies of scale, with expected positive effects on TFP growth and investment incentives.

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APPENDIX

TABLE 3A.1

Germany and the United States: Average Annual Growth Rates of GDP, GDP per Capita, and GDP per Hour Worked, 1950–2009 (Percent)

	Average annual growth in		
	GDP	GDP per capita	GDP per hour worked
1950–1973			
Germany	6.0	5.3	5.8
US	3.9	2.5	2.6
1973–1995			
Germany	2.1	1.8	2.8
US	2.9	1.7	1.2
1980–1995			
Germany	2.1	1.8	2.8
US	3.0	1.9	1.4
1995–2004			
Germany	1.4	1.3	1.7
US	3.4	2.3	2.4
2004–2007			
Germany	2.1	2.1	1.7
US	2.6	1.6	1.0
2008			
Germany	1.3	1.3	0.1
US	0.0	–0.9	0.8
2009			
Germany	–4.9	–4.9	–2.4
US	–2.6	–3.5	2.5

Sources: The Conference Board Total Economy Database, September 2010; and IMF staff estimates.
Note: Germany's pre-1988 population is estimated as the sum of West Germany and East Germany.
Relative levels are based on Elteto-Koves-Szulc (EKS) purchasing power parities for GDP for 2009.