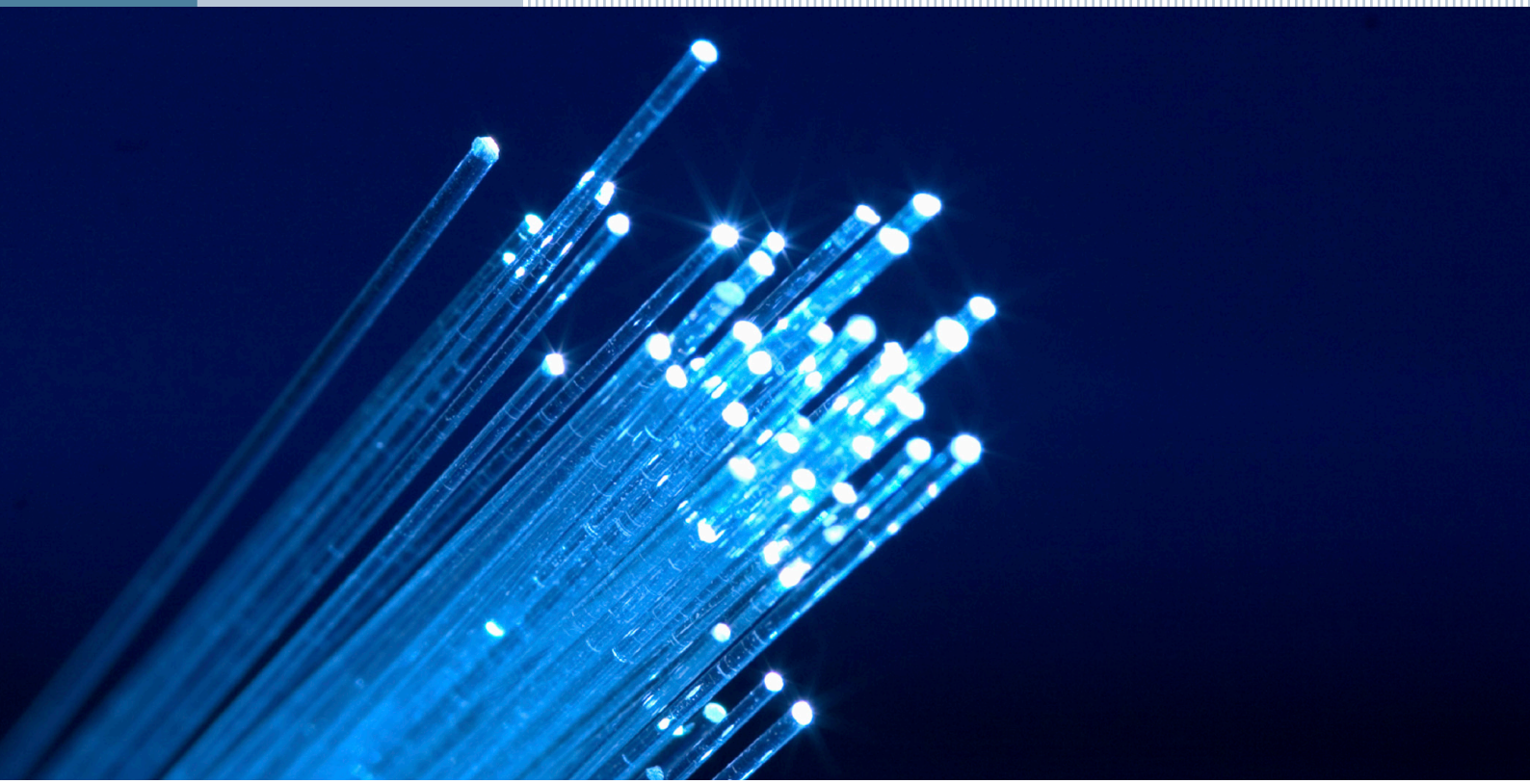


The Impact of Broadband on Jobs and the German Economy

DR. RAUL L. KATZ
Adjunct Professor, Columbia Business School,
Director of Business Strategy Research, Columbia Institute for Tele-Information (CITI) (United States)

DR. STEPHAN VATERLAUS
PATRICK ZENHÄUSERN
DR. STEPHAN SUTER
Polynomics AG (Switzerland)

Key Findings

The National Broadband Strategy will provide 75% of households with 50 Mbps while an ultra-broadband scenario will raise speeds to 100 Mbps for 50% of households

This study calculates the impact of investment in broadband technology on employment and output of Germany's economy. Two sequential investment scenarios are analyzed: the first one is based on the Government's "National Broadband Strategy" aimed at ensuring that 75 percent of German households have broadband access of at least 50 Mbps by 2014. The second scenario, covering 2015-2020, is labeled "ultra-broadband", and ensures that 50 percent of German households have access to at least 100 Mbps and another 30 percent to 50 Mbps by 2020.

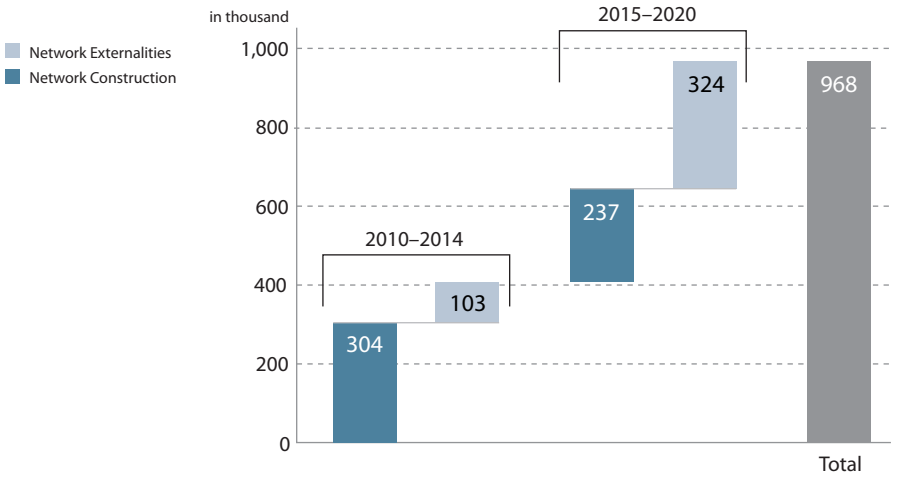
These scenarios will require 35.9 billion Euros of investment

Fulfilling the first target for 2014 will require an estimated investment of 20.2 billion Euros. This investment will ensure that all currently unserved households (730,000) have access to broadband; will upgrade households currently having sub-par access to download speeds up to 1 Mbps (2.8 million); and provide 50 percent of German households with VDSL service and 25 percent with FTTH. The deployment of ultra-broadband in subsequent years (2015–2020) will supply FTTH to an additional 25 percent of German households, requiring 15.7 billion Euros of additional investment.

This investment will create 968,000 jobs from broadband construction and network effects between 2010 and 2020

These investments will generate a substantial number of jobs and an incremental increase of the GDP. Based on analysis of input-output tables from the German Federal Statistical Office, network construction will create 304,000 jobs between 2010 and 2014, and an additional 237,000 between 2015 and 2020. Once the network is deployed, additional job creation will be triggered by network externalities, such as enhanced innovation resulting in new services and additional business growth. Based on regression-based forecasting, additional 427,000 jobs will be created, 103,000 in 2010–2014 and 324,000 in 2015–2020. The accumulated number of jobs over a ten year period (2010–2020) will reach 968,000.

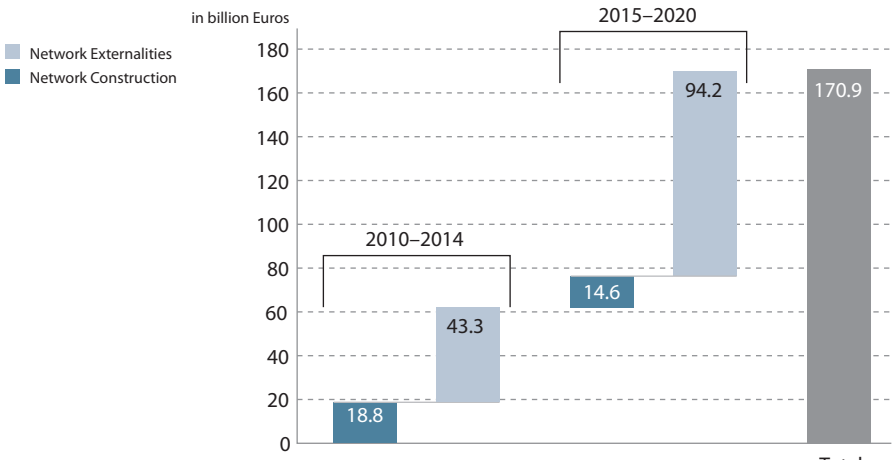
Incremental Employment Impact for Germany (in thousand jobs)



Broadband investment will result in 170.9 billion Euros in incremental GDP between 2010 and 2020

In output terms, the construction of the broadband network is expected to result in 18.8 billion Euros in additional GDP from 2010 to 2014, and 14.6 billion Euros in the subsequent phase of ultra-broadband rollout (2015-2020). The cumulative estimated increase of GDP from 2010 to 2020 therefore totals 33.4 billion Euros. For each Euro invested in constructing the broadband network, the expected value added amounts to 0.93 Euros. In addition, the resulting incremental broadband penetration is expected to add 137.5 billion Euros resulting from network externalities. Therefore, over a ten year period (2010–2020), the broadband investment is expected to result in 170.9 billion Euros of additional GDP (0.60% annual GDP growth) in Germany, of which the dominant share (108.8 billion Euros) is generated between 2015 and 2020. As a result, between 2010 and 2014, the total effect of broadband investment on GDP growth would be 0.49 percent while between 2015 and 2020, the contribution would rise to 0.70 percent.

GDP Impact on The German Economy (in billion Euros)



Appropriate regulation is critical for this investment to materialize

This analysis indicates that the National Broadband Strategy and the subsequent ultra-broadband evolution will significantly improve employment and economic growth in Germany. Broadband represents a high priority stimulus program that the government needs to rely on to improve the current economic outlook and create a solid foundation for future growth. Since roll-out of the German broadband infrastructure is primarily based on private investment, the Government's commitment to a newly designed growth and innovation-geared regulation is critical. The formulation of a regulatory framework which allows for appropriate risk diversification between investors and non-investors as well as improved a-priori planning and legal certainty for investing companies represents a key element of the needed investment-friendly environment.

Introduction

Governments are actively involved in promoting broadband deployment as a counter-cyclical measure

In times of economic crisis, national governments look for policy actions that can rapidly deal with rising unemployment and declining output. Infrastructure investments have been identified as key tools to fight the ongoing crisis because of the direct and indirect short-term labor effects in the construction industries and the substantial spillovers in terms of improving efficiencies and stimulating innovation in the production sector of the economy. As a result, several governments (Germany, United States, Australia, Portugal, Singapore, New Zealand and Ireland, among others) have recently decided to actively promote telecommunications investment.

The positive effects of broadband on the economy have been proven in numerous occasions

The economic benefits of broadband infrastructure are significant[1]. In information-intensive economies, such as Germany where 54 percent of the economically active workforce is considered to be information-based (from IT professionals to content producers and clerks), the deployment of infrastructure to facilitate the flow of information has an impact on productivity, innovation and business growth (Katz, 2009). In fact, multiple studies also point out that rankings in national competitiveness and network readiness are directly correlated.

This study aims to estimate the economic impact of Germany's National Broadband Strategy and a long range ultra-broadband scenario

The objective of this study is to estimate the impact of broadband infrastructure investments on the German economy, in particular on employment and output. This study analyzes the potential effects of Germany's "National Broadband Strategy" which is expected to be completed by 2014 (BMWi 2009a). In addition, the study assesses the economic impact of a second phase of ultra-broadband evolution, which results in a more advanced broadband network and is assumed to be completed by 2020. The study relies on a three-step-approach. First, the total costs for broadband deployment in Germany by 2014 and 2020 are determined. Second, by relying on input-output tables generated by the German Statistical Office and utilizing input-output analysis, the workforce which will be created by the roll-out of modern broadband is estimated. Third, regression-based forecasting is used to calculate the externalities of broadband deployment.

The study begins with an estimation of investment required to deploy broadband technology to meet the targets outlined in the National Broadband Strategy and in the ultra-broadband evolution. With that basis, the estimates of economic impact, both in terms of jobs and output (value added growth), of implementing the National Broadband Strategy and the long term evolution are presented and discussed.

1 To access references of academic research, please consult full study report available at http://www.citi.columbia.edu.

Study Methodology

The study methodology comprises three modules: 1) an estimation of total investment required to meet the broadband targets, 2) an assessment of economic impact of construction of the broadband network required to meet those targets, and 3) an estimation of the economic impact to be achieved once the network is deployed.

Estimation of total investment for broadband deployment

To estimate the investment required we first compare the National Strategy targets with Germany's current broadband supply

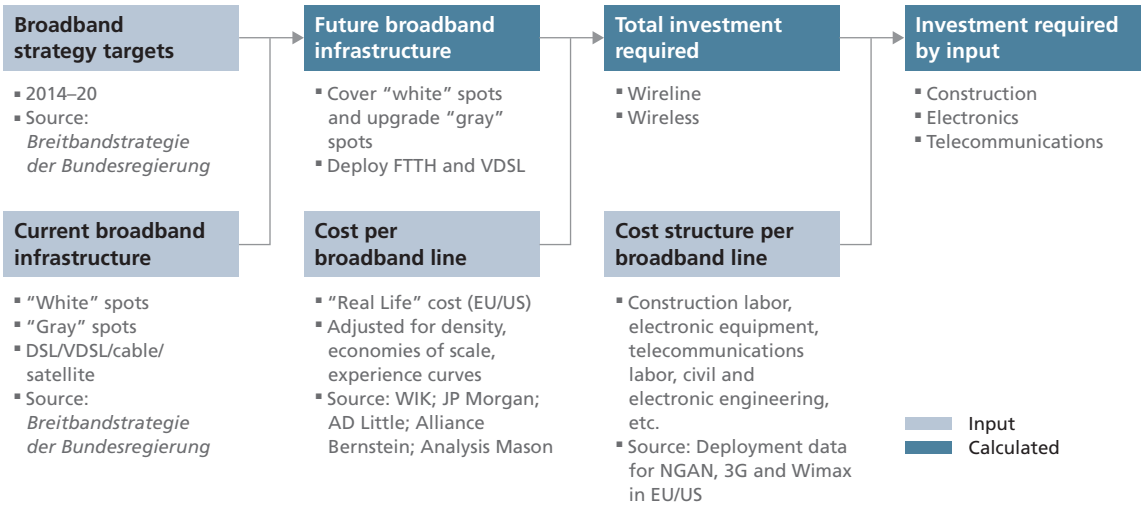
The coverage and service targets established by the Broadband Strategy are used to estimate the costs of deploying the targeted broadband infrastructure. Two sequential scenarios are defined: a 2014, built around the strategy targets (BMWi 2009a), and a 2020, defined on the basis of longer-term goals outlined in other government documents (BMWi, 2009c).

Once defined, the targets are compared against the current state of broadband deployment for which publicly available data has been analyzed. Data on current coverage is based on the National Broadband Strategy (BMWi 2009a) and the Broadband Atlas produced by the Federal Ministry of Economics and Technology (BMWi 2009b). The comparison between the current situation and the targets allows estimating the deployment objectives in terms of number of lines to: 1) cover the "white" spots (unserved areas), 2) upgrade the "grey" spots (areas with low access speeds), and 3) deploy VDSL and FTTH. Additional lines required are estimated for different type of broadband platforms (wireless, DSL, VDSL and FTTH).

Once the targeted number of lines are calculated, they are multiplied by costs per line benchmarks by platform

Once the number of lines by service target is estimated, they are multiplied by the costs per broadband line by type of platform. In order to determine the investment per line, the costs from deployment experience in Europe and the United States were relied upon, adjusted for factors such as urban density, economies of scale, and experience curve . This calculation yields the total investment required for wireless and wireline technologies. The total investment is split according to three cost categories: 1) construction labor, 2) electronic equipment, and 3) telecommunications labor . The resulting process yielded the amount of total investment by cost category.

Methodology for Estimating Deployment Costs



Assessment of economic impact of network construction

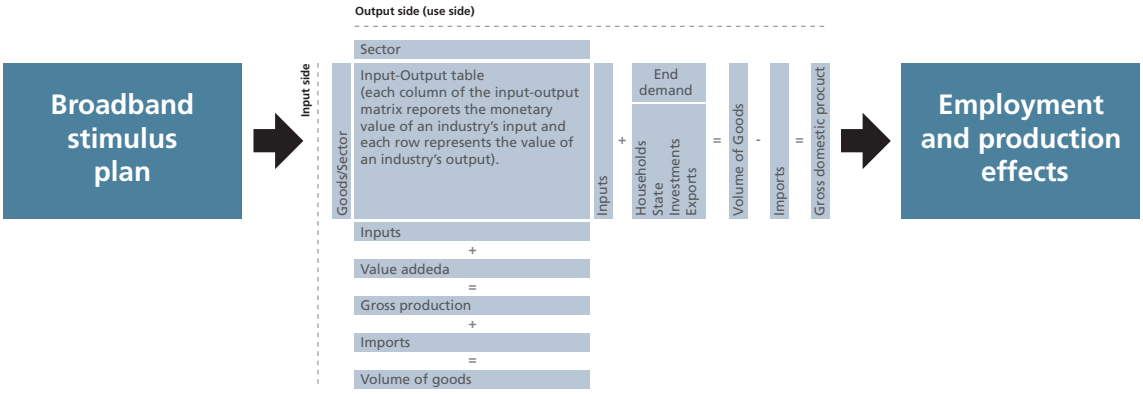
The impact of broadband construction comprises the estimation of direct, indirect and induced effects

The assessment of economic impact of network construction comprised the evaluation of effects on jobs and economic output. There are three types of construction effects. In the first place, network construction requires the engagement of direct jobs (for example, telecommunications technicians, construction workers, and manufacturers of the required telecommunications equipment). In addition, the creation of direct jobs has an impact on indirect employment (jobs of businesses buying and selling to each other in support of direct spending). Finally, the household spending based on the income earned from the direct and indirect effects leads to the creation of induced employment. To calculate the impact of broadband construction on employment and output, we rely on input-output analysis..

Input-output tables from the Federal Statistical Office are analyzed to estimate construction effects

Input-output tables calculate the direct, indirect, and induced employment and production effects of network construction. The interrelationship of these three effects can be measured through multipliers, which estimate total employment change throughout the economy from one unit change on the input side. In this study, the German input-output matrix supplied by Eurostat, and originally developed by the Federal Statistical Office is utilized.

Structure of Input-Output Table



Estimation of the economic impact to be achieved after network deployment

The spill-over impact of broadband comprises productivity improvements, new services growth and employment relocation

Once deployed, the broadband infrastructure yields three types of economic impact. First, business firms might improve their productivity as a result of the adoption of more efficient business processes, themselves enabled by broadband services. Secondly, broadband deployment yields an acceleration of innovation resulting from the introduction of new broadband-enabled applications and services. Thirdly, broadband can have an impact on the composition and deployment of industry value chains. In other words, broadband can facilitate the transfer of employment from other regions and countries as a result of the ability to process information and provide services remotely.

Externalities were calculated through econometric modeling of historical effects combined with forecasts of broadband deployment

The estimation of economic impact achieved after network deployment is conducted through econometric modeling. This is performed in three steps. First, statistically significant causal models are specified for German historical data sets. Data included broadband adoption, GDP growth, population growth and other time series between 2000 and 2006 at the Landkreise level. Data from the Federal Statistical Office, the 'Bundesamt für Bauwesen und Raumordnung' and the Broadband Atlas produced by the Federal Ministry of Economics and Technology is used.

Once the models are specified, they are utilized to forecast economic and employment growth as a result of an increase in broadband penetration (the independent variable). The increase in broadband penetration was estimated by inferring the net result of the broadband strategy. Once the estimates for employment and economic impact resulting from network deployment and externalities are generated, they are annualized and compiled to yield both aggregate and annual effects.

Broadband Investment in Germany

Broadband deployment targets were based on the National Broadband Strategy

According to our estimates based on data of the National Broadband Strategy, of all German households (total households: 39.7 million, Federal Statistical Office Germany 2006), 39 million have access to some type of broadband technology. Of these, 36.7 million can be served by DSL, 22.0 million are passed by cable TV networks (and, therefore potentially connected via a cable modem), and 730,000 can access the internet via fixed wireless or satellite technology. The remaining not covered households, so called "white spots", which comprise two percent of households (or 730,000), are either located in less densely populated areas or near the outer boundaries of already connected areas.

Telecommunications operators have been making considerable progress in access and download speeds

In addition to improving coverage, Germany has been making considerable strides in terms of raising the access speed of residential broadband users. The National Broadband Strategy reports that 98 percent of all German households have access to broadband internet with transmission rates of at a minimum 384 Kbps, while 92 percent of households are served by lines with at least 1 Mbps. About 2.8 million households are in "grey spots," meaning that they have broadband access between 384 Kbps and 1 Mbps.

Fiber is being deployed by the telecommunications incumbent and city networks

Germany is currently undergoing three levels of fiber deployment: 1) Fiber to the Main Distribution Frame for ADSL 2+ services for selected cities, 2) Fiber to the street cabinet for VDSL services, and 3) Fiber to the home (e.g. DTAG, NetCologne, M'net). In the case of VDSL, Deutsche Telekom has announced that 90 percent of households located in top 50 cities (which are estimated to be 10.9 million households) can have access to VDSL. Simultaneously, several municipal networks have launched or are planning to deploy FTTB networks although only 240,000 are covered. Deployment in this case is focused on densely populated areas of their home markets.

Cable TV operators have been upgrading their networks and are planning to deploy DOCSIS 3.0

The major cable players have all upgraded their networks to two way Hybrid Fiber Coax generally relying on DTAG ducts. Kabel Deutschland's acquisition of Orion in the first quarter of 2008 resulted in 7.6 million upgraded households passed (71 percent of homes passed). Unitymedia has 6.3 million upgraded households passed (72 percent of homes passed). Kabel BW has upgraded 91 percent of its network passing 3.3 million homes. All players are offering DOCSIS 2.0 and planning to roll out DOCSIS 3.0 by the end of 2010.

As in other countries, a demand gap still exists

Turning to the demand side, as of the end of 2008, there were 22.6 million broadband lines in Germany (Source: Bundesnetzagentur Jahresbericht 2008, 2009). As a result, Germany has reached 58 percent household penetration, or 27 percent of its population. Assessing demand in light of the supply perspective indicates that 58 percent of households served by any combination of broadband technologies actually purchase service:

Households Passed by Broadband

Technology	Coverage (*million*)	Subscribers (*million*)	Connected/Passed in %
DSL	36.7	20.9	57
Cable Modem	22.0	1.6	7
Fixed Wireless, satellite	0.730	0.092	13
FTTB	0.240	0.043	18
Total (assuming overbuilds)	39.0	22.6	58

The 'National Broadband Strategy' and an Ultra-broadband scenario

The National Broadband Strategy is aimed at achieving universal broadband coverage

The Federal Government of Germany has defined in its National Strategy two broadband strategy targets (see BMWi 2009a):

- Provide broadband access (1 Mbps capable) nationwide by the end of 2010.
- By 2014, 75 percent of German households should have access to a broadband connection of at least 50 Mbps, with the goal that such access lines should be available as soon as possible throughout the country.

The deployment actions required to meet these targets are four-fold. First, the 730,000 unserved households (white spots) will be covered by a mix of wireless and wireline technology. It is assumed, following Deutsche Telekom's recent announcement that 250,000 unserved households will be covered by DSL technology, while the remainder will be covered by wireless technologies. The second action will be to upgrade the 2.8 million "grey spots" households to 1 Mbps.

Additionally, significant improvement in access speeds are planned

Turning to the second target of the National Broadband Strategy, 75 percent of households will have to be served by at least 50 Mbps by 2014 and higher bandwidths beyond. This deployment is assumed to occur in two stages:

- Upgrade to FTTH: It is assumed that 9.92 million households (representing 25 percent of the German households) will be upgraded to FTTH given that VDSL technology deployed in dense cities has limits to the capability of offering 50 Mbps. Since the current number of households served by VDSL is 10.9 million and that they are located in the major 50 German cities, it is assumed that the majority of them will be migrating from VDSL to FTTH.

- Upgrade to VDSL: For this, it is assumed that the remaining 50 percent of households will be upgraded from DSL to VDSL. According to this calculation, it is estimated that the broadband lines to be connected as a result of this effort will be approximately 18.9 million.

The National Broadband Strategy entails major infrastructure deployment

To sum up, the broadband strategy will require the following investments to be completed by 2014:

- Unserved households (730,000) covered by a mix of wireless (480,000 lines) and wireline technologies (250,000 lines)
- "Grey spots" households (2.8 million) upgraded to 1 Mbps
- 9,930,500 households (or 25%) upgraded to FTTH: these will come from the 240,000 where FTTH has already been deployed (municipalities) and by upgrading the rest from the existing VDSL lines
- 18.9 million households (or 50%) upgraded to VDSL: this will be comprised by the remaining existing VDSL lines (980,000) and upgrading additional 17.9 million currently DSL lines

Longer term aspirations, as mentioned in other government reports (BMWi, 2009c, 38) foresee to build a national ultra-broadband infrastructure by 2020. We assume the objectives to be:

- Deploy FTTH to 50 percent of households
- Deploy VDSL to the next 30 percent of households
- Offer broadband services under 50 Mbps to the remaining population (20%)

The action implied from these targets is to upgrade an additional 25 percent of households to FTTH.

Total investment required to meet policy targets

The calculation of total investment required has been conducted for each action by relying on costs per line. First, the combined wireline and wireless costs required to cover the unserved households will require 924 million Euros for 2014, as depicted in the following table:

Investment Required to Cover Unserved Households for 2014

Technology	Number of households	Cost per line (*Euros*)	Total Investment (*million Euros*)
DSL	250,000	1,200	300
Wireless	480,000	1,300	624
Total	730,000		924

The calculation of VDSL and FTTH deployment relies on actual cost per line adjusted for an increase of cost per household resulting from further deployment of the technology in the network. For example, in the case of FTTH the initial ten percent of households (3,972,000) will cost 1,150 Euros per household to deploy, the next 10 percent will require 1,287 Euros, and the next ten percent, 1,425 Euros. In the case of VDSL, the first ten percent, will cost 300 Euros, while deploying beyond 50 percent, will require 450 Euros. Based on these figures and the number of lines to be deployed, the investment required to meet the FTTH target is 12,236 million Euros, while the investment required to meet the VDSL target would reach 6,747 million Euros. To sum up, the total investment required to fulfill the 2014 National Broadband Strategy will be 20,243 million Euros.

Total Investment Required to Achieve Objectives for 2014

Target	Amount (million Euros)
Address the unserved "white spots"	924
Upgrade the "grey spots"	336
Deploy FTTH to 25% of households	12,236
Deploy VDSL to 50% of households	6,747
Total	20,243

The incremental investment required to meet the FTTH target of 50 percent households served by 2020 will be 15,690 million Euros.[4]

[4] The difference between the first 25 percent, achieved in 2014 (12,236 million Euros) and the second 25 percent *tranche* achieved in 2020 (15,690 million Euros) is due to two factors: 1) the first *tranche* benefits from the 240,000 households already served by municipal networks roll-out and, more importantly, 2) the cost per line in the second phase rises from 1,150-1,425 Euros to 1,500-1,700 Euros.

Job Creation and Economic Impact of Germany's Broadband Strategy

Employment and economic impact of broadband network construction

The broadband investment is broken down in three primary sectors: manufacturing of electronic equipment, construction and telecommunications:

Breakdown of Broadband Investment to Fulfill the Broadband Strategy and 2020 Scenario

	Inputs	Wireline		Wireless		Total
		%	million Euros	%	million Euros	million Euros
2014	Electronics	12	2,354	45	281	2,635
	Construction	67	13,145	34	212	13,357
	Telecommunications	21	4,120	21	131	4,251
	Total		19,619		624	20,243
2020	Electronics	12	1,883	45	0	1,883
	Construction	67	10,512	34	0	10,512
	Telecommunications	21	3,295	21	0	3,295
	Total		**15,690**		**0**	**15,690**

Broadband construction between 2010 and 2014 will generate a total of 304,000 jobs and 237,000 between 2015 and 2020

These estimates were entered into the input/output matrix for the German economy to estimate the impact on jobs and the economy of investment in network construction. Fulfilling the 2014 objectives of the National Broadband Strategy will generate 304,000 jobs over five years (between 2010 and 2014). The primary sector benefited in terms of job creation will be construction with 125,000, followed by telecommunications (28,400) and electronics equipment manufacturing (4,700). Total indirect jobs generated by sector interrelationships measured in the input/output matrix will be 71,000. The key sectors benefited from the indirect effects are distribution (10,700), other services (17,000) and metal products (3,200). Finally, household spending generated directly and indirectly, will result in 75,000 induced jobs. Based on these estimates, the Type I multiplier for employment is 1.45 and Type II is 1.92.[5]

[5] Type I multipliers measure the direct and indirect effects (direct plus indirect divided by the direct effect), while Type II multipliers measure Type I plus induced effects (direct plus indirect plus induced divided by the direct effect).

Additionally, the implementation of the expected ultra-broadband evolution would generate 237,000 incremental jobs between 2015 and 2020. Similar to the breakdown shown above, this figure comprises 123,000 in direct jobs, 55,000 in indirect jobs and 59,000 in induced jobs.

Total Employment Impact of Broadband Network Construction

Type of Impact	2014 National Broadband Strategy	2020 Ultra Broadband	Total
Direct effect	158,000	123,000	281,000
Indirect effect	71,000	55,000	126,000
Induced effect	75,000	59,000	134,000
Total	304,000	237,000	541,000
Type I multiplier	1.45	1.45	
Type II multiplier	1.92	1.93	

Broadband investment is as effective in job creation as other infrastructure programs

The labor intensive nature of broadband deployment determines that the construction jobs to be created are significant and, despite the high technology nature of the ultimate product, broadband is to be seen as economically meaningful as conventional infrastructure investment such as roads and bridges.

Each Euros invested in network construction will trigger 0.93 Euro in incremental GDP

The investment in meeting the targets of the 2014 National Broadband Strategy (20,243 million Euros) will generate additional production of 52,324 million Euros in total. This means that for each Euro invested in broadband deployment, 2.58 Euros will be generated in output. Of this, 4,146 million Euros (8% of total output) will be based on imported goods, which indicate a relatively low level of output "leakage" to other national economies. Of the remaining production, 18,733 million Euros would be additional GDP (+ 0.15%). Again, each Euro invested in broadband deployment will trigger 0.93 Euros in incremental GDP.

Industrial Output of Broadband Construction
(in million Euros)

	2014 National Broadband Strategy	2020 Ultra-broadband	Total
Investment	20,243	15,690	35,933
Total additional production	52,324	40,749	93,073
• Domestic	48,178	37,609	85,787
Additional Value added	*18,733*	*14,631*	*33,364*
Intermediate outputs	*29,466*	*22,978*	*52,444*
• Imported	4,146	3,148	7,294

To sum up, the incremental GDP growth achieved by investing in broadband construction would amount to 33,364 million Euros, which represents +0.12% of the German GDP.

Employment and economic impact of externalities

Broadband has already had a strong impact on the German economy

Economic impact of broadband in terms of network externalities (that is to say, positive effects in employment and economic output resulting from enhanced productivity, innovation and value chain decomposition) have been found to be significant throughout Germany. The analysis of these effects has found that the economic stimulus impact of broadband is highest in the first year after deployment and tends to diminish over time. Results of the regression analysis for national time series between 2000 and 2006 indicates, with high significance levels, a strong impact of increased broadband penetration on GDP growth, although the degree of impact tends to diminish over time[6].

In addition, by splitting the national territory into two regions, Landkreise with 2008 average broadband penetration of 31 percent of population and Landkreise with average broadband penetration of 24.8 percent, we observe that the type of network effects of broadband varies by region[7].

In regions with high broadband penetration, the technology has a strong immediate impact on job creation and economic growth

In high broadband penetrated Landkreise, the impact of the technology is high, both on GDP and employment in the short term, and declines over time. This "supply shock" is believed to occur because, once deployed, the economy can immediately utilize the technology. Furthermore, the fact that employment and GDP grow in parallel indicates that broadband is having a significant impact on innovation and business growth, thereby overcoming any employment reduction resulting from productivity effects.

[6] For full model estimates, please consult study report available at http://www.citi.columbia.edu.

[7] This is consistent with the results of Lehr et al. (2006) for the US.

In regions with low broadband penetration, economic growth and job creation effects increase over time

On the other hand, in Landkreise with low broadband penetration, the impact on GDP of broadband deployment is lower than in high penetrated areas in the short term but "catching up" to comparable levels over time. With regards to employment, the impact of broadband at least in the initial years is slightly negative. This would indicate that the impact of broadband in low penetrated areas is more complex than in the high penetrated areas. The incremental deployment of broadband in low penetrated areas takes longer to materialize because the economy requires a longer period of time to fully assimilate the technology. However, after three years the level of impact of broadband in low penetrated regions is as high as in the more developed areas. This is consistent with Jorgeson's findings of lagged effect of ICT investment in productivity (Jorgeson et al., 2007). On the other hand, the fact that employment growth is initially negative would appear to indicate that productivity increases resulting from the introduction of new technology are the most important network effect at work resulting in employment reduction. However, once the economy develops, the other network effects (innovation, value chain decomposition) start to play a more important role, resulting in job creation. Therefore broadband deployment in low penetrated areas will likely generate high stable economic growth ("catch up" effect) combined with capital/labor substitution which initially limits employment growth ("productivity" effect).

Based on these differentiated effects, the impact of broadband on economic growth and employment are estimated. In order to do that, it is stipulated that broadband penetration in advanced areas would increase by 14.9 percent, while the low penetrated areas would increase in 12.6 percent. This last trend is largely driven by the coverage of "white spots" and an improvement of service in "grey spots". These trends reflect an incremental increase in penetration of approximately 25 percent in both regions between 2008 and 2011.

By factoring an imputed growth in broadband penetration resulting from the broadband strategy, we calculate a three-year impact of 47 billion Euros in GDP and 162,000 jobs

The percent increase was inputted in the regression models specified for the time series 2000-2006. The regression models estimate an incremental annual GDP growth rate of 0.61 percentage points for low penetrated Landkreise and 0.64 percentage points for high penetrated Landkreise. This additional percentage point increases were applied to the GDP of both regions (estimated to be 1,698 billion Euros for high penetrated Landkreise and 791 billion Euros for low penetrated Landkreise). This resulted in an incremental GDP of 32,809 million Euros for high penetrated Landkreise and 14,375 million Euros for low penetrated Landkreise. The total incremental GDP is 47,184 million Euros (+0.62%) in three years.

Regarding the impact on employment, following the same methodology, creation of a total of 162,000 jobs is expected, whereby the more penetrated broadband areas would contribute 132,000 and the low penetrated regions 30,000.[8] The differentials across regions are driven by the divergent effects dis-

[8] While it is not possible to determine, as in the case of network construction, what type of sectors would be mostly impacted by network externalities, experience indicates that higher developed areas will generate knowledge-intensive occupations such as R&D and product development, while less developed regions will attract low-end information intensive jobs, such as virtual call centers.

cussed above. Having estimated the three year (2009–2011) employment and economic impact of incremental broadband penetration, the prorated annual increments were applied to the period 2012-2020 (54,000 jobs, and 15.7 billion Euros of GDP per year). However, in doing so, the impact during the years 2012-2014 was adjusted downward because a portion of the construction effect is already accounted for in the regression models since these do not differentiate between construction and externalities. After 2014, no adjustments were made because with the construction of the National Broadband Strategy being finished, the regression models would be primarily forecasting network effects. A similar adjustment was made to the GDP impact.

The different short term economic impact between high-penetrated and low-penetrated Landkreise prompts the question of why to invest in the low penetrated areas if externalities are greater in more advanced regions? The answer is threefold: first, the impact in more advanced areas tends to decrease over time, which requires that in order to continue creating jobs the emphasis is shifted to the less penetrated regions; second, based on the "catch up" effect described above, it is expected that less penetrated areas will become engines of job creation in the long run; third, the social intangible benefits of addressing the "digital divide" problem remains an overriding imperative, regardless of the short term employment effects.

Effects were annualized to understand yearly impact on job creation and economic growth

Finally, as shown in the next figure, the estimates were split across several years depending on stages of network deployment to indicate that the 541,000 jobs as well as the 33.4 billion Euros of additional GDP being generated by network construction do not occur all in one year but over the ten year period considered.

Employment and Economic Impact per annum

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Employment [in thousands]													
Network Construction	National Strategy	60.8	60.8	60.8	60.8	60.8							304.0
	Ultra-Broadband						39.5	39.5	39.5	39.5	39.5	39.5	237.0
Total		**60.8**	**60.8**	**60.8**	**60.8**	**60.8**	**39.5**	**39.5**	**39.5**	**39.5**	**39.5**	**39.5**	**541.0**
Network Externalities				24.0	35.0	44.0	54.0	54.0	54.0	54.0	54.0	54.0	427.0
Total		**60.8**	**60.8**	**84.8**	**95.8**	**104.8**	**93.5**	**93.5**	**93.5**	**93.5**	**93.5**	**93.5**	**968.0**
Gross Domestic Product [in billion Euros]													
Network Construction	National Strategy	3.8	3.8	3.8	3.8	3.8							18.8
	Ultra-Broadband						2.4	2.4	2.4	2.4	2.4	2.4	14.6
Total		**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**2.4**	**2.4**	**2.4**	**2.4**	**2.4**	**2.4**	**33.4**
Network Externalities				13.9	14.5	14.9	15.7	15.7	15.7	15.7	15.7	15.7	137.5
Total		**3.8**	**3.8**	**17.7**	**18.3**	**18.7**	**18.1**	**18.1**	**18.1**	**18.1**	**18.1**	**18.1**	**170.9**

Conclusion

The National Broadband Strategy and the expected evolution to ultra-broadband through 2020 will have a significant impact on jobs and the German economy. It is estimated that a total investment of close to 36 billion Euros would generate a total of 968,000 incremental jobs, of which 541,000 are derived from construction of the network to meet the stipulated targets and 427,000 will be generated after the network is progressively deployed, resulting from enhanced innovation and new business creation. From an incremental economic growth standpoint, network construction would yield additional value added of 33.4 billion Euros, while network externalities will result in additional 137.5 billion Euros. In total this results in 170.9 billion Euros of additional GDP (0.60 % GDP growth) in Germany.

These economic returns on the broadband investment amply justify the need to move ahead with the announced plans, in particular to assure a growth and innovation-geared political and regulatory framework.

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Prof. Dr. Raul L. Katz
Adjunct Professor, Columbia Business School,
Director of Business Strategy Research,
Columbia Institute for Tele-Information (CITI)
Email: rk2377@columbia.edu
3022 Broadway, Room 1A
New York, NY 10027-6902
United States

Dr. Stephan Vaterlaus
Chief Executive Officer
Polynomics AG
Email: Stephan.Vaterlaus@polynomics.ch
Baslerstrasse 44
CH-4600 Olten
Switzerland

Patrick Zenhäusern
Head of Telecommunications and Media Practice
Polynomics AG
Email: Patrick.Zenhausern@polynomics.ch
Baslerstrasse 44
CH-4600 Olten
Switzerland

Dr. Stephan Suter
Project Leader
Polynomics AG
Email: Stephan.Suter@polynomics.ch
Baslerstrasse 44
CH-4600 Olten
Switzerland

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