ESTIMATING THE ECONOMIC IMPACT OF THE BROADBAND STIMULUS PLAN

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EXECUTIVE SUMMARY:

The objective of this research is to estimate the jobs that can be generated as a result of the grants to be disbursed by the broadband provisions of the conference report on the American Recovery and Reinvestment Act, published on February 13, 2009. Our study differentiates between jobs to be generated through capital spending in the form of grants allocated to unserved/underserved areas, and employment to be created as a result of the network externalities enabled by the deployment of such an infrastructure. By relying on input-output analysis, the study estimates that approximately 128,000 jobs (or 32,000 jobs per year) could be generated from network construction over a four year period, whereby each job would cost $50,000. For comparative purposes, a similar investment in "roads and bridges" would yield 152,000 jobs, at a cost of $ 42,000 per job. Differences lie on the construction-intensity and a lower proportion of imported goods in the industrial output of transit infrastructure.

While the estimates for network construction jobs are fairly robust and consistent with prior research, employment due to network externalities had to be ranged due to the uncertainty surrounding the impact of those effects. First, a "saturation" effect (i.e., when broadband adoption reaches high penetration levels nationally) might limit the economic impact of broadband. Second, ongoing research on the productivity impact of broadband indicates the potential for capital-labor substitution and consequently, the likelihood of job destruction resulting from broadband deployment. Third, since broadband tends to enable the outsourcing of jobs, a potential displacement of employment in the service sector from the area targeted for deployment might occur. Fourth, some job creation in the targeted areas could be the result of relocation of functions from other areas of the country, and therefore, should not be considered as creating incremental employment.

Nevertheless, the study results indicate that some impact of network externalities of the broadband program is feasible. Our estimates indicate that over four years the network effects could range from 0 to 270,000 jobs over four years (approximately 67,500 jobs per year), although anecdotal evidence would point to the lower end of this range. Narrowing this range will require additional research based on the specific geographic areas of program implementation. It is critical that the broadband plan is targeted on high impact areas and coordinated with an active program of job retention; if not, the net employment impact could be greatly diminished and reduced to the effects derived from network construction.

Broadband can ultimately help creating jobs as a result of network effects but only if a set of additional policies are put in place:

1. Coordinate broadband deployment with job creation and retention programs: Network effects resulting from the broadband stimulus program can be generated. However, their fulfillment is driven by success in implementing job creation and retention programs in parallel with network deployment. As an example, State and Local Governments in the targeted areas need to work with private sector companies in using

this new infrastructure for employment generation. Also governments need to work with businesses to discourage job relocation as a result of broadband deployment.

2. Rethink criteria for selecting areas to develop broadband: Consider deployment not only on unserved and underserved areas but also in regions where the possibility of developing regional growth, in coordination with broadband deployment, could act as a magnet to stimulate relocation, firm creation, and, consequently, jobs. While it is possible that such areas have already been targeted by private operators, it is reasonable to consider that opportunities for regional core development could still be identified. The experience of Germany, Sweden and the Netherlands in developing regional broadband cores could be very instructive in this regard.

3. Centralize program evaluation and grant allocation: As a corollary to the first recommendation, given that the ability to generate jobs as a result of network externalities is dependent on the regions being targeted, it would be advisable to centralize the process of allocating funds for network deployment and rely on a common framework for evaluating requests focused on economic growth and job creation. Having designated two points for funding disbursement (NTIA and RUS) raises the potential for lack of coordinated evaluation and oversight, and therefore, lowers economic impact. The creation of some coordination mechanism might be advisable in this regard.

In this context, it is critical to enhance the government's ability to monitor spending and results, especially if the stimulus program is largely mandated like an earmark as opposed to some other methods that have more control on disbursements.

4. Develop systematic tests based on social and economic criteria to evaluate the return of the investment: All submissions for grants/loans should be backed up with analysis of the social and economic returns supported by a common set of tools and benchmarks.

5. Evaluate the economic impact of NGAN: This study has not quantified the effect of faster access speeds resulting from Fttx and/or DOCSIS 3.0. Given that no research has been conducted to date in this area, it is important to launch some analysis in this area.

1. SCOPE OF THE RESEARCH:

In the first years of the Roosevelt Administration, two strategies were deployed to face the unemployment challenge, which had reached 24.9% as a result of the Great Depression. On one side, the Secretary of the Interior, Harold Ickes, who was put by President Roosevelt in charge of the Public Works Administration believed that economic rebounding could occur only as a result of large infrastructure works requiring extensive capital investments. It would be a policy built around this effort that would create the necessary bases to take the country out of the Depression. On the other hand, Harry Hopkins, who was in charge of FERA (Federal Emergency Relief Administration) considered that the priority remained to create jobs in order to put to work as many people as possible that were presently on relief. According to FERA's leader, the objective was job creation in projects in which the cost of materials was negligible. Both strategies were confronted when Congress authorized the Executive in 1935 (through the Emergency Relief Appropriations Act) to invest $ 5 billion in order to stimulate the economy (Leuchtenburg, 1963). To some degree, both visions remain valid today and although some economists argue that any stimulus would have to address both job creation and infrastructure deployment, sometimes choices need to be made between one and the other.

This debate is particularly relevant in the context of the discussion around the broadband stimulus program that has been voted in Congress. How should we assess an investment in broadband? Should it be considered as an infrastructure development project necessary to build a platform to foster economic growth?[1] Or should, alternatively be conceived as a job-creation policy with only a speculative belief in its future employment multipliers? Obviously, the answer could be both. But if that were to be the case, it would be useful to understand how many jobs could be created by the broadband stimulus program, both in the short run (as a result of digging trenches and erecting towers) and in the long run (as result of the potential innovation triggered by a broadband highway that reaches all corners of the nation). In doing so, it would also be pertinent to understand how robust the estimates are in terms of the validation of the research conducted so far on the impact of telecommunications (and information technology) on short-term and long-term employment creation. The objective of this research is to estimate the jobs that can be generated as a result of the grants to be disbursed by the broadband stimulus program. We have relied for purposes of this analysis on the broadband provisions of the conference report on the American Recovery and Reinvestment Act, published on February 13, 2009.

2. STATE OF KNOWLEDGE:

The study of the relationship between broadband and employment creation has produced few empirically driven pieces of research. Two types of studies have been conducted so far: a) aggregate cross-sectional research focused on identifying employment and/or

[1] The President Obama's continuous references to the need for the US to improve its current position in the world ranking of broadband penetration (currently 15th according to the OECD) underlines the assumption that broadband and growth go hand in hand.

output effects on national economies, and b) localized studies oriented to the assessment of broadband economic effects at the regional level. The aggregate studies comprise Crandall et al. (2003), Lehr et al. (2006), Crandall et al. (2007), Katz et al. (2008) and Atkinson et al. (2009). The localized studies include Strategic Networks Group (2003), Kelly (2003), and Ford and Koutsky (2005). Two methodologies are primarily used in these studies: input-output analysis and multivariate regression modeling (see figure 1).

Figure 1. Studies of the Employment Impact of Broadband

	National economies	Regional Economies
Input-Output analysis	• Crandall et al. (2003) • Katz et al. (2008) • Atkinson et al. (2009)	• Strategic Networks Group (2003)
Multivariate Regression Modeling	• Lehr et al (2006) • Crandall et al. (2007) • Thompson et al. (2008)	• Kelly (2003) • Ford and Koutsky (2005)

In 2003, Crandall, et al. conducted a study for the New Millennium Research Council relying on input-output analysis aimed at assessing the effect of full residential broadband adoption on investment, jobs and the economy at large. Based on the assumption of capital investments required to reach 95% of US households (from 60%), the authors estimated the number of jobs triggered in telecommunications manufacturing and the multiplier effect on household consumption resulting from the increased income. By relying on the multiplier effects calculated by the Bureau of Economic Analysis, the authors concluded that $63.6 billion of CAPEX would result in 61,000 jobs per annum. In addition, if investments were to be assigned to more advanced broadband platforms (VDSL, Fttx), the cumulative effect of current and new generation of broadband would result in an increase of 140,000 new jobs per year. By estimating the economic effect of increased consumer spending resulting from universal broadband adoption, the authors concluded that the total number of jobs could reach 1.2 million, broken down between 546,000 jobs triggered by network deployment and 665,000 generated in upstream industries.

In the same year, the Strategic Networks Group (2003) also used an input-output-model and a survey of South Dundas (Ontario, Canada) to estimate the impact of a local fiber optic network investment. The survey data revealed that the investment of 1.3 million CAD generated 62.5 new jobs, 2.8 million CAD in commercial and industrial expansion and 140,000 CAD in increased revenues and decreased costs. By relying on the survey data on the impact of fiber network as inputs for the input-output-table model, the authors could point out to an increase of GDP by 25.2mn CAD for Dundas County and 7.9mn CAD for the Province of Ontario. Furthermore, the authors found that the fiber network created 207 incremental person years of employment for Dundas County and 64 for Ontario and an increase of 3.5mn CAD in provincial and 4.5mn CAD in federal tax revenues.

Two years later, Ford and Koutsky (2005) used a seemingly unrelated regressions framework to estimate the effect of broadband on economic development for Lake County with broadband and other counties in Florida without broadband. They found that Lake County had a 100 percent greater growth in economic activity, although they did not address employment effects.

Also relying on standard regression analysis, a team of MIT and Carnegie Mellon researchers (Lehr, et al., 2006) conducted a study aimed at measuring the impact of broadband on economic activity. Focused less on forecasting impact, and more on assessing the economic effect of broadband, the researchers relied on multivariate regression analysis to estimate the impact on employment among several independent variables. Initially, the study tried to find causality between broadband and employment at the state-level but concluded that data at this level of aggregation did not permit observation of any measurable impact. It was only when they turned to zip code level that a positive impact of broadband on employment was found: the availability of residential broadband added over 1% to the employment growth rate in a typical community. Because of their approach, the researchers did not differentiate between job effects (network construction vs. utilization). However, they did prove the existence of a positive causality link with a time lag confirming that broadband availability does not immediately translate into adoption, utilization and economic impact but that it takes approximately two years to fully achieve an effect[2]. As a sideline in their research, the authors found that state-level regressions indicate that the positive impact of broadband on employment tends to diminish as penetration gets higher, alluding to the presence of a saturation effect.

Relying on the same methodology, Crandall et al. (2007) conducted a study focused on assessing the effects of broadband on output and employment for the 48 US states. The conclusion of their multivariate regression analysis was that "for every one percentage point increase in broadband penetration in a state, employment is projected to increase by 0.2 to 0.3 percent a year (…) (an increase of about 300,000 jobs, assuming the economy is not already at "full employment"". While in a recent statement, Crandall said that "there is a great deal of overstatement in most of these studies"[3] (Dixon, 2009), there are some conclusions that are particularly relevant for future research on the economic impact of broadband. First, consistent with Jorgeson's (2001) research on the "lag effect"

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[2] This is consistent with the ICT productivity impact research of Jorgensen et al. (2007)

[3] The Brookings Institution study, published in July 2007, is not particularly relevant now because of differing employment and related migration trends at the time of the study, Crandall said. Attempting to extrapolate it nationwide at this time is a "gross overstatement," he said. Most the data on jobs and broadband is not relevant because it does not apply to underserved, mostly rural and high cost areas targeted in the stimulus package, said Shane Greenstein, a professor at Northwestern University's Kellogg School of Management.

of ICT impact on productivity, the authors observed that the magnitude of impact of broadband on employment increases over time. Second, the study indicated that broadband tends to be more effective in stimulating employment growth in selected industrial sectors: education, health care, manufacturing and financial services.

Katz et al. (2008) studied the impact of the deployment of a national Ftth network in Switzerland at a cost of CHF 13 Billion. By relying on national input-output tables, the authors estimated that deployment of such a network could generate 114,000 jobs, broken down in 83,000 in direct jobs and 31,000 in indirect employment. The study did not estimate induced employment.

Thompson et al. (2008) employed a stochastic-frontier production function to measure the direct and indirect impact of broadband penetration on the GDP of the 48 states of the US. While they found that employment in certain sectors tends to grow with broadband penetration, they also pointed out to the potential existence of a substitution effect between capital and labor that is stimulated by broadband deployment.

Atkinson et al. (2009) relied on input-output tables from the US Bureau of Economic Analysis to assess the employment impact of a $10 Billion investment in broadband infrastructure. Their conclusion was that such an investment could create 64,000 direct jobs and 116,000 indirect and induced. In addition, the study estimated that the deployment of such an infrastructure could yield a "network effect" (innovation spill-over) of 268,500 jobs.

What can we conclude from the literature reviewed above? What is the level of certainty for each of those conclusions? In order to answer these questions, it is important to differentiate the two types of employment impact of broadband: 1) jobs created to deploy the infrastructure and 2) employment generated as a result of network externalities on other sectors of the economy. We will review the results of the research to date in these two areas in turn.

First, it is obvious that that network construction will result in some level of job creation, in terms of direct effects. The three national studies that attempted to estimate this amount are Crandall et al. (2003), Katz et al. (2009) and Atkinson et al. (2009). They all relied on input-output matrices[4] and assumed an amount for capital investment: $ 63 billion (needed to reach ubiquitous broadband service) for Crandall et al (2003), CHF 13 billion for Katz et al (to build a national open access fiber network for Switzerland), and $10 Billion for Atkinson et al. (2009) (as a US broadband stimulus).

All studies that have relied on input-output analysis have calculated multipliers, which measure the total employment change throughout the economy resulting from the deployment of a broadband network. Beyond network construction (direct employment

[4] From the Bureau of Economic Analysis for the US studies or the national statistics authorities of Switzerland for the Swiss study. In addition, the Strategic Networks Group (2003) also relied on input-output tables, although in this case they were the regional ones created by Canada's statistics agency, Statistics Canada.

effects), broadband construction has an employment effect at two additional levels. Following the sector interrelationships of input-output matrices, network deployment will result in indirect job creation (incremental employment generated by businesses selling to those that are directly involved in network construction) and induced job creation (additional employment induced by household spending based on the income earned from the direct and indirect effects).

The interrelationship of these three effects can be measured through multipliers, which measure total employment change throughout the economy from one unit change on the input side. 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). While multipliers from one area cannot be applied to another one, it is useful to observe the summary results of multipliers of the four input-output studies:

Figure 2. Employment Multiplier Effects of Studies relying on Input-Output Analysis

	Type I	Type II
Crandall et al. (2003)	N.A.	2.17
Strategic Analysis Group (2003)	2.03	3.42
Katz et al. (2008)	1.4	N.A.
Atkinson et al. (2009)	N.A.	3.60

Note: Crandall et al. (2003) and Atkinson et al. (2009) do not differentiate between indirect and induced effects, therefore we cannot calculate Type I multipliers; Katz el (2008) did not calculate Type II multiplier because induced effects were not estimated.

According to these studies, by generating one direct job in network construction, total employment in the study area could change between 2.03 and 1.4 jobs from direct and indirect linkages and between 2.17 and 3.60 jobs from direct, indirect and induced linkages. Since Type II multipliers subsume direct and indirect effects, the appropriate way of interpreting these numbers would be as follows:

Figure 3. Breakdown of Employment Multipliers of Studies relying on Input-Output Analysis

	Geography	Direct Effects	Indirect Effects	Induced Effects	Total
Crandall et al. (2003)	US	1.00	1.17		2.17
Strategic Analysis Group (2003)	Canadian county	1.00	1.03	1.4	3.42
Katz et al. (2008) (*)	Switzerland	1.00	0.38	N.A.	1.38
Atkinson et al. (2009) (**)	US	1.00	1.47	1.13	3.60

(*) This study calculates only direct and indirect effects; induced effects were not calculated
(**) We have recalculated Atkinson at al (2009) multipliers, by relying on Bivens (2003), which the authors cite as their source.

Although we cannot extrapolate multipliers from one economy to the other, their comparison can be useful in terms of their wide variance. According to the sector interrelationships depicted above, a European economy appears to have lower indirect effects than the US economy. Furthermore, the decomposition also indicates that a relatively important job creation effect occurs as a result of household spending based on the income earned from the direct and indirect effects.

While the input-output tables are a reliable tool for predicting investment impact, two words of caution need to be considered. First, input-output tables are static models reflecting the interrelationship between economic sectors at a certain point in time. Since those interactions may change, the matrices might lead us to overestimate or underestimate the impact of network construction. For example, if the electronic equipment industry is outsourcing jobs overseas at a fast pace, the employment impact of broadband deployment will diminish over time and part of the investment will leak overseas. Second, it is critical to break down employment effects at the three levels (direct, indirect and induced) estimated by the input-out table. All these effects have been quite codified and therefore, with the caveat of the static nature of input-output tables, we believe estimates are quite reliable.

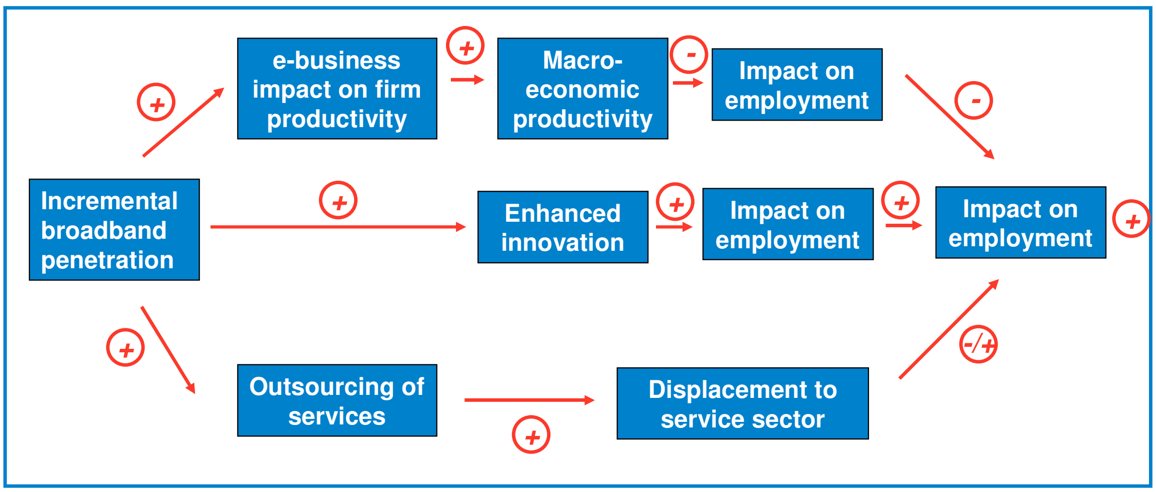
Beyond the employment and output impact of network deployment, researchers have been focusing on a set of network externalities variously categorized as "innovation", or "network effects" (Atkinson et al, 2009). In general, studies based on regression analysis do not differentiate between construction and spill-over effects. However, by examining the conclusions of the regression studies, we can identify some evidence regarding externalities that appears to be quite conclusive. First, broadband spill-over employment effects are not uniform, they tend to concentrate in service industries (e.g., financial services, health care, etc.), although Crandall et al. (2007) identified an effect in manufacturing as well. Second, two studies (Lehr et al, 2006, and Thompson et al., 2008) point to the productivity impact of broadband, which can result in a net **reduction** in employment resulting from capital-labor substitution.

Beyond, what can be inferred as "network effects" from the regression studies, two types of approaches have been utilized to isolate this impact: 1) top-down based on "network effect" multipliers, and 2) bottom-up estimates based on extrapolating findings of microeconomic analysis of impact of broadband on efficiency and effectiveness at the firm level.

Within the first group, key studies are Pocsiak (2002) and Atkinson et al. (2009). Both studies relied on an estimated "network effect" multiplier, which is applied to the network construction employment estimates. For example, Pocsiak relied on two multiplier estimates (an IT multiplier of 1.5 to 2.0 attributed to a think tank and another multiplier of 6.7, attributed to Microsoft) and calculated an average of 4.1. Similarly, Atkinson et al. (2009) derived a multiplier of 1.17 from Crandall et al. (2003). While the top-down approach allows to rapidly estimating a number, it does not have a strong theoretical support. Network effects are not built on interrelationships between sectors. They refer to the impact of the technology on productivity, employment and innovation by industrial sector.

On the other hand, we have found only one bottom-up study of network effects (Fornefeld et al., 2008). This study identified three types of impact of broadband on employment: first, the acceleration of innovation resulting from the introduction of new applications and services (with the consequent creation of employment); second, the improvement of productivity as a result of the adoption of more efficient business processes enabled by broadband; and third, the possibility of attracting employment from other regions as a result of the ability to process information and provide services remotely. These three effects act simultaneously, resulting in contradictory impact on employment (see figure 4):

Figure 4. Network effects of broadband on employment



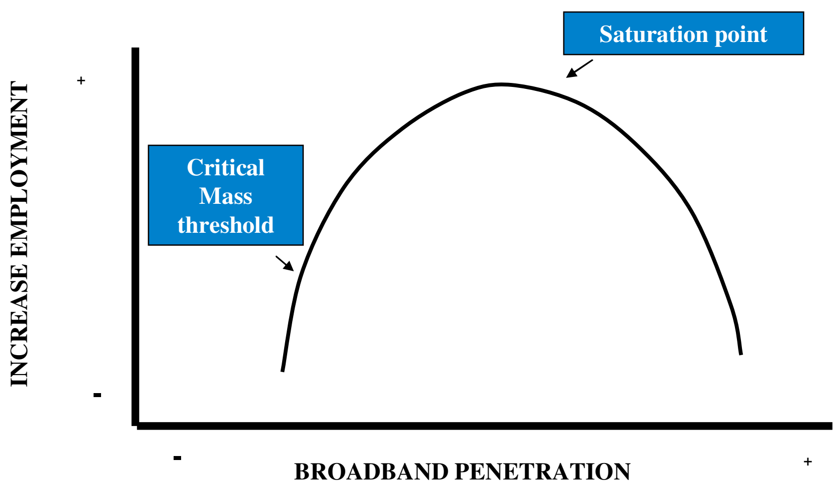
Note: This causality chain was adapted from a model originally developed by Micus in a report for the European Commission (see Fornefeld et al., 2008)

As the figure indicates, the increase in broadband penetration can have a positive impact on productivity, contributing as a consequence to a negative effect on employment. This effect was alluded to by Lehr et al. (2006) when they said that "broadband might facilitate capital-labor substitution, resulting in slower job growth", and is also alluded to by Thompson et al. (2008) as they mention that "there may be a substitution effect between broadband and employment."

However, this negative effect is compensated by the increase in the rate of innovation and services, thereby resulting in the creation of new jobs. Finally, the third effect may be comprised by two countervailing trends. On the one hand, a region that increases its broadband penetration can attract employment displaced from other regions by leveraging the ability to relocate functions remotely. On the other hand, by increasing broadband penetration, the same region can lose jobs by virtue of the outsourcing effect. While we are gaining a better understanding of these combined "network effects," the research is still at its initial stages of quantifying the combined impact. The study by Fornefeld et al. (2008) is probably the first that attempts to build a causality chain applying ratios derived from micro-economic research in an attempt to estimate the combined impact of all effects.

A critical element of the evolving theoretical framework of broadband network is the intensity of impact the technology might have on employment when considering relative infrastructure penetration levels. Is there a linear relationship between broadband adoption and job creation? Or are we in the presence of a more complex causality effect? Following the "critical mass" findings of research of the impact of telecommunications on the economy, it would be logical to assume that the impact of broadband on employment only becomes significant once the adoption of the platform achieves high penetration levels. At the other end of the diffusion process, at least according to what was found by Lehr et al. (2006), the relation between penetration and employment should not be linear "because broadband will be adopted within a state first by those who get the greatest benefit (while) late adopters within a state will realize a lesser benefit" (pp. 10). According to these points of view, it would appear that the strength of the relationship is highest once the technology has achieved a certain critical mass but before it reaches saturation. Unfortunately, the research has not yet identified the boundaries of this "window of opportunity" (see figure 5).

Figure 5. Impact of broadband on employment over diffusion process



The non-linearity (or inverted U shape) in the relationship between broadband penetration and employment creation appears to exist as indicated by economic theory. At the low end of broadband penetration, we believe impact of broadband on employment is minimal due to the "critical mass" concept. According to this theory, the impact of telecommunications infrastructure on the economic output is maximized once the infrastructure reaches a critical mass point, generally associated with levels of penetration of industrialized countries, leading to increasing returns on growth (see Roller and Waverman, 2001; Shiu and Lam, 2008). While Roller and Waverman, 2001 associate "critical mass" with near universal voice telephony penetration, experts have not yet measured what this would mean for broadband, and its impact on employment.

At the other end of the distribution, some authors have already pointed out to a potential "saturation" effect (Lehr et. al, 2006): beyond a certain penetration level (not specified), the effect of broadband on employment tends to lose strength. Atkinson at al. (2009) also point out that network externalities do decline with the build out of networks and maturing technology over time. There is considerable evidence that could support such an argument. First, as it has been demonstrated in diffusion theory: early technology adopters are generally those who can elicit the higher returns of a given innovation. Conversely, network externalities would tend to diminish over time because those effects would not be as strong for late adopters. Second, once a telecommunications infrastructure reaches a "critical mass point," the productivity gains will result in a reduction of employment due to capital-labor substitution (as pointed out in Fornefeld et al., 2008). Third, and linked to the prior point, achieving critical mass could accelerate labor displacement as a result of outsourcing trends.

How can we test the findings that have been reviewed above in light of the broadband stimulus program? How many jobs could be created as a result of network construction? How many as a result of other indirect and induced effects? How about network externalities? And finally, what are the policy implications of the results of the analysis?

3. APPROACH:

Our approach is based on applying two different methodologies for estimating job creation:

- **Jobs generated through deployment of additional broadband lines:** For this, we relied on input-output matrices for the estimation of jobs to be created through the flow of funds in the form of grants and loans for deploying additional lines, and
- **Jobs to be created through the network externalities once this infrastructure is deployed:** For this, we relied on chain ratio analysis built around broadband impact estimators derived from micro-economic studies

3.1. Jobs generated through deployment of additional broadband lines:

In order to utilize the input-output matrices, we needed to estimate first the amount of the total investment program. The objective is to estimate two types of employment effects:

- **Type I:** Impact on employment from direct or initial spending, plus indirect spending (incurred by businesses buying and selling to support of each other in support of direct spending); and
- **Type II** (also called induced): impact on employment from the household spending based on the income earned from the direct and indirect effects.

3.1.1. Sizing the amount of stimulus allocated to network deployment:

Our starting point is to determine the amount of money that will be flowing in the form of grants and loans for the deployment of broadband infrastructure. For that purpose, we have identified those items in the bill approved by Congress and determined the flow of funds that would be channeled to wireline or wireless technology. This was done because each technology has a different mix of inputs, which could impact employment. For this purpose, we have made the following assumptions:

- The grants to be channeled through the Department of Agriculture Rural Utility Services for the rural areas (primary focus) will be assigned to wireless broadband
- In the case of grants to be distributed by the National Telecommunications and Information Association ($ 4.7 billion), we assumed all funds will be invested in wireline broadband.

We recognize these assumptions to be somewhat simplistic. The NTIA portion of the bill is technology neutral, which means a portion of the funding will go to wireless, although this is difficult to estimate how much at this time. The RUS portion of the bill stipulates that at least 75% of the funding must go to rural areas; therefore, it could allocate some portion to wireline projects[5]**.** In addition, we excluded from our numbers all other funds which might not be directly related to employment generation, such as Broadband mapping ($350 million). The net result of this breakdown is that of the total $7.2 billion, $6.390 billion will be used as grants for broadband deployment, of which $3.890 billion will be assigned to wireline broadband and $2.5 billion to wireless[6].

Once those numbers were determined, we broke them down according to three cost categories (equipment manufacturing, construction, and telecommunications) in order to be able to enter them in the input-output tables. This was done with two matrices that were derived to estimate the input splits for wireline and wireless broadband. The first one (see figure 6) was built based on input provided by a telecommunications carrier in terms of the cost breakdown of an NGAN open access network.

Figure 6. Wireline broadband cost breakdown

Category	Access costs	Customer premise costs	Backbone costs	Total
Construction	54 %	11 %	2 %	67%
Telecommunications	20 %	1 %	0 %	21%
Electronic equipment	0 %	0 %	12 %	12 %
Total	74 %	12 %	13 %	100 %

Construction: 67%

Telecommunications: 21%

Equipment: 12%

Source: Telco carrier breakdown of NGAN open access network

[5] The privileged position that the rural LECs hold at the Department of Agriculture RUS, combined with the high default rate experienced by this agency in the past with regards to loans to rural wireless carriers (30%) could swing the RUS allocation to wireline. Furthermore, the original House Bill assigned 35% of NTIA's funds to wireless. Therefore, it is still difficult to predict what the final allocation will be.

[6] Given that the RUS funds can be assigned through grants, loans and loan guarantees, the funding could be larger than the one assumed in this study.

This breakdown directionally matches the cost split for a fiber line in the US (which do not include backbone upgrade costs) (see figure 7):

Figure 7. Cost structure of a fiber line

	Average	Verizon		ATT	
		Amount ($)	Percent	Amount ($)	Percent
Equipment	49%	200 (**)	31%	200 (*)	57%
Labor	56%	450	69%	150	43%
Total		650		350	

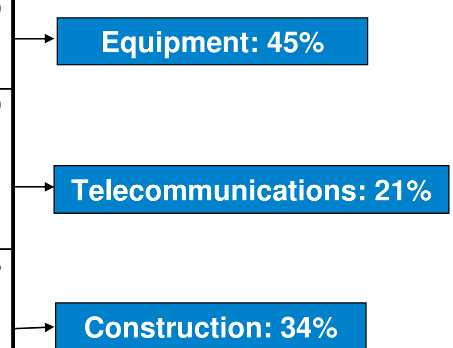
(*) Without DSL modem
(***) Without CPE

Source: Dave Burnstein

The second matrix enables us to split the wireless broadband funds (see figure 8).

Figure 8. Wireless broadband Cost Breakdown

Category	Item	Installation	Cost	Average	Total
Equipment	Telecom equipment		$50 K	$50,000	$91,500
	Ancillary	Greenfield	$50K	$41,500	
		Collocation	$40K		
Telecom	EF&I	Greenfield	$ 9K	$6,450	$41,450
		Existing	$ 6K		
	Tower	Greenfield	$80K	$29,000	
		Existing	$20K		
	RF Engineering		$ 6K		
Construction	Civil works	Greenfield	$65K	$54,375	$68,825
		Collocation	$52K		
	Architecture & engineering	Greenfield	$ 9K	$6,450	
		Existing	$ 6K		
	Site acquisition & zoning		$ 8K	$8,000	
Total					$201,775



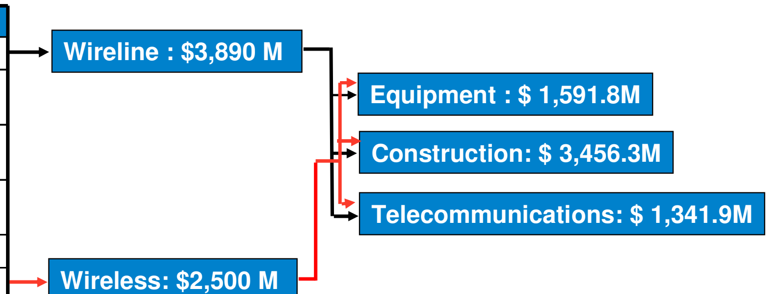
Note: 15% of installations are greenfield and 85% are based on existing infrastructure

Source: Spectrum management consulting

Based on these two matrices, we were able to break down the total amount of grants to be invested in broadband according to the stimulus bill (see figure 9):

Figure 9. Total Investment Amount by Category

Item	Amount
•NTIA unserved/underserved	$4,700.00
• Broadband adoption	$ 250.00
• Public computing centers	$ 200.00
• Broadband mapping	$ 350.00
• Oversight of grants	$ 10.00
•Rural Utility Services	$2,500.00
TOTAL	$7,200.00



At this point, we were ready to input these amounts in the input-output tables in order to estimate the employment effects of the network construction program.

3.1.2. Estimating employment effects:

The estimation of Type I effects is fairly straight forward. According to our analysis, the investment of $6.390 billion will generate 37,300 direct jobs during the course of the stimulus program (estimated to be four years). In addition, based on a Type I employment multiplier of 1.83, the bill could generate 31,000 indirect jobs. The split across sectors is presented in figure 10.

Figure 10. Type I employment effects of Broadband Stimulus Bill

	Sectors	Employment
Direct Employment	Electronic equipment	4,242
	Construction	26,218
	Communications	6,823
	Subtotal	37,283
Indirect Employment	Distribution	9,167
	Other market/non-market services	8,841
	Transportation	1,536
	Electronic engineering	959
	Metal products	1,839
	Other	8,704
	Subtotal	31,046
Total Type I Employment		68,329
Type I multiplier (Direct+Indirect)/direct		1.83

Once the Type I employment was calculated, we estimated the Type II effect. As mentioned above, the Type II refers to employment generated as a result of household spending derived from the Type I effect. To estimate this, we relied on the re-spending multipliers calculated by Bivens (2003) based on the BEA data. Because Bivens does not provide multipliers for all 28 BEA industry sectors, some of them were applied across more than one sector, yielding the following results (figure 11).

Figure 11. Type II employment effects of House Broadband Stimulus Bill

	Type I Jobs	Re-spending	Type II Jobs
Agriculture,forestry & fishing	460.9	0.5657	260.7
Extraction	328.8	0.8236	270.8
Food, beverages & tobacco	71.5	1.0320	73.7
Textiles, leather & clothing	118.3	1.0320	122.1
Wood & wood products	999.9	1.0320	1,031.9
Paper, printing & publishing	671.1	1.0320	692.6
Coke, petroleum & nuclear fuel	72.6	1.1646	84.5
Chemicals & man-made fibres	267.4	1.1646	311.5
Rubber & plastics	614.6	1.1646	715.8
Non-metallic minerals	1,044.5	1.1646	1,216.4
Basic metals	611.6	1.1646	712.3
Metal products n.e.c	1,838.8	1.2972	2,385.2
Mechanical engineering	415.5	1.2972	539.0
Computers & office equipment	17.4	1.2972	22.5
Elec. machinery&pparatus	4,436.8	1.2972	5,755.5
Electronic engineering	958.8	1.2972	1,243.8
Precision& optical instruments	76.4	1.2972	99.1
Motor vehicles & parts	124.2	0.7117	88.4
Other means of transport	25.1	0.7615	19.1
Other manufacturing	411.3	1.1646	479.0
Electricity, gas & water	172.2	2.1772	374.8
Construction	26,476.2	0.9108	24,114.5
Distribution	9,167.0	0.4635	4,248.9
Transport	1,536.2	0.7615	1,169.8
Communication	7,305.4	0.9935	7,258.0
Finance	1,266.0	0.9263	1,172.7
Other market services	6,662.5	0.5698	3,796.3
Non-market services	2,178.1	0.5698	1,241.1
Total	**68,328.9**		**59,499.9**

The Type II multiplier (direct + indirect + induced jobs/direct jobs) is 3.42. The combination of direct (37,300), indirect (31,000) and induced jobs (59,500) yields a total employment impact of the stimulus plan of 127,800 jobs over a four year period. The average annual employment generation effect is 31,950 jobs per year.

At this point, a cautionary note on induced effects is warranted. Under unemployment conditions, a portion of household consumption will already have been spent driven by unemployment insurance. Furthermore, the anticipation of an increase in taxes might reduce household consumption. While it is difficult to anticipate how these effects might play out, it is important to raise the point that induced employment might not be as high as the multiplier estimates.

3.1.3. Broadband versus "roads and bridges":

In order to test the results, we have estimated the jobs to be generated if we were to allocate the broadband stimulus to the construction of "roads and bridges".
Our estimates would indicate that if we were to invest $6.390 billion only in construction of "roads and bridges" (assumed "construction" to be the primary input in this type of

infrastructure), the direct, indirect and induced jobs to be created would be 152,000 (split between 48,500 direct, 33,900 indirect, and 69,600 induced) compared to 127,800 (split between 37,200, 31,000 indirect and 59,600 induced) under the broadband program. Part of this variance is explained by the construction intensity of a "roads and bridges" program. In addition, part of the difference is also explained in terms of the industrial output of both programs (see figure 12).

Figure 12. Comparative industrial output of Broadband versus "Roads and Bridges"

	Broadband Stimulus	Roads and Bridges
Investment (in million)	$ 6,390	$ 6,390
Total additional production	$ 11,681	$ 11,776
• Domestic	$ 11,104	$ 11,319
o Additional value added	$ 5,813	$ 5,933
o Intermediate inputs	$ 5,291	$ 5,386
• Imported	$ 577	$ 457

As the figures indicate, the proportion of investment "leaked" overseas in terms of imported goods is larger in the broadband stimulus than under "roads and bridges." We believe, in fact, that the proportion of "leaked revenue" might be understated in our estimates given that since 2002 (year when the input-output matrix was developed), overseas outsourcing of telecommunications equipment manufacturing has accelerated.

3.2. Jobs generated through network externalities:

The estimation of employment derived from network externalities is less robust than the projections of jobs generated through network construction. As reviewed above, the research in this domain is just beginning to be generated and has not achieved a comparable level of reliability. We believe, nevertheless, that the following results would help us set the upside and downside range.

The calculation of network effects can be done top-down and bottom-up. As described above, the top-down approach consists in applying a "network effect" multiplier to the employment number generated through deployment of broadband (Pocsiak, 2002; Atkinson et al, 2009). Given methodological and theoretical concerns raised in the review of the research literature, we decided to discard the top-down approach and rely on bottom-up estimates.

Our starting point was to define the economic universe within which the stimulus program is going to be applied. Since the ultimate result will depend on the application and award process, we estimated an a priori universe. The Bill determines that the target funding will be concentrated on "unserved and underserved" areas. An underserved area is defined as a low income community designed under section 45 D which is designated as a population census tract located in either: 1) a poverty rate of at least 20 %, or 2) median family income which does not exceed 80% of the greater metropolitan area median family income or statewide median family income.

For the purposes of our analysis, we selected those states in the US where the percent of residential premises which have access to at least one broadband supplier (that is to say telco or cable, primarily) (FCC Table 14 of HSPD1207) is 93% or less[7]. While we understand this to be an arbitrary number, this approach has the advantage of considering only those areas that are facing an infrastructure access problem, as opposed to an adoption problem. As the FCC Table 14 indicates, in a large portion of the US territory, most residences have access to at least one broadband platform (cable or DSL). Therefore, broadband subscription in those cases is less driven by access to the technology than to socio-economic factors such as level of education, affordability, etc.

The states considered for our network effects analysis are included in figure 13.

Figure 13. States identified for "unserved and underserved" targeting

State	Percent of Residential unserved <93%	Number of Lines	Households	Household Penetration	Population	Population Penetration
Alabama	92%	808,291	2,137,018	38 %	4,627,851	17 %
Arkansas	75%	532,171	1,287,429	41 %	2,.834,797	19 %
Georgia	92%	2,296,983	3,961,474	58 %	9,544,750	24 %
Indiana	92%	1,206,274	2,778,394	43 %	6,345,289	19 %
Iowa	90%	581,263	1,329,596	44 %	2,988,046	19 %
Kansas	91%	680,270	1,219,439	56 %	2,775,997	25 %
Kentucky	91%	843,641	1,906,096	44 %	4,241,474	20 %
Maine	93%	288,491	696,611	41 %	1,317,207	22 %
Mississippi	91%	384,772	1,254,908	31 %	2,918,785	13 %
Montana	88%	185,251	435,533	43 %	957,861	19 %
Nebraska	93%	406,674	780,804	52 %	1,774,571	23 %
New Mexico	82%	343,568	862,067	40 %	1,969,915	17 %
North Dakota	88%	137,207	310,548	44 %	639,715	21 %
Oklahoma	91%	815,765	1,623,010	50 %	3,617,316	23 %
Pennsylvania	93%	2,852,177	5,477,864	52 %	12,432,792	23 %
South Carolina	92%	844,013	2,021,947	42 %	4,407,709	19 %
South Dakota	80%	160,821	357,240	45 %	796,214	20 %
West Virginia	84%	297,852	882,685	34 %	1,812,035	16 %
TOTAL		13,665,484	29,322,663	47 %	66,002,324	21 %

Source: FCC table 14 of HSPD1207; US Census Bureau

As it can be seen, these eighteen states lag the national average broadband penetration significantly: while broadband has been adopted by 47% of households (or 21% of the population), the US national average is 60% (or 25% of the population). The assumption

[7] Table 14 actually overestimates the accessibility percent by approximately 4% because the FCC statistics comprise broadband coverage among those residences passed by operators. Since 4-5% of US homes are not passed by cable, they are not included. SNL Kagan mentions that 96% of US residences can get cable TV, of which 3-4% cannot get broadband. On the other hand, since nearly every household is reached by telephone lines, the DSL figures are more precise.

utilized to estimate the employment network effects of the stimulus program is that the program will deploy enough lines to allow these eighteen states to reach the national average, meaning that 3,928,000 subscribers should be added to the existing base. Given that the gap between households served by at least one broadband technology (average 89%) and broadband penetration (47%) is 42%. Therefore, if the ratio households served/adopted (1.90) is constant, in order to increase the subscriber base by 3,928,000, the capacity to serve 7,463,200 additional households needs to be deployed. This is well within the bounds of the total grants of the program. Thus, the evolution of broadband penetration was assumed to evolve as follows (see figure 14).

Figure 14. Broadband Penetration in Eighteen targeted states (2007-2012)

Year	Households	Broadband lines	Penetration
2007	29,322,663	13,665,484	47 %
2008	29,648,145	14,348,758	48 %
2009	29,977,239	15,640,146	52 %
2010	30,309,986	16,891,358	56 %
2011	30,646,427	18,073,753	59 %
2012	30,986,603	19,158,178	62 %

Although the penetration numbers assumed above refer to residential premises, we have followed Fornefeld et al. (2008) who have calculated a linear coefficient between broadband penetration and a composite indicator that measures infrastructure development and accumulation of intangible capital enabling adoption of services relying on broadband.

In order to estimate, network employment effects, we also compiled relevant economic indicators for the States under consideration (see figure 15).

Figure 15. Economic Profile of the Eighteen States under Consideration

	Data	Source
Employment, all economic sectors (10/08)	30,123,300	US Census Bureau
Employment, service sector (10/08)	24,791,300	US Census Bureau
Employment, information and business (10/08)	3,860,100	US Census Bureau
Labor productivity, all economy average	$ 75,291	Bureau of Economic Analysis
Labor productivity, business services sector	$ 144,298	Bureau of Economic Analysis
GDP (current dollars) (millions) (2007)	$ 2,574	Department of Commerce

As reviewed above, the estimation of network effects needs to be done stepwise by discriminating jobs that will be gained, versus those that could be lost. Network effect driven job gains in the targeted regions result from three combined trends: innovation leading to the creation of new services, attraction of jobs (from either other US regions or overseas), and productivity enhancement.

3.2.1. Jobs gained as a result of innovation effect:

The study of network externalities resulting from broadband penetration has led to the identification of numerous effects:

- New and innovative applications and services, such as telemedicine, Internet search, e-commerce, online education and social networking (Atkinson et al., 2009)
- New forms of commerce and financial intermediation (Atkinson et al., 2009)
- Mass customization of products (Atkinson et al., 2009)
- Marketing of excess inventories and optimization of supply chains (Atkinson et al., 2009)
- Business revenue growth (Varian et al. (2002); Lehr et al (2005))
- Growth in service industries (Crandall et al. (2007)

Unfortunately, most studies have failed so far to build a statistically reliable "innovation" or growth effect. Our approach follows Fornefeld, 2008 and calculates the impact of innovation on the professional services sector, by applying the ratio of productivity gains to the creation of new employment[8], and applying this effect to the economy of the targeted states as a whole. As a result, the following effect was estimated (see figure 16):

[8] Innovation is assumed to occur in the sectors and functions where productivity improvement takes place.

Figure 16. Jobs gained due to the innovation effect resulting from increased broadband penetration

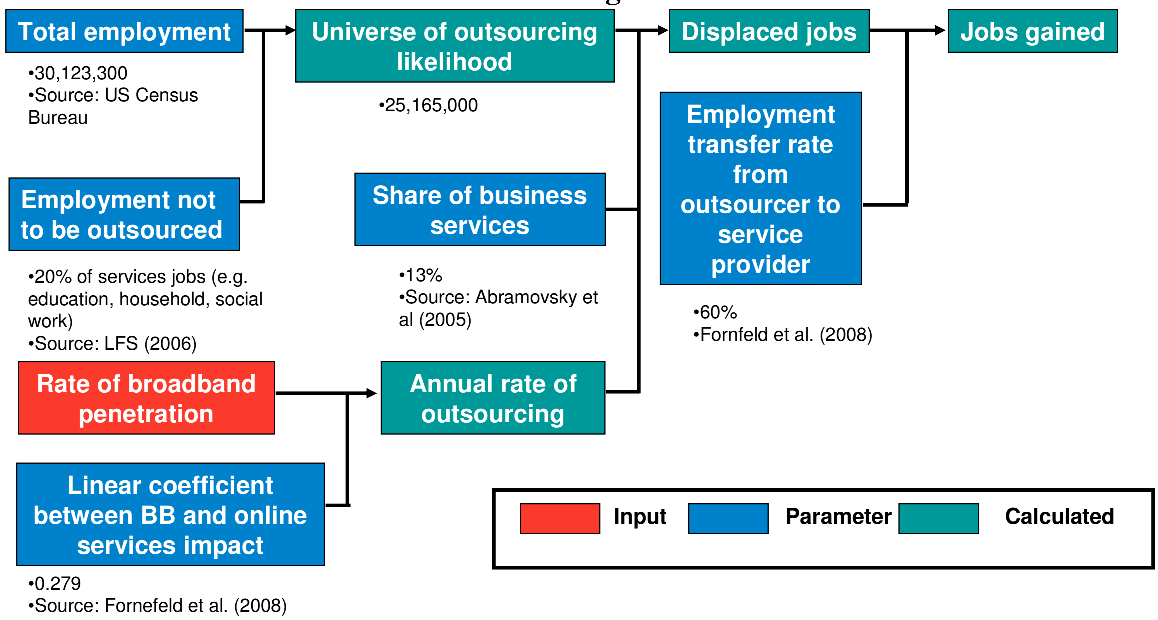
	2008	2009	2010	2011	2012	Total
Total Employment	30,123,300					
Employment likely to be affected by outsourcing trend	25,165,000					
Growth Rate in BB penetration		9%	8%	7%	6%	
Jobs gained by creation of new business services		55,000	47,000	40,000	33,000	175,000
Jobs gained as a result of new economic activity		64,000	55,000	46,000	38,000	203,000
Total jobs gained		119,000	102,000	86,000	71,000	378,000

However, the degree of certainty on these projections is low. The underlying assumption is that the economy can generate enough jobs through innovation in a rate comparable to productivity gains. In fact, while it is reasonable to assume that innovativeness in process efficiency and revenue growth can be linked, it is difficult to quantify that relationship and ensure successful execution of required business adoption.

3.2.2. Jobs gained and lost through outsourcing enabled by increasing broadband penetration:

The impact of broadband on outsourcing operates in the two directions: broadband can facilitate the attraction of new jobs and it can enable the relocation of others in regions other than the one being targeted. Those two effects have been captured by Fornfeld et al. (2008) as follows (see figure 17):

Figure 17. Methodology used to calculate jobs gained and lost due to the outsourcing effect



Source: adapted from Fornfeld et al. (2008)

Assuming the same rate of broadband penetration, we can estimate the gains and losses due to enhanced outsourcing (see figure 18).

Figure 18. Jobs gained and lost due to accelerated outsourcing resulting from increased broadband penetration

	2008	2009	2010	2011	2012	Total
Total Employment	30,123,300					
Employment likely to be affected by outsourcing trend	25,165,000					
Growth Rate in BB penetration		9%	8%	7%	6%	
Jobs gained		49,000	44,000	38,000	33,000	164,000
Jobs lost		82,000	73,000	64,000	55,000	274,000
Net		(33,000)	(29,000)	(26,000)	(22,000)	(110,000)

We consider, however, that the model might overestimate lost jobs due to the economic disadvantage of the targeted eighteen states. The position of these states in a ranking of salary differentials and cost of living indicates that they tend to be in the bottom quartile of the distribution, which would lessen the impact of a negative outsourcing trend. However, it is important to consider the impact that broadband might have in the potential displacement of jobs. Furthermore, given the fact that broadband might enable the possibility of gaining jobs in the targeted area, pro-active employment relocation policies could increase the rate of employment generation.

As a result of the uncertainty regarding how many jobs will be gained or lost, we believe that it is prudent to build two additional scenarios (an optimistic and a mid-course one) to be considered with the one derived above, which we consider to be pessimistic (see figure 19).

Figure 19. Alternative scenarios regarding outsourcing impact

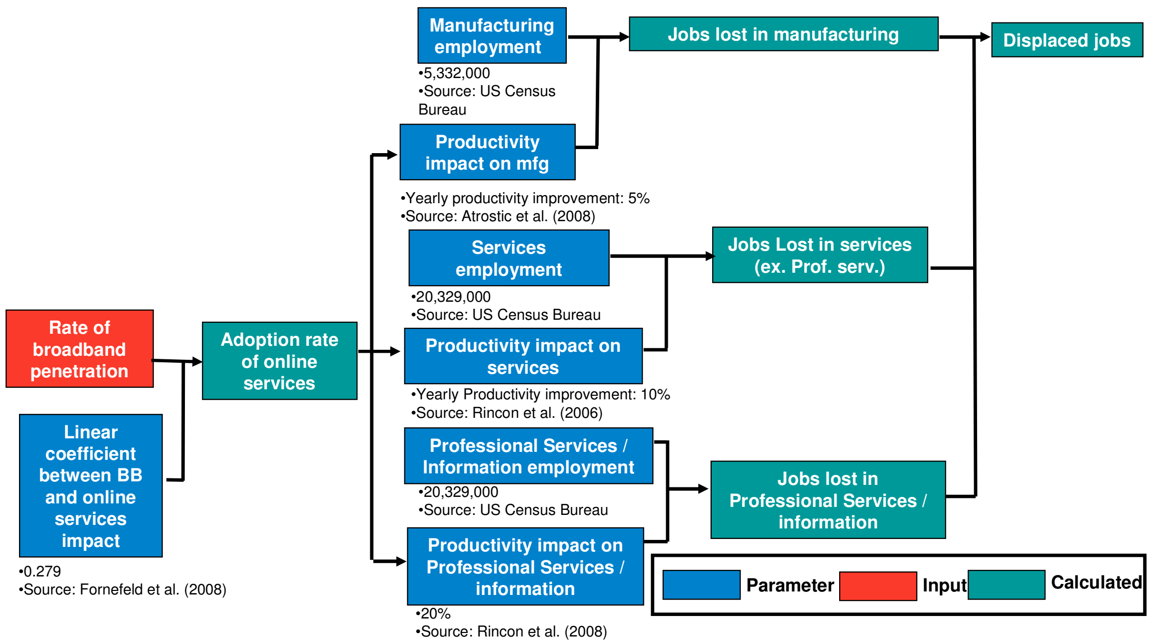
	2009	2010	2011	2012	Total
Pessimistic Scenario	(33,000)	(29,000)	(26,000)	(22,000)	(110,000)
Mid-course scenario	8,000	7,500	6,000	5,500	27,000
Optimistic scenario	49,000	44,000	38,000	33,000	164,000

The optimistic scenario assumes that the eighteen states' comparative advantage regarding factor costing, combined with labor retention policies, are sufficient to cancel out the trend toward job displacement. The mid-course scenario represents the mid-point between the pessimistic and optimistic. A side point worth mentioning here is that, unless the broadband program can help locate functions that are currently off-shored to the US, it could represent jobs lost to other areas of the national territory. In other words, if a call center located in Long Island, NY is relocated to a rural section of Iowa that was previously unserved by broadband, it does not represent a net national increase in jobs, and, therefore, should not be counted.

3.2.3. Jobs lost through increasing productivity driven by broadband penetration:

As mentioned above, increased adoption of broadband, as an enabler of more efficient business processes, has an impact on productivity. To calculate the productivity impact, we applied a methodology derived by Fornfeld et al. (2008), which is based on empirical firm-level study of sectoral productivity improvements resulting from adopting online services (Atrostic et al., 2006; Rincon et al., 2006). By differentiating the productivity impact in manufacturing (5%), professional and information services (20%), and the rest of the service sector (10%) and applying these ratios to sectoral employment, we derived the jobs that could be lost as a result of broadband diffusion (see figure 20).

Figure 20. Methodology used to calculate jobs lost due to productivity impact



Source: adapted from Fornfeld et al. (2008)

Assuming the same rate of broadband penetration in the targeted areas resulting from the stimulus program, we were able to calculate the jobs lost due to the increased adoption of more efficient processes enabled by broadband (see figure 21).

Figure 21. Jobs lost due to productivity improvement resulting from increased broadband penetration

	2008	2009	2010	2011	2012	Total
Manufacturing and Services Employment	25,661,000					
Professional and Information Services	3,860,000					
Growth Rate in BB penetration		9%	8%	7%	6%	
Broadband penetration	48%	52%	56%	59%	62%	
Jobs Lost in Professional and Information Services		19,000	17,000	15,000	13,000	64,000
Jobs Lost in other Sectors		61,000	54,000	47,000	40,000	202,000
Total Jobs Lost		80,000	71,000	62,000	53,000	266,000

As figure 21 indicates, the productivity effect resulting from increased broadband penetration could result in 266,000 jobs lost over four years.

3.2.4. Final results on network effects:

By adding all the different effects, we can build a bottom-up estimate of jobs created as a result of network effects (see figure 22).

Figure 22. Jobs gained and lost as a result of network effects

		2009	2010	2011	2012	Total
Productivity Effect	Jobs Lost in professional and information services	(19,000)	(17,000)	(15,000)	(13,000)	(64,000)
	Jobs lost in other sectors	(61,000)	(54,000)	(47,000)	(40,000)	(202,000)
	Subtotal	(80,000)	(71,000)	(62,000)	(53,000)	(266,000)
Outsourcing Effect	Pessimistic scenario	(33,000)	(29,000)	(26,000)	(22,000)	(110,000)
	Mid-course scenario	8,000	7,500	6,000	5,500	27,000
	Optimistic scenario	49,000	44,000	38,000	33,000	164,000
Innovation Effect	New business services	55,000	47,000	40,000	33,000	175,000
	New economic activity	64,000	55,000	46,000	38,000	203,000
	Subtotal	118,000	101,000	86,000	70,000	375,000
Total	Pessimistic scenario	5,000	1,000	(2,000)	(5,000)	(1,000)
	Mid-course scenario	46,000	37,500	30,000	22,500	136,000
	Optimistic scenario	87,000	74,000	62,000	50,000	273,000

According to these estimates, the network effects could result in a range between 68,250 average jobs per year (optimistic scenario) and -250 jobs lost (pessimistic scenario).

As a reference point for the model, two separate methodologies were applied to create alternative employment estimates. The ratio derived by Crandall et al. (2007) linking increase of broadband penetration and employment growth was applied only to the information and business services sector. Assuming an increase in broadband penetration from 47% to 60%, that would result in 3.25% increase in employment in information and business services of 125,000 for the targeted regions over four years (or 31,250 jobs per year).

The multiplier factor utilized by Atkinson et al. (2009) to estimate network effects (1.17) to the jobs created through network construction. The "network effect" calculated according to this methodology yields 129,000 jobs (or 32,300 per year).

Both estimates (125,000 jobs according to Crandall et al, 129,000 jobs according to Atkinson at el.) are considerably close to our mid-point estimates of network effects (136,000 jobs) giving some support to that projection.

4. ANALYSIS OF RESULTS:

The compilation of all employment effects calculated through the analysis reviewed above results in the following numbers:

Figure 23. Total Employment Impact of the Broadband Stimulus Plan

	2009	2010	2011	2012	Total
Direct effects	9,325	9,325	9,325	9,325	37,300
Indirect effects	7,750	7,750	7,750	7,750	31,000
Induced effects	14,875	14,875	14,875	14,875	59,500
Network effects (optimistic)	87,000	74,000	62,000	50,000	273,000
Network effects (mid-estimate)	46,000	37,500	30,000	22,500	136,000
Network effects(pessimistic)	5,000	1,000	(2,000)	(5,000)	(1,000)
Total (optimistic)	118,950	105,950	93,950	81,950	400,800
Total (mid-estimate)	77,950	69,450	61,950	54,450	263,800
Total (pessimistic)	36,950	32,950	29,950	26,950	126,800

Furthermore, these estimates allow us to compare our multipliers with those generated by prior research.

Figure 24. Comparison of Employment Multipliers

	This study	Crandall et al. (2003)	Atkinson et al. (2009)
Direct effects	1.00	1.00	1.00
Indirect effects	0.83		1.47 (*)
Type I	1.83		2.47 (*).
Induced effects	1.59		1.13 (*).
Type II	3.42	2.17	3.60
Network effects	0.07-7.28		1.17

(*) Estimated based on Bivens (2003)

These estimates allow us to draw the following conclusions for the network construction job creation:

- The deployment of broadband accesses resulting from the stimulus program has moderate direct employment effects (37,300 jobs over a four year period).
- Indirect and induced multipliers are important, generating a total of 127,800 jobs over four years.
- In the aggregate, our estimate of Type II multipliers is close to Atkinson et al. (2009), although our calculation of indirect effects (impact in other sectors of the economy based on interrelationships) is more conservative. On the other hand, our estimates of induced effects (derived from household spending) are more optimistic. This is because our estimation of induced effects is based on sector-specific multipliers rather than aggregate.
- The difference between Atkinson et al. (2009) and us in the number of total network construction jobs (229,475 versus 127,800) is due to the difference in the absolute size of the stimulus initially assumed ($10 billion versus $6.4 billion).
- Therefore, we believe the estimates for jobs created as a result of network construction are quite robust.

Let us move now to a more difficult area: the estimation of network externalities. Obviously, a key feature of our study is the wide range of network effects:

- Our estimates of network effects have been ranged from close to nil to much more optimistic than Atkinson et al. (2009).
- As a result, the broadband stimulus could either lead to no externalities at all or the creation of up to 273,000 jobs in four years. This number exceeds Atkinson et al. (2009) estimates for a $10 billion program (268,480 jobs).

However, by including the potential success in attracting jobs as a result of outsourcing, we have introduced a high level of uncertainty in the final projection. Since increased broadband penetration has an impact on productivity and outsourcing (which can result in job destruction), unless the innovation and in-sourcing programs are effective in promoting growth and job creation, any network effects can be significantly eroded. As a result, in order to be successful, the broadband stimulus program needs to be coordinated with other employment generation initiatives. We will expand on this in the next section.

5. CONCLUSIONS AND POLICY IMPLICATIONS:

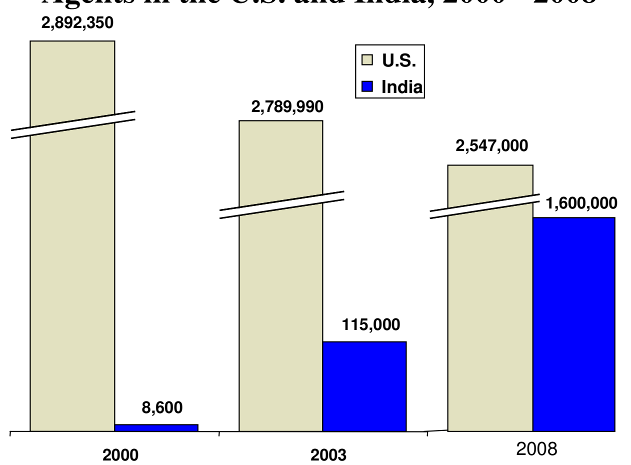
This study is not intended to provide a comprehensive evaluation of the broadband stimulus program, as employment creation is just one of the many dimensions for evaluating the benefits of the program. Considering broadband access as a public good requires a more holistic evaluation on the impact of the quality of life. From a national perspective, bringing broadband to the unserved and underserved areas is a policy of a huge social import.

However, if, going back to Harry Hopkins in 1935, the evaluation criteria is to create jobs, spending indiscriminately in broadband access might not be the more efficient way. Having said that, broadband can ultimately help creating jobs as a result of network effects but only a set of additional policies are put in place:

1. Coordinate broadband deployment with job creation and retention programs: Network effects resulting from the broadband stimulus program can be sizable. However, their fulfillment is driven by success in implementing job creation and retention programs in parallel with network deployment. As an example, State and Local Governments in the targeted areas need to work with private sector companies in using this new infrastructure for employment generation. Also governments need to work with businesses to discourage job relocation as a result of broadband deployment.

In addition, it is critical to deploy initiatives aimed at the creation of jobs enabled by broadband technology. As an example, governments should stimulate the development of rural virtual call centers as a way to bring jobs that were outsourced overseas (see figure 25).

Figure 25. Number of Customer Service, Technical Support and Telemarketing Agents in the U.S. and India, 2000 - 2008



Source: U.S. Department of Labor, India's NASSCOM,

Virtual call centers rely on rural population linked to a centrally located supervisor. They have become increasingly popular in the US due to the quality of the labor pool and economics close to matching call centers overseas.

2. Rethink criteria for selecting areas to develop broadband: Consider deployment not only on unserved and underserved areas but also in regions where the possibility of developing regional growth, in coordination with broadband deployment, could act as a magnet to stimulate relocation, firm creation, and, consequently, jobs. While it is possible that such areas have already been targeted by private operators, it is reasonable to consider that opportunities for regional core development could be found. The experience of Germany, Sweden and the Netherlands could be very instructive in this regard.

3. Centralize program evaluation and grant allocation: As a corollary to the first recommendation, given that the ability to generate jobs as a result of network externalities is dependent on the regions being targeted, it would be advisable to centralize the process of allocating funds for network deployment and rely on a common framework for evaluating requests focused on economic growth and job creation. Having designated two points for funding disbursement (NTIA and RUS) raises the potential for lack of coordinated evaluation and oversight, and therefore, lowers economic impact. The creation of some coordination mechanism might be advisable in this regard.

In this context, it is critical to enhance the government's ability to monitor spending and results, especially if the stimulus program is largely mandated like an earmark as opposed to some other methods that have more controls.

4. Develop a systematic test based on social and economic criteria to evaluate the return of the investment: All submissions for grants/loans should be backed up with analysis of the social and economic returns supported by a common set of tools and benchmarks.

5. Evaluate the economic impact of NGAN: This study has not quantified the effect of faster access speeds resulting from Fttx and/or DOCSIS 3.0. Given that no research has been conducted to date in this area, it is important to launch some analysis in this area.

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METHODOLOGY

The input-output matrix needed to be formatted to calculate the employment multipliers.

We relied on three original matrices and data sources:

- Bureau of Economic Analysis: Make table from 2002_IOMakeUse_summary.xls; Use table from 2002_IOMakeUse_summary.xls; Import Matrix from the 2002 Benchmark Input-Output Accounts
- Bureau of Labor Statistics: Employment by Industry ("Employment and Earnings Online," January 2008 issue)
- Oxford Economics: Sector share of employed persons by sector in the USA

The I/O-table was built based on the BEA make- and use-tables using a methodology from Chamberlain Economics LLC. To obtain an I/O-table that can be used to calculate multipliers that reflect domestic production it is necessary to exclude imports from the make-table. The resulting I/O-table from BEA data has the dimension of 133*133 industries. Due to the fact that the employment data used for further calculations is in a NACE code with 28 industries the I/O-matrix is transformed to a 28*28 industries matrix

Once the table was reformatted, we calculated the multipliers. From the above derived I/O-table it is possible to obtain multipliers for total industry supply and additional variables as value added and employment. The calculation of the multipliers for the total industry supply uses the direct requirement table which is also called Leontief-Inverse. The direct requirement table (DR) is calculated by the following formula:

$$DR = (I - A)^{-1}$$

with A = I/O-table / total industry supply (division of each cell of intermediate domestic supply by total industry supply)

I = Identity matrix

The sum of the columns per industry does now reflect the increase of the total industry supply by one additional unit of demand in this specific sector. A correction for the share of imports on total industry supply results in the total domestic production of the industries. The multiplying of the share of value added of total domestic industry production results in the value added multiplier. Using labor productivities it is possible to calculate the job effects now.