Infrastructure alternatives for 2005: employment and occupations

More investment in the Nation's infrastructure would result in new jobs in construction-related industries; however, even under optimistic assumptions about future growth, the impact on total employment is not large

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The Bureau of Labor Statistics recently published its biennial projections of the U.S. economy.[1] In a variation of the BLS moderate-case scenario that focuses on infrastructure spending for 2005, this article projects that an additional $41 billion in infrastructure investment would generate 833,000 new jobs. Most of these jobs would be in construction and related industries, as demand shifted into occupations with a close connection to working on the Nation's infrastructure.

As in the past, the BLS projections contain three alternatives covering the most plausible range of gross domestic product and its demand components, along with the expected change in employment by industry and occupation. Within this range of gross domestic product and employment are other paths the economy might follow if different events affect the distribution of demand. By varying the moderate scenario for 2005 to reflect other possible outcomes for selected demand categories, special assumptions can be derived and studied. In what follows, we analyze two such modifications of the moderate scenario, each focused on infrastructure spending.[2]

As will be shown, even under optimistic assumptions about future growth, the impact of infrastructure spending on employment is not great in total. However, this spending does affect certain industries, such as construction, very heavily. Note that the article focuses on infrastructure spending per se and does not examininc the productivity increases this type of investment might have on other parts of the economy.

Two alternative spending paths are laid out around the moderate-growth projections: a low-investment version, reflecting a fixed infrastructure share of gross domestic product over the projection period,[3] and a high-investment scenario, reflecting an increasing share of gross domestic product allocated to infrastructure replacement and improvement. Each of these alternatives provides some answers to questions regarding the potential impact of that alternative on employment and presents a range of both direct and indirect employment related to infrastructure spending. Certain assumptions were made to establish bounds between which infrastructure expenditures might fall. This study does not attempt to choose which is the best or correct level of infrastructure spending, but quantifies some of the alternative levels that have been suggested by researchers knowledgeable in the area.[4]

The study concentrates on five categories of infrastructure spending: highway construction, local transit construction, railroad and airport construction, water and sewage construction, and the operation of existing water and sanitation facilities.[5]

Modifications from the moderate projections are developed to measure the impact of infrastructure investment on the level and distribution of

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employment by industry and by occupation. Two methodological approaches were taken. One assumes that any increase or decrease in infrastructure spending is offset by other categories of gross domestic product, resulting in no change in the total projected gross domestic product for 2005. The second approach allows total gross domestic product to vary with the changes in infrastructure spending. This approach serves to highlight the industries and occupations that are sensitive to infrastructure spending. Assuming a constant gross domestic product, on the other hand, reflects the idea that the projected level of gross domestic product is the most likely to be attained, and, as a consequence, should a higher or lower level of one demand category take place, compared with its level in the moderate scenario, alternative offsets in other demand categories are more than likely to take place.

Background

Much discussion has occurred over the past few years about the state of the infrastructure in the United States, the lack of infrastructure investment during the 1980's, and the need to examine carefully the links between infrastructure spending and productivity. Deteriorating bridges, highways, and sewer systems, environmental regulations, shifts in population, and budget constraints frame the issues surrounding the U.S. infrastructure. Exacerbating these trends, over the past three decades infrastructure spending as a percent of gross domestic product has alternated between steadily declining and remaining constant. The National Council on Public Works Improvement has stated that "The quality of America's infrastructure is barely adequate to fulfill current requirements and is insufficient to meet demands of future economic growth and development."[6]

The current state of the U.S. infrastructure stock, coupled with projections of future demand, has been explored by other analysts. For example, a study conducted by the Office of Technology Assessment recommends a broad increase of 20 percent in total national infrastructure spending,[7] and another carried out by the National Council on Public Works Improvement goes even further, urging an increase of up to 100 percent.[8] In a similar vein, the American Association of State Highway and Transportation Officials estimates that total spending on highways should be 70 percent higher to keep pace with future travel growth.[9] The U.S. Department of Commerce estimates that infrastructure use by industries alone will increase at least 30 percent over the next 10 years.[10] And, according to the Environmental Protection Agency (EPA), local governments, which currently spend approximately 87 percent of all government outlays on water supply and resources and water and solid waste facilities, are expected to require a 65-percent increase in funding by the year 2000 to comply with the Clean Water Act and other EPA regulations.[11]

In the BLS models, employment is distributed both to industries that make direct expenditures on the infrastructure, thus comprising direct employment, and to industries that supply inputs that are consumed by infrastructure industries, making up indirect employment. The construction industry carries out most of the direct infrastructure spending, and in turn, the largest portion of infrastruc-

Table 1. **Infrastructure spending, 1990 and projected to 2005**

Category	1990	2005			Difference from moderate scenario	
		Low	Moderate	High	Low	High
Total (millions of 1987 dollars)	$ 75,141	$ 99,077	$ 107,944	$ 148,882	–8,867	40,938
New water supply and sewer facilities	17,468	23,805	24,608	35,708	–803	11,100
New roads	28,767	39,166	39,307	58,782	–141	19,475
New local transit facilities	1,731	2,327	3,292	3,524	–965	232
New nonbuilding facilities, n.e.c.	9,694	9,974	11,033	14,961	–1,059	3,928
Water and sanitation, including combined services	17,481	23,805	29,704	35,907	–5,899	6,203
Percent	100.0	100.0	100.0	100.0	100.0	100.0
New water supply and sewer facilities	23.2	24.0	22.8	23.9	9.1	27.1
New roads	38.3	39.5	36.4	39.5	1.6	47.5
New local transit facilities	2.3	2.3	3.0	2.4	10.9	.6
New nonbuilding facilities, n.e.c.	12.9	10.0	10.2	10.0	11.9	9.6
Water and sanitation, including combined services	23.3	24.0	27.5	24.1	66.5	15.2

NOTE: n.e.c. = not elsewhere classified.
SOURCE: Historical data, Bureau of Economic Analysis; projected data, Bureau of Labor Statistics.

Table 2. **Employment related to spending on infrastructure, 1990[1]**

[In thousands]

Industry	Total	Direct	Indirect
All industries	1,709.8	735.4	974.4
Agriculture, forestry, fisheries	9.8	.0	9.8
Mining	23.1	.0	23.1
Construction	680.1	635.9	44.2
Manufacturing	217.7	.0	217.7
Transportation	101.2	.0	101.2
Communications	9.2	.0	9.2
Public Utilities	111.0	99.5	11.5
Trade	119.7	.0	119.7
Finance, insurance, and real estate	32.2	.0	32.2
Services	299.2	.0	299.2
Government	106.5	.0	106.5

[1]Includes wage and salary workers, the self-employed, and unpaid family workers.

ture employment requirements fall into this industry. Manufacturing and service industries, which provide the materials and support necessary to construct the bridges, highways, and airports of the Nation, account for the majority of indirect infrastructure employment.

Assumptions

Using 1990 as a starting point, we developed a plausible range of assumptions regarding the portion of gross domestic product allocated to infrastructure spending, to produce high and low alternatives for the year 2005. The distribution of infrastructure spending among the various designated categories was obtained by reviewing government and private studies on recommended infrastructure spending priorities. For the high-investment case, it was assumed that infrastructure's share of gross domestic product would increase by 50 percent over the 1990 level; for the low-investment case, it was assumed that the share would remain at the 1990 level. (See table 1.)

Highway construction is an area that has received much interest because of the relatively low growth in spending that has been prevalent since the interstate highway system was completed. Demand for truck transportation has been affected by today's "just in time" inventory policy, which depends on an efficient road system, as do the smaller, but specialized, high-technology firms that are important for employment growth. The category "new nonbuilding facilities, n.e.c." includes railroad and airport construction. Spending on railroad construction may increase if high-speed train usage replaces a portion of the growth in automobile usage in intercity passenger travel. Furthermore, the same two factors of "just in time" inventory management and high technology that influence truck transportation may be reflected in some changes in railroad demand. More airport construction can also be expected as the economy resumes a projected growth path closer to full employment and as population and income grow. Construction of new local transit facilities is expected to increase as government incentives to conserve energy and lower pollution continue to be offered. Finally, environmental pressures will necessitate more spending on the construction and operation of waste treatment facilities and clean water projects.

Table 2 presents the direct and indirect employment related to spending on infrastructure in 1990. From 1977 to 1990, the portion of gross domestic product spent on the selected infrastructure sectors declined, a trend BLS expects will be reversed in its 1992–2005 projections. However, investment spending as a share of real gross domestic product is still expected to be lower than in 1977. (See table 3.)

In the moderate-growth projections to 2005,

Table 3. **Infrastructure shares of gross domestic product, selected years, 1960–90, and projected to 2005**

[Percent of gross domestic product in 1987 dollars]

	1960	1970	1977	1987	1990	2005[1]
Total	2.45	1.98	1.67	1.56	1.54	1.62
New water supply and sewer facilities	.41	.37	.35	.37	.36	.37
New roads	1.16	.96	.56	.59	.59	.59
New local transit facilites	.02	.05	.04	.03	.04	.05
New nonbuilding facilities, n.e.c.	.59	.37	.38	.21	.20	.17
Water and sanitation, including combined services	.26	.24	.35	.37	.36	.45

[1]Percentages based on values published in Ronald E. Kutscher, "Historical trends, 1950–92, and current uncertainties," p. 6, and Norman C. Saunders, "The U.S. economy: framework for BLS projections," p. 12, *Monthly Labor Review*, November 1993.

NOTE: n.e.c. = not elsewhere classified.

SOURCE: Historical data, Bureau of Economic Analysis; projected data, Bureau of Labor Statistics.

Table 4. **Employment related to infrastructure spending, 1990 and projected to 2005, with gross domestic product level in 2005 varying as infrastructure spending varies**

[Thousands of jobs]

Industry and occupation	1990	2005			Difference from moderate scenario	
		Low	Moderate	High	Low	High
Industry						
Total, all industries	1,709	2,012	2,190	3,024	−178	833
Agriculture, forestry, fisheries	10	10	11	15	−1	4
Mining	23	22	23	33	−1	10
Construction	680	845	886	1,268	−41	382
New roads	317	414	415	621	−1	206
New water supply and sewer facilities	193	252	260	377	−8	117
New nonbuilding facilities, n.e.c.	107	105	117	158	−12	42
Maintenance and repair construction	44	49	59	75	−10	15
Manufacturing	218	176	190	265	−14	75
Cement, concrete, gypsum, and plaster products	34	26	28	40	−1	12
Transportation services	101	117	135	176	−18	41
Trucking and warehousing	85	101	117	151	−16	34
Communications	9	7	8	10	−1	2
Public utilities	111	141	175	213	−34	38
Water and sanitation, including combined services	100	132	164	199	−32	35
Wholesale and retail trade	120	140	153	210	−13	57
Finance, insurance, and real estate	32	36	39	54	−3	15
Services	299	398	422	598	−24	175
Engineering and architectural services	157	193	200	290	−7	90
Government	107	120	148	182	−28	34
State and local government enterprises, n.e.c.	96	111	138	168	−27	30
Occupation						
Total, all occupations	1,709	2,012	2,190	3,024	−178	833
Executive, administrative, and managerial	199	250	271	376	−21	105
General managers and top executives	49	51	55	76	−4	21
All other managers and administrators	25	38	41	57	−3	16
Construction managers	19	27	29	41	−2	12
Professional specialty	147	197	214	296	−17	82
Technicians and related support	63	78	85	118	−6	33
Drafters	26	28	30	43	−1	13
Marketing and sales	108	132	142	198	−11	56
All other sales and related workers	40	45	49	68	−4	19
Marketing and sales worker supervisors	24	29	31	44	−2	13
Administrative support occupations, including clerical	247	261	290	393	−29	102
Secretaries, except legal and medical	43	41	45	62	−4	17
General office clerks	38	45	50	68	−5	18
Bookkeeping, accounting, and auditing clerks	36	36	39	54	−3	15
Service occupations	105	139	156	209	−17	54
Agriculture, forestry, fishing, and related occupations	43	44	47	66	−3	19
Precision production, craft, and repair	456	541	583	813	−42	230
Carpenters	62	74	78	112	−4	34
Blue-collar worker supervisors	51	59	65	89	−6	24
Electricians	36	45	47	67	−2	20
Plumbers, pipefitters, and steamfitters	27	29	31	43	−2	13
Painters and paperhangers, construction and maintenance	21	27	29	41	−2	12
Operators, fabricators, and laborers	341	369	403	554	−33	152
Truckdrivers, light and heavy	77	93	104	140	−11	36
Helpers, construction trades	51	58	61	87	−3	26
All other helpers, laborers, and material movers, hand	47	55	60	83	−5	23

NOTE: n.e.c. = not elsewhere classified.
SOURCE: Historical and projected data, Bureau of Labor Statistics.

Table 5. **Employment related to infrastructure spending, 1990 and projected to 2005, with gross domestic product level in 2005 remaining constant as infrastructure spending varies**

[Thousands of jobs]

Industry and occupation	1990	2005			Difference from moderate scenario	
		Low	Moderate	High	Low	High
Industry						
Total, all industries	122,028	147,492	147,482	147,449	10	–33
Agriculture, forestry, fisheries	3,276	3,326	3,325	3,323	1	–2
Mining	734	574	575	581	–1	6
Nonmetallic minerals, except fuels	111	108	108	113	0	5
Construction	6,617	7,450	7,483	7,826	–33	343
New roads	317	414	415	621	–1	206
New water supply and sewer facilities	193	252	260	377	–8	117
New nonbuilding facilities, n.e.c.	107	105	117	158	–12	42
New educational buildings	179	314	312	304	2	–8
Manufacturing	19,525	18,024	17,999	17,896	25	–103
Cement, concrete, gypsum, and plaster products	227	176	177	189	–1	12
Fabricated structural metal products	440	347	347	353	0	6
Metalworking machinery	337	341	339	330	2	–9
Computer equipment	395	239	237	230	2	–7
Miscellaneous electric components	345	303	302	297	1	–5
Transportation services	3,816	4,654	4,667	4,685	–13	18
Trucking and warehousing	1,815	2,242	2,256	2,278	–14	22
Communications	1,319	1,135	1,135	1,133	0	–2
Public utilities	965	1,051	1,084	1,117	–33	33
Water and sanitation, including combined services	187	270	303	337	–33	34
Wholesale and retail trade	27,730	32,533	32,523	32,478	10	–45
Retail trade, except eating and drinking places	14,426	15,947	15,945	15,934	2	–11
Wholesale trade	6,519	7,617	7,610	7,577	7	–33
Finance, insurance, and real estate	7,361	8,782	8,781	8,778	1	–3
Services	32,381	47,887	47,890	47,963	–3	73
Engineering and architectural services	874	1,104	1,109	1,194	–5	85
Personnel supply services	1,575	2,646	2,644	2,634	2	–10
Government	18,304	22,076	22,021	21,669	55	–352
State and local government enterprises, n.e.c.	625	769	795	823	–26	28
State and local government hospitals	1,072	1,259	1,250	1,209	9	–41
State government education	1,730	2,318	2,301	2,226	17	–75
Local government education	6,042	8,069	8,012	7,750	57	–262
Occupation						
Total, all occupations	122,028	147,492	147,482	147,449	10	–33
Executive, administrative and, managerial	12,252	15,191	15,195	15,221	–4	26
Construction managers	202	264	265	276	–1	11
Education administrators	340	434	432	423	2	–9
Professional specialty	16,284	22,838	22,801	22,634	37	–167
Other teachers and instructors	791	1,085	1,082	1,069	3	–14
All other teachers and instructors	513	734	731	717	3	–14
Teachers, special education	347	628	625	608	3	–17
College and university faculty	788	1,032	1,026	998	6	–28
Teachers, elementary	1,414	1,776	1,767	1,722	10	–45
Teachers, secondary school	1,226	1,735	1,724	1,678	11	–46
Technicians and related support	4,203	5,664	5,664	5,667	0	3
Drafters	329	349	350	360	–1	10
Marketing and sales	13,257	15,665	15,665	15,669	0	4
Administrative support occupations, including clerical	22,454	25,410	25,406	25,357	4	–49
Service occupations	18,859	25,821	25,820	25,792	1	–28
Janitors and cleaners	2,846	3,413	3,410	3,395	3	–15
Agriculture, forestry, fishing, and related occupations	3,531	3,649	3,650	3,658	–1	8
Precision production, craft, and repair	14,273	15,358	15,380	15,521	–22	141
Carpenters	1,050	1,173	1,176	1,205	–3	29
Blue-collar worker supervisors	1,835	1,971	1,974	1,986	–3	12
Electricians	564	617	618	635	–1	17
Plumbers, pipefitters, and steamfitters	383	377	378	389	–1	11
Painters and paperhangers, construction and maintenance	463	568	569	578	–1	9
Operators, fabricators, and laborers	16,914	17,896	17,902	17,930	–6	28
Helpers, construction trades	514	528	530	554	–2	24
Truckdrivers, light and heavy	2,448	3,031	3,039	3,060	–8	21
All other helpers, laborers, and material movers, hand	1,669	2,042	2,044	2,055	–2	11
Busdrivers, school	380	506	504	493	2	–11

Note: n. e. c. = not elsewhere classified.
Source: Historical and projected data, Bureau of Labor Statistics.

most of the categories of infrastructure investment maintain a real share of gross domestic product that is very close to the share they accounted for in 1990. The one exception is water and sanitation services, for which a significant increase in investment spending has been anticipated over the coming decade and a half. The category is projected to jump from a 0.36-percent share of gross domestic product (a 23.3-percent share of all infrastructure investment) in 1990 to a 0.45-percent share of gross domestic product (a 27.5-percent share of all infrastructure investment) in 2005. In both the low- and the high-investment scenarios, this growth in water and sanitation services is projected to slow and be partially replaced by higher expenditure shares for new water supply and sewer facilities.

After establishing infrastructure category totals, we used BLS data to distribute each category to the direct inputs necessary for production. We used BLS input-output tables to determine the industry outputs required to satisfy the direct and indirect demand. For example, construction depends heavily on the paint, paving and asphalt, stone and clay, iron and steel, and engineering, architectural, and surveying industries as primary inputs. In addition, water and sanitation services rely on the maintenance and repair construction, scientific and controlling instruments, and petroleum industries. After we determined output by industry for each scenario, we derived the employment by industry.

Results

The level of spending on infrastructure outlined above results in 178 thousand fewer employees in the low-infrastructure scenario and 833 thousand more employees in the high-infrastructure alternative, compared with the level of employees in the moderate-growth scenario for 2005. (See table 4.) In the high-infrastructure scenario, for example, construction employment is up 382 thousand, followed by services, up 175 thousand, and manufacturing, higher by 75 thousand. Changes at the industry level affect mostly small industries, such as asphalt, cement, concrete, and gypsum production.

Table 4 also shows each industry's occupational requirements in the three scenarios. As expected, occupational categories required by the construction industry, such as precision production, craft, and repair and operators, fabricators, and laborers, highlight the list. Within these two major categories are occupations such as carpenters, electricians, plumbers, painters, truckdrivers, and helpers. Broadly represented in all industries, administrative support occupations also respond to the changes assumed in the investment alternatives. The executive, administrative, and managerial category, as well as the technicians and related support category, encompasses construction managers, drafters, architects, surveyors, civil engineers, and landscapers, all of whom are employed for construction purposes.

GDP offsets

A different perspective is attained by offsetting the alternative infrastructure spending scenarios in 2005 with other areas of demand gross domestic product. Because spending is not carried out in a vacuum, it is plausible to assume that an increase in one type of spending will be offset by a decrease in another type. Projections of gross domestic product developed for 2005 have been adjusted to reflect the low- and high-infrastructure scenarios by keeping total gross domestic product for that year unchanged. This has been accomplished by assuming that changes in infrastructure spending are matched by offsets in producers' durable equipment spending and in State and local government purchases. The outcome is a picture of employment reflecting a heavier emphasis on infrastructure spending. (See table 5.)

Such an analysis shows almost no variation in the level of employment between the alternatives at the total stage, but does in the sector distributions. For example, because education represents a large part of State and local government spending, it shows the largest offset. Also, manufacturing in total, and especially the large industries of investment spending—in particular, computers and metalworking machinery—show the impact of the offset. In the occupational analysis, the expected results: occupations demanded by the education and manufacturing industries are those most affected by the offset in infrastructure spending changes. □

Footnotes

[1] See *Monthly Labor Review*, November 1993.

[2] Although BLS depends on a model to project economic variables for 2005, the analysis we present does not use that model to drive the various infrastructure spending levels. This is because the areas targeted for more outlays are fairly detailed—well beyond the detail in the macroeconomic model used by BLS.

[3] While the projection articles in the November 1993 issue of the *Monthly Labor Review* cover the period from 1992 to 2005, the analysis we present examines the period 1990–2005 because actual data for 1991 and 1992, which would have allowed us to use either of those years as the initial year for our projections, were unavailable to us.

[4] See, for example, David Alan Aschauer, "Infrastructure:

America's Third Deficit," *Challenge*, March–April 1991, pp. 39–45; Andrew C. Lemer, "We Cannot Afford Not to Have a National Infrastructure Policy," *APA Journal*, Summer 1992, pp. 362–67; Kevin McDermott, "Reinvesting the Infrastructure," *D & B Reports*, September–October 1992, pp. 20–23; William M. Miller, "The American Infrastructure," *Industry Week*, May 21, 1990, pp. 80–90; John Prendergast, "Rehabbing the U.S.," *Civil Engineering*, September 1991, pp. 66–69; Suneel Ratan, "Repairing Our Infrastructure," *Fortune*, October 19, 1992, pp. 91–93; and Joan Szabo, "Our Crumbling Infrastructure," *Nation's Business*, August 1989, pp. 16–24.

[5] In acknowledging the limitations of the study, it is important to note that long-run changes in employment are generated by supply-side forces. To generate an alternative, changes in demand were made at the industry level. Employment would then change only as spending effects were felt in industries with differing productivities. Because total employment would remain virtually unchanged, the study is consistent with the fact that supply shocks drive long-run employment, whereas demand shocks affect only the distribution of employment.

[6] *Fragile Foundations: A Report on America's Public Works* (National Council on Public Works Improvement, February 1988), p. 1.

[7] *Delivering the Goods: Public Works Technology, Management, and Financing*, OTA-SET-477 (U.S. Congress, Office of Technology Assessment, April 1991), p. 17.

[8] *Fragile Foundations*, p. 2.

[9] Cited in Szabo, "Our Crumbling Infrastructure," p. 22.

[10] *Fragile Foundations*, p. 56.

[11] *Delivering the Goods*, pp. 170–71.

Devising a "new gender" politics

Many of the most powerful and vocal internationals within the labor movement are now unions with large female constituencies . . . it has been these unions that have provided national leadership on a wide range of women's concerns, from pay equity to parental leave, devising what sociologist Ruth Milkman has called a new "gender politics." They have also pioneered more democratic, participatory approaches to organizing and representation—approaches that appear to be more in line with "female styles" of leadership and conflict resolution. Their sensitivity toward and surprisingly successful advocacy of women's issues have gone a long way toward undermining the longstanding feminist critique of unions as bastions of male power and privilege.

—Dorothy Sue Cobble

Women and Unions: Forging a Partnership (Ithaca, NY, ILR Press, 1993), p. 10.