

ECONOMIC IMPLICATIONS OF FUTURE YEARS DEFENSE PURCHASES AN ILLUSTRATION OF *DEPPS*

Douglas S. Meade, Inforum and Ron Lile, Department of Defense, OSD PA&E*

1. Introduction

Despite the downsizing of the Defense Department that started in the late 1980s, defense spending still comprises 3.2 percent of GDP, and this share may be expected to grow, according to the recently released fiscal year 2003 defense budget. Both inside and outside the Pentagon, defense policy analysts, businessmen and economists are interested in the economic implications of these defense purchases. Since the distribution of spending among industries and states is by no means uniform, and since many of the economic effects are indirect, an analytical tool is needed to determine these spending implications. Also of interest is the effect of defense spending on the demand for skilled and professional labor.

The Defense Employment and Purchases Projections System (*DEPPS*) was designed to help analysts understand how industries, states and occupational groups are affected by changes in the defense budget. *DEPPS* consists of three major components: an interindustry model, a state model and an occupational model. The interindustry model (*IDEPPS*) consists of the Inforum detailed interindustry model *Iliad*, joined with the defense translator, a matrix that translates outlays on detailed defense budget programs to the industries that directly supply these programs. The state model (*RDEPPS*) distributes defense spending by industry to the state level, based on state shares derived from historical data. The occupational model (*LDEPPS*) translates defense related employment by industry to the occupational level.

The *DEPPS* projections are made for calendar year outlay estimates derived from the Future Year Defense Purchases (FYDP), as published in *National Defense Budget Estimates*. The projections are also informed by recent historical industry and state spending patterns derived from various published and unpublished sources.

In this paper, we'll take a tour through the highlights of the *DEPPS* projections. The sample tables in this paper are from the fiscal year 2001 projections. (There were

no projections in 2002, as there was no FYDP released, and the 2003 projections are now in progress.) We'll discuss each of the main parts of *DEPPS* in turn, and then conclude with some general observations. Along the way, we'll try to provide some insight into the calculations that lie behind the projections.

2. *IDEPPS*, The Interindustry Component of *DEPPS*

The purpose of *IDEPPS* is to determine defense-related production needed to supply the bill of goods and services specified in the FYDP. Defense-related production includes both direct purchases by DoD, such as an Abrams tank or a Commanche helicopter. It also includes indirect purchases, such as the semiconductors used to make the electronic systems in tanks, helicopters, ships and aircraft. Using this information, one can easily see if the planned defense budget contributes to growth or decline in a given industry. One can also see the projected share of total output comprised of defense-related production.

The *IDEPPS* projections can be summarized as follows:

- They are produced at a level of 320 industries, the same used for the detailed Inforum model of the U.S. economy.
- They are made in constant (inflation-adjusted) dollars, by calendar year, for the interval defined by the FYDP.
- They reflect planned expenditures or outlays, not appropriations or budget authority.
- They reflect DoD expenditures for military programs only.
- They exclude expenditures for pay.

For each of the 320 industries that supply directly or indirectly to defense, several tables of information can be compiled from the projections. We'll look at three sample tables for the Electronic components industry.

* Douglas S. Meade, Inforum, c/o Department of Economics, University of Maryland, College Park, MD 20742, (301) 405-4607. Ron Lile, Office of the Secretary of Defense, Program Analysis & Evaluation, 1800 Defense Pentagon, Washington, DC 20301-1800, (703) 614-3840.

Table 1. Projected Defense Purchases of Electronic Components, 2000-2005
(In Millions of 2001 dollars)

	2000	2001	2002	2003	2004	2005
<i>Summary of Defense Purchases</i>						
Direct	1,837	1,883	1,884	1,940	1,944	1,949
Indirect	1,653	1,676	1,705	1,760	1,795	1,809
Total	3,489	3,559	3,589	3,700	3,740	3,758

Indirect Defense Purchases by Purchasing Sector

Missiles	54	57	60	64	62	62
Ammunition	32	33	35	36	36	36
Tanks and Tank Components	0	0	0	0	0	0
Other Ordnance	1	1	1	1	1	1
Communications Equipment	638	652	665	689	706	707
Other Electronic Equipment	269	273	272	276	277	276
Motor Vehicles	3	3	4	4	4	4
Aircraft and Parts	86	90	94	102	108	110
Aircraft Engines and Parts	7	7	7	7	7	7
Shipbuilding	4	4	4	5	5	5
All Other	558	555	563	577	588	599
Total	1,653	1,676	1,705	1,760	1,795	1,809

Table 2. Sources of Projected Direct Plus Indirect Defense Purchases of Electronic Components, 2000-2005
(In Millions of 2001 dollars)

	2000	2001	2002	2003	2004	2005	00-05
Military Personnel	6	6	6	6	6	7	4.14
Operations & Maintenance + Revolving Funds	1,354	1,367	1,344	1,360	1,367	1,368	0.21
Procurement	1,489	1,547	1,614	1,727	1,774	1,801	3.80
Aircraft	278	291	309	332	345	359	5.08
Missiles	381	379	409	418	419	411	1.54
Weapons and Tracked Vehicles	3	2	2	3	3	3	1.61
Ships and Conversions	21	17	17	19	17	13	-9.17
Ammunition	1	1	1	1	1	1	1.92
Other	805	856	875	953	988	1,014	4.60
RDT&E	579	581	572	559	545	530	-1.76
Military Construction	46	44	39	34	33	36	-4.67
Family Housing	15	14	14	14	14	14	-0.45
Total	3,489	3,559	3,589	3,700	3,740	3,758	1.48

Table 3. Projected Domestic Production, Defense Purchases, and Imports for Defense Production of Electronic Components, 2000-2005
(In Millions of 2001 dollars, except as noted)

	2000	2001	2002	2003	2004	2005	00-05
Total U.S. Domestic Production	39,384	42,039	44,201	46,673	49,289	52,160	5.62
Plus Imports	6,158	6,467	6,670	6,930	7,212	7,554	4.09
Less Exports	15,354	16,776	18,111	19,518	21,011	22,550	7.69
= Domestic Use	30,188	31,730	32,760	34,085	35,490	37,163	4.16
Import Share of Domestic Use (percent)	20.4	20.4	20.4	20.3	20.3	20.3	-0.07
Defense Purchases	3,489	3,559	3,589	3,700	3,740	3,758	1.48
Less Imports	337	341	347	358	365	368	1.75
Domestic Defense Purchases	3,152	3,218	3,242	3,342	3,375	3,390	1.46
Domestic Defense Purchases as a Share of Domestic Production (percent)	8.0	7.7	7.3	7.2	6.8	6.5	-4.16

In each of these tables, projections are shown for each year of the FYDP. In several tables, the last column shows the average annual growth rate.

Table 1 shows how total defense-related purchases are divided between direct and indirect purchases. For the indirect purchases, it also indicates from which major direct purchasing sector they are derived. For example, Table 1 indicates that in 2000, an estimated 638 million *indirect* expenditures for Electronic components was needed to supply the *direct* expenditure of Communications equipment to DoD. Also note that Electronic components is an industry for which a large share of defense purchases are indirect. In 2001, DoD was estimated to spend about \$1,883 million directly, and \$1,676 indirectly.

Table 2 shows the origins of defense-related demand for Electronic components from the major headings of the DoD budget. This table can help to understand how the demand for an industry will shift as purchases are reallocated from one major budget category to another. From this table we can see that operations and maintenance, procurement and RDT&E (Research, Development, Test and Evaluation) comprise almost all of the defense-related demand for this industry. Within the procurement budget, the largest sources of demand are aircraft, missiles and other procurement.

Table 3 is useful for comparing trends in defense and nondefense purchases. Shown in the first block of items in the table are projections made by Inforum of economy-wide domestic production, net imports (imports less exports) and domestic use. (Domestic use is the sum of domestic production and net imports). Also shown is the projected share of domestic use supplied by imports.

The middle part of the table presents projections (for comparison to the estimates of total domestic production) of defense purchases from domestic suppliers. “*Domestic* defense purchases” are defined as *total* defense purchases less *imports* for defense production. In the example used, total projected defense purchases of electronic components amount to about \$3,559 million, with \$341 million supplied by imports. Defense purchases from domestic producers were therefore calculated to total about \$3,218 million in 2001.

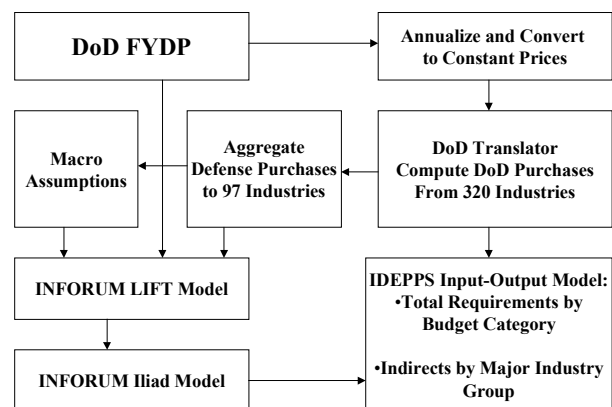
Shown at the bottom of the table are estimates of the share of total domestic production accounted for by defense purchases. Again using electronic components as an example, defense purchases are projected to account for about 7.7 percent of the industry’s output in 2001 and for 6.5 percent in 2005.

How the IDEPPS Projections are Made

Figure 1 summarizes how the *IDEPPS* projections are computed. The Future Years Defense Plan or FYDP is the starting point. This is essentially the defense part of the published federal budget, except the nonmilitary functions. Projected outlays by major program in constant prices are made available on a fiscal year basis in the publication *National Defense Budget Estimates*.

The next step in *IDEPPS* starts with the constant price outlays and converts these to implied direct purchases from each of 320 industries, using what is called the “defense translator”. The translator is a matrix that embodies information on many detailed defense programs. Any particular program may purchase inputs from a dozen or more industries. Table 4 illustrates how the translator for one of the budget accounts listed earlier--Aircraft procurement--would allocate outlays, in the year 2001, among various industries. Note that, in this example, about 77 percent of the outlays go to the three aircraft-related industries.

Figure 1. IDEPPS Projection Flow



The translators for the major accounts allow the computation, from the budget data described above, of direct defense purchases from each of the 320 industries in the system. These projections are computed in constant dollars for the upcoming budget year.

The *IDEPPS* projections of total defense purchases are made using the 320-sector interindustry Inforum model. This model is used to calculate the indirect requirements of the expenditures indicated by the translator, as well as determine what proportion of total requirements in each industry is satisfied by imports.

The interindustry model is used several times in *IDEPPS*, for the direct DoD purchases associated with:

- the DoD budget as a whole;
- each of the major aggregate DoD budget accounts; and

Table 4. Estimated Distribution Among Industries of Outlays from the Aircraft Procurement Account, 2001

	2001 Value	Share (%)
22 Ammunition, except small arms	1491.6	8.3
220 Communication equipment	279.2	1.5
235 Aircraft	7332.8	40.6
236 Aircraft and missile engines	706.0	3.9
237 Aircraft and missile parts	5804.5	32.1
238 Ship building and repairing	439.1	2.4
246 Search and navigation equipment	633.9	3.5
290 Research laboratories and management consulting	288.5	1.6
295 Engineering and architectural services	759.9	4.2
296 Other professional services, including accounting	341.9	1.9
Total	18077.6	100.0

Table 5. New Mexico Summary

	2000	2001	2002	2003	2004	2005	00-05
AGGREGATE MEASURES							
Total Direct Expenditures (Purchases and Pay)	2,431	2,394	2,368	2,365	2,375	2,391	-0.33
Indirect Defense Purchases Resulting from Direct Purchases	1,013	975	996	1,013	1,034	1,062	0.95
Indirect Defense Purchases Resulting from Pay	603	592	585	584	586	592	-0.37
Total Nondefense Expenditures	87,090	89,819	91,204	93,416	95,977	98,626	2.49
Total Output	91,138	93,780	95,154	97,378	99,971	102,672	2.38
Government Industry Compensation	1,390	1,372	1,351	1,343	1,344	1,352	-0.55
LARGEST PURCHASES BY INDUSTRIAL SECTORS							
Total Direct Expenditures (Purchases and Pay)							
Research labs, and other professional services	458	458	450	445	438	430	-1.28
New construction	115	117	113	113	113	114	-0.22
Air transport	95	94	95	102	112	117	4.13
Trucking, highway passenger transit	57	58	60	61	63	65	2.79
Gas utilities	38	35	34	34	34	34	-1.92
Indirect Defense Purchases Resulting from Direct Purchases							
Research labs, and other professional services	148	147	148	150	151	153	0.62
Gas utilities	105	102	99	99	96	95	-2.09
Other business services	104	104	106	109	112	114	1.96
Real estate and royalties	74	72	71	72	76	79	1.14
Crude petroleum	74	55	61	59	61	67	-2.04

Table 6. Top 10 States in Direct Purchases of Communication Equipment (Millions of 2001 Dollars)

	2000	2001	2002	2003	2004	2005	00-05
Florida	1,141	1,156	1,154	1,154	1,155	1,138	-0.05
California	878	901	913	938	963	963	1.85
Massachusetts	706	728	743	767	792	792	2.30
Washington	517	540	565	593	621	624	3.77
Indiana	518	534	544	562	581	583	2.34
Maryland	395	404	407	418	429	429	1.67
Texas	381	392	399	413	426	427	2.28
New York	317	325	328	336	345	344	1.64
Virginia	274	277	274	276	278	275	0.12
Iowa	197	205	212	221	230	231	3.14
Top 10 Total	5,324	5,460	5,540	5,677	5,817	5,806	1.73
Total U.S.	6,315	6,471	6,553	6,709	6,868	6,854	1.64

- each of 11 aggregate industrial sectors.

The first application of the table yields projections of total, direct, and indirect defense purchases (Table 1). Indirect defense purchases are calculated by subtracting direct defense purchases from total domestic requirements from defense. The remaining applications disaggregate defense purchases by budget category (Table 2).

The *IDEPPS* reports include projections, made by Inforum, of total domestic production (Table 3). The projections are derived from two types of data: 1) the DoD budget data used in *IDEPPS* and 2) other assumptions underlying the projections are those made by Inforum in its published baseline forecasts. The projections reported for domestic defense purchases (also shown in Table 3) are calculated by subtracting estimates of imports used to produce defense purchases from total defense purchases. The import share of total apparent consumption for each year in the forecast period is computed from Inforum projections of imports and consumption.

3. *RDEPPS*, The State-Level Projections Component of *DEPPS*

IDEPPS addresses the question: "What industries produce defense goods and services?" *RDEPPS* addresses the question: "Where will defense-related production occur?" In this component of *DEPPS*, the geographical distribution of the industry level purchases from *IDEPPS* is determined. Due to limitations in the available data, these projections are made at a level of only 97 industries, which corresponds to the sectoring of the Inforum *LIFT* model. The projections are made for each of the 50 states and the District of Columbia. Unlike *IDEPPS*, *RDEPPS* also determines spending impacts of active duty and military retirement pay that is spent in the U.S.

The expenditure projections are presented in two formats; one designed to show the level and composition of potential expenditures in individual states, and the other to show the geographic distribution of purchases from given industrial sectors.

Expenditure Tables. Table 5 illustrates the format of the state-expenditure projections, using the forecast for New Mexico as an example. The first block of the table shows aggregate measures, in dollar value, of projected direct and indirect defense expenditures in the state during each of the projection years. A projection of nondefense economic activity and total output, prepared by Inforum is also provided. The second and third blocks of the table show the industrial sectors projected

to lead in defense or defense-related sales over the projection period.

Starting at the top of the table "Direct Defense Expenditures" (\$) are the monies disbursed by DoD to pay for purchases of goods and services and to cover payroll expenses. Purchases of magnetic recording tape by the Defense Logistics Agency and the wages of military and civilian personnel at Kirtland Air Force Base are two examples of such expenditures. Direct purchases, in turn, trigger subsequent rounds of transactions, referred to collectively as "indirect defense expenditures from direct purchases." These expenditures represent purchases by DoD's prime contractors (and their suppliers) of parts and materials used in producing items ordered by DoD. Fuel bought by a trucking company for transporting a shipment of goods to DoD would be examples of this type of expenditure. "Indirect purchases resulting from pay" (\$592 million in 2001) represent purchases by DoD's military and civilian employees of goods and services for their personal use. The purchases of a clock radio by a DoD employee would be an example of this category of expenditure. The personal consumption expenditures of military and civilian employees may be taken as a measure of the indirect effects of the pay portion of the DoD budget. These are included in *RDEPPS* (but not other parts of *DEPPS*) because they are often a focus of attention in local development efforts.

In 2001, some \$2,394 million in direct expenditures was projected to be disbursed by the Defense Department in New Mexico to pay its employees and reimburse its direct suppliers for the goods and services they provide. Pay to military members and civilian government workers accounts for a large share of DoD's expenditures in the state (\$1,372 million). Indirect purchases of \$975 million dollars are projected to result from DoD Purchases and from purchases made by DoD employees. In terms of defense-related expenditures, sales of research labs and other professional services absorb the largest share of indirect defense dollars (\$147 million).

Tables 6 and 7 illustrate the format of the industry projections, using estimated purchases from the Communications equipment sector as an example. Two tables are provided for each of 97 industrial sectors, the first showing the top 10 states in which the sector is projected to make the bulk of its direct defense sales over the forecast period and the second showing the top 10 states in which indirect defense sales resulting from direct purchases are projected to be concentrated. Altogether, the 10 states represented in table 6 are estimated to account for 84 percent of the total direct purchases of Communications equipment. The top 10

states in table 7 comprise 69 percent of total indirect spending.

How the RDEPPS Projections are Made

The state level estimates cover expenditures originating from the following aggregate accounts of the defense budget: (1) military personnel; (2) procurement; (3) research, development, test, and evaluation (RDT&E); (4) operations and maintenance (O&M); and (5) military construction and family housing. For each of these accounts, total defense-related expenditures can be classified into three categories:

- Pay projections, both for active-duty and retired military personnel, and for the DoD civilian workforce;
- Projected direct defense purchases derived from IDEPPS; and
- Projected indirect defense purchases derived from IDEPPS.

DoD Pay. Historically, the distribution of DoD pay among states has differed significantly from the distribution of direct purchases. Consequently, in estimating future levels of defense expenditures, it is useful to treat pay and purchases separately. This requires some transformation of the budget data because pay expenditures are not grouped into a single account. With the exception of the retired pay account, which consists entirely of pay, several of the budget accounts cover both purchases and pay.

RDEPPS separates, for each budget account, non-pay outlays from pay components. The pay portions cover the wages and salaries of military and civilian DoD personnel, whether they are stationed in the United States or abroad. Because the state-level estimates consider only expenditures made in the United States, the aggregate pay data must be adjusted to remove the fraction of pay disbursed outside the country.

This adjustment is quite substantial. In 2001, about 15.8 percent of the active-duty force was stationed overseas, in U.S. territories, or aboard ships in foreign waters. An estimate of these individuals' pay is subtracted from total military pay in order to arrive at an estimate of the amount of pay going to military personnel stationed in the United States. (Though service members stationed outside the country do not necessarily receive all of their pay abroad, there is no simple way to determine what proportion is received by dependents living in the United States, or how those funds are distributed among the individual states.) Some civilian personnel are also stationed overseas or in U.S. territories, and some military retirees live abroad. Small adjustments to

civilian (6.2 percent) and retired pay (1.5 percent) are therefore made as well.

Direct Defense Purchases. Direct defense purchases for the nation as a whole are aggregated from IDEPPS 320 industries to the RDEPPS 97 industry sectoring. The result is projections, for each account, of domestic direct defense purchases from each of the 97 industrial sectors. After the purchases have been allocated by sector, they are distributed at the state-level on the basis of state shares of direct purchases arising from each budget account. Note that the state shares differ for each of the major accounts. Furthermore, pay is distributed using pay shares, as described below.

This procedure has the very important advantage of reflecting the effects of changes in the composition of defense purchases, but it requires very detailed information on historical state shares of direct defense expenditures. This information is derived primarily from historical data on contracts awarded.

Indirect Defense Expenditures. Indirect purchases are triggered by purchases made directly by DoD. Each indirect purchase, in turn, typically generates a series of subsequent purchases. Although indirect defense purchases constitute a sizable share of total defense spending, only fragmentary data on their geographical distribution are available. Moreover, assembling a reasonably complete data series would be a very large undertaking. Instead, such purchases were estimated using assumptions typical of regional analysis.

Industries are divided into two categories: "basic" and "non-basic". "Basic" industries are those for which the national market is considered the relevant one. All manufactured goods are assumed to fall within this category. "Non-basic" industries, on the other hand, are industries for which the state is considered the relevant market. Indirect purchases for "basic" industries are assumed to be distributed according to the same state shares as total production for that industry. This distribution is assumed to be that projected by the Inforum STEMS model, which forecasts economic activity by state. Indirect purchases for non-basic industries are assumed to be distributed according to the distribution of the direct spending which generates these purchases.

The results are estimates of the indirect defense purchases that arise from the nonpay portion of the DoD budget. The pay portion of the budget also has indirect effects, which arise from the consumption expenditures of DoD employees. Consequently, in making the state-level estimates, indirect defense purchases are defined as the sum of: (1) indirect purchases stemming from the purchases component of the DoD budget;

**Table 7. Top 10 States in Indirect Purchases of Communication Equipment
(Millions of 2001 Dollars)**

	2000	2001	2002	2003	2004	2005	00-05
California	112	117	122	126	128	130	2.84
Florida	73	76	81	84	85	87	3.51
Texas	71	72	74	76	77	78	1.90
Massachusetts	59	61	63	65	65	65	1.93
Illinois	56	57	58	60	60	61	1.65
New Jersey	32	34	35	37	37	38	3.34
Nevada	26	28	29	30	30	30	2.78
Virginia	26	27	29	30	30	30	3.11
Ohio	26	27	27	28	28	28	1.10
New Mexico	26	26	27	27	27	28	1.57
Top 10 Total	507	524	544	563	567	574	2.47
52 All U.S.	733	756	783	809	815	826	2.37

**Table 8. Top 5 Industries Employing Aeronautical and Astronautical Engineers
Total U.S. Employment and Defense-Related Employment
Thousands of Workers, Ranked by Level in 2001**

	Defense-Related Employment						
	2000	2001	2002	2003	2004	2005	00-05
100 Federal government, defense	9.1	8.8	8.7	8.6	8.5	8.6	-1.10
51 Aerospace	5.1	5.3	5.4	5.6	5.6	5.6	2.05
54 Search & navigation equip.	0.2	0.2	0.2	0.2	0.2	0.2	-2.96
47 Communication equipment	0.2	0.2	0.2	0.2	0.2	0.2	-1.42
77 Professional Services	0.1	0.1	0.1	0.1	0.1	0.1	-4.47
	Total U.S. Employment						
	2000	2001	2002	2003	2004	2005	00-05
51 Aerospace	26.8	27.9	28.9	29.7	31.1	32.6	3.92
100 Federal government, defense	9.1	8.8	8.7	8.6	8.5	8.6	-1.10
101 Federal government, nondefense	4.6	4.7	4.7	4.8	4.9	5.0	1.57
80 Other business services	2.8	2.8	2.8	2.8	2.8	2.8	-0.03
53 Other transportation equipment	2.2	2.3	2.4	2.4	2.5	2.6	2.92

**Table 9. Share of Defense-related Employment by Occupation
Thousands of Workers**

	Total	Defense	Percent
		Related	Share
TOTAL EMPLOYMENT	149322	2864	1.92
74 Shipfitters	12	7	59.67
3 Aeronautical and astronautical engineers	59	16	26.71
60 Aircraft mechanics and engine specialists	174	36	20.44
64 Aircraft assemblers, precision	21	4	18.73
19 All other physical scientists	32	6	17.81
6 Electrical and electronics engineers	399	68	16.94
15 Operations research analysts	57	9	15.78
8 Mechanical engineers	230	33	14.29
5 Civil engineers, including traffic engineers	170	22	12.91
14 Mathematicians and all other mathematical scientists	35	4	10.63

and (2) consumption expenditures (indirect purchases resulting from the pay of military and civilian personnel) of defense personnel. Indirects from pay are calculated by first calculating the share of consumption out of total income, and then allocating the consumption by type of good. The shares used are the same as projected at the national level. As with the indirects from purchases, there are both basic and non-basic industries, so not all consumption goods and services are purchased in the given state.

Once indirect purchases have been estimated for each of the 97 industries, the computations proceed in much the same way as those for direct defense purchases. Since there is no basis for estimating how state shares of indirect purchases vary by budget account, indirect defense purchases from each of the 97 sectors are presented only in total.

Estimation of State Direct Purchases Shares. State shares of direct purchases are calculated on the basis of historical data showing how those expenditures have been distributed at the state level in recent years. Since adequate historical data on the distribution of indirect defense purchases are not available, a somewhat different method is used to calculate state shares of those purchases. This section describes how state shares are established for each category of expenditures, and notes the potential limitations of the methods.

State Shares of Pay. Estimated outlays for military pay are allocated among the states on the basis of their shares of total military pay in the most recent year for which this information is available. These shares are held constant over the projection period. Military retired pay and civilian pay likewise are distributed among the states on the basis of the distribution in the base period.

Because the state distributions are fixed at historical levels, increases in military or civilian pay (or in military retirement annuities) over the projection period only affect the estimated amount of pay going to each state, not each state's share relative to other states. That is, if the amount of military pay disbursed in state "x" in the base period were twice that disbursed in, state "y," the estimates for each future year would show twice as much military pay being disbursed in state "x" as in state "y."

This "fixed shares" assumption will lead to serious distortions in the estimates only if there are major changes in the number of personnel within given states (or in the distribution of personnel among pay grades) over the projection period.

4. LDEPPS, The Defense-Related Employment and Skilled Labor Component of DEPPS

This component of DEPPS tracks employment generated by DoD direct hire, and from direct and indirect purchases. It also uses the projected occupational matrix from BLS to show the employment for each of 100 occupational groups by industry.

Questions of the affect of defense purchases on the demands for labor of various occupational groups is interesting for a number of reasons. Defense-related employment is an important segment of employment for several professional and skilled occupations. This is particularly true for certain types of scientists and engineers. Forecasting demand for these occupational categories can help individuals decide whether this is a good field of study in which to invest in education. For policy makers, it is helpful to know if certain occupations may be in relatively short supply, thus leading to bottlenecks or excessive wage costs.

LDEPPS employment projections are based on projections of defense-related production combined with projected changes in labor productivity. Employment by occupation is then calculated using the occupational shares matrix. The BLS occupational shares describe, for example, what share of employment in the motor vehicle industry will be mechanical engineers. Labor productivity is the ratio of gross constant dollar output divided by total hours worked, in each industry. *LDEPPS* relies on the productivity and employment projections calculated in the Inforum *LIFT* model.

For each occupation, both total and defense-related employment are broken down among 89 industries comprising total GDP. These 89 sectors are essentially the sectors in the Inforum *LIFT* model which have employees, with a few special definitions such as education, hospitals, domestic servants, and government employees.

Presented in Table 8, as an example, are the *LDEPPS* projections of employment of aeronautical and astronautical engineers. The first 6 columns show the year by year projections in thousands of persons. The last column shows the average growth rate over the period, 2000 to 2005.

The top half of this table shows what is called "defense-related employment." Defense-related employment of people in an occupation is defined as the sum of:

- Employment in that occupation by DoD;
- Private sector employment in that occupation directly engaged in defense production; and,
- Private sector employment in that occupation indirectly engaged in defense production (i.e.,

engaged in production of inputs to goods bought by DoD; production of inputs to those inputs; and so on through the chain of production).

Shown in the lower half of the table is projected total employment of aeronautical and astronautical engineers. Nondefense employment (not shown separately) is the difference between total and defense-related employment in the category.

The format of the projections is the same for all of the 100 occupations included in *LDEPPS*. The “aeronautical and astronautical engineers” occupation is a convenient example because employment is concentrated in comparatively few industries. It is, however, unrepresentative in two respects. First, employment in most occupational categories is much more widely distributed among industries. Second, defense-related employment is about 27 percent of total employment of aeronautical and astronautical engineers. (This is not surprising, as DoD and defense-related purchases account for over half of the output of the domestic aerospace industries). For most occupations, including other engineering specialties, the defense-related share of total employment is much smaller.

Table 9 shows total employment and defense-related employment for the top 10 occupations, ranked by the share of defense-related employment in the total. Overall, defense-related employment makes up only 1.9 percent of total employment in 2001. However, for the occupations presented in this table, defense-related employment is a much larger share, ranging from 10 percent to almost 60 percent.

How the LDEPPS Projections Are Made

The *LDEPPS* projections are computed in two main parts:

1. projecting employment in each of 89 sectors; and
2. estimating (sector by sector) employment in each of 100 occupational categories.

The first part relies on the employment projections from the Inforum *LIFT* model. The second part relies heavily on projections and data published by the Bureau of Labor Statistics (BLS) of the U.S. Department of Labor.

Total Employment by Industry. *LDEPPS* takes as its point of departure *IDEPPS* projections of purchases from each of 320 SIC industries. For the base year the coefficients in the *LDEPPS* are ratios of employment to industry output. The projected values of the labor input coefficients reflect expected trends in labor productivity. (Note that employment per dollar of output is the reciprocal of average labor productivity.)

Employment by Occupation. The 100 occupational categories in *LDEPPS* are aggregations of more detailed categories established by BLS. Definitions of the occupational categories used by BLS change somewhat from one survey to the next. BLS maintains detailed definitions of the categories used.

The BLS National Industry-Occupational Matrix gives, for each industry, the shares of employment in the industry accounted for by various occupations. This matrix, which covers wage and salary workers, is prepared biennially by BLS. BLS generates projections of occupational distribution by industry by analyzing the factors expected to influence trends in the staffing patterns of industry as technologies change. Currently, the BLS projected matrix that is in *LDEPPS* is for 2008. Inforum has enhanced the BLS matrix by estimating the distribution of the self-employed and family workers, as well as filling in numerous cells not disclosed in the original table.

LDEPPS uses (for each year of the forecast horizon) the appropriate linear interpolation between the National Industry-Occupational matrix for the most recent year and the projected table for 2008. For each industry, the estimated shares of employment accounted for by the different occupational categories are multiplied by total projected employment in the industry. Projected employment for an occupation is the sum across industries of employment in the occupation in question.

DoD direct employment is, however, handled somewhat differently. The total number of civilian employees in the Department of Defense is derived from the FYDP. Distributions of employees into occupational categories are based on special tabulations developed by BLS from Office of Personnel Management reports. It should also be noted that in *LDEPPS* teachers and other educational workers employed by state and local governments are included in Sector 87 (Private and public education, and non-profit organizations) rather than in Sector 102 (State and local government). Also, state and local hospital workers are combined with private hospital workers in sector 83 (Private and public hospitals). Sector 102 excludes hospitals and education. The reason for this is that no separate occupational employment information is available for these sectors.

5. Concluding Comments

DEPPS was designed as an analytical tool to understand the economic implications of planned defense purchases. This paper has described how the three main components of *DEPPS* work together to produce estimates of defense-related spending by industry, by state, and employment by occupational group. *DEPPS* is used by DoD after the release of each FYDP to

produce a projections book entitled *Projected Defense Purchases: Detail by Industry and State*, which can be found on the DoD web site (see the References). Additional detail on DEPPS can be found in the *DEPPS Primers* at that site.

Other applications for DEPPS include: (1) comparing the implications of two or more alternative defense budgets; (2) tracking the historical contribution of defense spending to U.S. economic growth (Meade, 1998); (3) determining likely bottlenecks of increased defense spending in time of conflict (Meade, 1999); (4) deriving alternative measures of defense deflators (Meade and Lile, 2001); and (5) assisting state governments to determine the impacts of defense budgets on state economies.

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