

Import price indexes for crude petroleum

On the basis of data reported by firms to the U.S. Department of Energy, BLS has developed measures of monthly price change for oil imports

EDWARD E. MURPHY AND MARK MCENEARNEY

The Bureau of Labor Statistics' International Price Program is responsible for calculating import and export price indexes for the United States. These indexes are statistical measures of the average change in prices of commodities that are traded between the United States and the rest of the world.

The program was originally funded by Congress in 1970. Price indexes were first published for exports in 1971, and for imports, in 1973. As of June 1982, published indexes accounted for 71 percent of the value of exports and 96 percent of the value of imports. Plans for the program include provisions for increasing the share of exports and imports for which indexes are calculated to 100 percent.

This article describes the International Price Program's price index for crude petroleum imports. The index, which was first published in November 1981,¹ is calculated using price and quantity data collected by the U.S. Department of Energy.

The data in table 1 show how important crude petroleum imports have become to the U.S. economy. In 1970, the United States imported 545 million barrels of crude petroleum at a cost of \$1.3 billion. These imports accounted for 13.4 percent of the total U.S. supply of crude petroleum (imports plus domestic production) and 3.2 percent of total merchandise imports. In 1981, U.S. imports of crude petroleum, which measured 1,763 million barrels and cost \$61.9 billion, accounted for 36.1 percent of the total U.S. supply of crude petroleum

and 23.7 percent of total merchandise imports.

The following discussion is divided into sections that focus on different aspects of calculating and publishing the index. These include: (1) the construction of the index; (2) the specification of items in the index market basket; (3) the prices and weights that are used to compute the index; (4) the sources of the data; (5) the results of index calculations for the months January 1976 to May 1982; and (6) the policy for revising previously published index values.

Construction of the index. The price index for U.S. imports of crude petroleum is a Laspeyres fixed base-weighted index. The index may be interpreted as a measure of the change in the cost of buying the index market basket, or as a measure of the average change in the prices of items in the index market basket. For this index, the market basket consists of the various crudes—

Table 1. U.S. imports of crude petroleum, 1970-81

Year	Crude imports (millions of barrels)	Crude imports (billions of dollars)	Crude imports as a percent of total U.S. supply	Crude imports as a percent of total imports
1970	545	1.3	13.4	3.2
1971	676	1.7	16.4	3.7
1972	901	2.4	20.7	4.3
1973	1,294	4.2	27.8	6.1
1974	1,367	15.3	29.9	15.3
1975	1,585	18.4	34.1	19.1
1976	2,050	25.5	40.8	21.1
1977	2,520	33.6	45.6	22.9
1978	2,392	32.1	42.9	18.7
1979	2,467	46.1	44.1	22.3
1980	1,977	62.0	38.6	25.7
1981	1,763	61.9	36.1	23.7

SOURCE: Bureau of the Census, *U.S. General Imports*, FT135, and U.S. Department of Energy, *1981 Annual Report to Congress*.

Edward E. Murphy is chief of the Division of International Price Indexes, Bureau of Labor Statistics. Mark McEneaney is an economist in the same division.

for example, Saudi Arabian Light, Mexican Isthmus, and Nigerian Bonny Light—that refiners and other buyers imported into the United States in 1980. A simplified version of the formula for computing the index is:

$$(1) I^t = \frac{\sum_{ij} P_{ij}^t \times Q_{ij}^0}{\sum_{ij} P_{ij}^0 \times Q_{ij}^0} \times 100$$

$$(2) = \frac{\sum_{ij} W_{ij} \times P_{ij}^t / P_{ij}^0}{\sum_{ij} W_{ij}} \text{sf}, 10 \times 100$$

$$\text{for } W_{ij} = P_{ij}^0 \times Q_{ij}^0$$

where:

I^t = the index in month t ;

P_{ij}^0 = the price, in dollars per barrel, that company i paid for shipments of crude type j imported in month 0 (the base period);

P_{ij}^t = the price, in dollars per barrel, that company i paid for shipments of crude type j imported in month t (the comparison period);

Q_{ij}^0 = the quantity, in barrels, of crude type j that company i imported in month 0 (the base period);

W_{ij} = the dollar value weight assigned to crude type j imported by company i .

Specification of items in the market basket. Price indexes of the Laspeyres type are designed to measure changes in the cost of a given market basket (as opposed of differences in the cost of different market baskets). In the calculations for the crude petroleum index, this is accomplished by ensuring that the items that correspond to the prices in the numerator and denominator of each term in expression (2) above have identical specifications in all months.

The specification of each item in the market basket consists of two pieces of information. These are (1) a crude stream identifier, which shows where the crude in each import shipment was produced (the crude stream accounts for the essential quality characteristics of each crude, such as specific gravity, pour point, sulfur content, and trace element content); and (2) an identifier for the purchasing party. The inclusion of these two pieces of information in the specification ensures that when prices are compared over time they are compared for identically specified items.

Prices. The prices used to compute the index are the amounts, in dollars per barrel, that importing companies pay for their crude, plus any charges incurred in placing the crude on board ship at the foreign port of loading. Prices do not include any of the costs involved in transporting crude from the foreign port to the U.S. port of entry.

Weights. The weight assigned to each item in the market basket is the dollar value of all shipments of that item that were imported into the United States in 1980. In the process of computing the index for the current month, the weights are normalized to account for items in the market basket that were not imported. This is equivalent to imputing a price change equal to the weighted average price change of all items that were imported in the current month, as measured by the change in the index, to items that were not imported in the current month.

Data sources. The data used to compute the index are collected by the U.S. Department of Energy on the monthly Transfer Pricing Report (Form ERA-51, Schedule B). Reporting firms are major importers (those that import 500,000 or more barrels of crude in a given month) and firms that acquire imported crude from affiliated entities. About 40 firms file the report on a regular basis. In 1980, the data in the reports filed by these firms accounted for approximately 90 percent, in dollar terms, of all U.S. imports of crude petroleum.

Firms have 45 days after the end of a given month to file their reports with the Department of Energy. At the Energy Department, data from the reports are keypunched and screened for simple arithmetic errors and errors in transcription. In cases involving apparent errors in the data that cannot be resolved on the basis of the available information, the Department contacts the reporting firm to verify the data that have been reported and, if necessary, obtains the correct information.

Approximately 60 days after the end of a given month, the Department of Energy provides BLS with a computer tape containing these data. At BLS, the data are screened again. Any questions that arise with respect to the data are referred to the Department of Energy and resolved before the data are used to compute the index. The processing associated with computing the index is generally complete within 10 days of receipt of the tape from the Energy Department.

Index values, January 1976 to May 1982. Table 2 shows index values that have been calculated for 11 categories of crude petroleum imports. These include imports from all countries, from members of the Organization of Petroleum Exporting Countries (OPEC)² and from non-members, and from selected regions and countries. The number of regions and individual countries for which index values are shown is limited by the availability of price data. In keeping with BLS standards for maintaining the confidentiality of company level data, index values that were calculated with prices from fewer than three companies are not shown.

As measured by the index for imports from all countries, prices of imported crude petroleum have nearly tripled since January 1976, the first month for

Table 2. Price indexes of U.S. imports of crude petroleum by source, January 1976 to May 1982

[June 1977 = 100]

Year and month	Imports from all countries	OPEC	Non-OPEC	Selected regions				Selected countries			
				Africa	Far East	Latin America	Middle East	Indonesia	Mexico	Nigeria	Saudi Arabia
1976: January	91.7	92.0	90.6	89.5	92.6	91.0	94.7	92.9	91.6	89.1	94.9
February	91.7	92.0	90.6	89.5	92.7	90.9	94.7	92.9	91.6	89.1	94.9
March	91.6	92.0	90.5	89.6	92.4	90.9	94.6	92.7	91.5	89.2	94.9
April	91.9	92.2	91.0	89.8	92.5	91.5	94.8	92.8	92.2	89.3	95.1
May	91.9	92.1	91.0	89.7	92.6	91.5	94.8	92.8	92.2	89.5	95.1
June	91.9	92.2	91.1	89.9	92.6	91.5	94.8	92.8	92.1	89.6	95.1
July	92.4	92.7	91.5	90.8	92.8	91.9	94.7	93.0	92.6	90.5	95.0
August	92.4	92.7	91.5	90.9	92.8	91.9	94.7	93.0	92.6	90.6	94.9
September	92.5	92.8	91.7	91.2	92.8	92.2	94.7	93.1	92.9	90.8	94.9
October	93.1	93.3	92.7	91.8	93.2	92.8	94.9	93.5	93.5	91.8	95.0
November	93.4	93.5	93.4	92.2	93.3	93.6	94.9	93.6	93.7	91.9	95.1
December	94.0	94.0	94.1	92.9	93.6	94.4	95.2	93.8	94.8	92.4	95.3
1977: January	98.4	98.3	98.7	98.1	98.5	99.1	98.3	98.6	99.5	97.8	98.4
February	99.2	99.1	99.3	99.0	99.3	99.5	99.1	99.4	99.6	98.4	99.0
March	99.7	99.7	99.7	99.3	99.9	99.9	100.1	100.0	100.0	98.6	100.1
April	100.0	100.0	99.9	99.9	99.9	100.0	100.0	99.9	100.0	99.9	100.0
May	100.0	100.0	100.0	99.9	100.0	100.0	100.1	99.9	100.0	100.0	100.0
June	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
July	101.3	101.4	101.0	100.7	100.4	100.9	102.5	100.3	100.8	100.2	102.7
August	102.1	102.2	101.6	101.0	101.0	101.4	104.0	100.9	101.3	100.3	104.1
September	102.5	102.6	101.9	101.2	101.0	101.7	104.8	100.9	101.5	100.4	104.9
October	102.3	102.5	101.7	100.9	101.0	101.6	104.7	100.9	101.4	100.0	104.9
November	102.2	102.4	101.7	100.6	100.8	101.6	104.9	100.7	101.4	99.9	105.1
December	102.2	102.4	101.7	100.6	101.0	101.6	104.9	100.9	101.4	99.8	105.1
1978: January	102.0	102.2	101.5	99.7	100.9	101.5	105.4	100.8	101.3	98.6	105.2
February	101.6	101.8	101.1	99.5	100.6	101.0	104.8	100.5	101.0	98.3	105.2
March	101.6	101.8	101.2	99.5	100.6	101.0	104.9	100.5	101.1	98.2	105.2
April	101.2	101.3	100.8	98.7	100.3	100.7	104.6	100.3	100.8	97.3	105.1
May	101.1	101.2	100.8	98.7	100.1	100.6	104.6	100.1	100.8	97.3	104.9
June	101.1	101.2	100.7	98.7	100.1	100.5	104.5	100.1	100.7	97.3	104.9
July	101.1	101.3	100.7	98.7	100.8	100.2	104.6	100.6	100.1	97.3	104.9
August	101.1	101.2	100.7	98.6	100.7	100.2	104.5	100.4	100.1	97.2	104.9
September	101.1	101.3	100.7	98.9	100.5	100.2	104.4	100.3	100.0	97.2	104.9
October	101.5	101.6	101.1	99.3	100.9	100.6	104.6	100.6	100.4	97.7	105.0
November	102.2	102.3	101.8	100.5	101.5	101.2	104.8	100.9	101.0	98.5	105.1
December	102.1	102.3	101.8	100.5	101.7	101.1	104.8	101.1	100.8	98.4	105.0
1979: January	105.5	105.5	105.4	104.6	103.6	104.7	107.5	102.6	104.8	102.0	107.7
February	108.7	108.7	108.4	107.7	106.8	107.5	111.0	105.8	107.6	104.5	111.2
March	110.1	110.1	110.2	109.3	108.7	108.8	112.1	107.8	108.5	105.6	112.2
April	115.0	114.2	117.4	115.9	111.8	117.0	113.7	110.6	118.4	115.0	112.3
May	126.7	125.9	129.4	130.0	123.7	128.7	122.5	122.4	128.3	128.9	119.5
June	135.2	134.8	136.3	141.7	130.1	133.9	129.3	128.3	131.9	143.0	126.5
July	150.3	148.5	155.6	154.4	145.3	154.2	144.2	142.1	159.0	154.5	141.9
August	163.7	163.0	165.8	170.1	163.2	163.1	156.6	160.7	166.1	170.7	152.8
September	165.5	164.7	167.9	171.1	166.4	165.4	158.9	164.8	167.6	172.4	154.6
October	168.6	167.1	173.3	173.9	168.4	171.8	160.7	166.5	175.9	175.1	156.4
November	173.4	171.8	178.2	183.2	165.3	175.6	162.7	162.0	177.9	177.9	157.6
December	184.5	183.9	186.5	195.6	173.4	180.8	176.5	169.8	182.8	193.3	169.9
1980: January	205.8	206.1	205.1	216.4	195.4	200.2	200.3	192.8	201.6	209.1	195.2
February	223.3	221.9	227.7	233.9	218.8	223.5	211.9	216.5	232.0	221.7	205.9
March	232.9	232.5	234.2	247.1	227.0	228.3	226.4	224.8	236.4	240.6	214.1
April	234.1	233.8	235.2	247.5	230.8	228.6	222.0	228.6	236.5	241.2	216.6
May	236.7	236.8	236.3	247.9	232.4	229.3	228.5	230.3	238.7	242.3	226.8
June	244.0	244.3	243.1	255.8	240.7	236.3	235.0	238.9	244.1	250.1	232.8
July	246.5	246.6	246.5	258.6	242.9	240.5	236.6	240.8	248.5	252.9	233.9
August	247.6	247.5	247.9	260.3	242.7	242.5	236.9	240.4	251.3	255.3	234.0
September	247.3	247.4	247.1	259.2	242.3	242.3	237.8	240.0	251.1	255.4	234.7
October	250.4	251.2	248.2	258.5	242.7	243.3	247.9	240.1	251.8	255.0	246.7
November	250.5	251.2	248.4	257.8	242.5	243.8	249.0	240.0	252.6	253.5	247.5
December	252.6	253.5	250.1	259.4	244.0	245.6	252.2	241.5	255.9	255.5	250.9
1981: January	263.0	262.5	264.5	267.9	248.6	263.8	262.7	245.4	278.5	265.6	261.8
February	273.4	273.1	274.0	279.6	264.7	271.5	270.9	261.9	284.4	275.0	268.7
March	272.9	272.5	274.2	279.2	265.8	272.6	269.2	263.2	285.4	275.0	266.3
April	271.4	271.1	272.0	278.0	264.5	270.5	267.4	262.1	282.6	274.0	264.6
May	271.5	271.6	271.2	278.9	264.6	269.4	267.4	262.1	281.3	273.8	264.7
June	267.6	269.4	262.2	276.3	262.7	258.2	265.4	260.7	264.0	271.8	262.8
July	267.6	269.7	261.0	275.3	262.3	258.5	267.1	260.5	264.4	271.1	265.3
August	262.9	266.8	251.1	271.0	259.9	248.3	264.5	258.6	250.0	268.5	264.1
September	261.3	265.4	248.9	268.3	259.5	245.8	264.1	258.4	250.7	264.2	263.8
October	258.0	261.5	247.2	260.4	258.1	244.8	264.4	257.6	249.7	253.7	265.8
November	258.8	262.1	248.8	260.0	258.9	246.3	266.2	258.2	252.0	252.3	267.9
December	262.1	265.6	251.7	263.3	260.7	247.5	270.9	259.8	253.5	255.5	271.7
1982: January	262.5	266.2	251.5	262.2	260.4	247.4	273.5	259.4	252.1	255.7	276.4
February	260.2	264.1	248.2	259.5	257.9	244.7	272.5	257.0	248.4	254.1	275.9
March	257.2	262.5	240.9	256.3	256.9	237.3	272.3	256.3	242.0	251.7	276.2
April	256.0	261.7	238.6	254.8	256.3	234.0	272.5	255.9	240.6	250.2	276.8
May	252.6	258.6	234.5	251.3	254.5	229.8	269.3	254.4	235.3	246.7	273.5

which the index was calculated. Prices increased slowly during 1976 and 1977, rising a total of 11 percent over the 24-month period. In 1978, a quiet year in the world petroleum market, prices were virtually unchanged, but between January 1979 and January 1980, the index rose 100 points, from 105.5 to 205.8. During the latter year, political events seriously disrupted the flow of petroleum exports from Iran, at one time the leading oil producing country in OPEC after Saudi Arabia. Prices continued to rise in 1980 and in the first 2 months of 1981. The index reached its highest level to date in February 1981, when it stood at 273.4, then declined slightly over the next 8 months as depressed demand for petroleum led to greater competition among producers trying to maintain their market shares. The index registered slight increases in November and December 1981 and in January 1982, largely in response to higher prices for OPEC's benchmark crude, Saudi Arabian Light, which took effect in October 1981. In February 1982, prices resumed their decline and by May, the last month for which the index has been calculated, the measure had fallen to 252.6, the lowest since December 1980.

The indexes for imports from OPEC member countries and non-OPEC countries followed the same general pattern as the index for imports from all countries between 1976 and the first 5 months of 1981. The difference between the two indexes was less than half an index point in May 1981, with the index for imports from OPEC measuring 271.6 and the index for imports from non-OPEC countries measuring 271.2. The next month, the two indexes began to diverge and at year's end stood 13.9 index points apart, with the OPEC index at 265.6 and the non-OPEC index at 251.7, off 2.2 percent and 7.2 percent respectively from May. In 1982, the difference between the indexes widened further as the non-OPEC index registered large decreases, while the OPEC index declined only slightly. In May 1982, the index for imports from OPEC was calculated at 258.6 and the non-OPEC index, at 234.5.

Of the four indexes for crude petroleum imports from selected regions, the index for the Middle East, 269.3 in May 1982, increased the most from June 1977, which equals 100. In contrast, the index for Latin America, which until June 1981 followed the same trend as the Middle East index, measured 229.8. The May 1982 index values for the other two regions, Africa and the Far East, were calculated at 251.3 and 254.5.

Among the indexes from selected countries, the index for Mexico, which measured a full 10 index points higher than any of the others as recently as March

1981, stood at 235.3 in May 1982, the lowest of the four country indexes. The May 1982 values for the other indexes were 254.4 for imports from Indonesia, 246.7 for imports from Nigeria, and 273.5 for imports from Saudi Arabia.

Revision policy. There are two factors that affect the data that are used to compute this index which could lead to revisions in previously published index values. These are (1) the timing of some of the reports that importing companies file with the Department of Energy, and (2) company or Department of Energy corrections to data on individual transactions.

Of these two factors, the first is more likely to lead to revisions. Approximately 30 percent of the data that are used to calculate the index for a given month are not available when the index is first calculated. This is the result of differences in the accounting practices of some companies: Companies that book their crude when it is loaded at the foreign port are required to report on all shipments loaded in a given month, while companies that book their crude when it lands in the United States are required to report on all shipments that land in a given month. When BLS first computes the index for the current month, the reports of many of the companies in the second group (the "landed" companies) are not available. Given the amount of data involved, it is likely that the estimate of the index for the current month will be revised when the outstanding data become available.

The second factor, company or Department of Energy corrections to data on individual transactions, has so far not been significant enough to affect aggregate index values. This is not surprising in view of the strength of the sample from which the index is calculated, and what so far has been a low incidence of corrections to data that actually enter into the calculation of the index. Users of the index should realize, however, that these kinds of corrections could affect future index values and, where the effects are significant, result in BLS' revising the index.

An analysis of the results of different calculations of the index over time has shown that index values become fairly stable 3 months after they are first calculated. In view of this, the Bureau's policy will be to revise published index values for up to 3 months preceding the current month for which the index is calculated. Revisions of index values for earlier months are not anticipated, and will not be made unless significant reporting or calculation errors are discovered, or there is a change in the Department of Energy's reporting requirements. □

— FOOTNOTES —

¹ The price index for U.S. imports of crude petroleum from all countries is published quarterly in the BLS press release "U.S. Import and Export Price Indexes." The release is available on request.

² The current members of OPEC are: Algeria, Ecuador, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela.