Immigration from Mexico:
Effects on the Texas Economy

James E. Pearce and Jeffery W. Gunther

The industries in Texas most sensitive to immigration reform are agriculture, construction, and durable goods manufacturing. Workers already residing in Texas most directly in competition with illegal immigrant workers are Hispanics and adults without high school degrees. These conclusions follow from analysis of the 1980 Census data on Mexican-born Texas residents who speak no English. The analysis assumes that the occupational distribution of these workers approximates that of illegal immigrants from Mexico.

15 Effects of Reducing the Deficit
with an Oil Import Tariff

Ronald H. Schmidt and Roger H. Dunstan

Reducing the federal budget deficit with an oil import tariff would be more detrimental to the economy than would other commonly used tax policies. Although most taxes reduce economic growth by raising prices or lowering income, the magnitudes of the induced distortions are different for different tax policies. Simulations reveal that a broader-based tax that raises identical revenue, such as an income tax surcharge, has smaller adverse effects on GNP and inflation than does an oil import tariff. The simulations also show that an import tariff would provide short-term protection to the energy industry by raising energy prices, but the gains in the energy sector are dwarfed by the losses in the rest of the economy.

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Illegal Immigration from Mexico: Effects on the Texas Economy

James E. Pearce

Vice President
Federal Reserve Bank of Dallas

Jeffery W. Gunther

Economic Analyst
Federal Reserve Bank of Dallas

Current legislation limits to 270,000 the number of potential immigrants who may obtain visas to enter the United States in any one year. The number of visas allocated to any one country is 20,000.[1] The number who actually enter the United States from Mexico is, of course, much larger. At least 1 million illegal immigrants from Mexico were residing in the United States in 1980, and approximately 80 percent of them entered the United States after 1970.[2]

This article explores the potential of using data from the 1980 Census to acquire a fuller understanding of how reducing immigration from Mexico would affect the Texas economy. Texas ranks second among the states in number of illegal Mexican immigrants, and these immigrants represent about 1 percent of the state's population.[3] These facts lead most observers to agree that immigration has become an important influence on the Texas economy, but a consensus on the size and nature of this influence has not emerged. A major problem has been that information on illegal immigrants, to

this point, has been vague and incomplete. The 1980 Census can contribute much to our understanding of this issue.

Although Texas has attracted people from all over the world, immigration from Mexico is the major

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1. Immigration quotas are more liberal than these simple statements imply. For example, "immediate relatives" of visa holders are not included in either ceiling, and refugees are admitted under a separate system. For further discussion of current immigration restrictions, see Vernon M. Briggs, Jr., "Employment Trends and Contemporary Immigration Policy," in *Clamor at the Gates: The New American Immigration*, ed. Nathan Glazer (San Francisco: ICS Press, 1985), 135-60.

2. These figures are estimates computed by the staff of the Census Bureau from the 1980 Census and other sources. The analysts argue that these estimates should be treated as lower bounds; the actual number of illegal immigrants may be as much as 50 percent higher. See Jeffrey S. Passel and Karen A. Woodrow, "Geographic Distribution of Undocumented Immigrants: Estimates of Undocumented Aliens Counted in the 1980 Census by State," *International Migration Review* 18 (Fall 1984): 642-71.

3. The figures are from Passel and Woodrow, who also estimate that two-thirds of all illegal Mexican immigrants reside in California, while 10 to 15 percent reside in Texas. The 1-percent figure is also a lower bound.

Table 1
**CHARACTERISTICS OF IMMIGRANT WORKERS,
RESIDING IN TEXAS, BY PLACE OF BIRTH**

Characteristic	Place of birth			
	Mexico	Asia	Europe	Other
Share of immigrant population (percent)	56.0	14.7	11.4	17.9
Percent of each group: Immigrating before 1975	70.8	48.4	82.3	69.4
Speaking only some English[1]	31.2	12.1	1.7	9.2
Speaking no English at all	23.4	2.1	0.3	5.1
Not completing high school[2]	72.7	15.5	14.4	28.3

1. Does not include those speaking no English at all.
2. Includes all individuals not completing high school and not currently enrolled.
SOURCE OF PRIMARY DATA: Public-Use Sample from the 1980 Census.

source of controversy. Mexico is the origin of the largest number of illegal immigrants and is likely to remain so. Much of the controversy centers around the belief that the standard of living for many U.S. natives is being reduced by competition with immigrants. Because Mexican immigrants lack education, the natives with whom they are competing most directly also are uneducated and thus have low standards of living even in the absence of immigration.

Some background on immigrants residing in Texas is provided in Table 1. The Mexican immigrants are exceptional for their low skill levels and their numbers. They are much less likely to speak English or have high school degrees. They are also less likely to be citizens (once the data are adjusted for years since immigration). Of immigrants responding to the Census questionnaire, Mexicans constitute a clear majority, even though some fraction of the illegal immigrants probably avoided the Census takers.

The procedure described in this article uses Census responses of those Texas residents who were born in Mexico and speak no English to identify 16 occupations that employ the Mexican immigrant workers most likely to be excluded by immigration reform. This strategy is based on the assumption that the limited education of these Census respondents and their inability to speak English leave them with handicaps representative of those restricting the employment opportunities of illegal immigrants.

Identifying the occupations provides a basis for determining which U.S. citizens compete most directly with illegal immigrants. The industries that rely heavily on the 16 occupations also can be identified, so that the products whose costs are most sensitive to changes in immigration can be isolated. Many of the findings in this study confirm commonly made statements about the activities of illegal immigrants. Other results provide support for propositions often suspected to be true but on which evidence has been difficult to obtain.

The occupations in which non-English-speakers are most commonly employed are farm work, construction labor, and sewing machine operation. Other prominent occupations include household service and janitorial work. The industries that depend most heavily on these occupations are construction, agriculture, and textile manufacturing. Although these findings from the Census contain little new information, they provide reassurance that analysis of the Census data will yield plausible conclusions on the effects of immigration reform.

The analysis, however, also reveals that non-English-speaking immigrants commonly are found in some occupations generally considered to require more skill than those listed above. These include carpentry and welding. Another interesting discovery in the current study is the extent to which construction and durable manufacturing depend on occupations sensitive to illegal immigration. In construction, about one-third of the workers are practitioners of one of the 16 occupations. Nearly one-fourth of workers in durable manufacturing are in these occupations. Consequently, restrictions on immigration have the potential to be disruptive to these industries.

The 1980 Census

The Census taken in 1980 is more useful for investigating illegal immigration than Census data collected in previous years. Data on respondents' fluency with English and a more serious effort to obtain information from all U.S. residents (not just citizens) distinguishes the 1980 Census from its predecessors. Information on place of birth and citizenship has customarily been obtained in the Census. But with the more complete coverage and the information on language, the Census may add much to current knowledge of illegal immigration.

These advantages notwithstanding, the Census does not single out aliens who are in the United States illegally. That omission, however, does not prevent use of the data for the purpose at hand, which is to provide information on the effects of a modest reduction in illegal immigration from Mexico. Much can be learned about this issue by identifying a set of respondents who are representative of the immigrants likely to be excluded from the United States by stricter enforcement quotas. Respondents born in Mexico who speak no English constitute such a proxy group.

Even if many members of this proxy group are not actually illegal immigrants, the sample from the Census can provide much of the information desired. Spanish-speaking respondents and illegal immigrants have comparable skills and are likely to use similar sources of information to find jobs. The correspondence is strengthened by the large proportion of the proxy group that the Census identifies as noncitizens. Only 20 percent of the Mexican immigrants who do not speak English are citizens.

The Census data have additional advantages.

First, they provide detailed information on the occupation and industry of each respondent who works. This permits identifying the immediate impacts of immigration reform more precisely than is usually possible. In addition, the sample is probably more nearly random than direct surveys of illegal immigrants, which overrepresent workers near the border and in work sites already known to contain illegals. Such data provide few opportunities to learn how pervasive the employment of illegals has become.[4]

This research, however, does not include estimating the *size* of immigration's effects. Proceeding to that step requires information not only on the number of immigrants but also on demand and substitution elasticities.[5] Consequently, the conclusions here are limited to qualitative statements only—identifying which workers and products in Texas would be affected by lower immigration rates.

The reliability of the Census data is addressed in the Appendix. Because recent immigrants who do not speak English may make many errors in completing Census questionnaires, the principal aspect of reliability examined is the accuracy of the responses. The representativeness of the sample also receives some attention.

The evidence presented in the Appendix indicates that the Spanish speakers' replies to the Census questions do relate to one another in a reasonaable way. This increases confidence that serious effort was put into completing the Census form and that the records contain information that is logically consistent. Research by the staff of the Census Bureau also supports this conclusion and provides confidence that the 1980 Census provides a reasonably representative sample of Mexican immigrants.

Occupations of immigrants

Immigrants compete most directly with citizens for whom they substitute most effectively. Because, as

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4. See Vernon M. Briggs, Jr., "Methods of Analysis of Illegal Immigration into the United States," *International Migration Review* 18 (Fall 1984): 623-41, for a thorough discussion of the problems with data available on illegal immigrants.

5. John K. Hill reviews the importance of these elasticities in "The Economic Impact of Tighter U.S. Border Security," *Economic Review*, Federal Reserve Bank of Dallas, July 1985, 12-20.

Table 2
PRINCIPAL OCCUPATIONS OF NON-ENGLISH-SPEAKING IMMIGRANT WORKERS FORM MEXICO RESIDING IN TEXAS

Occupation	Percent of employment[1]
Males	
1. Farm workers	12.2
2. Construction laborers	11.0
3. Laborers, except construction	6.9
4. Carpenters, except apprentices	4.3
5. Janitors and cleaners	3.9
6. Welders and cutters	3.2
7. Painters, construction and maintenance	3.0
8. Machine operators, not specified	2.6
9. Groundskeepers and gardeners, except farm	2.5
10. Assemblers	2.3
SUM	51.9
Females	
1. Textile sewing machine operators	16.7
2. Farm workers	11.3
3. Janitors and cleaners	6.3
4. Maids and housemen	5.6
5. Hand packers and packagers	4.5
6. Laborers, except construction	4.1
7. Private household cleaners and servants	4.1
8. Assemblers	3.6
9. Cooks, except short-order	3.3
10. Miscellaneous food preparation occupations	2.6
SUM	62.1

1. Percentage of immigrant workers, by relevant sex, ages 16-60, born in Mexico, residing in Texas, speaking Spanish and speaking no English at all.
SOURCE OF PRIMARY DATA:
Public-Use Sample from the 1980 Census.

a rule, workers in the same occupation are good substitutes for one another, identifying the occupations in which large fractions of non-English-speaking Mexicans find work is the first step in determining which workers face direct competition from immigrants.

The 10 most common occupations for males and females are shown in Table 2. As four of the occupations appear on the lists for both sexes, the procedure identifies 16 distinct occupations. Under the assumption that the proxy group represents those illegal immigrants most susceptible to more effective restrictions, these are the occupations that would be most affected by changes in immigration.[6]

Although limiting the list to 10 occupations for each sex may seem arbitrary, the Spanish-speaking immigrants are widely dispersed outside these occupations. Thus, competition between non-English-speaking immigrants and English-speaking natives appears to be concentrated in these occupations.

The list accords well with reports from direct surveys of illegal immigrants. Farm work and manual labor, which are the top occupations of males in the Census sample, have been cited as common occupations for male illegal immigrants in Texas. Maid service and private household cleaning are high on the list of occupations for females. Surveys have found that domestic service occupations are common among female illegal immigrants from Mexico.[7]

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6. In some cases, despite follow-up procedures used to obtain missing information, certain information for a person or housing unit would still be missing when the questionnaire reached the central processing offices of the Census Bureau. In such cases, the information was "allocated," or assigned, by the Census processors. In the case of non-English-speaking immigrants from Mexico, the occupation had to be supplied through allocation for 17 percent of the working respondents. Most of these allocations were made on the basis of the occupational information supplied by persons possessing similar characteristics. The occupational distribution of the proxy group was calculated with these individuals excluded to determine if the allocation scheme influenced the results. For both males and females, the 10 most common occupations are the same whether the people whose occupation was allocated are included in the calculation or not.

7. Examples of studies of illegal immigrants are two reports prepared under contract in 1978 for the United States Commission on Civil Rights, Texas State Advisory Committee. The first is by Roy Flores and Gilbert Cardenas, under contract no. CR7AC020, entitled A Study of the Demographic and Employ-

Table 3
PERCENTAGES OF TEXAS WORKERS IN LOW-INCOME GROUPS

Occupation	Hispanics[1]	Immigrants from Mexico	Non-English-speaking immigrants from Mexico[2]	Blacks	Teenagers
Farm workers	56.5	20.4	8.8	4.8	25.3
Construction laborers	38.2	15.6	5.3	18.1	19.0
Laborers, except construction	32.4	10.3	3.8	20.8	18.3
Carpenters, except apprentices	23.5	7.9	1.9	5.2	8.0
Janitors and cleaners	33.3	8.5	2.3	26.2	18.4
Welders and cutters	28.1	9.5	1.9	9.8	7.3
Painters, construction and maintenance	32.0	11.6	2.9	8.2	11.8
Machine operators, not specified	29.0	9.4	2.1	22.3	8.3
Groundskeepers and gardeners, except farm	28.8	8.8	3.3	15.8	33.4
Assemblers	25.4	6.8	2.0	20.5	11.6
Textile sewing machine operators	53.2	21.3	7.2	8.4	5.0
Maids and housemen	36.4	9.2	3.0	39.1	9.8
Hand packers and packagers	39.3	9.9	3.6	15.1	14.2
Private household cleaners, servants	28.5	9.3	3.0	56.5	4.1
Cooks, except short-order	23.5	5.8	1.2	25.6	28.2
Miscellaneous food preparation	33.4	8.7	2.7	19.7	34.5
Sixteen occupations combined	33.4	10.6	3.3	19.1	16.4
Texas labor force	18.1	3.7	0.9	11.1	10.3

1. Includes all individuals identifying themselves as being of Spanish origin.
2. Includes all immigrants, born in Mexico, speaking Spanish at home but speaking no English at all.
SOURCE OF PRIMARY DATA: Public-Use Sample from the 1980 Census.

Previous studies have not, however, specifically indicated that the manufacturing-type occupations in the Table 2 listing—such as textile sewing machine operation, welding and cutting, assembly, and machine operation—are especially common

among Mexican illegal immigrants in Texas. Rather, they have simply reported that some illegal immigrants in certain areas of Texas are employed in manufacturing.

Citizens competing with aliens

The list of occupations in Table 2 is useful in identifying which native workers compete most directly with immigrants from Mexico. Tables 3 and 4 provide information on all Texas residents in these occupations. A primary motive in constructing these tables is to show evidence for the proposition that

Table 4
EDUCATION AND EARNINGS OF TEXAS WORKERS

Occupation	All Texas workers			Non-Hispanic Texas workers		
	Mean years of schooling	Percent of dropouts[1]	Hourly wage[2]	Mean years of schooling	Percent of dropouts[1]	Hourly wage[2]
Farm workers	7.7	58.5	4.3	10.9	29.2	4.1
Construction laborers	9.4	53.0	6.0	10.9	37.2	6.2
Laborers, except construction	9.9	44.2	5.8	11.1	32.1	5.9
Carpenters, except apprentices	10.6	42.3	6.9	11.5	33.4	7.3
Janitors and cleaners	9.5	50.2	5.7	10.7	38.9	6.1
Welders and cutters	10.4	44.4	8.8	11.2	35.8	9.1
Painters, construction and maintenance	10.0	51.2	6.5	11.1	40.7	7.0
Machine operators, not specified	10.4	42.2	6.3	11.4	31.4	6.7
Groundskeepers and gardeners, except farm	9.6	41.5	5.2	10.9	28.4	5.2
Assemblers	10.6	41.8	5.7	11.3	33.9	5.8
Textile sewing machine operators	9.1	63.5	3.9	10.7	47.4	3.9
Maids and housemen	8.9	65.2	4.2	10.2	54.1	4.4
Hand packers and packagers	9.7	51.3	5.1	10.9	39.7	5.1
Private household cleaners, servants	8.7	69.1	4.9	9.8	62.5	5.1
Cooks, except short-order	10.1	43.5	4.5	10.7	36.8	4.4
Miscellaneous food preparation	9.4	46.7	4.2	10.4	36.7	4.5
Sixteen occupations combined	9.7	49.4	5.6	10.9	37.3	5.8
Texas labor force	12.1	24.6	7.0	12.7	19.2	7.3

1. Includes all individuals not completing high school and not currently enrolled.
2. Computed from data on annual income and hours worked.
SOURCE OF PRIMARY DATA: Public-Use Sample from the 1980 Census.

illegal immigrants compete most directly with the disadvantaged subsets of the native population. The data generally support that proposition.

Information on the extent to which disadvantaged groups are represented in these occupations is provided in Table 3. Hispanics and blacks, who account for a disproportionate amount of poverty in the United States, are more heavily represented in these occupations than they are in the general population. The proportion of Hispanics is high in each of the occupations, but the proportion of blacks is average to low in a couple of them. Concern has also been expressed about the effect of immigration on

employment opportunities for teenagers. The table shows that teenagers account for a large share of employment in about half of the occupations.

That the average level of schooling is lower in these occupations than in the Texas population generally is demonstrated in Table 4. The exceptionally large fractions of workers in these occupations who did not finish high school indicates why these averages are low. Hispanics have low schooling completion rates, and removing them from the sample raises the figure on average education for the remaining Texans. The education levels for non-Hispanic workers in these 16 occupations are still

relatively low, however.

Wages also tend to be on the low side in these occupations. In each case, however, the averages are above the legal minimum. In a couple of the occupations, the average is fairly high. Wages for Hispanic and non-Hispanic workers are much more nearly equal than are the schooling levels for the two groups.

The picture outlined in these tables is consistent with the "stylized facts" of illegal immigration— illegal immigrants compete with people who have little education and who do manual work. The next section identifies the industries that rely heavily on these 16 occupations.

Identifying product prices sensitive to immigration

The purpose of this section is to make some broad statements about which industries would be affected the most by reduced immigration. The products associated with these industries are the ones whose prices likely would rise if immigration from Mexico were curtailed. Unfortunately, analysis of the effects of changes in labor supply on unit production costs can quickly become complicated. Thus, some simplifying assumptions must be made before any useful conclusions can be drawn.

Assumptions. The first important assumption is that all domestic workers in the 16 occupations identified in the previous section can be treated as a separate, homogeneous group. This means that immigrants substitute equally well for citizens in each of the occupations.[8] In addition, it is assumed that citizens move freely among the 16 principal occupations. Mobility of labor between the 16 principal occupations and all other occupations is ruled out.[9] Thus, under this assumption a reduction in the supply of labor in any one of the 16 occupations will

put upward pressure on wages in the other 15, but wages in occupations not listed in Table 2 will not be affected.

Next, it is assumed that labor is mobile among industries, so that the response of wages to changes in immigration is common across industries. Any industry-specific wage increase in an occupation should result in movements of members of that occupation from other industries to the affected industry, and vice versa. Such flows equalize wages across industries.

Finally, it is assumed that for each industry the share of total employment accounted for by the 16 occupations can be used to measure the sensitivity of cost in that industry to illegal immigration. This simple procedure has limitations. First, in highly capital-intensive industries, employment shares overstate the contribution of the 16 occupations to product cost. Second, in industries where other factors of production are easily substitutable for labor in the 16 occupations, the sensitivity of cost to changes in the supply of labor to these occupations would be low even if the 16 occupations accounted for a significant amount of employment.

Despite these shortcomings, the approach identifies which industries face potentially large effects from changes in immigration policy. The rest of this section presents the contributions of the occupations to employment in 16 groups of industries. Most of the groups are broad, but a few narrow ones have been singled out where the occupations are extremely concentrated.

Results. Several industries rely heavily on occupations in which Mexican immigrants are common (see Chart). Slightly over half of the workers in textile manufacturing, services to buildings, and services to households and hotels are members of the occupations sensitive to illegal immigration. These industries do not constitute major segments of the Texas economy, however. If they were to lose their access to illegal immigrants' labor, the cost of living in Texas would increase only slightly. Of more general interest are the effects of reduced immigration on the larger sectors of the economy—agriculture, construction, and durable goods production.

Agriculture is important in that it accounts for a significant share of total Texas income, though it does not employ a large fraction of the Texas labor force. The category "farm laborers" accounts for nearly half of employment in agriculture. This frac-

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8. This does not imply that immigrants are perfect substitutes for citizens. On the contrary, immigrants are likely to be hired only at a discount. The assumption maintains, however, that the discount will be the same in all 16 of the occupations.
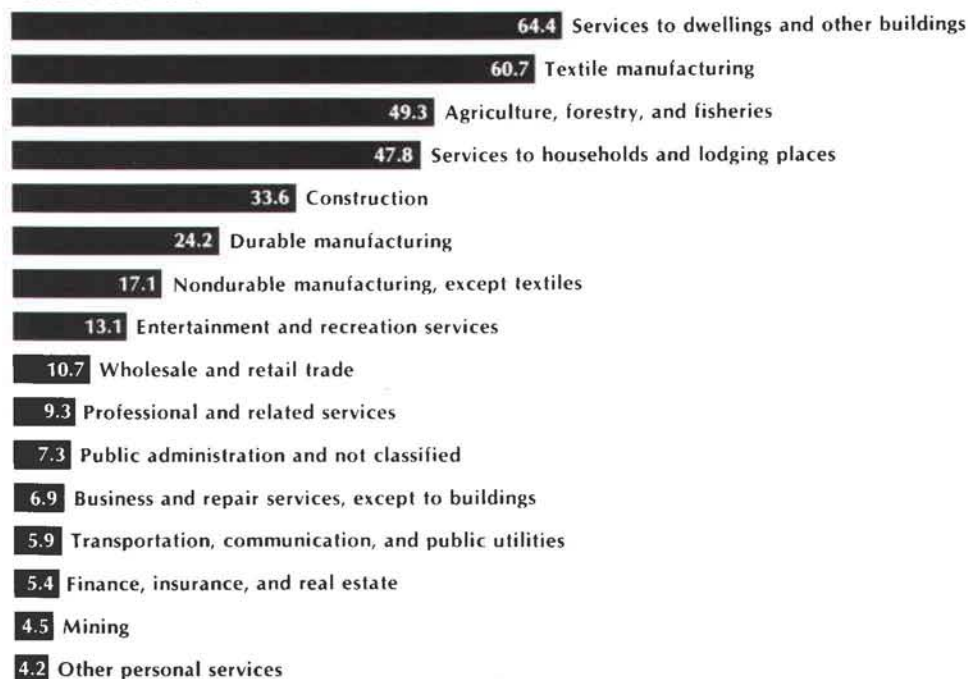
9. This division of the labor force corresponds to the standard practice of referring to "unskilled labor" and "skilled labor" as factors of production. The third factor commonly isolated is capital. In the present analysis, no substitution is allowed between unskilled labor and either of the other two factors. For a discussion of the effects of relaxing this restriction, see Hill, "The Economic Impact of Tighter U.S. border Security."

Chart 1

**Importance of 16 Combined Principal
Occupations to Texas Industries**

PERCENT OF INDUSTRY EMPLOYMENT

64.4	Services to dwellings and other buildings
60.7	Textile manufacturing
49.3	Agriculture, forestry, and fisheries
47.8	Services to households and lodging places
33.6	Construction
24.2	Durable manufacturing
17.1	Nondurable manufacturing, except textiles
13.1	Entertainment and recreation services
10.7	Wholesale and retail trade
9.3	Professional and related services
7.3	Public administration and not classified
6.9	Business and repair services, except to buildings
5.9	Transportation, communication, and public utilities
5.4	Finance, insurance, and real estate
4.5	Mining
4.2	Other personal services

SOURCE OF PRIMARY DATA: Public-Use Sample from the 1980 Census.

tion is an average that combines the labor-intensive fruit and vegetable operations near the border with Mexico and the land- and capital-intensive cattle, grain, and cotton producers in the North and West. Immigrants are concentrated in the labor-intensive sector,[10] which faces relatively inelastic demand[11] and has limited possibilities for substituting capital for labor. Thus, restricting immigration probably would lead to higher prices for fruits and vegetables, and some operators probably would withdraw from the market.

The effects on construction also vary. The industry can be divided into two sectors, residential and nonresidential. Although the Census codes do not identify the two sectors separately, the occupations sensitive to immigration probably account for a larger share of cost in the residential component. Nonresidential construction is both more skill intensive and more capital intensive. Consequently, home construction costs are more sensitive to immigration than are the costs of commercial and industrial buildings.

Durable manufacturing is the third major sector of the Texas economy that the chart identifies as

10. See *Immigration Reform and Agricultural Labor*, by Robert Coltrane, Economic Development Division, Economic Research Service, U.S. Department of Agriculture, Agricultural Economic Report no. 510 (Washington, D.C.: Government Printing Office, April 1984), for a discussion of the effect of reduced immigration on agriculture.

11. The basis for this assertion is that produce is perishable—and thus cannot be stored—and that alternative U.S. sources of supply are limited and are equally dependent on immigrant labor. Mexico represents a potential alternative source of supply for citrus and winter vegetables, but the potential is not likely to be realized. Restrictions on the importation of Mexican produce are likely to accompany immigration reform.

Table 5

IMPORTANCE OF 16 INDIVIDUAL PRINCIPAL OCCUPATIONS TO TEXAS INDUSTRIES

Industry group	Percent of industry employment							
	Farm workers	Construc-tion laborers	Laborers, except con-struction	Carpenters, except apprentices	Janitors and cleaners	Welders and cutters	Painters, construc-tion and mainte-nance	Machine operators, not specified
Agriculture, forestry, fisheries	40.7	0.1	1.1	0.1	0.3	0.2	0.0	0.3
Mining	0.0	.4	1.3	.1	.6	1.5	.1	.0
Construction	.0	12.4	0.0	12.8	.6	2.2	4.9	.3
Nondurable manufacturing, except textiles	.0	.1	3.1	.3	1.7	.8	.2	5.0
Textile manufacturing	.0	.0	2.0	.0	1.0	.1	.0	1.6
Durable manufacturing	.0	.1	2.5	.5	1.2	4.5	.3	4.4
Transportation, communication, public utilities	.0	.2	2.3	.2	1.0	.6	.1	.6
Wholesale and retail trade	.0	.0	1.8	.1	.9	.2	.1	.2
Finance, insurance, real estate	.0	.1	.3	.2	3.1	.0	.3	.0
Business and repair services, except to buildings	.0	.1	1.2	.1	.7	3.4	.2	.3
Services to dwellings and other buildings	.0	.0	1.0	.1	53.6	.0	.2	.2
Services to private households and lodging places	.0	.1	.8	.2	3.2	.0	.2	.0
Other personal services	.0	.0	.7	.0	1.3	.0	.0	.1
Entertainment and recreation services	.0	.1	1.0	.2	3.4	.0	.1	.2
Professional and related services	.0	.0	.2	.1	3.4	.0	.2	.1
Public administration, and not classified	.0	.2	1.5	.2	2.2	.2	.3	.2

sensitive to immigration changes. The ability of producers to increase prices in response to upward pressure on wages is more problematic here than in the case of agriculture or construction. Foreign supply of competing products has proved to be sensitive to appreciation of the dollar in recent years, so cost increases would be difficult to pass on. This high demand elasticity implies that reduced immigration might lead to lower output or to lower returns to other factors of production. Thus, immigration reform could make Texas less attractive to manufacturers of durable goods.

Individual occupations are sometimes concentrated in one or two industries, but more often they are dispersed across several. Table 5 presents the contribution, by each of the 16 individual occupations, to employment in the groups of industries. In some of the industries in which the 16 occupations account for a large share of employment, the contribution is confined to only one of the 16 occupations. This is the case, for example, in the textile manufacturing industry. In other industries, such as construction, several of the 16 occupations combine to form a large share of cost.

Table 5—Continued
IMPORTANCE OF 16 INDIVIDUAL PRINCIPAL OCCUPATIONS TO TEXAS INDUSTRIES

	Percent of industry employment							
	Grounds-keepers and gardeners	Assemblers	Textile sewing machine operators	Maids and housemen	Hand packers, packagers	Private cleaners, servants	Cooks, except short-order	Miscellaneous food preparation
Agriculture, forestry, fisheries	5.7	0.0	0.0	0.2	0.4	0.0	0.2	0.0
Mining	0.1	.3	.0	.0	.0	.0	.1	.0
Construction	.2	.2	.0	.1	.0	.0	.0	.0
Nondurable manufacturing, except textiles	.0	1.9	.3	.1	3.2	.0	.2	.1
Textile manufacturing	.0	1.1	52.9	.1	1.8	.0	.1	.1
Durable manufacturing	.0	9.5	.3	.1	.8	.0	.0	.0
Transportation, communication, public utilities	.1	.1	.0	.1	.3	.0	.2	.0
Wholesale and retail trade	.1	.3	.0	.1	.7	.0	4.7	1.5
Finance, insurance, real estate	.6	.0	.0	.7	.0	.0	.0	.0
Business and repair services, except to buildings	.1	.5	.0	.2	.1	.0	.1	.0
Services to dwellings and other buildings	.4	.0	.0	8.9	.0	.0	.1	.2
Services to private households and lodging places	2.0	.0	.0	14.7	.0	23.7	1.7	1.2
Other personal services	.1	.2	.9	.4	.2	.0	.1	.0
Entertainment and recreation services	3.4	.1	.0	.7	.0	.0	2.5	1.2
Professional and related services	.3	.1	.0	1.4	.0	.0	2.4	1.2
Public administration, and not classified	1.1	.2	.0	.4	.2	.0	.3	.1

SOURCE OF PRIMARY DATA: Public-Use Sample from the 1980 Census.

Concluding remarks

The analysis presented above has not produced any startling conclusions. Most of the findings add support to assertions already in circulation in discussions about the effects of illegal immigration. The conservative assumptions in this study are responsible for the uncontroversial quality of the results.

Substitution of immigrant labor for citizens' labor has been assumed to be confined to a small subset of the labor market. The group of workers affected by reduced immigration, however, is probably larger than the analysis implies. But specifying where additional substitution would occur becomes more speculative as one moves beyond the obvious cases covered above.

The potential of the Census data can be more fully exploited if one is willing to make slightly bolder assumptions. This can be done in several ways. The subset of the labor force used to identify the principal occupations of illegal immigrants could be expanded to Mexicans who speak English, but not fluently. Allowing greater occupational

mobility than was assumed is another possibility. Both these alternatives provide information on the longer-term effects of immigration reform.

An interesting way to extend the analysis would be to assume that reduced immigration would affect the occupations chosen by all people with limited education, not just people who work in the 16 occupations singled out above. Thus, consideration could be extended to other occupations that attract workers without high school degrees. Workers in these occupations also are likely to be affected by immigration because they and the workers in the 16 occupations are close substitutes.

The jobs that this extension brings into consideration generally require more interaction with legal institutions or with English-speaking customers and coworkers. A list of the leading occupations of Texas workers who have not completed high school is shown in Table 6. Among males, the principal additions are truck driving, auto repair, and supervisory work. Among females, additional common occupations include cashiering, waiting tables, hospital positions, and secretarial and clerical work.

Though these are not occupations that illegal immigrants can work in immediately upon arrival from Mexico, the compensation in these occupations may well be affected by immigration policy. If a decline in immigration produced higher wages in the 16 principal occupations listed in Table 2, those occupations might begin to attract people who otherwise would have found employment in the occupations shown in Table 6. This competition would then exert upward pressure on wages in the occupations listed in the preceding paragraph.

This example illustrates the flexibility of the analysis. It also demonstrates how any exercise of this nature is dependent on the analyst's assumptions. The range of defensible assumptions is wide, and specific conclusions are sensitive to the substitution possibilities allowed. But the results under varying conditions are worth exploring, because only then can the full range of possible effects of changing policy be brought to public attention. The Census data can be used to advantage in this effort.

Table 6
PRINCIPAL OCCUPATIONS OF TEXAS WORKERS NOT FINISHING HIGH SCHOOL

Occupation	Percent of employment[1]
Males	
1. Truck drivers	8.3
2. Supervisors	6.2
3. Construction laborers	4.1
4. Janitors and cleaners	3.9
5. Carpenters	3.8
6. Farm workers	3.5
7. Laborers, except construction	3.2
8. Welders and cutters	3.0
9. Automobile mechanics	2.8
10. Managers and administrators	2.6
SUM	41.4
Females	
1. Cashiers	6.0
2. Cooks, except short-order	5.3
3. Nursing aides, orderlies, and attendants	5.2
4. Waiters and waitresses	5.0
5. Textile sewing machine operators	5.0
6. Maids and housemen	4.0
7. Janitors and cleaners	3.5
8. Secretaries	3.0
9. Sales workers	3.0
10. Assemblers	2.9
SUM	42.9

1. Percentage of workers, by relevant sex, ages 16-60, residing in Texas, not finishing high school and not currently enrolled.
SOURCE OF PRIMARY DATA:
Public-Use Sample from the 1980 Census.

Appendix

A Review of the Census Data

The Census questionnaire

The data used in the study are obtained from the Census of Population and Housing, 1980, Public-Use Microdata Samples. The data are based on a stratified 5-percent sample of households in Texas, the largest sample publicly available from this source. The sample is a subsample of the full Census sample that received Census long-form questionnaires—19.4 percent of all households.

The questions relating to language were organized as follows. Individuals were first asked if they spoke a language at home other than English. If so, they were asked to report this second language. Individuals who spoke a language other than English outside but not within the home, as well as individuals whose use of a language other than English at home was very limited, were counted as speaking only English at home.

Individuals who did use substantially a language at home other than English were asked to indicate whether they spoke English (1) very well, (2) well, (3) not well, or (4) not at all. Individuals in the first category have no difficulty speaking English, those in the second have only minor problems, those in the third have serious limitations, and those in the fourth simply do not speak English.

The Census long-form questionnaire also included a question regarding place of birth, in which foreign-born persons were asked to report their country of birth. The responses were manually coded into a classification system consisting of over 250 foreign countries or groups of countries, as well as 22 categories for outlying areas of the United States. Mexico is identified as an individual country.

Completeness of Census coverage

The Census questionnaire was delivered, along with an instruction guide, to all households by postal carriers. Both were available in the Spanish language upon request. In most areas of the United States, the householders were requested to return the completed questionnaires by mail on April 1, 1980. If the questionnaire was not returned, an enumerator visited the address. If a questionnaire had an unacceptable number of incompletions or inconsistent answers, the household under question was contacted to obtain the necessary information.

Every housing unit in the country received either a short-form or a long-form questionnaire. The long-form version contained requests for information about the respondent's labor market activity (and other matters) that were not on the short form. A sampling procedure was used to determine which households were to receive the long-form questionnaires. In most areas of the country, about 17 percent of the housing units

Table A
GEOGRAPHIC DISTRIBUTION, BY RELEVANT SEX, OF IMMIGRANT WORKERS, BORN IN MEXICO, RESIDING IN TEXAS, SPEAKING SPANISH AT HOME BUT SPEAKING NO ENGLISH AT ALL

| Location | Percent | |
	Males	Females
Houston	25.2	13.9
El Paso	13.1	21.1
McAllen-Pharr-Edinburg	11.3	16.1
Dallas-Fort Worth	11.0	8.5
Brownsville-Harlingen-San Benito	7.7	10.0
San Antonio	5.5	4.6
Area outside SMSAs	11.1	10.8
Other	15.1	15.0

SOURCE OF PRIMARY DATA:
Public-Use Sample from the 1980 Census.

received the long-form version, while in smaller geographic subdivisions that number was expanded to 50 percent.[1]

Evidence to date indicates that efforts to improve the coverage of difficult-to-count populations were successful. The "undercount" of legal residents was less than 1 percent, and many more foreign-born residents were counted in 1980 than in 1970. The inclusion of large numbers of young male immigrants among Census respondents also lends support to the argument that coverage was high.[2] (Young males are the least accurately represented group in surveys of minority populations.)

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1. For a description of the data collection and processing procedures used in the Census, see U.S. Department of Commerce, Bureau of the Census, *1980 Census of Population and Housing, Users' Guide: Part A. Text*, PHC80-R1–A (Washington, D.C.: Government Printing Office, March 1982); *Part B. Glossary*, PHC80-R1–B (November 1982); *Part C. Index to Summary Tape Files 1 to 4*, PHC80-R1–C (November 1982).

2. These points are made by Jeffrey S. Passel and Karen A. Woodrow in "Geographic Distribution of Undocumented Immigrants: Estimates of Undocumented Aliens Counted in the 1980 Census by State," *International Migration Review* 18 (Fall 1984): 642-71.

Table B
CHARACTERISTICS OF SPANISH-SPEAKING IMMIGRANT WORKERS, BORN IN MEXICO, RESIDING IN TEXAS

Degree of English-speaking ability	Occupational distribution		Other characteristics				
	Number of occu-pations	Correlation with Texas population[1]	Mean education	Percent immigrating before 1975	Percent non-citizens	Mean wage per hour	Sample size
Males							
Very well	283	0.90	10.2	86.2	47	6.4	1,587
Well	243	.73	8.0	79.3	60	6.0	2,096
Not well	229	.62	5.8	62.3	76	5.6	2,791
Not at all	183	.49	4.2	46.0	82	5.4	1,917
Females							
Very well	157	.93	10.7	90.8	46	4.5	1,147
Well	151	.59	8.5	84.5	60	4.3	1,060
Not well	146	.40	6.1	73.5	77	4.0	1,406
Not at all	122	.30	4.6	59.9	80	3.7	1,230

1. Correlation between frequency distribution of immigrants in the respective language groups and Texas workers of the same sex. Denote the frequency for occupation i and group j as $F_{ij} = N_{ij}/N_j$, where N_{ij} is the number of workers of group j working in occupation i and where N_j is the sum of the N_{ij} over all values of i. For each sex, then, the figures in the table are correlations of F_{ip} with F_{ik}, where p represents the Texas labor force of the relevant sex and k ranges from 1 to 4, corresponding to the group's English-fluency rating.

SOURCE OF PRIMARY DATA: Public-Use Sample from the 1980 Census.

Such findings make analysts hopeful that Census data will provide a more representative picture of illegal immigrants than the direct surveys have. Direct surveys tend to overrepresent workers near the border and in work sites already known to contain illegals. Table A presents the geographic distributions of members of the group used to identify occupations in which illegals are likely to be employed. A significant portion of the sample resides in areas distant from the Mexico border, although metropolitan areas near the border are heavily represented. Thus, the Census data can provide information on the occupations and industries of illegals who seek employment in areas in the state away from the border of Mexico.

Response quality

The results of some preliminary tests for reliability are shown in Table B. The statistics are computed from the responses of immigrants who were born in Mexico and speak Spanish at home. The figures show that occupational choice and measures of skill and earnings are meaningfully correlated with English-speaking ability.

First, consider some basic properties of the occupational distribution. Spanish-speaking individuals who do not speak English would be expected to be able to compete only in occupations which do not require communication in English. Groups with a somewhat greater command of English should be employed in a wider range of occupations than those who cannot speak the language at all, but their occupational distribution should still be more concentrated than the distribution for those completely fluent in English. In column 1, the number of occupations in which individuals in the various English-speaking groups are employed increases consistently with English-speaking ability.

It also seems intuitive that the similarity of the occupational distributions of Spanish-speaking groups with that of the population as a whole should increase with English-speaking ability. Groups with severe limitations in their English-speaking proficiency should enter into occupations in different proportions than does the population as a whole, so that the correlation of their occupational distributions with that of the population should be relatively small. The correlation will be higher for groups whose command of English is somewhat higher. In column 2, the correlations of the occupational distributions of the various groups with the occupational distribution of the entire population of the same sex increase with English-speaking proficiency.

The qualitative aspects of these statistics in the first two columns are consistent with intuition and offer some reassurance about the reliability of the responses. The patterns in the distributions may not reflect the effects of English-speaking ability alone. Education and years spent in the United States are probably important as well.

Education should be positively related to English-speaking ability because Spanish speakers who received very little schooling are less likely to have learned English than those who spent more time in school. Mean education, shown in column 3, increases with English-speaking ability throughout the range of the latter variable.

One would expect English-speaking ability to increase with the duration of an individual's stay in the United States because people who have lived in the United States longer have had more opportunity to learn English. One would also expect that a larger fraction of people who speak English well would be citizens. Column 4 shows the percentages of immigrants who migrated after 1975. Higher values of this percentage are consistently associated with greater English-speaking ability. Under fairly general conditions, this correspondence implies that mean years since immigration and ability to speak English are positively related. In column 5, the percentage of those who are not citizens declines consistently with English fluency.

The mean wage rate should be positively related to English-speaking ability.[3] Proficiency in speaking English by itself raises a Spanish-speaker's value to some employers, and English-speaking ability is positively associated with other skills. Immigrants who speak better English are thus likely, on average, to receive higher wages. The mean wage rate in column 6 increases consistently with English-speaking ability, again confirming expectations.

These simple tests allay the obvious concerns one would have in using the Census sample. Even though the immigrants have a limited command of English, the questions about their work status were answered in a logically consistent way. Thus, the data appear to be reliable for broad issues such as those addressed in this article.

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3. Most research on the correlation between English proficiency and the earnings of Hispanic men residing in the United States concludes that differences in ability to speak English explain much of the difference between earnings of Hispanics and non-Hispanic whites. For evidence from a national sample, see Walter McManus, William Gould, and Finis Welch, "Earnings of Hispanic Men: The Role of English Language Proficiency," *Journal of Labor Economics* 1 (April 1983): 101-30. For evidence from Texas and California samples, see Alberto E. Davila, "Racial Earnings Differentials in Texas," *Economic Review*, Federal Reserve Bank of Dallas, November 1984, 13-22.

Effects of Reducing the Deficit with an Oil Import Tariff

Ronald H. Schmidt

Senior Economist
Federal Reserve Bank of Dallas

Roger H. Dunstan

Associate Economist
Federal Reserve Bank of Dallas

The concerns raised by the magnitude of the current U.S. budget deficit have increased interest among some lawmakers in sources of additional revenue.[1] Recent declines in oil prices, combined with the weakness in domestic energy industries, have focused some of that interest on taxing oil imports. Proponents argue that levying a tariff on imported oil would have the multiple advantages of generating revenues for the U.S. Treasury, promoting domestic oil exploration and production, and reducing dependence on foreign oil.[2]

An oil import tariff, however, would have widespread effects on the economy. As demonstrated by past responses to energy price increases, a rise in oil prices can induce changes in energy consumption that reduce the economy's aggregate output and raise unemployment during the adjustment process.

This paper examines the effects on the U.S. economy of an oil import tariff and discusses the national security issue of reducing oil imports.[3] In

particular, simulation experiments conducted with a large macroeconometric model examine the effect of an oil import tariff of $5 per barrel. The effects are measured against two standards: a base case with no tax imposed and a simulation imposing an income tax surcharge that raises the same revenue as the import tariff.

If a tax increase is considered necessary to reduce the budget deficit, the macroeconomic results tend to argue against adopting an oil import tariff.

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1. Addressing the Federal Government deficit is a controversial issue. Some believe that additional taxes are necessary to reduce the deficit. Others argue against new taxes because they believe that spending cuts or economic growth will eventually reduce the deficit. This article does not take a position on how, or even if, the federal deficit should be reduced. We concentrate on the impact of one suggested new tax, an oil import tariff.

2. For example, see Mark Potts, "Independent Oil Refiners Call for Import Protection," *Washington Post*, 22 February 1985, Business section; and "The Product Import Battle," *Oil Daily*, 22 February 1985, 4.

3. For expositional simplicity we have used the term "oil imports," which includes not only crude oil but also petroleum products.

Simulation results suggest that an income tax surcharge could raise equal revenues with less impact on the economy. The tariff was found to result in larger reductions in real gross national product (GNP) and employment and higher inflation than an income tax surcharge designed to raise equal revenue.

From the perspective of energy independence, the simulations provide evidence that oil imports could be reduced—at least during the period in which the tariff is maintained. The higher price resulting from the tariff does stimulate additional production during the term of the simulations.

In the long term, however, the tariff is unlikely to promote energy security. The most promising areas for major discoveries are in the Alaskan and offshore fields, which are expensive to explore and develop. As long as oil prices continue to trend downward and the tariff is expected to be lifted eventually, the financial prospects for finding reserves are likely to remain poor.

Tax distortions in the economy

Economic theory suggests that relative market prices of commodities tend to reflect a pattern of transactions and production that maximizes economic welfare. By changing relative prices, taxes alter the consumer's choice of commodities and a producer's use of inputs. Tax policies discourage consumption of commodities with prices that are higher after imposition of the tax and favor consumption of commodities with relatively lower prices as a result of the tax. Any tax that changes relative prices of different goods and services, therefore, distorts economic decision-making.

Assuming that a producer maximizes profits with his choice of inputs, purchased at the pretax rates, any changes the tax causes in producer behavior are likely to reduce output. Similarly, consumers choose goods that maximize their utility on the basis of after-tax prices. The imposition of a tax yields a less preferred outcome, unless the tax is imposed to correct existing distortions (such as taxes to reduce pollution or congestion).[4]

In practice, nearly all tax policies distort relative prices. The function of our study is to determine which tax results in the smallest distortion. Most research suggests that the amount of distortion varies directly with the price elasticity of demand for the commodity.[5] With a given percentage price increase, purchases of a commodity whose demand is elastic fall more than those of a commodity whose demand is inelastic.

The argument has further implications. Commodities for which demand is relatively elastic are often those for which substitutes are readily available. When taxes raise the price of such a commodity, consumers and producers decrease their use of the taxed commodity and increase their use of substitutes. As the tax induces consumers and producers to change their purchases, some of the burden of the tax is shifted to other commodities in the form of higher prices.

This process of shifting occurs with the oil import tariff. The tariff changes the relative price of a factor of production if, as we assume, the tax is included in the price charged to oil consumers. A producer faces higher costs and is likely to reduce output, lay off workers, and decrease capital utilization. Some of the increased cost of production is shifted forward to final consumers in the form of higher prices for goods using oil in their production. Energy users with the capability of switching between fuels—especially industrial consumers and electric utilities—can avoid the effects of price increase by switching to natural gas or coal.

Furthermore, fuel switching would probably bid up the prices of substitute energy products. These energy price increases would then force increases in the production costs of other goods. Such increases would result in further losses of real income for the consumers who purchase those goods.

The preceding discussion highlights the point that there is widespread shifting of the burden of some taxes. By causing producers and consumers to alter their decisions, such shifting may introduce inefficiencies or distortions into the economy that reduce

4. See William J. Baumol, "On Taxation and the Control of Externalities," *American Economic Review* 62 (June 1972): 307–22.

5. Optimal commodity taxation is based on the Ramsey pricing rule, which relates optimal tax rates inversely to the price elasticity of demand. See Anthony B. Atkinson and Joseph E. Stiglitz, *Lectures on Public Economics* (New York: McGraw-Hill Book Company, 1980), 366–93; and Arnold C. Harberger, "Three Basic Postulates for Applied Welfare Economics: An Interpretive Essay," *Journal of Economic Literature* 9 (September 1971): 785–97.

aggregate production. This shifting is not uniform for all taxes, however. An income tax surcharge would also generate some economic distortions but, if placed on all sources of income, would be more difficult to avoid. At the margin, it could induce some individuals to reduce investments or substitute leisure for work because the returns to work would fall relative to the returns to leisure. Nevertheless, the economic effects of introduced distortions are likely to be relatively small compared with those for an oil import tariff.

The degree to which a tax is shifted has one further important implication for revenue raising. If the tax is easily shifted (or applied to a small tax base), the rates applied to achieve a given revenue target must be higher than for a tax applied to a larger base that cannot be shifted easily. As discussed below, both the shifting capability and the smaller tax base in the oil import case forced the imposition of considerably larger tax rates on oil imports than on income to raise equal revenue.

Effects on the economy of an oil import tariff

Alternative tax plans have different effects on relative prices and economic growth. Deriving quantitative estimates of the relative effects of different tax policies is possible through the use of simulation models. Although all models are imperfect mirrors of the real world, they give some insight into the interrelationships of economic variables. A comparison of different scenarios can provide some information on the magnitudes of the potential consequences to help rank various tax policies.

Simulation experiments were conducted using a modified version of the MIT-Penn-SSRC (MPS) model of the U.S. economy. The model, which contains over 120 behavioral equations and over 200 identities, is operated and maintained by the Board of Governors of the Federal Reserve System. We modified the structural model to increase the detail in the energy sector, but the bulk of the model was unchanged. A discussion of the nature of the modifications made to the MPS model structure is presented in the Appendix.

Three simulations were conducted with the model: a base case with no tax increase, a case with an oil import tariff applied, and a case with an income tax surcharge. Because forecasts produced by simulation models depend on a large number of assumptions about other factors, only changes in

the tax parameters were allowed. Government expenditures, monetary growth rates, and oil prices, while allowed to change over time, were kept identical across scenarios.[6]

The simulations compared forecasts for the period from the first quarter of 1985 through the second quarter of 1988. Nominal oil prices were assumed to decline from $27.25 per barrel for imported oil at the beginning of 1985 to $24.75 per barrel by the end of the forecast period. Monetary policy was assumed to set growth rates for the money supply—in this case, M1—that fell from an average of 6.7 percent in 1985 to 4.5 percent in 1988. Nominal federal expenditures (less interest payments) were assumed to increase 17.5 percent between the first quarter of 1985 and the second quarter of 1988.[7]

Conducting the oil import tariff experiment required certain additional assumptions. For simplicity it was assumed that the Organization of Petroleum Exporting Countries (OPEC) does not or is unable to retaliate by imposing an oil embargo or raising prices.[8] A tax of $5 per barrel was imposed on all

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6. The experiments yielded differential increases in the consumer price index (CPI). The different increases in inflation, in turn, may have different effects on government expenditures that are indexed to the CPI. Because of the difficulty in determining which segments of government spending would be affected—the decision is political as well as statutory—such increases in nominal spending were ignored in both alternatives. Similarly, the responsiveness of Federal Government expenditures to slight changes in GNP was also ignored. Social service would be the category of spending most likely to be affected as unemployment rises. State and local governments are responsible for a significant portion of this spending category. It is unlikely that the marginal increases in Federal Government purchases would change the relative impact of the import tariff or income tax. If anything, the increased government spending required by the increased unemployment in the import tariff example would strengthen the case against the tariff.

7. Because comparisons are limited to those between scenarios, the assumed money growth rates, oil prices, and government expenditures are relatively insignificant. Although the level of GNP and most other variables would be changed if different assumptions were used, the differences between scenarios—which are the focus of this study—would not be materially affected.

8. Additionally, an oil import tariff may contravene the General Agreement on Tariffs and Trade, raising the possibility of countervailing tariffs by countries exporting petroleum to the United States. Nevertheless, we assume that such tariffs are not imposed.

imported oil for the period from the third quarter of 1985 to the middle of 1988, with the tariff revenues entering into the budget as federal customs duties. Because domestic oil prices were assumed to follow the after-tax price of imported oil, domestic oil prices increased by the amount of the tax.[9] The net effect of the tariff was to reduce the budget deficit an average of $8.6 billion in each of the three years.[10]

The income tax surcharge experiment was designed to raise the same amount of revenue as the oil import tariff over the same period. The resulting 2.2-percent tax rate was levied on aggregate taxable personal income after deductions, exemptions, and exclusions.

The results from the simulations provided evidence that the two tax policies would have significant macroeconomic effects. The immediate effect is a reduction of the deficit. Beyond that, both tax policies can be expected to lead to short-run declines in real GNP and employment because a reduction in the deficit without offsetting monetary policy is generally contractionary. Even though these policies reduce the deficit by an equal amount, however, the magnitudes of the real GNP and employment effects are quite different.

Differences in macroeconomic consequences stem from fundamental differences in the way the

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9. We assumed that coal and natural gas prices were not significantly affected by the tariff. The justification for this assumption is that most gas is contracted for long periods. Such contracts require considerable time to pass before gas prices can fully adjust to changes in oil prices. Only recently have some gas prices begun to fall, and others (especially for old gas) remain controlled at below market prices. The current surplus of coal and natural gas will also reduce upward pressure on prices.
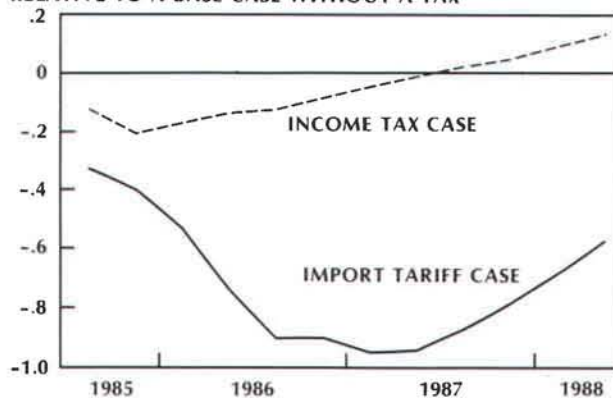
10. The tariff is a large percentage of oil prices because of the limited capability of the tariff to raise revenues. Although an oil import tariff stimulates revenues from the windfall' profit tax (through the effect on higher domestic oil prices), the windfall profit tax, the tariff, and the higher expenditures on oil are deducted from corporate income, reducing corporate income tax collections. The amount of the tariff is somewhat arbitrary, largely reflecting the amount various groups have suggested as appropriate. Part of the rationale for a $5 increase is that it would not raise nominal oil prices above the peak levels in 1980–81. The Congressional Budget Office also uses $5 in its analysis. See U.S. Congressional Budget Office, *Reducing the Deficit: Spending and Revenue Options*, pt. 2 of 1985 Annual Report (Washington, D.C.: Government Printing Office, February 1985).

two taxes distort the economic system. The import tariff affects the system by changing the price of a factor of production—oil. Because oil is an important factor of production, the higher price is passed on to the final prices of other goods, leading to a general increase in the price level. The increase in the price level affects the economy by raising nominal interest rates, driving down investment, and reducing the real wealth of consumers.

In contrast, an income tax surcharge has its principal effect on consumption, lowering aggregate demand for goods rather than changing relative factor prices and the price level. Both the inflation rate and interest rates are reduced by the income tax, but the magnitudes of these changes are minor compared with the increases in the import tax case. (For a more complete discussion of the differences in the effects of the two tax policies, see the accompanying box.)

In general, the income tax introduces smaller distortions than the import tariff. The tariff, by changing factor prices, has the dual effect of removing revenue from the economy through the tax as well as causing the price level to rise. In effect, the tariff is partially shifted to the rest of the system in the form of higher costs. The income tax, on the other hand, removes the same level of revenue from the economy without significantly affecting prices.

The different effects the tax policies have on real GNP are traced in Chart 1. For both the import tariff and the income tax cases, the percentage difference in GNP relative to GNP in the base case for the same period is plotted. The model projections indicate a substantially larger negative effect on the economy in the case of the import tariff than for the income tax surcharge. This effect was especially significant at the end of 1986 and in early 1987: GNP was nearly 1 percent lower as a result of the tariff, while the slowdown in the economy from the income tax was nearly over by then. In both cases the effects on GNP were diminished toward the end of the period.

The two tax policies also yielded measurable differences in unemployment rates. The unemployment rate during the latter half of the period was projected to be nearly four-tenths of a percentage point higher with an import tariff than in either the base case or the income tax case (Chart 2). This difference is equivalent to more than 400,000 jobs. Consistent with the hypothesis that an income tax is

Chart 1
Effects on Real GNP of the Two Policies

PERCENT CHANGE IN GNP
RELATIVE TO A BASE CASE WITHOUT A TAX

Chart 2
Effects on Unemployment

CHANGE IN UNEMPLOYMENT RATE FROM TAX POLICY

difficult to shift, the effect on employment in the income tax case was relatively small.

The increase in energy prices resulting from imposition of the import tariff led to an immediate acceleration of inflation. The wholesale price index for fuels jumped 12 percent immediately as a result of the tariff and remained essentially unchanged for the rest of the period. Because monetary policy, as measured by the growth rate of M1, was assumed not to react to the tax policies, the initial price changes in the oil tariff case caused nominal interest rates to rise compared with the other cases. It is worth noting that since the growth of M1 remained unchanged, the inflation rate subsequently slowed and eventually returned to the base case rate. By the end of the modeling period, the inflation rate was almost equal to the rate in the base case.

The two policies also had minor differential effects on international trade. The current account deficit decreased with imposition of the import tariff, partially offsetting the effect of the decline in GNP. The value of total imports fell, led by the drop in petroleum imports. The reduction in domestic consumption following the decline in GNP contributed to the fall in total imports.

The income tax scenario also yielded changes in exports and imports. The effects were minor, however, and generally followed the movements in GNP.

Because the import tax led to a relative change

in factor prices, effects on the use of inputs— particularly a shift toward less energy-intensive capital—should be expected. In the relatively short time horizon modeled in this scenario, however, significant changes in the mix of the capital stock did not emerge.

Energy independence

Despite the poor performance of the oil import tariff when compared with an income tax, other considerations—in particular, a desire to reduce dependence on foreign sources of energy—may still favor an oil import tariff. By raising oil prices, a tariff might increase domestic oil production and decrease oil imports, thereby making the United States less vulnerable to the threat of an oil supply disruption.[11] To some, this prospect makes the tariff

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11. Much of the recent concern about petroleum imports has stemmed from the issue of imported petroleum products. Reduced demand for petroleum products has left significant excess capacity in the refining industry. Many domestic refiners have closed plants, and more closures are threatened. The argument has been made that if additional refineries are closed, the domestic refining industry will not have enough capacity to supply all needed petroleum products in the event of an embargo or some other kind of supply disruption. The model did not contain sufficient detail to simulate the results for this industry. Presumably, petroleum product imports would be reduced by the tariff along with crude oil imports, providing some measure of protection for the domestic refining industry.

A Simplified Macroeconomic Model

The MPS model, like other large macroeconomic models, is an immensely complex structural model of the economy.[1] In the MPS model, over 300 variables are simultaneously determined for each period of the forecast horizon.

Despite this complexity, at the heart of most structural macroeconomic models—including the MPS model—lies a relatively simple theoretical framework known as an *IS-LM* model.[2] This simplified framework can be used to understand the differences generated by the two tax policies in the MPS model.

A typical *IS-LM* model is shown graphically in Figure A. It contains two curves, an *IS* curve and an *LM* curve, each drawn as a function of real income (GNP) and real interest rates. Each point along the *IS* curve represents an equilibrium combination of income and interest rates that is consistent with a specific level of government spending, consumption, and investment. Consumption and investment functions are assumed to be negatively related to interest rates and positively related to income. Consequently, the *IS* curve is downward sloping: equilibrium combinations with higher interest rates are consistent with lower consumption and investment levels—which implies lower income. The *IS* curve separates the possible combinations of income and interest rates into three regions: on the *IS* curve, where supply equals demand; to the right of the *IS* curve, where supply exceeds demand; and to the left of the curve, where demand exceeds supply. A reduction in government spending or an increase in taxes will shift the *IS* curve to the left.

Similar in construction, the *LM* function represents possible equilibrium combinations of real income and interest rates, given the current stock of money. Money demand is positively related to income and negatively related to interest rates; higher income levels are then consistent only with higher interest rates, given a constant money supply. Consequently, the *LM* curve is positively sloped. An increase in the money supply or a decrease in the price level shifts the *LM* curve to the right.

Typically in the *IS-LM* model, prices are held constant and output is allowed to change in response to excess supply or demand in the commodities market. The model can easily be extended, however, to allow
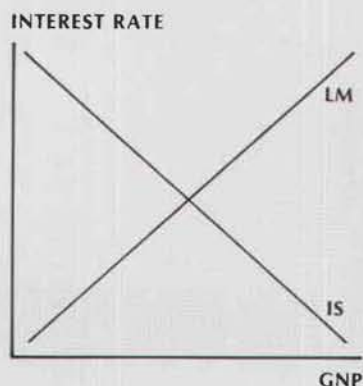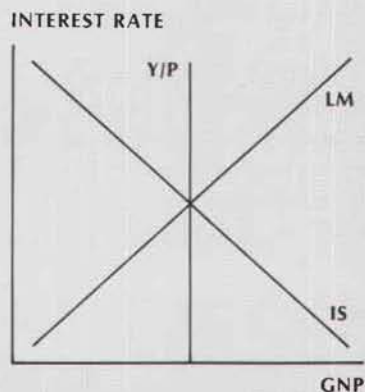
for variable prices by including a real output (*Y/P*) line (Figure B). The *Y/P* line represents the current level of output, given a particular combination of input prices and output prices. Output is assumed to be a function of factor inputs, including labor, capital, and energy. Firms are assumed to maximize profits and are free to hire each of the inputs; thus, the quantity of each input is determined by real input costs. An increase in the real unit price of labor, for example, will involve a reduction in the amount of labor hired and will lower output, shifting the *Y/P* line to the left.

Full equilibrium occurs at the point where the *IS* and *LM* curves and *Y/P* line intersect. The intersection

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1. Similar models are operated by Chase Econometrics, Data Resources, Inc., and Wharton Econometric Forecasting Associates.

2. A more complete description of the *IS-LM* framework can be found in most macroeconomics textbooks. See, for example, Robert J. Gordon, *Macroeconomics*, 2d ed. (Boston: Little, Brown and Company, 1981), or Charles W. Baird and Alexander E. Cassuto, *Macroeconomics: Monetary, Search, and Income Theories*, 2d ed. (Chicago: Science Research Associates, 1981).

Figure A
The IS-LM Model

INTEREST RATE

GNP

Figure B
The IS-LM Model with a Real Output (Y/P) Line Added

INTEREST RATE

GNP

represents a level of income, prices, and interest rates that satisfies equilibrium conditions simultaneously in the goods and money markets, given existing production relationships.

The different effects of the two tax policies can be explained by using this framework. Imposition of the income tax directly reduces consumption at each level of GNP and shifts the *IS* curve to the left. Decreased consumption leads to an excess supply of goods and to downward pressure on output prices. The lower product prices are not, in general, matched by equiproportional reductions in input prices, which raises factor costs to firms. Higher input costs cause firms to reduce output—a shift of the *Y/P* line to the left. As seen in Figure C, the new equilibrium solution has lower GNP and lower interest rates.[3]

The oil import tariff has a different effect. Because the tariff leads to an increase in the cost of a factor of production (oil), producers decrease use of that factor. Assuming that perfect substitutes for the input are not available, purchases of other factors decline and output is reduced. The *Y/P* line shifts to the left as output decreases, creating an excess demand for goods. Prices rise in response to the excess demand for goods, but the increase in the price level does not fully offset the higher input costs, leaving the *Y/P* line to the left of its original position. Because of the increase in the price level—and the assumption that monetary policy does not accommodate the higher price level—the real money supply falls. Eventually there is a leftward shift in the *LM* curve, which is consistent with a rise in interest rates (Figure D).

Without estimates of the relationships behind the *IS-LM* curves and the *Y/P* line, graphical comparisons of the relative effects of an import tariff and an income tax are difficult. Interest rates are clearly higher in the former case, but GNP is lower in both. The price level is also higher in the import tariff case.

In the model simulations, the decline in GNP is larger in the import tax case. For the most part, the reduction in GNP is the result of the effects of higher interest rates and prices on production and consumption. Lower prices and interest rates in the income tax case partially offset the decline in production, yielding smaller GNP reductions. Although there are also offsetting effects in the import tax case, these shifts are not as large.[4]

3. We have described only the principal shifts of the *IS, LM,* and *Y/P* curves for expositional clarity. As the economy moves to a new equilibrium, secondary shifts occur in all the curves in each case and clearly affect the final result, but the dominant effects are those described in the text.

4. For a more complete description of the relationships between wages, prices, interest rates, and output, see Flint Brayton and Eileen Mauskopf, "The MPS Model of the United States Economy," *Economic Modelling,* forthcoming, pt. 3.

Figure C
The Effect of Increasing Income Taxes
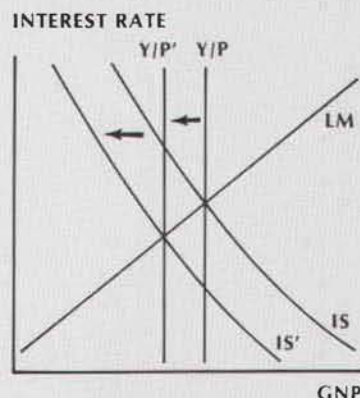
An increase in income taxes lowers consumption at each level of GNP, shifting the IS curve to the left to IS'. The resulting excess supply of goods leads to reduced final output prices, causing the Y/P line to shift to the left to Y/P'. A new equilibrium is established and has lower GNP and lower interest rates.

Figure D
The Effect of Imposing an Oil Import Tariff
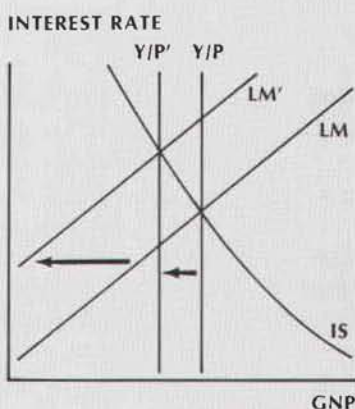
Imposing an oil import tariff increases production costs. Producers reduce output, shifting the Y/P line to Y/P'. Resulting excess demand for goods causes output prices to rise, leading to a leftward shift of the LM curve to LM'. The new equilibrium has lower GNP and higher interest rates.

Chart 3
Oil Imports

MILLIONS OF BARRELS PER DAY

Chart 4
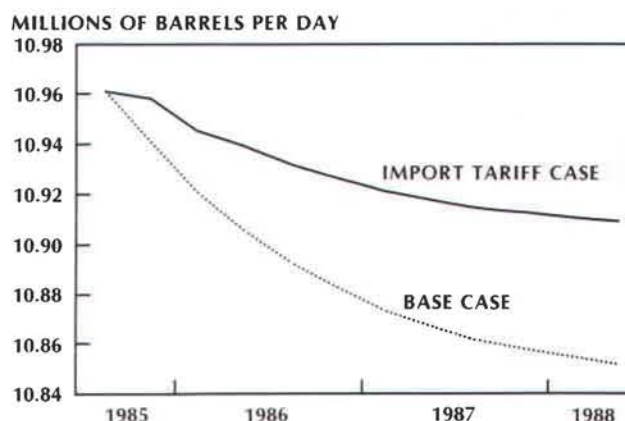**Domestic Oil Production**

MILLIONS OF BARRELS PER DAY
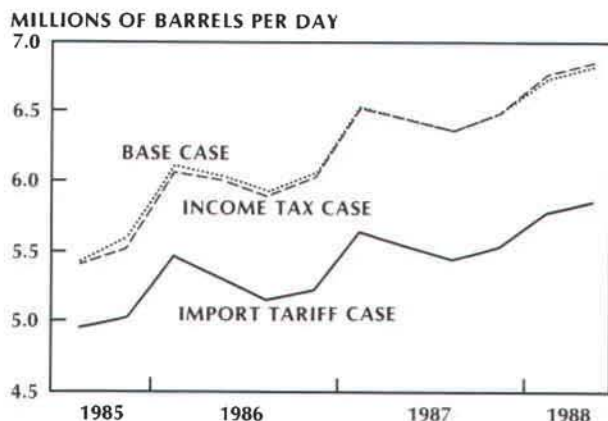
a doubly attractive tax instrument, despite the evidence that an import tariff would have stronger negative macroeconomic consequences than other possible tax plans.

The concern over dependence on foreign oil imports is not without merit. In response to U.S. support for Israel in the 1973 Middle East war, an embargo was imposed on oil shipments to the United States, and OPEC production was decreased. The resulting increase in prices contributed significantly to higher inflation and unemployment throughout much of the world. Despite increased non-OPEC production and reduced petroleum demand, OPEC remains an important, albeit diminished, source of supply for petroleum consumed in this country. The importance of OPEC, especially Arabian OPEC countries with large reserves, is likely to grow as reserves outside OPEC decline.

From the perspective of reduced petroleum imports, the simulations indicate that the oil import tariff would be successful. As shown in Chart 3, oil imports were virtually unchanged by the income tax surcharge but fell more than 14 percent (nearly 1 million barrels per day) with the tariff.

Similarly, while domestic oil production continued its long-term decline in all cases, the decline was slower in the import tariff case (Chart 4). The increased domestic price, it should be noted, did not reverse the trend toward reduced production. Even with the tariff, inflation-adjusted prices at the end of the period were lower than at the present time.

Consequently, the tariff could protect domestic producers in the near term, but the tariff does not fundamentally alter the pessimistic outlook for oil prices and domestic production.

There are, however, ambiguities with the general argument that an oil import tariff promotes energy independence. Most important, the national security argument requires the existence of high volumes of domestic production at the time of a crisis. If an oil import tariff merely increases current production at a time when there is no significant threat of a shutoff, long-term energy independence may actually be reduced. The policy may simply hasten depletion of existing reserves unless the tariff encourages domestic producers to discover and develop new fields that would otherwise not be developed.

It also needs to be recognized that the potential for large discoveries in the United States is somewhat limited, given the extensive exploration that has already occurred. The potential for large additions to reserves appears greatest in areas that are relatively expensive to develop, such as offshore or in Alaska. Since real oil prices decline in all scenarios, incentives to engage in new exploration are limited. This is especially true if the development costs are expected to be high, as they are with the Alaskan and offshore sources of oil.

The results generated by the MPS model in the oil import tariff experiment are typical of events that normally follow from protectionism. Domestic

energy industries gain from the tariff in the short run, but their gains are more than offset by losses in income and employment elsewhere in the economy.[12] Furthermore, if the policy is lifted after the three-year period, the normal processes of adjustment—the shift of resources away from energy to other industries—would be retarded by the tariff, making eventual adjustment more disruptive.

Overall, the effects on national security are ambiguous. The decline in the reserve base might be reversed or reduced, depending on the perception of the longevity of the tariff and the responsiveness of exploration activity to the higher domestic price. The import tax should lead to increased domestic oil production in the short run, although at the possible cost of reducing domestic reserves.

Conclusions

The results here generally argue against the use of an oil import tariff. Simulation experiments suggest that more broadly based taxes would have less distorting effects on the economy. Compared with an income tax surcharge, the import tariff was found to generate higher inflation and unemployment and lower GNP. The negative consequences of higher energy prices on output are considerably larger than the reduction in consumption caused by a tax on income.

From the perspective of energy independence, an oil import tariff may not have a significant effect on

augmenting reserves. Unless oil prices are expected to begin to rise, development of costly new reserves will be limited. Consequently, an oil import tariff would most likely encourage current production of oil at the expense of future production.

This research indicates the importance of the planned duration of the tax in designing an oil import tariff. If the tax is to promote domestic oil exploration and the development of alternative energy sources, it is essential that producers can be led to believe that the tax will not be quickly abandoned. From the perspective of increased energy conservation, consumers must also believe oil will remain expensive and that they should invest in energy-saving appliances and insulation.

Furthermore, if the tariff is to be temporary, the adjustment costs that would result with sudden removal of the tariff could be large. To the extent that the import tariff forestalls the more gradual decline in investment and employment that would ordinarily occur, the sudden removal of the tax would force a sharp adjustment to lower energy prices.

Finally, we assumed that an oil import tariff could be imposed unilaterally without retaliation by OPEC or other oil-exporting countries. In reality, OPEC or other oil-exporting countries could retaliate either by imposing an oil embargo on any country imposing a tariff or by imposing countervailing import tariffs on all goods and services from that country. On the other hand, such a move could trigger rapid price declines if the loss of exports cut further into OPEC's dwindling production and destabilized the cartel.

12. Similar results were reported in a recent study by Wharton Econometric Forecasting Associates. See Sharon Denny, "Product Import Tariff Could Harm General Economy, Panel Is Told," *Oil Daily*, 7 June 1985, 2.

Appendix

Changes to the MPS Model

The MPS (Massachusetts Institute of Technology–University of Pennsylvania–Social Science Research Council) model is an aggregate model of the U.S. economy.[1] The model, which is maintained and modified by the staff of the Board of Governors of the Federal Reserve System, has been used over the years as a tool to provide input into the possible consequences of monetary and fiscal policy regimes.

The model currently contains 332 structural equations: 124 behavioral equations and 208 identities. At its center is a growth model of the economy, with output generated by a Cobb-Douglas production function that uses labor, capital, and energy and with consumption decisions based on life-cycle theories. Forecasts

1. See Flint Brayton and Eileen Mauskopf, "The MPS Model of the United States Economy," *Economic Modelling*, forthcoming, for a detailed discussion of the model and its properties.

are made on a quarterly basis.

Considerable detail is included to model taxation. Income taxes are formed through a complicated procedure that takes into account different marginal tax brackets, deductions, exemptions, and exclusions, weighted by demographic factors. Corporate taxes are levied on corporate income after removal of other taxes (including customs duties and state taxes), expenses, and depreciation, with the treatment of depreciation changing as tax codes change over time.

The international sector is represented, with the exchange rate determined in the model to equilibrate the current account and capital account flows. The value of imported oil is included in the international trade flows.

Before our changes, the energy sector of the original model was for the most part exogenous. Total Btu (British thermal unit) consumption was determined endogenously as a function of the wholesale price index of fuels and real GNP, with all energy prices determined exogenously. Energy consumption was then divided among fuels by applying exogenously specified shares. Domestic production was determined exogenously, with imports specified as the difference between domestic consumption and production. Energy prices generally affect the rest of the model through investment in capital equipment and consumption of durables (including automobiles). Exogenously determined windfall profit tax receipts are included as indirect business taxes, which appear in the federal budget identity and the calculation of corporate income.

To conduct the experiments discussed in this paper, several additions and alterations were required. First, the shares of petroleum, natural gas, and coal consumption were made endogenous by estimating share equations for petroleum and coal as a function of time and the price of each fuel relative to the prices of other goods. A relative increase in petroleum prices then leads to an erosion of petroleum's share of total energy consumption. The share equations were of the form

(1) $OILSHR = .6687 - .0019\ TIME$
  $(6.45)\quad (-2.50)$

  $- .0622\ [\ln(OILP)/\ln(OTHER)]$
  (-8.03)

  $+ .0690\ [\ln(NGASP)/\ln(OTHER)]$
  (3.83)

  $+ .0498\ [\ln(COALP)/\ln(OTHER)]$
  (1.12)

and

(2) $COALSHR = -.0890 + .0026\ TIME$
  $(-1.49)\quad (6.01)$

  $+ .0239\ [\ln(OILP)/\ln(OTHER)]$
  (5.35)

  $- .0389\ [\ln(NGASP)/\ln(OTHER)]$
  (-3.75)

  $- .0070\ [\ln(COALP)/\ln(OTHER)],$
  $(-.27)$

where OILP, NGASP, COALP, and OTHER are price indexes for oil, natural gas, coal, and non-energy goods. The share of energy attributed to natural gas is the residual. Figures in parentheses are t statistics.

Second, to capture the effect of changes in oil prices on domestic production, a domestic oil supply equation (OIL) was estimated and included in the model:

(3) $\ln(OIL) = .6757 + .3990\ \ln(OIL_{t-1})$
  $(2.88)\quad (2.74)$

  $+ .2922\ \ln(OIL_{t-2})$
  (2.16)

  $+ .0093\ \ln(OILP_t).$
  (2.35)

Third, to determine the windfall profit tax revenues endogenously beginning in the third quarter of 1985, the following formula was used:
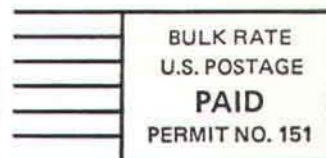
(4) $WPT = (OILP - BASE) \cdot RATE \cdot OIL,$

where the BASE price is set at $22 per barrel and appreciates 1.6 percent each quarter, the tax RATE is set at 25 percent, and total domestic oil production (OIL) is measured in billions of barrels per year. (In calculating national income account figures, all variables are put in annual terms.) The quarterly growth rate of 1.6 percent (6.55 percent at an annual rate) was chosen to proxy for a real increase of zero to 2 percent in the base price (assuming inflation is slightly above 5 percent).[2]

It is worth noting that the revenues from imposition of an import tax cannot be calculated by multiplying the amount of the tariff by the quantity of imports. First, the increased domestic price leads to higher windfall profit tax collections. Second, revenues from the tariff and windfall profit tax, as indirect business taxes, are deducted from corporate income. This process reduces revenues from the corporate profits tax. Lastly, demand for imports falls as a result of the higher price of petroleum.

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2. This procedure grossly simplifies the actual calculation of the windfall profit tax. In actuality, domestic oil production is classified into three general tiers, each of which has a different base price that appreciates at different rates. The tax for a tier is then determined as the difference between the selling price and the base price for that category multiplied by a tax rate that is specific to each tier. The total revenues calculated using this procedure were approximately the same as those estimated by the U.S. Congressional Budget Office in *Reducing the Deficit: Spending and Revenue Options*, pt. 2 of 1985 Annual Report (Washington, D.C.: Government Printing Office, February 1985).