A California Oil Severance Tax: Who Gains? Who Pays?

Frank Camm and Christopher W. Myers
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PREFACE

This is the first in a series of Rand reports that explain how certain public policies and socioeconomic trends are likely to affect specific regions, industries, and individuals. The Rand Corporation has a continuing, strong commitment to research on these distributional consequences. Objective information improves the quality of the policy debate: When there is no consensus on the magnitude of gains and losses, policymakers must often rely on conflicting claims of affected parties. Further, policy actions may have major, unintended consequences. By identifying as many of them as possible, research can contribute to better, more comprehensive policies. Better understanding of distributional consequences may suggest policy designs that enhance the political feasibility of a desired change. Finally, such research contributes to the assessment of alternative policy proposals.

This report presents the principal findings of a Rand Corporation study of oil severance taxation in California. The California State Assembly began to consider a new severance tax on oil production in 1981. The Assembly supported research at Rand to determine what the principal effects of such a tax would be. That research established the range of potential revenues the tax would raise for the state and then estimated what share of these revenues would come from oil producers, refiners, and consumers and what share would come from the federal and other state governments. The research indicated that many California policymakers would find a severance tax attractive. The Rand Corporation takes no position on the desirability of such a tax. We examined neither alternative sources of revenue within California nor whether California requires new revenues. The research looked only at the severance tax itself and reported its probable effects as objectively as possible.

Our results are likely to interest not only the California policy community but a broader audience outside the state. The tax itself would have important effects outside California. Further, the methods for examining a hypothetical tax in California could be used to provide insights about oil severance taxes that other states now or in the future might levy to generate revenue. This summary report was produced out of Rand's own corporate funds to inform a wider audience about this important research.

\footnote{For a detailed account of that research and its results, see F. Camm et al., \textit{Effects of a Severance Tax on Oil Produced in California}, The Rand Corporation, R-2940-CSA, September 1982.}
SUMMARY

All the major oil-producing states in the country, except California, have revenue-producing oil severance taxes, typically percentage taxes on the gross revenue generated by oil production. As federal aid declines and voters increasingly resist higher personal income and property taxes, states have increased their use of such excise taxes. Since 1980, almost half of all the states have considered imposing new severance taxes or raising existing ones. As of fall 1982, California was considering a new oil severance tax in the range of 2 to 7 percent.

To perform the analytic tasks necessary to understand the complex effects of severance taxes, we used an extensive data base on the characteristics of individual California oil properties, constructed formal tax-incidence and production-planning models, and conducted a statistical analysis of oil investment decisions during 1981. The methods and models developed for this study permit us to estimate the aggregate effects of new severance taxes in California, and they should also apply both to severance taxes in other states and to other natural resources besides oil.

An oil severance tax would provide substantial revenue for California—$125 to $450 million annually. Even though severance taxes reduce state and local revenues from other sources, the state would still net 76 percent of these new revenues from oil produced on state lands and 96 percent from oil produced on private lands.

The tax would be formally imposed on oil producers, but most of the new state revenue would not come out of their profits. Taxing authorities outside California would effectively "pay" part of the producers' share, because severance taxes could be deducted from producers' federal and other-state tax liabilities. Other states would lose little, but the federal government could subsidize well over half the severance tax. If California succeeded in raising $400 million through a new severance tax, and the tax did not affect oil prices paid by consumers much, federal revenues could fall by $300 to $425 million.

Given these reductions in other tax liabilities, producers could wind up paying only 35 to 70 percent of the severance tax bill. That fraction would be further reduced if they were able to shift some of the tax to refiners and consumers through higher prices. However, producers and refiners cannot price their products above world market levels when substitutes from out of state are available. California refiners would probably have to accept California producers' higher prices for
heavy crude oil, but they can readily find substitutes for California light crude. Producers could therefore not shift much of the tax for light crude oil to refiners. Because California consumers can find substitutes for most refined oil products, except, notably, bunker fuel oil, refiners could not pass much of the tax on to consumers.

The severance tax would affect different producers' profits differently, depending on exemptions contained in the tax law, a property's windfall profit tax status, and any production cuts induced by the tax. The tax burden on producers should grow as the windfall profit tax is phased out and production cuts increase in response to the severance tax.

These conclusions about who pays the tax are sensitive to the amount that can be passed forward to consumers. If enough is passed forward, a potentially large portion of the losses in federal revenues could be offset when higher oil prices raise corporation income and windfall profit tax receipts. Outside the United States, oil producers could retain most of the new income generated by a price rise, suggesting that some multinational firms could benefit from a severance tax in California. We did not address these issues, but they warrant careful attention in the future. We currently expect little of the tax to be passed forward.

In the short run, total production would not suffer much, largely because wells that became unprofitable under the tax would be the least productive wells. For the vast majority of properties, a 6 percent tax would induce production cuts below 1 percent. Nevertheless, these cuts would have a slow cumulative effect on production, and that effect would be greater if the tax caused firms to delay or cancel new investment in properties.

New investment takes a long while to affect production: After two years, post-tax investment would account for only about 15 percent of total production; but after nine years, it could account for as much as 50 percent. When real oil prices are rising, a severance tax is more likely to delay than to cancel new investment. Nonetheless, delay reduces total production from new investment over the next ten years or longer. When the effects that a 6 percent tax has on new investment are considered, annual production ten years following a tax could fall as much as 4 percent.

In all, our study indicates that:

- Severance taxes can provide states with new net revenues;
- The financial burden of those revenues falls mostly out of state, principally on the federal government;
- Oil producers and refiners also bear a sizable portion of the tax, and this portion grows as the windfall profit tax phases out and production cuts increase; and
- Negative effects on production—at least in California—would be small in the few years after a tax, but could grow over time.
ACKNOWLEDGMENTS

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I. INTRODUCTION

Oil severance taxes provide oil-producing states with a potentially rising source of income. As of the fall of 1982, all the major producing states except California use oil severance taxes to collect revenues from oil production. Because these taxes are usually tied to total revenue generated by oil production, they tend to rise as oil prices rise. According to some estimates, oil decontrol will raise over $100 billion in new state revenue during the 1980s even if severance tax rates remain at current levels. In fact, those rates will probably rise. Such a rich source of tax revenues is bound to attract the interest of states at a time when they find federal aid harder to get and new personal income and real property taxes harder to impose. Since 1980, almost half the states have considered legislation to adopt new oil severance taxes or raise existing ones.

With this growing interest in oil severance taxes, policymakers and analysts should understand exactly how these taxes will affect government tax revenues and oil companies' profits and production. California legislators are considering imposing a revenue-generating oil severance tax. This report examines the key effects a California severance tax would have and pinpoints the lessons we can learn from California about the effects of severance taxes more generally.

Several features make a severance tax an effective revenue source for California: It raises net revenues considerably, much of the burden falls outside California borders, and it affects consumers very little. Because companies can deduct severance taxes from federal and other tax liabilities, non-California taxing authorities "pay" much of the tax. In fact, the severance tax causes considerable reductions in federal tax revenues, which subsidize well over half the severance tax burden imposed on producers. Of the remaining burden on producers, part may be shifted to refiners of heavy oil, but not of light oil. However, refiners can shift the burden to consumers for only one heavy oil product, bunker fuel oil, which is used as ship fuel.

1 A severance tax is simply an excise tax on the production of oil, coal, natural gas, or other minerals produced in the state. Oil severance taxes are levied as a specific dollar amount per barrel or as a percentage of revenues generated by oil producers. Currently, Alaska, Florida, Louisiana, New Mexico, North Dakota, Oklahoma, Texas, and Wyoming have revenue-generating oil severance taxes.

2 More details about the results and conclusions reported here may be found in F. Camm et al., Effects of a Severance Tax on Oil Produced in California, The Rand Corporation, R-2940-CSA, September 1982. Hereafter cited as Camm et al. (1982).
As of fall 1982 there were tax bills before the California Assembly and Senate proposing severance taxes ranging from around 2 percent to 7 percent. The higher level taxes could raise as much as $450 million a year. The tax would be levied on oil producers within the state, with the largest proportion coming from the 30 firms that account for 95 percent of the state's oil production. As Table 1 indicates, some of these major producers are not well known, especially outside the state, but many are among the better known multinational oil companies. On this basis alone, revenue-producing severance taxes imposed in California will have ramifications far beyond state borders.

To estimate the effect on production, we constructed a detailed data base on the characteristics of individual oil properties. Using a state-provided file listing 47,000 producing oil wells in California, we created units of observation that approximate individual oil properties in the state. For each "property," we collected information on producer characteristics, geological nature, prices, oil produced, techniques for producing it, etc.

To establish the producers' ability to pass some of the tax on to refiners and consumers, we examined the extent of California's integration in external markets through a series of price comparisons for crude oil and petroleum products in California and Texas—the major U.S. oil market.

To understand how the severance tax might be shifted to other taxing authorities and affect other tax revenues, we constructed a formal tax-incidence model allowing us to: (1) examine seven major taxes that affect oil production in California, (2) show how a change in any one of these affects revenue collection from the others, and (3) show how a change in any tax affects corporate profits net of taxes.

To assess the short-term effects on production, we constructed a simple production-planning model. With it, we can determine how profitable individual wells or properties will be, using information on oil prices, production costs, taxes, etc. This model is particularly useful for determining what kinds of properties would become unprofitable under the new severance tax.

To discover how the tax might affect future production, we conducted a statistical analysis of investment decisions made during 1981. Using data from the property-characteristics file, we asked what spe-

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3Some of these lesser known companies have a deceptively low profile. For example, the THUMS Corporation is actually a consortium owned by Texaco, Humble (now Exxon), Union, Mobil, and Shell.

4For more detailed discussion of the data and methodology, see R. Y. Arguden, "Management of Large Data Sets: A Case Study with California Oil Wells," The Rand Corporation, P-6802, August 1982.
Table 1  

**Top Producers of California's Oil**

<table>
<thead>
<tr>
<th>Operator</th>
<th>Annual Oil Production</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Williams Brothers Engineering</td>
<td>62,707,093</td>
<td>17.7</td>
</tr>
<tr>
<td>2. Shell California Production Inc.(^a)</td>
<td>55,733,427</td>
<td>15.2</td>
</tr>
<tr>
<td>3. Getty Oil Company</td>
<td>44,206,993</td>
<td>12.5</td>
</tr>
<tr>
<td>4. Chevron USA, Inc.</td>
<td>37,173,331</td>
<td>10.5</td>
</tr>
<tr>
<td>5. Thums Long Beach Company</td>
<td>22,802,000</td>
<td>6.4</td>
</tr>
<tr>
<td>6. Union Oil</td>
<td>15,341,216</td>
<td>4.3</td>
</tr>
<tr>
<td>7. Mobil Oil</td>
<td>14,952,041</td>
<td>4.2</td>
</tr>
<tr>
<td>8. Texaco</td>
<td>12,518,785</td>
<td>3.5</td>
</tr>
<tr>
<td>9. Santa Fe Energy Company</td>
<td>11,010,746</td>
<td>3.1</td>
</tr>
<tr>
<td>10. Aminoil</td>
<td>7,646,622</td>
<td>2.2</td>
</tr>
<tr>
<td>11. ARCO</td>
<td>7,017,299</td>
<td>2.0</td>
</tr>
<tr>
<td>12. Tenneco Oil Company</td>
<td>5,861,087</td>
<td>1.6</td>
</tr>
<tr>
<td>13. Exxon Corporation</td>
<td>5,779,800</td>
<td>1.6</td>
</tr>
<tr>
<td>14. Sun Exploration &amp; Production Company</td>
<td>5,511,224</td>
<td>1.6</td>
</tr>
<tr>
<td>15. Champlin Petroleum Company</td>
<td>4,177,732</td>
<td>1.2</td>
</tr>
<tr>
<td>16. Conoco, Inc.</td>
<td>4,090,849</td>
<td>1.2</td>
</tr>
<tr>
<td>17. Long Beach Oil Development Company</td>
<td>3,589,676</td>
<td>1.0</td>
</tr>
<tr>
<td>18. Gulf Oil Corporation</td>
<td>3,388,037</td>
<td>1.0</td>
</tr>
<tr>
<td>19. Petro-Lewis Corporation</td>
<td>2,158,537</td>
<td>.6</td>
</tr>
<tr>
<td>20. Occidental Petroleum Corporation</td>
<td>2,079,949</td>
<td>.6</td>
</tr>
<tr>
<td>21. Getty Oil Company, Operator(^b)</td>
<td>1,451,374</td>
<td>.4</td>
</tr>
<tr>
<td>22. M.H. Whittier Corporation</td>
<td>1,308,348</td>
<td>.4</td>
</tr>
<tr>
<td>23. MCO Holdings, Inc.</td>
<td>1,205,977</td>
<td>.3</td>
</tr>
<tr>
<td>24. Powerine Oil Company—Long Beach</td>
<td>1,147,735</td>
<td>.3</td>
</tr>
<tr>
<td>25. Tenneco Oil Company, Operator(^b)</td>
<td>1,143,702</td>
<td>.3</td>
</tr>
<tr>
<td>26. Grace Petroleum Company</td>
<td>995,385</td>
<td>.3</td>
</tr>
<tr>
<td>27. Husky Oil Company</td>
<td>962,769</td>
<td>.3</td>
</tr>
<tr>
<td>28. Superior Oil Company</td>
<td>944,209</td>
<td>.3</td>
</tr>
<tr>
<td>29. General American Oil Company of Texas</td>
<td>784,561</td>
<td>.2</td>
</tr>
<tr>
<td>30. Victory Oil Company</td>
<td>740,932</td>
<td>.2</td>
</tr>
</tbody>
</table>

\[335,431,436 \ (95\%)]

**Source:** California Division of Oil and Gas.

\(^a\)Includes Kernridge.

\(^b\)Reported for unit operations.
cific characteristics enhanced the probability that new investments would be made on the property that year.

These methods and models can be adapted to estimate effects of severance taxes in other states and on other natural resources in California and elsewhere.
II. DISTRIBUTIONAL CONSEQUENCES
OF SEVERANCE TAXES

The growing interest in severance taxes implies that states find
them financially and politically attractive. Our analysis indicates
that although states imposing them benefit substantially, there are
some surprising consequences for federal revenues and oil producers’
tax burdens.¹

Although California produces just under one million barrels a day—
about 11 percent of the nation’s oil—it imposed only a nominal sever-
ance tax of $.0164 per barrel as of 1981.² In contrast, Texas charges
4.6 percent. New Mexico uses three different severance taxes that
total 6.5 percent, and Alaska charges 15 percent on most properties,
all to produce state tax revenues.

HOW MUCH REVENUE WOULD OIL SEVERANCE
TAXES RAISE FOR CALIFORNIA?

To determine how much revenue oil severance taxes would raise,
consider how a severance tax would affect revenues from other Cali-
ifornia state and local taxes. Severance taxes are deductible from state
income taxes and reduce assessed property values. Hence, increasing
the severance tax reduces tax collections from these sources. There is
a considerable difference in tax yield for oil produced on private and
state lands. The lefthand column in Fig. 1 represents the tax yield for
private lands. For every dollar of severance tax California raises from
production there, the state will lose up to two cents in income tax, and
local governments will lose up to two cents in property taxes—a total
of four cents at most. As the righthand column shows, the yield for
state lands is lower because when the severance tax reduces oil pro-
duction, it reduces the state royalties on production, which vary from
about 16 to 50 percent across the state.³ The figure uses the average
royalty of about 30 percent. For every dollar in severance taxes from

¹We assume that no other state reacts to the new state’s severance tax by changing
its taxes in turn. Our results do not imply that every state with a severance tax today
is better off than it would be if no state had a severance tax.
²It is designed specifically to cover the operating budget of the California Division of
Oil and Gas.
³We have excluded public lands in the Long Beach Tidelands, where special royalty
arrangements make the net revenue yield of a severance tax so low that the state would
probably not apply severance taxes.
Fig. 1—Effect of severance tax on other California revenues

oil production on state lands, the state would lose up to two cents of income tax and, on average, 20 cents in state royalties. Combined with a loss of two cents in local property taxes, this totals 24 cents at most on the average property.

Although this royalty loss is considerable, it is still quite small compared with the large revenues raised by the severance taxes. The state is considering severance taxes that would generate between $125 million and $450 million in payments annually. By our calculations, the state would net at least 96 percent of these taxes on private
lands and 76 percent on public lands—a sizable net revenue gain.\textsuperscript{4} Because private land accounts for over 90 percent of the oil production likely to be taxed, a net yield of 95 percent for the state as a whole is a reasonable expectation.

WHO WOULD PAY THE TAX?

Formally, the severance tax is imposed on oil producers. But our research indicates that not all of the new state revenue would come out of their profits. The amount they actually pay is the amount by which their after-tax profits fall when the tax is imposed. In addition to its effect on California taxes, the severance tax would reduce producers’ tax liabilities for income taxes in some other states and for federal income and windfall profit taxes. Indeed, these reductions shift the tax burden away from oil companies rather dramatically. As Fig. 2 shows, when the tax has no effect on production, taxing authorities wind up “paying” a considerable portion of the severance tax bill.\textsuperscript{5} Moreover, oil producers might be able to shift part of the tax forward to refiners and consumers.

Effects on Other States’ Tax Revenues

Many oil firms have operations in several states. If those states use unitary tax arrangements, they would, in effect, pay part of the firms’ California severance tax bill. Under unitary arrangements, corporations pay state income taxes on the state’s “fair share” of their national or international earnings, rather than on their earnings in that state. If a severance tax in California reduces profits for corporations, it reduces their national or international profits, in which case the corporations will pay less income tax under unitary arrangements in other states.\textsuperscript{6}

Looking at unitary arrangements in various states, we found that a severance tax would have small effects on other states’ tax collections. For every dollar of severance tax California might raise (on private or public lands), the other affected states would lose about one to three

\textsuperscript{4}We assume the state makes up the local government property tax revenue loss.

\textsuperscript{5}As we will demonstrate below, even though the producers’ share grows with production cuts, over time the federal government will continue to shoulder a large part of the burden.

\textsuperscript{6}Of course, California uses unitary arrangements, so it also loses tax revenue when severance taxes are imposed in other states.
Fig. 2—Fraction of severance taxes borne by oil companies
(Based on midpoint estimates; assumes no production effect; WPT Tier 2; excludes shareholder effect.)

cents of tax revenue. As the figure shows, these reductions would lighten the severance tax burden slightly for producers.

Effect on Federal Tax Revenues

The tax system would shift a large part of the severance tax burden to the federal government. The severance tax would have the greatest effect on federal windfall profit and corporate income taxes. Assuming that the severance tax does not affect production, its influence on federal revenues is primarily determined by a property's status under the federal windfall profit tax (WPT)—the higher the marginal rate of WPT, the more a severance tax reduces a producer's federal tax
liability. However, the tax also affects federal revenues because corporate profits are taxed twice—once as corporate income and once as dividends or capital gains to stockholders. As the severance tax reduces corporate profits, it reduces dividend payments and capital gains and, hence, federal tax receipts from shareholders' income taxes.

Figure 3 shows the loss in federal revenues, per dollar of severance tax collected, for properties in the various WPT tiers. For oil in Tier 1, where the marginal rate of the windfall profit tax is high, federal revenues will fall up to 80 cents for every dollar of state severance tax revenues. About 60 cents of this is from corporation taxes. The remaining 20 cents is the maximum probable loss of personal income taxes paid by the shareholders who ultimately receive corporate profits. For WPT tiers that have lower marginal rates, federal revenue losses are also lower. Nevertheless, the federal government still loses as much as 70 cents for every severance tax dollar collected in California, even when there is no windfall profit tax. Should California succeed in raising $450 million through a new severance tax, federal revenues could fall by $325 million or more—if the tax does not affect production. But what if it does?

Figure 4 shows the effects of moderate (3 percent) and large (6 percent) production cuts, both induced by a 6 percent severance tax. These levels represent the sizes of production cuts we might expect on individual properties. We discuss the actual levels of production cuts we expect for the state as a whole below. Production cuts clearly intensify the pattern of effects on federal revenues across the WPT tiers. Cuts in production cause additional federal revenue losses in each tier; and the larger the production cut, the greater the reduction in federal tax revenues. Double taxation of profits accounts for part of this growth. In addition, taxes cause inefficiencies in production that actually destroy wealth. Because the level of oil taxes gives the federal government such a large share of oil wealth (at the margin), federal revenues suffer more as losses in wealth rise. For example, if a property falls into WPT Tier 1 and the severance tax induces a 6

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7Although the windfall profit tax is a complex tax, it can be viewed simply as a federal severance tax that applies different tax rates to different types of oil. Old oil, in "Tier 1," is taxed at 22 to 31 percent. "Tier 2" oil is taxed at 10 to 20 percent. New, higher cost oil, in "Tier 3," is taxed at 8 percent. These rates will fall over time until the tax phases out in the early 1990s. State severance taxes are generally deductible from the tax base used to calculate the WPT. Hence, when a high WPT rate applies, a new severance tax cuts federal tax liabilities more than when the tax rate is low.

8To bound the federal government revenue loss, we assume that all profits are distributed as dividends in the year they are earned and taxed at the high rate of 80 percent. Actual losses will typically be much lower.

9In the parlance of economists, they induce "deadweight losses."
percent production cut, the federal government could lose more in revenues than California actually collects from the severance tax. In other words, in these circumstances, the severance tax induces a net reduction in total taxes on this property because of the large drop in federal tax liability. We expect the severance tax to make production fall only slightly in the short run but by as much as 4 percent after ten years for the state as a whole. Within this range, if all California oil properties fell under Tier 1, federal revenues could fall by $540 million per year when California raised $450 million per year in severance taxes.  

\[10\]

\[10\]In fact, only a portion of California's production falls into Tier 1.
Fig. 4—Effects of production cuts on federal tax revenues (Includes maximum estimates of shareholder effect)
Shifting the Tax to Refiners and Consumers

Potentially, producers can pass some of the tax on to refiners, and refiners can pass part on to consumers. The possibilities for tax shifting depend on the type of product involved, and the extent of tax shifting depends on the availability of substitutes.

When producers try to pass part of the tax forward in higher prices, refiners will have to accept it only when they cannot find substitutes for the taxed oil outside California. And their ability to find substitutes depends on the kind of oil.

California differs from most oil-producing states in the variety of oils produced, varying mostly in terms of "gravity." About two-thirds of the state’s production is heavy oil, a low quality oil best used to produce low quality fuel oils. Other states produce more light oil, which is easier to transform into gasoline and other high quality products. We found that because of this variety, a severance tax would affect different types of producers in different ways. Refiners can easily import light oil substitutes from Alaska, Indonesia, Saudi Arabia, or elsewhere, so the producer will bear the full burden of any tax on California light oil.11

California heavy oil is another story. Heavy oil is expensive to ship relative to its value. Even if it could be shipped economically, California is one of the principal producers of heavy oil. Faced with part of the producer's tax burden for heavy oil, California refiners can either accept it or refuse to process heavy oil. But refiners would like to have more capacity than they now have for refining heavy crude into higher quality unfinished oils, so they are unlikely to stop refining heavy oil simply because a tax increases its price. Thus, refiners will share a portion of any tax imposed on heavy oil production.

This contrast indicates why a uniform severance tax on all grades of oil would have different effects on different types of producers. Light oil producers will bear the full burden of the tax, but heavy oil producers can share the burden with refiners.

What, if any, share will California consumers have to absorb?12 The answer to this question depends on how integrated the California refined oil product market actually is with the U.S. and world market. Because all California-produced oil is refined in California, and most

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11 Producers could pass a portion forward in these circumstances if the California tax raised prices everywhere in the world. At most we find a 6 percent tax could raise world prices by 0.2 percent or about one mil per gallon of gasoline. That amount could be important when we consider its effects not only in California but worldwide. More research is required in this area. For an introduction to the issues involved, see Camm et al. (1982).

12 By consumers, we mean retailers, utilities, transportation companies, and other types of industrial and commercial users as well as households.
of the refined products are marketed in California or in the surrounding states, the California oil market is often characterized as isolated from the rest of the U.S. and world market for oil. If it were really isolated, consumers could not find substitutes for California oil products, and refiners could pass part of the tax to them. In fact, our analysis shows that California has good links to the U.S. and world market, conducting an active trade as either net exporter or net importer for almost all major petroleum products. As a result, consumers now using California petroleum products can readily find substitutes if those products are tax encumbered.

To illustrate how close this linkage is, take the case of gasoline. If California were not well integrated into the national market for that product, prices in California should not closely track prices outside California. Yet, as Fig. 5 indicates, wholesale gasoline prices at refinery terminals in Los Angeles and Houston fluctuate nearly in tandem. After the Iranian revolution in 1979, world oil prices more than doubled over the next two years. Decontrol of heavy oil, which is important in California but not in Texas, came during 1979, followed by total oil decontrol in 1981. Despite these major market changes, prices in California and Texas remain very much alike. We can trace similar price trends for most other major petroleum products.\textsuperscript{13}

Bunker fuel oil is an exception. Its production and price are primarily influenced by conditions in the California oil market. This low quality product of heavy crude oil, most commonly used as fuel for ships, accounts for about 3 percent of California's refining production. Refiners produce bunker fuel when they lack sufficient capacity to refine heavy oil into higher quality unfinished oils. As noted earlier, California refiners have less capacity than they would like to produce the lighter oil products. By default, they produce more bunker fuel than they want to, which has lowered the price for that product. In fact, many ships going to the Panama Canal from the eastern Pacific detour to Los Angeles for the bargain prices.

If a severance tax reduced California production of heavy oil, it would also tend to reduce production of bunker fuel. The supply reduction would raise the price, effectively passing a portion of the severance tax to bunker fuel consumers and affecting the cost of shipping in the eastern Pacific.

In sum, our analysis suggests that the nature of California oil production and the integration of California oil markets with the U.S. oil markets will dictate how much of the severance tax producers can

\textsuperscript{13}In these circumstances, refiners could pass part of the tax to consumers if they could raise prices everywhere when the tax shifts. See Camm et al. (1982) for cases in which this might be important.
shift to refiners and consumers. Where refiners can find substitute sources of crude oil—as with light oils—the producers cannot shift any of their burden. Where substitutes are not readily available—as with heavy crude oil—refiners will share some of that tax burden. However, they can pass part of that on to consumers for only one product—bunker fuel oil.

**Effects on Producer Profits**

We have demonstrated that the federal government and other taxing authorities absorb much of the severance tax levied on oil producers and that heavy oil producers can pass a portion of their burden to refiners. However, most of the remaining burden will come out of producers' profits, and their share will grow over time. The effect on profits will vary from producer to producer, depending on the type of exemption built into the new tax, on a property's WPT status, and on any production cuts induced by the tax.

**Profits and Exemptions.** Because their share of total production is so low, most of the state's oil producers are likely to be exempt from the severance tax. If so, the tax, profit, and production effects we dis-
cuss would apply primarily to the state's top producers. California has about 650 oil producers, but 95 percent of the state's oil is produced by the 30 firms listed in Table 1. Figure 6 plots the percentage of production over a wider range of firms. Along the vertical axis, it shows the cumulative percentage of oil produced by the largest firms. Along the horizontal axis, it shows the 10 largest companies, the 20 largest, the 30 largest, and so on. Several proposals now before the California Assembly and Senate contain exemption arrangements that would concentrate severance taxes on a small number of firms. The figure confirms that under these arrangements most oil produced in the state would still be captured for taxation.

![Cumulative percentage of oil produced vs. number of producers](image)

Fig. 6—Percent of oil California firms produce

**Profits and WPT Status.** To examine the effect of WPT status on profits, start by assuming that the severance tax does not affect production. The effect of WPT status on profits will differ with the WPT tier under which a company sells its oil. For example, Fig. 7 shows that if the oil is sold under Tier 1, profits will fall about 35 cents for every dollar increase in severance taxes. Profits will fall more in tiers with lower marginal rates because there companies get smaller concomitant federal tax reductions. With no windfall profit tax, profits would fall about 55 cents for every dollar of severance tax. These results suggest that as the windfall profit tax phases out, the net effect
of the severance tax on profits will tend to grow, increasing the amount of the tax that private companies bear.

**Profits and Production Cuts.** If the severance tax causes production cuts, profits will be affected even more—as was true with federal tax revenues. And again, the pattern is consistent with the pattern for WPT status. As Fig. 8 shows, production cuts affect profits more in WPT tiers with lower marginal tax rates. Moreover, profits fall more relative to severance tax collected as production cuts grow. We expect the production response to rise over time. Like the phasing out of the windfall profit tax, production cuts will cause the companies to pay an increasing share of the severance tax bill.

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14Recall that Tier 1 has the highest rate, Tier 3 the lowest. Where tax rates are high, a firm can cut its federal tax obligations more when a new revenue tax is imposed.
Figure 8—Effects on profits as production declines

Figure 9 summarizes the effects that cuts in production have on producers' relative tax burdens for every dollar of severance tax the state collects. The left column shows the producers' share with no production cuts (recalling Fig. 2). The right column illustrates that with production cuts, although there are greater losses in all tax revenues, relatively more comes out of producers' profits.

**HOW WILL THE SEVERANCE TAX AFFECT CURRENT AND FUTURE PRODUCTION?**

The severance tax affects tax revenues and producers' profits more if it induces production cuts. Thus, it is important to know whether producers are likely to respond by cutting production and, if so, by
Fig. 9—Companies' share of severance tax with production cuts
(Based on midpoint estimates; assumes 6% severance tax;
WPT Tier 2; excludes shareholder effect)
how much. By projecting the severance tax’s net effect on production profits, we have identified two ways production might change and have estimated the probable degree of change. First, wells may become unprofitable and thus have to be shut in earlier than they would without the tax.\textsuperscript{15} Second, producers may “reduce” future production from new wells by delaying or canceling plans for new investment.

**Effects on Current Production**

Producers generally shut in wells when production from them becomes unprofitable.\textsuperscript{16} To understand how a severance tax might affect the decision to remove a well from production, in Fig. 10 we consider the productivity of wells on a hypothetical property. The vertical axis indicates the level of production for each well; and producing wells are ranked along the horizontal axis according to production level. The area under the resulting profile represents the total production from all working wells on the property. The lowest ranked well produces at a level that just covers its fixed operating costs. Other wells on the property would have been shut in if they produced less than that.

A severance tax raises the level of production required to cover operating costs, accelerating the time when marginal wells become unprofitable. Thus, the wells would probably be shut in before their time, reducing the property’s total production. How drastic this effect would be depends on the shape of the production profile and how much the tax changes the shut-in point. Figure 10 allows us to compare the property’s production before the severance tax with its estimated production afterward to determine the tax’s proportional effect. We believe that the effect on total production will generally not be large because, even if a severance tax affects many wells on a property, it generally causes only the least productive wells to be shut in. By applying the production planning model to the range of properties that will probably be important in California, we obtained results, represented in Fig. 11, that support that belief. The horizontal axis shows

\textsuperscript{15}“Shutting in” a well is a way of withdrawing it from production without actually abandoning it, but bringing it back into production is no easy task.

\textsuperscript{16}Oil producers can potentially adjust production from existing wells in a number of ways when a tax is imposed. In particular, they might change their rate of withdrawing oil from the ground. The literature on production planning suggests that this response would be extremely costly; hence, we rule it out. When the rate of production from a well is fixed, opportunities to shut in wells are the most important tax response we should expect in production from existing wells.
the level of production cut that a 6 percent severance tax might induce. The vertical axis shows the frequency with which such a level of cut would occur in our sample frame. In a few atypical cases, a 6 percent severance tax can have fairly large effects on production. For example, it can induce production cuts of 4 to 5 percent on properties that have many older wells whose revenues just covered operating costs before the tax. But the tax would have a much smaller effect on properties dominated by younger, more productive wells. Most important, as the figure indicates, the vast majority of effects fall below 1 percent, and half fall below .6 percent. In all probability, then, the severance tax will have a very small effect on current production.

Investment and Future Production

But what of investment for future production? Analyzing the severance tax's effect on new investment involves speculation about assets that might be built in the future in particular circumstances. Two of
Fig. 11—Production loss from shut-in wells

our findings help clarify the effect of the severance tax on future production.

First, new investment takes a long while to affect production. Figure 12 illustrates this point with data based on historical trends in California. The horizontal axis marks time after the inception of the tax. In the short term, new investment is responsible for a small portion of total production in the state. For example, after two years, post-tax investment accounts for only about 15 percent of that production. Only after nine years does it account for as much as 50 percent. Thus, if the tax discourages new investment, and if a considerable amount of investment is consequently delayed or canceled, the effects will be cumulative and felt only after a long period.

Second, a tax is more likely to delay the date on which a property is developed than to prohibit the development of that property altogether. The delay becomes shorter as real oil prices rise faster over time. Current forecasts suggest that real oil prices will rise 0 to 4 percent a year. We have no basis for identifying a specific rate of increase, but any increase at all assures that if properties would have
been developed without the tax they will ultimately be developed with it.

Figure 13 indicates why this is true. To dramatize the size of the effect, we assume that oil prices rise annually at the highest rate—4 percent. The vertical axis shows the remaining amount of oil that can be economically developed, relative to the amount so identified before the tax is put in place. In these circumstances, with no tax, the amount of oil that can be economically developed grows steadily into the future. However, with a 6 percent severance tax, the amount of economical oil for future development initially drops off. As prices rise, the amount of oil considered feasible for development also rises, returning after a short time to the pre-tax level and eventually growing beyond that.

With the assumptions of a 6 percent severance tax and a 4 percent annual rise in real oil prices, the tax simply delays by less than two
years the time when it is economical to develop any given level of oil. The gap between the two curves in the figure shows that. In other words, as prices continue to rise, they will eventually wash out the tax's effects, allowing investment to continue. Nevertheless, over the ten year time span likely to interest policymakers most, the amount of oil available to develop is smaller in every year with the tax than without it. As a result, the tax will probably cut oil production over this period. Oil that would have been produced during this period will still be produced, but only in the distant future, well beyond the planning horizon of most policymakers. A careful analysis of one production area similar to those in California suggests that a 6 percent tax could cut total oil production each year by as much as 4 percent after 10 years.

In sum, a severance tax of 2 to 7 percent should affect existing wells very little. Even in the example assuming a 6 percent tax, most prop-
erty types experience shut-ins of less than 1 percent. It is not possible to make such precise estimates of the effects on new investment and future production. However, in the short run the tax should not affect production very much. To the extent that it inhibits new investment, the tax could have a considerable long-run cumulative effect. Although the tax is more likely to delay new investments than to cancel them, it could still cut annual production up to 4 percent a year after a decade.
III. CONCLUSIONS AND IMPLICATIONS

Although our analysis has concentrated on the effects of a fiscal
decision that must be made in California, our findings are important
to public policymakers and corporation officials outside of California
as well. A new California tax itself would have effects that reach far
beyond the state's borders. Further, many of our findings help explain
the probable effects of new and existing severance taxes outside Cali-
ifornia.

First, a new California severance tax will probably affect oil produc-
tion and oil refining, both major industries. Because the tax would
have only minor effects on most crude oil and oil product prices, little
would be passed forward to industries and households that consume
these commodities. Refining firms will bear part of the tax only to the
extent that they refine heavy oil. Because 80 percent of the heavy oil
refined in America is currently refined in California, only a California
severance tax is likely to affect refinery profits much. Severance taxes
elsewhere will affect only oil producers (including, of course, the own-
ers of oil-producing land).

These results apply only for each individual state tax viewed in
isolation. Taken together, all existing severance taxes raise oil prices
and thereby pass a portion of these taxes on to oil consuming indus-
tries and households. Our results are most important to observers in-
terested in the effects of changes in any one state tax by itself.
Although severance tax rates appear to be drifting up around the
country, this trend ultimately occurs through a series of individual
rate hikes. Our analysis addresses the effects of these discrete events.

Second, the full effects of a new severance tax are not realized
immediately. For example, oil producers and refiners suffer losses in
profits equal to only about 35 to 40 percent of the tax revenue collect-
ed in the first few years after a tax is imposed. If the state continues
to collect a fixed quantity of revenue each year, profits will gradually
drop as the windfall profit tax phases out, eliminating a federal tax
that can be offset against the severance tax, and as production con-
tinues to adjust more and more to the tax over time. Ten years after
California introduced a severance tax, losses in profits would grow to
60 percent or more of the revenue collected. We believe severance
taxes elsewhere have similar effects.

Third, there are good reasons why states are becoming more inter-
ested in oil severance taxes. As federal aid falls and state and local
money is harder to raise from traditional income, property, and sales
taxes, taxes on oil offer an option with features that attract many state and local officials. Tax effects are focused on the oil industry and not on households that vote. The tax has small effects on production, at least in the short term most important in political decisionmaking. A larger portion of the tax burden can be exported from the state through the tax system than is true for most tax options. And the tax has only small effects on other state and local sources of revenue—effects that can easily be compensated for with new severance tax revenues. These features help explain why all major oil producing states but California now raise revenue through oil severance taxes. In the end, a severance tax gives a state very close to a fixed share of gross revenues from oil production within its borders. If the price of oil continues to rise faster than prices in general, the desirability to individual states of introducing new severance taxes or increasing existing rates will grow apace.

Just because each state by itself opts for a severance tax does not suggest that every state with a severance tax is better off than it would be if no state had a severance tax. Recall that severance taxes cut federal tax revenues and tax revenues in other states. When the effects of all severance taxes are taken together, they very well may cut more tax revenue at the federal and state levels than they collect. However, no single state can view the question of adopting or increasing a severance tax from this perspective. Each state takes other severance taxes as given. And in this setting, experience has demonstrated that individual states are willing to rely heavily on severance taxes for revenue. Our analysis of a new tax in California is fully consistent with this observation.

Finally, the perspective of the federal government is quite different from that of any state by itself. The federal government loses enormous sums of money to states that use oil severance taxes. Our analysis suggests that the federal treasury would lose as much as a dollar for every dollar collected through a new California severance tax. That number depends on conditions in California. But if it is representative of the loss from existing severance taxes in other states, these taxes cost the federal government over $5 billion a year today. This conjecture relies on an implicit assumption that severance taxes do not affect oil prices. Taken together they do. Because the federal income and windfall profit taxes allow the federal government to capture a large portion of new oil revenue generated by a tax-induced rise in oil prices, the effect of all severance taxes taken together on federal revenues must be smaller than $5 billion a year. Further research will be required to determine how much smaller.

In a somewhat broader view, the federal government must ultimately recognize that oil severance taxes provide new revenue for
some states and not others. States without oil already recognize this and assert that oil-producing states can use severance taxes to lower other taxes and thereby attract industry from states without oil. Some have-not states, arguing that oil is a national resource and not a state resource, recommend a national severance tax on top of the existing federal windfall profit tax to replace at least a portion of existing state severance taxes. Only the federal government can resolve this type of tax issue.

In the end, our analysis suggests that oil companies, the federal government, and other state governments may lose considerably more than the state of California gains from a new severance tax. This net social loss, caused by tax-induced inefficiencies in production, is only compounded when we examine all severance taxes together. It is entirely possible that many states currently using oil severance taxes would be better off if no severance taxes existed. That is a topic for careful federal consideration and probably for future research.